One of these things is not like the other: Time to differentiate between relative age and biological maturity selection biases in soccer?

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ABSTRACT

Both maturity and relative age selection biases are entrenched within professional academy soccer programmes. Lay opinion, and that of some scholars, holds that relative age effects exist as a product of advanced biological maturity. That is relatively older players succeed as a consequence of the physical and athletic advantages afforded by earlier maturation There is, however, a growing body of evidence to suggests that this is not the case, and that relative age and maturation should be considered and treated as independent constructs. To avoid a disconnect between contemporary academic evidence and practitioner practice, the aim of this commentary is to provide discussion of pre-existing and new evidence relating to maturity and relative age selection biases in soccer. It is hoped that this commentary will provide an overview of new insight regarding the differences between the two selection phenomena and enable practitioners who are responsible for the (de)selection of academy soccer players for talent development programmes to make more informed decisions regarding their retention/selection strategies.

Key words: Soccer, relative age effect, maturation, peak height velocity, talent identification

Introduction

To promote 'home-grown' talented soccer players, professional soccer clubs and national governing bodies have developed long-term player development frameworks to optimise talent (de)selection and development strategies [1]. To safeguard the sustained effectiveness of such frameworks, it is important that talent development systems are free from (sub)conscious, temporary, maturity and relative age-related selection bias which threaten the 'strength' of each soccer club's talent pool of players available for domestic and national team selection. Such is the importance of developing successful talent development frameworks, there has been a marked increase (~314%; n = 323) in soccer specific growth and maturity-related peer-reviewed, published research since the conception of the English Premier Leagues, Elite Player Performance Plan (EPPP) directive in 2011. Given that the onset of the adolescent growth spurt (i.e. peak height velocity [PHV]) is highly individualised[2] and the onset and cessation of PHV likely occurs at 10.7 to 15.2 years of age [2 3] in male soccer players, much of this research has focussed upon the confounding influences of biological maturation and relative age upon talent selection and development processes within the youth development phase (i.e. under 11 to 16) of academy soccer systems [4-6]. Where the influence of maturation timing and status can confound the talent selection and player development processes [2 5-9]

Biological maturation

Biological maturation can be defined as the process and progress of a person achieving a fully mature state within the constituent biological systems [10]. Variation in maturation results from a combination of genetic and environmental factors, and children of the same chronological age can vary by as much as five to six years in terms of skeletal age; an established proxy of maturation in youth. Of these systems, the maturation of the skeletal system is of relevance to soccer practitioners given that a non-linear relationship exists between the growth of skeletally related anthropometric characteristics (e.g., stature and body-mass) with decimal age [2 3]. The asynchronous relationship between stature development and age is caused by the variation in the timing of the onset of PHV [11], eliciting accelerated phases of stature growth (approximately +7.5 to 9.7 cm. year^{-1}) across adolescence in male soccer players. Therefore, it

is commonplace within chronologically ordered playing age groups which span PHV (e.g., U11 to U15) that early maturing players (i.e. post-PHV) will likely be characterised as having temporary enhancements in maturity-related anthropometric (i.e. typically stature, mass, lean mass) and/or physical fitness characteristics, in comparison to their less mature counterparts (i.e. pre-PHV) [5 6 12]. The extent to which variation in maturation status impacts technical, tactical, or psychological ability is less clear, although emerging evidence suggests that later maturing players must be more advanced in these areas if they are to be retained in the academy system [13-17]. Such advantages may contribute to the misidentification of talent, and over-selection of early maturing soccer players for talent development programmes [6 7].

The Relative Age Effect (RAE)

The over-representation of academy [4-6 18] and professional [19-22] players born in the first three months (quartile[Q]) of the domestic soccer season is referred to as the relative age effect (RAE) [23]. This phenomenon has been argued to occur within soccer (and other football codes [24-27]) due to the application of arbitrary and chronologically aged (bi)annual (i.e. 12 or 24 months) groupings (e.g. under [U]10, U11, U12 etc.) that do not account for transient, large between-player maturity-related differences in anthropometry and physical fitness characteristics [18]. A long-held belief in soccer is that relatively older players are beneficiaries of advanced maturation [18 23] and, thus, possess superior anthropometrical dimensions (stature and weight) and performance characteristics (power, speed, strength and endurance) [28-30]; resulting in the over-selection of players born in Q1 and Q2 in professional academies [4 6 18 31]. With the concentration of relatively older players likely becoming strengthened if relatively younger players are systematically deselected or drop-out from the development pathway. Whereas some studies suggests that U10-U13 players born in Q1 of the soccer season likely possess a *small* anthropometric (e.g., stature and body-mass) and physical (e.g., speed and lower-limb power) advantage over their relatively younger counterparts born in Q4 [5 32], an equivalent number of studies document no such advantages [29 33]. The existence of RAEs in non-physical achievement domains also challenges this assumption. Despite the persistence of RAE and maturity selection biases in academy soccer [5 6 34 35], talent practitioners state that they do not consider enhanced maturity or relative age

characteristics as a desirable factor when selecting players for talent development programmes [36]. This suggests a likely disconnect between knowledge of child development and applied talent selection practices.

New evidence within soccer

Contrary to the widely held position that maturity-related differences in growth and development are the primary contributor to the RAE [37], recent evidence from academy soccer research confounds the certainty of this theory [33 38], showing strong evidence to suggest that relatively older, academy soccer players are not beneficiaries of advanced maturation. Therefore, we feel such evidence in soccer should be brought to the fore and discussed within the context of pre-existing and new evidence so that practitioners who are responsible for the (de)selection of academy soccer players for talent development programmes can make informed decisions regarding their retention/selection strategies.

A recent study by Parr, et al. [33] has shown that the effect of both maturation and relative age upon physical performance measures in youth soccer players are discrete, highlighting that these measures should not be considered mutually influential. This implies that the underpinning mechanisms for these selection phenomena in this scenario are separate entities. However, relative age did have a *weak* (R = 0.19 to 0.23) correlation with physical performance measures; that said, it was biological maturation which likely acted as the underpinning mechanism for change within these phenotypes evidenced by *strong* (R = 0.75 to 0.71) and significant ($P < 0.01$) correlation values of the examined physical fitness characteristics, with only maximal vertical jump height being significantly ($P < 0.05$; R^2 = 0.23) influenced by relative age. It is, therefore, likely, that individual biological development is responsible for regulating these physical characteristics. Despite limitations associated with the participant group, specifically a small sample size representing Q4 and all players being from the same academy setup, the results agree with previous research by Johnson, et al. [38]

The influence of maturation and the onset of relative age upon physical development and subsequent talent selection (dis)advantages manifest at different stages of development, with previous literature highlighting the onset of a maturational bias emerges concomitantly with the commencement of puberty [10 38 39], whilst the existence of the RAE in children as young as six. Studies by Johnson, et al.

[38] and Hill, et al. [8] suggest that maturity selection and relative age bias exist and operate independent of one another. Whereas the RAE is present and marked from late childhood and maintained through adolescence; the selection bias towards males advanced in maturation emerged with puberty and increased in magnitude with age. Further, the study by Hill, et al. [8] suggested little to no association between maturation and relative age within age groups. Both of these studies suggest that relative age serves as the strongest predictor of player selection at the foundation level (i.e., childhood); whereas maturational status is unequivocally a stronger selection factor during adolescence [38]. The influence of relative age upon player selection with the Johnson, et al. [38] study peaked with players born earliest in the selection year being 2.2 times more likely to be selected for development programmes than those born in the last months. However, according to Johnson, et al. [38], at the period of greatest influence upon talent selection, within the U17 age group, enhanced skeletal age exerted a 20-fold increase in likelihood of selection to the elite teams. Despite Johnson, et al. [38] not reporting an underpinning explanation for this phenomena, it might be postulated that this is due to temporary, maturity-related enhancements in physical fitness and anthropometric characterises often afforded to earlier maturing players [33]. It was noted by Johnson, et al. [38] that advantages associated with a developed physical profile, such as increased speed and strength [6], will only manifest when all players, irrespective of maturational tempo and timing, reach full development. By this point, deselected later maturing/developing players will have likely been lost from soccer development programmes [39-41]. Subsequently, likely concentrating the talent pool which domestic soccer clubs and national teams can select from with early maturing players, characterised as likely having underdeveloped psychological and technical characteristics due to the absence of their regular exposure to challenging experiences to develop such traits in comparison to the later maturing counterparts [15]. The deselection of later maturing players, in favour of those who express their developmental traits earlier in their biological development only serves to diminish the available talent from which a club can hope to nurture young future players.

Take home messages for key stakeholders

Relative age and maturity clearly confound the physical and talent development processes implemented by professional soccer academies [4-6 39 41]. These effects do, however, exist and operate independent of

one another and, as a consequence will likely require separate solutions and will be implemented at difference stage of player development. Strategies designed to addresses the impact of biological maturation (i.e., bio-banding) [42-46] should be delayed until late childhood and early adolescence (i.e., 11-12 years). In contrast, strategies designed to counter the RAE age-ordered (e.g., shirt numbering[47], birthday banding[48] and biological date of birth [4]) are best implemented in early-to mid-childhood and in advance of entry to the academy system. Similarly, bio-banding should not be discussed as a solution [49] , or misplaced solution [50], for the RAE. Bio-banding is not designed as a solution for the RAE and, thus, would have little to no benefit on this bias. It is equally important that coaches, scouts and practitioners also recognise maturation and relative age as separate constructs. It is entirely possible for a player to be the oldest yet least mature individual with an age cohort, and vice versa. Those players at greatest risk for deselection or under-representation include those who are both relatively young and late maturing. We have highlighted in this commentary that since the introduction and implementation of national governing body player development frameworks, both practitioner and academic researcher knowledge/appetite to understand how the intricacies of maturation and relative age confound player development programmes are constantly evolving. To avoid a disconnect between contemporary academic evidence and practice, we feel it important for practitioners and researchers to reconsider the application of historical, research-informed soccer practices, and readily acknowledge that maturation and relative age in soccer should be considered as independent entities. It is hoped that by recognising this will contribute to optimising player development and selection initiatives and reduce early and unnecessary deselection of players who are either relative younger or later maturing.

Disclosure statement:

The authors declare they have no competing interests.

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