‘He’s Got Growth’: Coaches Understanding and Management of the Growth Spurt in Male Academy Football.

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Abstract:

The majority of studies investigating maturation in football have focused upon the impact of maturity status or timing upon athletic performance. There is comparatively little research investigating the impact of the adolescent growth spurt, and the few research articles that have, focus upon injury incidence and burden rather than performance.

The aim of this study was to explore and better understand how the adolescent growth spurt impacts youth football players within professional academies. This longitudinal mixed-methods study aimed to understand youth football coaches’ perceptions, experiences, and management of male adolescent football players. Players maturity status, growth velocities, and match performance were measured and interviews with coaches were conducted in parallel. The qualitative and quantitative data were combined to generate a deeper contextualised understanding.

This study revealed that academy football coaches describe adolescent growth as a ‘condition’; players are diagnosed with growth through perceived signs and symptoms, which coaches must manage and treat. Growth was also seen to impact coaches’ perceptions and therefore had implications for selection and release decisions. The findings from this study emphasise the

complexities of experiencing and managing adolescent growth and maturation in the context of elite youth football.

Introduction

Academy football is a high-pressured competitive environment [1,2] that challenges players physically and psychologically.[3,4,5.] Academy players must meet these challenges while simultaneously navigating the passage of adolescence.[6,7] All individuals experience adolescence, however, they do so at different rates and ages.[7,8] Individual variation in age at pubertal onset is considerable; children of the same chronological age can differ by several years in maturity status [8,9]. The most salient change in puberty is the adolescent growth spurt. Peak Height Velocity (PHV), the most rapid point of growth in stature, occurs in boys at approximately 14 years of age.[10,11] Boys who mature early may attain PHV around 11-12 years of age, compared to late maturing boys who may experience PHV at 16-17 years. As a consequence of this variation, coaches have to manage children who are pre- circum- and post-PHV, within a single year age-group.[12,13]

All healthy children follow a similar growth pattern, regardless of maturity timing.[14] Human growth occurs distal to proximal, whereby the extremities, (feet, hands and head) undergo growth first, followed by the arms, legs and trunk.[8,15,16] Boys in PHV experience rapid increases in stature (7-14 cm. per year); at rates markedly higher than in childhood (4-5 cm. per year). [8] The saltatory nature of growth, means higher growth rates are not uncommon, particularly if growth measurements are taken more frequently.[17,18,19] Three-to-six months after PHV, Peak Weight Velocity (PWV), the most rapid point of growth in mass occurs; individuals gain approximately 9-10 Kg. per annum in PWV, compared to 2-3 Kg. in childhood.[8,20] Alongside increases in height and weight, adolescent boys experience increases in testosterone, muscle mass and bone accretion, and skeletal changes resulting in wider shoulders.[8,20]

Challenges related to adolescence include growth-related injuries and adolescent awkwardness.[18, 21] Athletes are more vulnerable to injury during the growth spurt.[21,22,23,24,25,26] Increased growth rates, vulnerability of growth plates, and differences in biological and chronological age increase injury risk during this phase.[24, 27] Adolescent awkwardness, a temporary period of motor coordination disruption coinciding with the adolescent growth spurt, may also increase the likelihood of injuries.[23,28] Adolescent awkwardness, though debated in scientific literature, is generally accepted in coaching communities.[18,21,29,30,31] Temporary

decrements in motor and athletic performance have the potential to impact coaches' and scouts' evaluations of athletic competence and potential, influencing decisions to select or exclude players.[32]

The need to assess and monitor growth and maturity in young athletes is well accepted.[13,33,34] Maturation has important implications for talent identification and development, training design and implementation, and competitive equity.[13,35] Academy coaches' are key actors in youth soccer and play pivotal roles in the development of young players.[33,36] The adolescent growth spurt may adversely influence coaches' perceptions of performance, irrespective of maturity timing.[32] What is less clear, however, are the mechanisms and beliefs underlying these biases, the extent to which coaches are knowledgeable of and/or aware of these biases, and the degree to which they seek to support and/or manage players through this phase of development.

To better understand how adolescence influences athlete performance and development, a more explorative approach is required. Objective quantitative studies dominate the current literature [32, 37]; very few qualitative studies have been conducted exploring how changes associated with adolescence impact young athletes and their coaches'.[38] A coach's subjective opinion of players' performances and potential is decisive in whether young players are retained or released. [32, 33.] With greater understanding of how the adolescent growth spurt and maturity timing affect coaches' perceptions and experiences of their athletes, youth sport programmes may be able to better develop players through adolescence and mitigate some of the maturity associated selection biases. Therefore, the aim of this study was to understand youth football coaches' perceptions, experiences, and management of male adolescent football players.

Methodology

Design:

A longitudinal mixed methods approach was employed to understand coaches' perceptions, experiences and management of male academy football players through adolescence. Quantitative and qualitative data were collected simultaneously over 12-months in three phases. Data were analysed and combined to provide a deep contextualised understanding of coaches' experiences, perceptions and beliefs (see supplementary file). Adolescent players were monitored through the growth spurt to understand how coaches perceive and managed

this stage of development. Measures of each player's maturity status, growth velocities, and match performance were conducted and interviews with coaches occurred in parallel, every four months. The quantitative player data (growth, maturity and performance data) did not influence the interviews with the coaches; instead, it provided context and perspective when mapped onto the coaches' qualitative comments, to generate a deeper, contextualised understanding.

Sample:

The sample included U12 to U16 male players and their respective coaches from an English Premier League Category One Academy[39], reflecting the ages at which the adolescent growth spurt is most likely to occur.[8] Within the Premier League, academies are independently audited on a number of different factors and given a category status of one to four, with one being the most elite.[39] Due to the dynamic nature of academy football and the longitudinal nature of the study, the sample evolved throughout the study period. Some players were released and several players entered the academy system. Thus, some participants left and enrolled into the study at various points. The inclusion criteria specified males aged 11-16 years registered and attending the club's academy programme, and associated academy coaches. Coaches ranged in age from late twenties to early sixties, with years of experience ranging from 8 years to over 30 years. Of the nine coaches, three were qualified to UEFA-B licence, five held UEFA-A licence and one held UEFA-Pro licence. The overall sample comprised nine male coaches and 98 players.

Procedures:

The data collection followed a series of steps with two distinct, yet integrated, methodologies (1) quantitative measures of maturity, growth velocities and game time/performance grades and (2) qualitative enquiry into coach's experiences and management of players in this adolescent period.

Growth Velocities and Maturity Status:

Monthly height and weight measurements were taken to calculate growth rates and estimate biological maturity using standardised procedures for each phase of the study for all players. All measurements were taken by the researcher and the sport scientist associated with that team at a standardised time. Biological maturity was estimated using percentage of predicted adult height (PPAH) at time of observation.[40] A range of between 86 and 95% PPAH was used to

classify players as "circa" or during the growth spurt.[13,14,41] This band has been shown to correctly classify 96% of players as being circa PHV.[42]

Game Performance:

Each player receives a subjective performance grade for every game they participate in. This is assessed by their age-group coach with grades ranging from one to four. Grades represent whether players are below (1), approaching (2), meeting (3) or exceeding (4) the academy standard. Game performance grades were collected and averaged for each phase of the study (January to April, May to September, October to January).

Procedures: Qualitative Methodology:

Semi-structured interviews were used to obtain experiential accounts from youth football coaches about their experiences, perceptions, and management of adolescent football players. Overall, five group interviews and eight interviews were conducted across the study; interviews were conducted face to face at the training ground ranging in time from 47 to 90 minutes. Group interviews were utilised when the head and assistant coach preferred to work together. Interviews were recorded before being transcribed into written form by the primary researcher in order to be coded and analysed.[43]

Inductive thematic analysis was used to identify, analyse, and report patterns and themes within the data.[43] Inductive, or 'bottom-up' thematic analysis is data-driven, whereby the qualitative data is not forced into pre-existing codes or driven by the researcher's theoretical interest.[44] The initial coding process was led by the primary researcher, with preliminary codes subject to reflexive analysis across the project team to verify and refine coding patterns. Case studies are presented for exploring the coach's experiences, perceptions, and management in different contexts, for individual players, utilising both the qualitative and quantitative data. The case studies were inductively constructed from the mixed methods approach and were utilised to illustrate archetypal examples within the academy, thus, they were not made for every player; the case studies do not just provide richly illustrative data representation but they also served as a vital source of data triangulation, allowing for the substantiation of coaches' comments with quantitative data on those specific players.

The combination of the qualitative and quantitative data allowed for the corroboration of the coaches' experiences and perceptions to better understand the manner in which changes in growth and maturation in adolescence influence performance and perceptions and the

dynamic nature of this relationship. In this study, the researcher actively participated in the research process by becoming immersed in the environment over the study period.

Ethics:

Prior to any data collection, approval for this research was sought and granted from the University of Bath Research Ethics Approval Committee for Health (REACH, BATH). Additionally, the objectives, rationale and procedures of the study were explained to the Football Club for further approval.

Data Synthesis: Case Studies and Mixed Methods Approach:

The quantitative and qualitative data were collected simultaneously over a period of 12 months from January to January between 2016 and 2020. For each player, growth, maturity status, and game performance were recorded over three phases of the study. The qualitative data was recorded and analysed over the same three phases (see supplementary file). The data were then combined to gain further understanding and context and synthesised to create case studies. Case study methodology is a comprehensive approach to describing and exploring complex issues, where the researcher is interested in the phenomenon and the context in which it occurs.[45] In this study, the case studies produced used qualitative and quantitative data to aid the illustration of themes raised by coaches in their observations about specific players and their growth experiences, including what they perceived to be extreme or archetypal examples.

Results and Discussion:

Table 1 shows the mean, standard deviation, and range of players' growth velocities over time for each age group. Mean growth rate values varied over time and across age groups, consistent with previous research.[19] Descriptive statistics for percentage of predicted adult height (PPAH) over time for each age group are shown in Table 2. As expected, mean PPAH increased over time and with successive age groups. Table 3 shows descriptive statistics for coach evaluated player match grades over time for each group. These three tables (1-3) present further evidence and context to the nature of growth, maturation, and performance grades within this academy. Under 16 players were removed from this analysis due to the high frequency of missing data; selection and release decisions in this age group meant many players were released from the academy and therefore left the study.

[Table 1]

[Table 2]

[Table 3]

While the adolescent growth spurt is not a medical condition or disease, the coaches in this study perceived growth as an individualized 'condition'. As detailed in the following sections, including selected quotations presented in Tables 4 to 8, this dominant framing of growth among coaches often included perceptions on the associated signs and symptoms, specific recommendations for treatment and management, as well as views on the implications for selection, retention and release. Three case studies are also presented to provide contextualised examples of the variation and idiosyncratic nature of how coaches perceived growth.

1: "Having" Growth

Coaches described the adolescent growth spurt in the same manner that one would describe a medical condition, despite it being a natural process that all adolescents experience. Rapid growth was portrayed as a condition that adversely affected players; coaches described a number of indicators of the adolescent growth spurt. Coaches talked of players being "affected by" and "suffering" from growth with symptoms varying from physical, technical, and psychological factors. Coaches described players as "having" growth and perceived it to be a factor that explain decrements in performance: "I don't know if he has growth or it has been pretty steady, but the way he moves is just horrendous" (Coach 5; player-96.3% PAH, performance grade 2.20). Growth, in many cases, was not described as a process; the word 'have' or 'got' was often describing players mid growth spurt. Players who were categorised as experiencing 'growth' were often described as performing poorly in training, games, and testing. Some coaches explained performances may return post growth spurt.

> *"…his testing scores throughout have been quiet poor, it may be due to growth, because it has been worse this current season, it may be that he is going to dip and come back up" (Coach 1; player- growth velocity 6.33 cm/year, 88.3% PAH, performance grade 2.76).*

Research has shown growth-related decrements in functionality and performance can temporarily handicap young athletes.[18,32,46] Consistent with this reasoning, coaches described

players in the growth spurt as inconsistent or performing below expectations (See Case Study One: The Roller-coaster).

Coaches expressed worry that the symptoms/side effects of the adolescent growth spurt would not lessen or disappear after the adolescent period. Questions about whether a player would return to their pre-growth performances were common. Some coaches emphasised that they worried about the recovery of players who experienced growth-related injuries. Young athletes are particularly vulnerable to injury due to the physical and physiological processes of growth and possible underdeveloped skills, coordination, and perceptions.[27,47,48] It is important for athletes to remain injury free through the growth spurt, avoiding significant time loss from training and competition.[9,22,49]

> *"...been injured for a long time, even pre-growth spurt and whether that has just exaggerated the problems I just don't know, but he is a terrific player, I just hope that he comes out of this period ok" (Coach 5; player- growth velocity 11.55cm/year, PAH 97.6%).*

The preceding quote highlights that coaches perceived 'growth' as detrimental. Research by Tanner showed rapid growth for boys in the adolescent growth spurt takes place over a number of years; on average a boy increases in height by 7 to 9 cm, per annum over a three-year period, before decelerating to adulthood.[50] Thus, players may experience accelerated growth and the associated effects over a sustained period of time, adversely impacting evaluations of talent, potential and selection decisions.

Adolescent growth is non-linear in nature, with periods of saltation and stasis, and is highly variable across individuals.[19,51] Although each child will differ in the timing and magnitude of their growth, coaches need to understand the process and its effects. Johnson suggests monitoring immature athletes through the growth spurt, with monthly measures of height and weight, to allow coaches to understand their player's development and adapt training accordingly.[34] Better educated and more aware coaches may perceive growth as less problematic, and not as a 'condition'. Increased knowledge and awareness may also enable coaches to better identify and manage athletes through adolescence, leading to optimal athletic development.

[Table 4]

2: Perceived Signs and Symptoms

Describing their experiences coaching adolescent boys, coaches identified key signs and symptoms that they used to "diagnose" a player with 'growth'. Table 5 presents supporting quotes from interviews; Table 6 outlines signs and symptoms perceived by coaches characterising growth as a condition. It is recognised that these perceived signs and symptoms vary across individuals, however, coaches presented a clear pattern 'symptomology'.

Visual signs such as long legs, big feet, broadening and filling out, and becoming lean and "gangly" were characteristics identified by coaches as indicating changes in size and proportion. "He catches his feet when he is walking on the floor, like they are that big" (Coach 10- growth velocity of 9.31cm/year, 91% PAH, performance grade 2.33). Coaches noted growth occurring in the feet and legs first; growth occurs distal to proximal, with the outer extremities growing first such as the head, hands, and feet, followed by the arms and legs, length and width of the trunk. [8,16] Thus, peak velocity of growth in the legs occurs before peak growth velocity in the trunk; rapid growth of the lower extremities is characteristic of the onset of the adolescent growth spurt.[18] Although coaches noticed visual changes in size and proportion they were interested to know objectively if players had grown.

> *"I don't know where he is growth wise, because whether he naturally just has long legs or whether that is growth related, because at the moment his legs seem very long, he is very long and gangly, lanky almost at times, without being harsh" (Coach 6; player-growth velocity of 6.04 cm/year, 96.6% PAH, performance grade 2.43).*
>
> *"I would be interested to see what his growth spurt has been like…I think he has popped up quite a lot, I think the top part of his torso has filled out quite a bit in a short period of time" (Coach 4; player- growth velocity of 12.34cm/year, 89.2% PAH, performance grade 2.13).*

Coaches discussed visual changes in players' size and weight, with some attributing these to the growth spurt; "Body weight seems to fluctuate quite a bit, sometimes he looks a bit heavy and I think that is linked to his growth" (Coach 1; player-growth velocity of 2.27cm/year, 88.6% PAH).

Alongside physical changes, coaches noted other signs indicating a growth spurt, including lethargic, tired, or sluggish behaviour. Fatigue is an accepted part of adolescence, reflecting the physiological demands of growth and increases in educational and social pressures.[52] For

young athletes, increases in the level of training and competition may accentuate these demands. Notably, sleep laboratory studies have shown adolescents require more sleep than younger children yet are consistently reporting getting insufficient sleep.[53,54,55] For many of the players within this sample, the opportunity to sleep is restricted by weekday school schedules and evening training, and weekends spent socialising or commuting and attending matches.[56] Brown and colleagues found academy players to be resilient to changes in training schedules, yet susceptible to low sleep durations.[55] Adolescents commonly report daytime sleepiness, irrespective of changes in sleep time.[53] This may result in performance dips and failures, their ability to learn is impeded, and mood affected.[53] Thus, coaches perceiving their players to be fatigued is unsurprising, Coaches did not, however, describe if sleep was measured or managed within the academy; further research pertaining to the impact of adolescent sleep on sport performance is warranted.

A sudden lack of pace, strength and power were also cited as indicators of 'growth'. "He has been growing, he is very long legged, he is slow, he has been growing" (Coach 1; player-growth velocity of 10.29cm/year, 88.5% PAH, performance grade 2.8). Coaches perceived these athletes to be weaker and slower. Adolescent spurts in functional capacities such as VO_2 max, static strength, speed and power accompany the growth spurt.[8,18,57,58,59] Unlike the preceding quote, longitudinal research generally shows positive velocities in strength and motor tasks throughout the adolescent growth spurt.[18] These findings are, however, based upon group means and absolute tests of fitness, it is possible for some individuals to encounter temporary reductions in relative speed, strength, and power.[18] Beunen and colleagues found a number of motor performance tasks were negatively affected by the growth spurt, mainly for the higher performing players.[57] For static strength, running speed, and explosive strength, 1.4%, 33.5% and 7.0% of the players assessed showed declines in performance at the time of PHV.[57] The perceived decrements in speed, strength and power observed by coaches for some players within this sample, may reflect their original advanced level of performance and the adolescent growth spurt (See Case Study One- The Roller-coaster).[18]

Players complaining of pain and soreness was also noted as a sign of growing: "He has got some knee pain at the moment" (Coach 2; player-growth velocity of 6.31cm/year, 88.1% PAH). Coaches described many of these players as playing with pain.

> *"Has had growth related injuries, I think a combination of his training load and spikes…he gets aches and pains and hips and he's got a hamstring strain at the moment*

so he has had a tough run, but quiet a resilient kid he has got on with it" (Coach 1; player- growth velocity of 10.80cm/year, 86.9% PAH).

Growth related injuries in this age range are common and an additional indicator of growth: "Osgood Schlatters with him, might suggest a bit of a growth spurt" (Coach 3; player-90.1% PAH). Coaches described various player's injuries as a direct consequence of growing: "…injured, injured, injured, you know the more growth they have, and the amount of injuries is interesting" (Coach 1). Injuries during the growth spurt was described as expected: "…one of those things that happen with growth so, would suggest he's gone through a bit of a growth spurt" (Coach 3*;* player-93.9% PAH, performance grade 2.73). Some players experienced major injuries resulting in a long period of exclusion, which coaches believed may have resulted from growth.

Pain is not always associated with injury.[60] Previous research shows pain in adolescent athletes to be common, with a prevalence of 4 to 40%; research has also shown a dose-response between pain and time spent participating in sports.[60,61] The players in this study participated in high-level training and competition, thus reports of pain are unsurprising. There is a lack of research, knowledge, and guidance on pain conditions in adolescent athletes. This is due to many athletes continuing to participate in sport and the primary method of measuring conditions, is time loss from participation.[60] Malmborg et al studied the frequency of pain in a group of sports students and found 93.8% of youth athletes experienced some level of pain, mainly in the legs, knees, and feet.[60] Further, male athletes categorised as in constant pain also underperform.[60] Coaches in this study described their players as often complaining of lower leg pains, which, in turn, was perceived to adversely impact performances.

The adolescent growth spurt is associated with increased risk and susceptibility for musculoskeletal injuries.[46,62] Research in youth football show that time loss per injury and injury incidence is highest in the U14 and U15 age groups, coinciding with the period around PHV.[63,64] Adolescents at PHV, show increased joint stiffness resulting in an increased risk of injury[24] and are particularly vulnerable to overuse injuries due to the cartilaginous structures such as the physes, apophyses, and articular surfaces being less resistant to tensile, shear and compressive forces than mature bone.[46] This results in a high prevalence of overuse injuries such as Osgood Schlatter disease and Sever's disease.[24] This risk is exacerbated by the increasing demands of training and competition that arise from increasing age and competitive level.[46] In line with these observations, coaches in this study described some of their players as

struggling with growth-related overuse injuries, highlighting the need to account growth and maturity status when designing and implementing training programmes.

Changes in attitude, mood and focus were also attributed to the adolescent growth phase. Typical adolescent behaviours such as mood swings and heightened emotionality were discussed, with coaches attributing these outcomes to the changes in hormones that accompany puberty and the growth spurt: "…definitely going through that teenage bit, maybe that's a hormonal thing" (Coach 3). Coaches perceived that changes in players concentration and mood, as well as adolescent awkwardness, led to mistakes and poorer performances.

> *"He looks like he's gone through a bit of a growth spurt…his coordination was really off, he was miss kicking things like kicking the floor, and just he seems to have got over that a little bit now, but not all the way through it. Socially and emotionally, he can be quite unstable, gets upset quite quickly, doesn't seem to be as mature as some of the other boys in terms of dealing with adversity and challenge. Quite hormonal and irritational". (Coach 2; player-growth velocity 12.63cm/year, 89.6% PAH, performance grade 2.88)*

> *"Looks like he is going through a horrendous one [growth spurt], how it has affected his brain a little bit, pretty sure he has had issues with focus and stuff before but probably not to this extreme. Some say he looks less interested at the moment I don't really see that I think he is just trying to handle his body going through this incredible period" (Coach 5; player-growth velocity 5.96cm/year, 95.7% PAH, performance grade 2.67).*

In-keeping with these findings, adolescents are renowned for their stereotypical 'teenager' behaviour, moody and emotional; this behavioural change has been associated with their new "raging hormones".[65] Research shows, aside from the physical changes often associated with puberty, the hormonally driven process also results in the activation, reorganisation, and rewiring of brain structures impacting emotions, motives, and drives.[66] Adolescence is a time of increased emotional reactivity, increased risk-taking behaviours and a period of time where peer influence plays a significant role in an individual's actions, irrespective of potential consequences.[67,68] As discussed previously, sleep deprivation in adolescence can also affect a player's mood and focus.[53] Moreover, for the elite adolescent athletes in this study, maturing and developing in the 'pressure cooker' academy environment [2] may further add to the teenagers' stress and attitude. Therefore, the coach's experiences of some of their players being 'irrational' or 'unstable' reflect the hormonal, cultural and societal changes occurring in an adolescent's life. Although more research needs to be conducted on how puberty impacts the

adolescent brain, education around the development of the teenage brain to practitioners would aid in the understanding and management of adolescents.

Adolescent awkwardness was described as a primary symptom of the growth spurt. All coaches described awkwardness in some capacity within their interviews. Discussion around players movement and technical ability regressing was considered symptomatic of rapid growth. Visual decrements in simple tasks such as striking the ball, skill cleanliness and awkward movements were often attributed to rapid growth, even when marked change in size had not been observed. Impacted players were also described as clumsy and awkward, with a loss of speed, power and agility.

> *"Going through some growth, making him very clumsy, movement is not good, lateral movements again are a bit awkward. He has got no power at the moment where he has grown so much, there is a lack of power, that is what I am seeing in games" (Coach 3; player- growth velocity of 9.83cm/year, 92.3% PAH, performance grade 2.44).*

Players perceived to be experiencing growth were described as "poor movers" i.e., less fluid, controlled or efficient in movement. Coaches recognised adolescent awkwardness as a contributor to mistakes and inconsistent performances, attributing such outcomes to players struggling with proprioception and adjusting to their new size and lengthening limbs in space: "…does have awkwardness, will make mistakes…because his legs are probably longer than his brain thinks they are" (Coach 1- player-growth velocity 9.31cm/year, 92.3% PAH).

Although all coaches discussed awkwardness in the interviews, their understanding, awareness, and belief in the concept of adolescent awkwardness varied. For some coaches, a decline in performance and technique signified adolescent awkwardness and a side effect of the changing adolescent body: "…maybe gone through a bit of a growth at the moment because of the awkwardness that comes with it" (Coach 2). Whereas other coaches believed adolescent awkwardness was not a justification for any dips in player performance: "… the technique, I am not sure we can put it down to a growth thing" (Coach 7).

The complexity of understanding adolescent awkwardness is confounded by quantitative studies showing inconclusive results and a lack of qualitative exploration of the phenomenon.[18,21,29] The difficulty surrounding if and how adolescent awkwardness presents itself and whether it can be measured adds to the complexity.[21] Although this study makes no attempt to objectively measure adolescent awkwardness, findings suggest that many youth football coaches 'observe' adolescent awkwardness in their players. For the majority of

coaches in this sample, adolescent awkwardness was an accepted secondary effect of the growth spurt.

Coaches perceived a dip in the technical ability alongside the awkwardness movements and the signs and symptoms discussed previously, as a further indicator of the growth spurt.

> *"…don't look particularly fluid, they look uncoordinated in their movement, if you see a sudden drop in the technical side of their game, when they look tired I tend to think is that energy going to growing rather than the game, when they start to lack a bit of focus at times, those would be the main bits, lack a little bit of strength and seem weaker than they were" (Coach 5).*

Case Study One- The Roller-coaster, provides an example of coaches' perceptions regarding a player's struggles with adolescent awkwardness and the signs and symptoms of the growth spurt. This case study depicts one player's journey through the study period, and their coach's experiences and perceptions across this time. In this case, the player's high growth rate and the coach's perceptions emphasising performance inconsistencies, provide further evidence of players struggling through their growth spurt.

[Table 5]

[Table 6]

[Case Study One]

3: Management and Treatment

A number of coaches described how they managed the many challenges associated with the growth spurt. Case Study Two (The Growth Patient) provides a detailed coach account of how one player's training programme was adapted for the growth spurt. Table 7 presents further quotes to support this sub theme.

Coaches explained that monitoring players in the growth spurt was important due to the detrimental effects discussed previously. Education around the subject, and informed sports science and strength and conditioning teams made this process easier. Coaches explained that sport scientists were primarily responsible for monitoring the players in their growth spurt.

> *"It's not particularly difficult, because we have got S and C guys who are monitoring it every week, it's not that difficult, I think the coaches are far more educated now than they were, we cannot batter them through the growth spurt, there has been enough evidence out there to show the damage and effects we are having on them long term" (Coach 5).*

Growth related injuries were described in all interviews. Monitoring players' aches and pains was considered one of the most effective strategies for managing the growth spurt: 'We have to monitor him because of both of his knees, he does have a bit of pain in both his knees, which we have put down to some growth (Coach 3). Reducing training load and modifying training content was also described as a technique to reduce growth related injuries (See Case Study Two: The Growth Patient).

Importantly, coaches need to recognise and identify players at an increased risk of injury due to growth and maturation.[25,34] The strategy of reducing and monitoring training load during the growth spurt to reduce injuries is accepted in the literature and was endorsed by the coaches in this study (See Case Study Two: The Growth Patient).[19,46,60,62,69] Common growth-related injuries including Osgood Schlatters, Sever's and Sliding-Larsen syndrome can be managed by controlling load, rest, and pain palliation.[46] Although coaches did discuss attempts to manage and reduce injuries, coaches also expressed that more could be done.

Coaches explained that for some adolescent players, they could have better managed their load and game time; "…yeah some players continue to play a couple of games a week, we haven't been too bad with it, but I think we could have been better" (Coach 5). Coaches explained playing the boys in their own age group, rather than challenging them in the age group above

was another strategy in protecting the boys in the growth spurt. One coach described using the growth spurt period as a chance to challenge and develop other skills (See Case Study Two: The Growth Patient). Some players perceived to be suffering from adolescent awkwardness were also offered individual practices to work on fundamental movements and skills.

Research suggests variation in training significantly reduces the risk of overloading and repetitive strain injuries.[62] Variation can be provided naturally by the changes associated with the adolescent growth spurt.[70] The ASM suggests children in the pubertal growth stage should continue to participate in activity but rather retrain and refine all basic movement skills in their constantly changing body; basic movement skills such as crawling, hopping and walking on all fours enables coordination to be continually developed through this growth phase.[70] Lloyd and Oliver suggest training of fundamental movement skills should be present within any programme for an athlete of any age.[35] In keeping with the findings of this study, the adolescent growth spurt phase can present an opportunity to refine fundamental movement skills to maintain and improve physical literacy (See Case Study Two- The Growth Patient).[71] Finally, coaches described educating players who were perceived to be struggling in the growth spurt. "I think we always try and frame it in the right way and tell him that we understand" (Coach 1; player-growth velocity 9.31cm/year, 89.6% PAH, performance grade 2.33). Coaches expressed support, patience and empathy for players affected by growth.

There is limited knowledge and research on the benefits of educating teenagers on the processes of puberty and adolescence. Blakemore suggested educating teenagers on the normal changes, turbulence and difficult times experienced in adolescence, being a natural biological process, would help teenagers understand.[72] Blakemore goes on to state that teenagers have a right to know and understand the biology behind their changes in body and feelings and suggests educating teenagers on puberty can empower and enlighten teenagers.[72]

In this study, some coaches implied that they educated some players on why they may be struggling in the growth spurt, however, this was the exception rather than the norm. Coach/Player/Parent education regarding the nature and implications of the adolescent growth spurt may benefit player development, mitigate injury risk and ease transition through this developmental stage. Further research in this area is warranted.

[Table 7]

[Case Study Two]

4: Implications for Selection, Retention and Release

The timing of the growth spurt was perceived by coaches to have important implications for long term player development. Firstly, coaches noted concerns regarding the impact of the growth spurt upon scouts and successive age group coach's evaluations of individual players (See Case Study Three: The Enigma). Quotes to support this sub theme are presented in Table 8.

> *"Periods where he has really been struggling with coordination and struggling to turn, dealt with it incredibly well, but it has definitely impacted the opinions of the 16's coaches. I think he is going through a growth spurt. But yeah, they went from scholar to not sure about this lad, quite quickly and that coincided perfectly with that time. So, it has had impact" (Coach 5; player-growth velocity of 8.57cm/year,* 95.6% *PAH, performance grade 2.46).*

Similarly, some coaches attributed a player's failure to meet season long expectations to the presence of the growth spurt. Equally, coaches expressed they had limited time to understand where a player was in their development before players transitioned age-groups.

> *"A lot of the time as staff we work with them for not even 12 months so you meet the player and he could be in the middle of something or he could be in a good moment and you form an opinion on them and then stuff happens and then you hand them over to someone else" (Coach 1).*

The growth spurt was also deemed to have implications for scholarship decisions. Some coaches believed players experiencing the growth spurt at the time of selection were less likely to be selected in certain age-groups: "Maybe decisions at 12 and 14's is a challenge if they are experiencing something that is going to hinder their performance" (Coach 5). Timing of the growth spurt was described as important in terms of selection periods, as growth was described as significantly impacting coaches' evaluations of ability.

Coaches worried about players experiencing 'growth'. The symptoms of growth were problematic for coaches; deterioration in movement patterns, performance and attitude changes and injuries attributed to the growth spurt. Coaches described their techniques to reduce players suffering in the growth spurt but also explained the further implications of growth, including the change in perception from other coaches and scouts (see Case Study Three- The Enigma).

Practitioners and academy coaches should consider individual differences in growth and maturity in the processes of player evaluation and selection. Coaches, scouts and academy managers should be educated on the processes of growth and maturation and the potential negative implications of the growth spurt. They should also be made aware of which players are currently experiencing the growth spurt in the lead up to selection decision (See Case Study Three- The Enigma); Equally, players and parents should be educated as to the changes to expect during adolescence and the potential 'side-effects'.

[Table 8]

[Case Study Three]

Conclusion:

In summary, this study examined coaches' perceptions, experiences and management of adolescent changes and the growth spurt in academy football players. The results of this study are specific to one professional football academy and a small number of coaches and thus may not be generalisable to other football academies around the world with different philosophies, values, and practices. Further research across a larger sample, including more academies and talent pathways is required to substantiate and develop these findings. Additionally, this research only focused upon male adolescent football players (and their male coaches) and therefore results cannot be generalised to the female game, which warrants separate future research.

The findings of the study suggest that the consequences of adolescent changes and more specifically the growth spurt, present numerous challenges for both players and coaches and yet is highly individualised across players. Academy football coaches were seen to describe adolescent growth as a 'condition', whereby players were diagnosed through signs and symptoms, which coaches had to manage. Adolescent changes were described to impact coaches' perceptions and selection and release decisions, illustrating the complexities of managing the adolescent growth spurt in academy football.

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