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Maturation**

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Junior Sports Framework Review – Draft Briefing Paper Topic: Growth and Maturation

Author's Declaration

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Junior Sport Framework (JSF) Project

Growth and Maturation in Junior Athletes

Don Bailey, Craig Engstrom, and Stephanie Hanrahan

1. INTRODUCTION

Physical activity and participation in sport and games have long been accepted as important considerations for the normal growth and development of the child. Although popular conceptions have tended to focus attention on biophysical growth and development (i.e., associated with muscle, bone and physiological function) through sport involvement, it is being increasingly acknowledged that children's psychosocial growth and development, associated with individual feelings, attitudes and beliefs and interaction with others may be strongly influenced through sport. Quality experiences for children in sport settings have been shown to support appropriate bone and muscle development, increased physiological capacities as well as offering opportunities for individuals to develop adaptive behaviours and social skills.

“Children's and adolescent's perceptions of themselves and their abilities change qualitatively and quantitatively as they move through the childhood years” (Thelma Horn, 2004, p. 130)

In recent years however, debate has arisen regarding the potentially harmful effects of excessive physical training on the young athlete and damaging effects of highly controlling and abusive junior sport environments. The impact of intensive training and exclusively win-focused contexts on the growth of the maturing skeleton and the development of psychosocial skills is a significant concern amongst many coaches, teachers, health care professionals, sport administrators, parents and their children.

With the increasing national and international prestige attached to athletic success and professional sports, more intensive and/or sophisticated training and sport programs are being

developed for progressively younger children. This is particularly evident in sports such as swimming, gymnastics, athletics, tennis and the various football codes. The high levels of intensity, frequency and duration found in the training and playing regimes of some young athletes would not have been considered achievable for adults 40 years ago and this raises a number of fundamental questions in relation to biophysical and psychosocial development:

- Do these programs have an effect on the dynamics and timing of growth and development in children?
- What are the short and (potentially) longer-term effects of sport-induced stresses on the young athlete?
- Can intense physical training alter/delay pubertal growth (what is meant by “pubertal” growth?) and/or accelerate psychological development?
- When are children ready for the complexities and rigors of intense sport training and competition?

2. WHAT WE KNOW

Overall, the developmental process of children is tremendously variable because it is subject to an individual's genetic template (e.g., timing and tempo of growth attributable to genetics.) and environmental factors (e.g., access to adequate nutrition and quality of sport leadership). Development of the child can be influenced depending on how these individual and environmental factors interact. While the biophysical and psychosocial aspects are separated out in the discussion below for the sake of clarity, they are nevertheless highly intertwined in reality. Consider the case of a girl with early breast development (relative to peers) and her involvement in swimming or the case of a boy with late height development (relative to peers) and his involvement in basketball. These are some readily identifiable cases in which biophysical and psychosocial development interact in a sporting context.

2.1 Biophysical

Three interacting processes drive human development in the first twenty years: growth, maturation, and adaptation. Growth primarily refers to size increases in of the body and its constituent parts. Typically, children become taller and heavier as they move through childhood to adolescence to adulthood and exhibit typical age- and sex-related changes in lean muscle mass, bone and fat tissue, and internal organ size and function. ?? There are also increases in the size and functional capacities of many of the body systems and internal organs.

The following example demonstrates the differential scale of changes in children's bodies during growth. From birth to maturity the size of:

- The head increases two fold
- The trunk increases three fold
- The arms increases four fold
- The legs increases five fold

Clearly, growth is not uniform. Indeed it is a complicated and differential process. At the individual level, different parts of the body grow at different rates, starting and stopping at different times. Changes in body proportions over the growing years have major influences on the biomechanical and performance aspects related to motor skills.

Children also undergo a process of maturation. Maturation refers to the genetically programmed series of changes leading to a mature state. Various tissues and systems mature

at different rates leading to an endpoint when a youth attains adult status. Every child passes through all the stages of maturation in the same order, but the timing (when a particular event occurs; i.e., the age of peak linear growth) and tempo (the length of time taken to pass from the initial to final stage of each stage is highly variable between individuals; for example, development of secondary sexual characteristics).

The biophysical development of children is also subject to the process of adaptation. In this process, changes at the individual level occur in response to external or environment factors in concert with internal genetic, maturational factors. For example:

- Intensive physical training for sport in children can result in notable skeletal or physiological adaptations.
- Caloric intake and nutritional quality can impact lean mass and physiological function.
- The use of special nutritional/dietary regimes in “elite” young athletes (potentially including prohibited substances and drugs) to induce changes in lean body mass.
- Swim training is often recommended, as an environmental intervention, as a beneficial form of exercise for asthmatic children

Because of the variability in the maturation process, chronological age is of limited value in determining a child’s level of physical maturity. Physical maturity is more accurately evaluated in terms of skeletal development (skeletal age), sexual development (appearance of secondary sexual characteristics), and somatic development (age of peak height velocity).

Human growth is characterized by a long childhood period from the age of 2 to the onset of puberty during which height increases at a steady rate of 5–6 cm per year. This growth rate accelerates at approximately 9–10 years of age in girls and 11–12 years in boys, signifying the beginning of the adolescent growth spurt. During this period, the rates of growth can more than double that observed during childhood. Growth rate continues to increase until the age of peak height velocity (PHV) is reached, after which there is a rapid decline until linear growth eventually ceases. Girls typically start their growth spurt, reach PHV (at age 12 in girls, 14 in boys) and stop growing two years earlier than boys.

During the adolescent years, whole combinations of maturity events take place which are interrelated and occur in sequence although the timing is highly variable. At any given chronological age, there is a wide variation among children in size, physique, and body composition. The timing and tempo of biological maturation is wide.

The onset, duration and magnitude of the adolescent growth spurt are highly variable between individuals. For example, the age range for the occurrence of menarche in girls is 9–17 years of age (although this may be the case, I think many medicos in Australia would consider primary amenorrhea in a 16 year girl, particularly an athlete, who hadn't had their first period). The duration required for a girl to pass through all events of adolescence may take 5 years or 18 months. However, a definitive relationship has not been observed between the age of onset of puberty and the length of time from the beginning to the end of puberty. The uneven spread in maturity status in children of the same age creates one of the most difficult challenges facing coaches of young children and adolescents.

2.2 Psychosocial

In addition to the biophysical changes that children experience, they are also developing psychologically and socially. The psychosocial development of children through sport is largely dependent on the quality of the sport experience, which in turn is usually determined by the quality of the adult leadership provided. Youth participation in sport has been found to influence values, attitudes, and beliefs – both positive and negative. Positive psychosocial effects that sport can foster include discipline, fair play, respect, cooperation, leadership, assertiveness, positive self-esteem, and self-confidence. Unfortunately sport can also result in negative psychosocial effects such as aggression, cheating, negative self-esteem, low levels of confidence, feelings of inadequacy, anxiety, and fear of making mistakes.

An important point to consider is that children are usually more interested in having fun, learning skills, and making friends than they are in winning. Said another way, winning is not a prerequisite for enjoying participation in youth sport. Sport leaders who prioritise winning over enjoyment and involvement are more likely to create environments where participants have poor experiences. Junior sport participants who have poor experiences are then more likely to withdraw from sport (potentially missing out on the positive effects that may have been fostered by sports leaders in later age groups) and/or experience the negative psychosocial effects described above. Alternatively, those sport leaders who focus on creating a supportive environment where fun and skill development are prioritized are more likely to foster adaptive behaviours in their junior participants. Indeed it has been consistently demonstrated that environments that feature regular positive reinforcement can increase athletes' self-worth, motivation, and feelings of competence.

Finally, it should be acknowledged that while sport leaders are rightly considered to be the architects of the junior sport environment, athletic peers make strong contributions to

psychosocial development. For example, adolescents (approximately 13-19 years of age) are usually more influenced by their peers than by coaches or parents. It is for this reason that sport leaders must be cognizant of and work to shape the nature of interactions between junior participants.

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3. WHAT WORKS

In relation to optimal biophysical and psychosocial development, numerous authorities have suggested that pre-pubescent children should be encouraged to participate in a wide range of activities requiring a variety of skills (physiological, perceptual, motor) before beginning to specialize in a “chosen” sport. In this way, all children have opportunities for developing a broad base of techniques and skills, late developers are potentially encouraged to stay in sports long enough to derive satisfaction and benefit from their eventual maturity.

It is imperative that sport leaders make a distinction between encouraging children to gain satisfaction from doing their best and pushing children beyond their capabilities and level of maturity. Those who are able to prioritise fun, effort and predominately self-referenced skill development are more likely to foster adaptive development of junior sport participants.

3.1 Biophysical

In general, healthy children have few adverse physiological responses to normal levels of physical training. When an injury does occur adverse skeletal responses are usually reversible and can be minimized with proper precautions. Studies suggest that with improved coaching techniques, most junior sports are relatively safe with most injuries being mild and self-limiting. Examples of injuries/issues specific to adolescents include:

- Fracture risk associated with intensive impact sport training is increased during adolescence due to the dissociation between linear growth and bone mineral accrual leading to a transient period of relative skeletal porosity.
- Overuse injuries such as those associated with exceeding the structural tolerance limits of the growth plates (the structural integrity of bone is weaker as the growth plates are at their widest during the growth spurt) due to excessive mechanical and repetitive loading could lead to a disturbance in bone growth.
- “Acute” fractures through the growth plates can cause growth problems.
- Eating disorders and forced weight loss is a major health concern, particularly as adolescent girls experiencing amenorrhea or anorexia nervosa may develop reduced bone density leading to increased susceptibility to stress fractures, and osteoporosis later in life.

As described above, the practices of sport leaders can serve to increase or decrease the likelihood of these issues.

3.2 Psychosocial

Similarly, the practices of sport leaders can serve to increase or decrease the development of positive psychosocial development. For example, children with coaches who provide encouragement, praise and provide technical and informational instruction like their coaches more and think their coaches are better teachers than children who have coaches who are negative or fail to provide information about what they doing well, what they can improve upon, and how to improve. Junior sport participants with positive coaches also like their teammates more, enjoy participating in sport, and desire to continue to participate to a much greater extent than those who have less positive coaches.

It has also been established that coaches who focus on effort and personal development have athletes who like playing for them, think their coaches are good at instruction, have a great desire to play for the same coach the following season, and enjoy their sport experiences compared to coaches who predominately focus on outcomes (i.e., winning). Finally, letting athletes have some input or control regarding their sporting experiences increases their awareness, and abilities to think and make decisions, and results in them feeling less manipulated (it helps athletes learn to take responsibility for their actions).

4. WHAT DOESN'T WORK

A clear message is that sport leaders who focus exclusively on winning are more likely to have athletes who burn-out, drop out and/or experience biophysical and psychosocial distress. Regularly associated with this performance-focused orientation is the inappropriate application of elite models of sport participation to junior sport. In short, junior sport participants cannot be treated like miniature adults.

4.1 Biophysical

Identifying talented children and beginning specialized sport-specific training very early does not increase the chances of developing an adult champion; one exception is the sport of gymnastics and diving. Findings from the Medford Growth Study suggest that the majority of talented outstanding elementary school athletes were not outstanding in junior or senior high school. Of the all-time top junior 100m sprint athletes up to 1988, only one went on to win an Olympic or world championship medal. While exceptions exist, getting children to specialize too early likely increases the chance that they will drop-out of the sport.

4.2 Psychosocial

Punishing athletes for mistakes is counter-productive to the development of positive psychosocial outcomes. Although using physical activity for punishment may work in the short term (e.g., running laps may work in the short term regarding altering behavior), the long term message being sent is that physical activity or exercise is unpleasant, something to be avoided, and something to be endured only when one has misbehaved. The overuse of punishment can also lead to junior athletes developing a fear of failure – worrying about making mistakes. Accordingly, junior participants are more likely to withdraw from sport in the long term. Similarly, favoring the most talented athletes at the junior level sends clear messages to less-talented athletes about what is valued in the sporting context. Problematically (as described in the above section), performance at the junior level is not always a sound predictor of performance at senior levels of competition.

5. WHAT WE DON'T KNOW

Biophysical and psychosocial domains have long, but separate histories in relation to youth development. There is not a great deal known about the interaction between them. In addition, questions remain within each as separate domains.

5.1 Biophysical

There is currently insufficient data to draw clear conclusions regarding possible harmful long-term effects of intensive early sport training on growth and maturation (particularly in selected sports such as gymnastics where small size and early entry is an advantage). Similarly, there is little evidence-based / systematic data (positive and negative) from interventions aimed at taking better account of developmental age as opposed to chronological age. For example, at this point, little is known about the use of body weight divisions instead of chronological age groupings in certain football codes on developmental and skill acquisition.

5.2 Psychosocial

In the psychosocial domain, a chicken-or-egg dilemma exists with respect to the interaction between the individual and the social in sport. For example, it is not known whether participation in sport leads to certain personality traits or if certain personality traits lead to participation in sport.

6. ADVICE TO THE ASC

6.1 Understanding/education/expectations

- Provide programs for parents, coaches, teachers and technical directors to ensure that the adults involved in youth sport will have a thorough understanding of the tremendous variation in normal growth rates in children.
- Adults should have thorough understanding of the structural and functional differences that exist between a growing child and an adult.
- Don't expect (require) children to perform as miniature adults.

6.2 Actions of sport leaders

- The uneven spread in maturity status in children of the same chronological age creates one of the most difficult challenges for leaders in youth sport. Youth sport programs need to be organized so that more children can experience the positive aspects of sport regardless of maturational status. Ensure that children are playing with others of their own size and ability, not against players who are significantly (physically) larger or out-weigh them. Encourage and nurture late developers to keep them in the sport long enough to benefit from their eventual maturity.
- In youth sport, coaches should emphasize skill development and effort rather than winning. Remember that the game is for the child not the adult. Keep fun in games and practices. Even top performers will quit a sport when it is no longer fun,
- In the pre-pubertal years, children should be introduced to a variety of different sports and physical activities, which will help in the development of fundamental motor skills thereby providing a launching pad for either future continuation and/or specialization in sport. Avoid specializing players into positions or roles (or even sports) at an early age.
- Every child should have the opportunity to play. A good leader lets everyone play. Sports may not be for everyone, but the opportunity to try should be.

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