

What is the impact of early sport specialization on overall pediatric health and what can be done by health care providers to monitor this growing phenomenon?

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The University of Toledo

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Dedication

This paper is dedicated to my parents and younger sisters for their unwavering support, encouragement, and love; to all my past teammates and coaches; and to the next generation of

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Thank you to my advisor, Dr. Carolina Wishner, M.D., for sharing my passion, believing in my project and myself, and guiding me through this entire process with nothing but happiness and confidence.

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Chapter 1

Introduction

With an estimated 60 million youth in some organized form of athletics and 27 million youth between the ages of 6 to 18 years- old participating in team sports, sports are a major source of physical activity for youth (DiFiori et al., 2014; Malina, 2010). Participation in youth sports also offers psychological benefits including the development of self- esteem and peer socialization (DiFiori et al.).

In today's society, the evolution of a child's participation in sports has gone from playing for the love and fun of the game to emphasizing high competition, structure, and success. As a result, many young people participating in sports feel that one must specialize in a single sport to achieve elite- level skills and earn recognition (Jayanthi, Pinkham, Dugas, Patrick, & Labella, 2013). Consequently, an increasing number of youth are choosing to participate in one sport only at younger and younger ages, which is exposing children to repetitive, intense activity (Smucny, Parikh, & Pandya, 2015).

In the United States of America in 1997, the number of participants in organized athletics among children 6 years-old and younger was about 9%. In 2008, that number increased to about 12%. The reality is that very few athletes will ever play beyond the high school level. In fact, less than 1% of young athletes ages 6 to 17 years-old will play collegiate or professional basketball, soccer, baseball, softball, or football (Jayanthi et al., 2013). According to DiFiori et al. (2014), such an excessive focus on early intensive training and competition at young ages rather than skill development can lead to overuse injuries and burnout. With the advent of sport specialization and year- round expectations, overuse injuries are becoming increasingly prevalent

in youth sports (Caine, Maffulli, & Caine, 2008). While most experts in any field agree that some degree of specialization is needed to achieve goals at an elite level, the debate remains open as to whether such deliberate practice in one sport during childhood is the most beneficial way to optimize success (Jayanthi et al.).

According to Smucny et al. (2015), identifying burnout is critical for clinicians taking care of youth athletes who specialize in one sport. Up to 50% of all injuries seen in pediatric sports medicine are related to overuse (Brenner, 2007). There are an estimated 2.6 million emergency department visits annually in the United States for sports-related injuries among patients 5 to 24 years-old, with the most common population including male athletes age 5 to 14 years-old (Soprano & Fuchs, 2007). According to the Committee on Sports Medicine and Fitness (2000), health care providers who encounter children should be able to recognize risk factors for pediatric overuse and burnout, and in doing so, be able to manage the health of these young athletes, help reduce any negative consequences associated with high-level sports participation, and educate both the young athlete as well as the parent or guardian.

Problem Statement:

As early sport specialization becomes the new expectation within our society, there appears to be a growing trend in the severity of pediatric injuries, both physical and psychological. With parents and coaches challenging children to obtain collegiate scholarships or play sports at a professional level from such a young age, children are experiencing many negative consequences that may progress with the child into adulthood. The risks of early sport specialization could indeed outweigh the benefits, but more research and analysis are needed to

better educate parents, coaches, and the players, and better alert medical professionals to risk factors associated with pediatric overuse and burnout.

Purpose:

The purpose of this literature review is to investigate the epidemiology of early sport specialization, recognize the biological maturation that occurs throughout childhood and adolescence, examine risk factors for overuse and burnout, understand the potential physical and psychological outcomes for the athletes, and to determine the current recommended guidelines for health care providers to treat and educate this pediatric population.

Scope:

This review focused on what the short-term and long-term impact of early sport specialization is on children both physically and psychologically. Also, this research examined the various recommendations available to clinicians and determined what guidelines should be practiced as the standard of care to optimize the health of pediatric athletes. Original research articles were the main source of information used in this review.

Literature Review Background:

As the culture of youth sports changes, the definition of success is no longer defined by laying the foundation for a healthy lifestyle, but instead it is defined by attaining an elite status (Smucny et al., 2015). One of the most well-known relationships identified in behavioral science is the strong, positive correlation between time spent practicing and the level of achievement realized (Baker et al., 2009). So how does a child decide to only play a single sport? Usually in

the beginning, a parent or guardian introduces a child to a sport; the child accomplishes some level of success; and then a coach encourages specialized training to achieve even higher accolades (Jayanthi et al., 2013). What is early sport specialization? Early sport specialization is suggested to encompass 4 specific parameters: early start age in a given sport; early involvement in a single sport as compared to participating in several sports throughout the year; early dedication in focused, high intensity training; and early involvement in a competitive sport (Baker et al.). There is a general agreement, based on the behavioral science claim stated earlier, that the number of hours spent in dedicated practice and intense, consistent training will positively correlate to a certain level of achievement (Jayanthi et al.). Still, the debate remains at what age should athletes make the decision to move towards deliberate practice?

During childhood, there are crucial periods of biological development that occur, including rapid bone growth, which can lead to inflexibility and tightness around joints due to the fact that the muscles and tendons have not yet increased in length (Baker et al., 2009). Similarly, during a child's growth spurt, bone mineralization may not be uniform throughout, which could leave the bone more vulnerable to injury during this temporary period (Caine et al., 2008). Since the bones in children grow at a faster rate than the surrounding structures, a physiologic imbalance is created, which can be exploited during periods of time when the child's body undergoes intense physical activity (Baker et al.). To demonstrate this point, according to Caine et al., studies examining fracture occurrence demonstrated an increase in epiphyseal fractures during the pubescence growth spurt period. The special anatomy and physiology of a youth athlete places the child already at a baseline injury risk, which is then compounded when the child participates in repetitive, intense physical activity that can occur with sport specialization (Smucny et al., 2015).

Coaches and parents often lack the adequate knowledge about normal development for children, both physically and psychologically, which can result in unrealistic expectations that may do more damage to the child than benefit (DiFiori et al., 2014). As research continues on this topic, there are some risk factors that the literature seems to corroborate. Potential risks for athletes who participate in early sport specialization include social isolation, overdependence, burnout, compromised growth and maturation, and injury (Malina, 2010). According to the Committee on Sports Medicine and Fitness (2000), further risk factors for burnout specifically include physical and emotional stress, missed social and educational opportunities, and disruptions of family life. Caine et al. (2008) and DiFiori et al. both explore intrinsic and extrinsic risk factors associated with common overuse injuries. Overuse injuries may be classified into 2 separate categories based on the clinical scenario (Christopher & Cogeni, 2002). Although little scientific data is known today that links a relationship between proposed risk factors and overuse injuries, clinicians must recognize these potential signs of injury in young athletes in order to devise injury prevention and to limit recurring injuries (DiFiori et al.).

Overuse is one of the most common etiologic factors that lead to injuries in the pediatric and adolescent population (Brenner, 2007). There are both physical and psychological outcomes for early sport specialization athletes. While it is known that an increase in physical activity stimulates the musculoskeletal system to grow, excessive stress or overload could lead to tissue breakdown and injury, which can result in overuse injuries (Committee on Sports Medicine and Fitness, 2000). According to Soprano and Fuchs (2007), the most common overuse injuries identified in young athletes are tendonitis, apophysitis, chronic anterior knee pain, and stress fractures. The Committee on Sports Medicine and Fitness reports that since there is potential for long- term growth disturbances, injuries to epiphyseal plates are a major concern for young

athletes because an injury to the growth center could lead to growth arrest or deformities in the long bones. Caine et al. (2008) claims that there is evidence to support that with less severe injuries of the knee and ankle, there is an increased risk for osteoarthritis later in life. There are many psychosocial outcomes that have been identified thus far in the research. According to Smucny et al. (2015), there are 2 perspectives to understand the emotional consequences of sport specialization: isolation and overdependence. A culture has been created in which the concept of sports has transitioned from an enjoyable activity into an all-consuming, stressful job, which unfortunately leads to an early end of many young athletes' athletic careers (Smucny et al.).

Thus far, research is finding that child athletes who participate in a variety of sports and specialize only after reaching puberty tend to be more consistent performers, have fewer injuries, and participate in sports longer compared to those children who specialize in a single sport before the age of puberty (Committee on Sports Medicine and Fitness, 2000). In increasing severity, there are 4 stages of overuse: (1) pain in a certain after post physical activity, (2) pain during the physical activity, without restricting performance, (3) pain during activity with restricted performance, and (4) chronic, unrelenting pain even during periods of rest (Smucny et al., 2015). It is also important for clinicians to be aware that overtraining and depression share many similarities and therefore it is the clinician's responsibility to carefully study and monitor patients in which these similarities are identified (Matos & Winsley, 2007). The Committee on Sports Medicine and Fitness (2000) highlights several suggestions to health care providers who treat or come in contact with this special pediatric population, however, there is still much unknown and research is ongoing. According to Brenner (2007), ultimately it is important for the medical provider to discuss the goals, motivation, and desires of the young athlete and focus on providing guidance for what the child wants.

Research Question:

What is the impact of early sport specialization on pediatric health and what is the role of health care providers to treat, monitor, and educate this specific pediatric population?

Definitions:

Burnout – response to chronic stress in which young athletes cease to participate in a previously enjoyable activity (DiFiori et al., 2014)

Deliberate Play – activities that are intrinsically motivating, designed to maximize fun and enjoyment, and provide immediate gratification (Cote, Lidor, & Hackfort, 2009)

Deliberate Practice – highly structured specific, focused, skill based practice that generates no immediate reward and is motivated by the goal of improving performance rather than inherent enjoyment (Cote et al., 2009; Ferguson & Stern, 2014)

Diversification – an approach focusing on enjoyment in a variety of playful sporting activities during childhood (Baker, Cobley, & Fraser-Thomas, 2009)

Early sport specialization – children who commit exclusively to a single sport during the early to middle elementary school years (Jayanthi et al., 2013)

Overtraining – results from an accumulation of training and non- training stressors that has a detrimental long- term effect on performance, with a recovery period that may take several weeks to months (Matos & Winsley, 2007)

Overtraining Syndrome – a series of psychological, physiologic, and hormonal changes that result in decreased sports performance (Brenner, 2007)

Overuse injuries – occur due to repetitive submaximal loading of the musculoskeletal system when rest is not adequate to allow for structural adaptation to take place (DiFiori

et al., 2014); tendinitis, apophysitis, and stress fractures (Committee on Sports Medicine and Fitness, 2000)

Sport Specialization – intense, year- round training in a single sport with the exclusion of all other sports (Jayanthi et al., 2013)

Methodology:

The databases primarily used for this literature review include MEDLINE, PubMed, and Google Scholar. Within these databases, the main search terms and phrases used were early sport specialization, pediatric burnout, pediatric overuse, overuse injuries, sport injuries, overtraining, biological maturation, growth patterns, diversification, history, prevention, guidelines, and treatment. The inclusion criteria for this research consisted of articles from all over the world investigating early sport specialization in the pediatric population and clinical guidelines for practitioners. Any article that was not written in the English language, was written prior to 2000, or required purchase to be read was excluded from this review.

Chapter 2

Literature Review

This chapter investigates research literature that pertains to how early sport specialization is impacting pediatric health. The main sections of this literature review include epidemiology of early sport specialization, biological maturation of pediatric health, physical and psychological consequences of sport specialization, early sport specialization versus diversification, and healthcare provider's clinical assessment guidelines for pediatric athletes.

Epidemiology of Early Sport Specialization

There are several components that have contributed to the popularity and expectation of early sport specialization in our society. The first component is the perception of the East. According to Malina (2010), during the communism era, there was a perception that Eastern European nations began training children at early ages year-round, which led to success in world competitions. For the West, that perception of the East's achievements reinforced the necessity of the early sport specialization model in our own culture. After some modification, in the 1990s, long-term athlete development was beginning to be adopted throughout sports.

Another component is the pursuit of scholarships and professional contracts. Once young athletes are labeled 'elite' or 'gifted', many young athletes, with encouragement from parents, begin specialized sport training with the goal of obtaining a college scholarship or becoming a professional athlete or reaching the Olympics (Malina, 2010). However, in 2000, only 2.2% of females and 2.0% of males participating in high school sports received any form of college scholarship (Malina). Consequently, while even a smaller percentage of those who receive college

scholarships go on to pursue professional athletic careers, the media highlights and easily visualizes these select few athletes, which only leads to a stronger desire for children and their parents to help their child “get ahead” (Malina).

The final component is the misinterpretation of a study by K. Anders Ericsson in 1993. In this infamous article, he investigated what factors helped predict expert performance (Ferguson & Stern, 2008). He specifically examined musicians, chess players, and mathematicians. According to Ericsson, high volumes of deliberate practice before 5-7 years of age was the strongest predictor of becoming an expert performer. He also noted high volume of practice likely should be between 5,000-10,000 hours to become an expert (Ferguson & Stern). His study also demonstrated it was difficult to become a master of a task if one began later in age or did not acquire as many deliberate hours as required. Eventually, this model was transferred and applied to youth sports with the premise that early acquisition of skill and a high number of training hours will lead to greater success (Ferguson & Stern).

Biological Maturation of Pediatric Athletes

Overall, participation in physical activity and sports is highly encouraged for all children and can provide numerous physical, psychosocial, and health benefits. In addition to developing sports related skills, participation in athletics can also foster growth of life skills such as leadership, teamwork, and character (Kaleth & Mikesky, 2010). Still, when examining the validity of early sport specialization, the natural biological maturation of a child must be taken into account. In order to fully appreciate the potential consequences of single sport specialization on the pediatric athlete, one must understand the innate structural and physiologic differences between immature and mature athletes (Smucny et al., 2015). According to Ford et al. (2012),

describe post-natal growth as “s-shaped.” Ford et al. and Rogol, Clark, and Roemmich (2000) note although there are differences in gender, the most rapid period for human growth occurs between infancy and early childhood (0-6 years old). This is followed by a relatively constant growth during middle childhood (7-11 years old) and then a rapid growth spurt during adolescence (11-16 years old). Growth and its milestones are determined by the growth of the bones, while skeletal maturity is expressed by the degree of calcification of the epiphyses (Molinari, Gasser, & Largo, 2013). In adolescents, the skeleton grows first in size and length, after which it gains in density and strength (Manna, 2014). The major growth locations before the start of rapid adolescent growth are in the extremities and during the adolescent growth spurt, the trunk grows most rapidly (Manna). As adolescence continues and growth begins to slow, the growth plates begin to fuse firmly together with the shaft of the long bones (Manna).

In addition to increase in human stature, another aspect of biological maturation is body fat storage. Ford et al. (2012) adds there is an average increase in body fat storage from 11-15% in boys and 14-25% in girls between the ages of 6-17 years old. He also notes the distribution of fat in boys is mostly in the abdomen, while girls have equal distribution between the abdomen and the extremities.

There is a significant increase in lean body mass during biological maturation, with large increases in muscle mass from 42-54% for boys and 40-45% for girls of total body mass between the ages of 5-17 years old (Ford et al., 2012). Such changes in muscle mass are actually related to changes in muscle size rather than composition, meaning there is a restriction on an individual’s maximal athletic trainability and performance during growth until biological and sexual maturation are reached (Ford et al.; Matos & Winsley, 2007).

Furthermore, anatomical and muscular developments are impacted by the functions of the endocrine system. Increased bone growth and muscle maturation during the onset of puberty is related to the increase in insulin-like growth factor and steroid-sex hormones (Ford et al., 2012). Similarly, Ford et al. explains during adrenarche and gonadarche, there are increased secretions of gonadotropin-releasing hormone, testosterone, estradiol, progesterone, follicle-stimulating hormone, and lutenizing hormone. According to Ford et al., when young athletes try to maximize their individual athletic potential, the changes in hormone levels will have a significant influence on the adaptive or maladaptive response of the body during training and recovery as the endocrine system regulates metabolic and growth processes.

Finally, genetics must be discussed when considering the biological maturation of young athletes. Physical potential of an individual is dictated by one's genetic make-up. This fact can either give young athletes an advantage prior to beginning training or it will limit an athlete regardless of the sport specialization (Kaleth & Mikesky, 2010).

Consequences of Sport Specialization

There are several theories that provide some rationale for supporting the claim that early sport specialization is an independent risk factor for injury: 1) Specialized athletes are more likely to have year- round (>8 months per year) exposure to a single sport 2) Repetitive technical skills and high- risk mechanics 3) Overscheduling and competition (Myer et al., 2015). There is evidence in the literature to support that these three theories are the basis for the physical and psychological consequences of early sport specialization.

Physical Consequences

There is an inherent risk of injury for all ages and all levels of athletes. Yet, the emerging evidence indicates that increased degree of specialization is positively correlated with increased serious overuse injury risk (Myer et al., 2015). There is a clear correlation in the literature between training volume and intensity and injury risk, particularly overuse injuries (Smucny et al., 2015). The emergence of specialized, one-sport athletes has predictably led to a rise in overuse injuries and in fact it is now estimated that over 50% of all injuries in middle and high school athletes are from overuse (Hill & Andrews, 2011). Hill and Andrews explain today the one- sport athletes are pushed and expected to perform at an elite level for an extended period of time without sufficient rest to allow their bodies to recover. Physical fitness levels in youth are declining and the combination of increased exposure and decreased preparedness for sports participation has led to increasing rates of sports- related injuries (Mostafavifar, Best, & Myer, 2013). With increased youth sport participation, there has been a notable increase in sports-related injuries, with 2.6 million emergency room visits each year for those aged 5-24 years, and per the National Center for Sports Safety, 3.5 million children aged 14 and younger receive medical care for sports- related injuries (Merkel, 2013). According to Merkel, due to rapid expansion of bones while growing and slowly elongating muscles, tension develops across the growth plates, the apophyses, and the joints. This increase in tensile forces places the aforementioned structures at risk of injury (Merkel). The musculoskeletal risks are predominantly overuse injuries as up to 50% of all injuries seen in pediatric sports medicine are related to overuse (Mostafavifar et al.). The majority of injuries seen in young athletes are related to specific, repetitive movement patterns that result in damage to a tissue structure, such as bone, muscle, or tendons, without allowing for sufficient rest periods to allow positive bone

remodeling (Kaleth & Mikesky, 2010; Mattson & Richards, 2010). If a young athlete returns too soon from an injury, chronic pain, dysfunction, increased time away from the sport, and repeated injury to the same or a different body part can occur (Merkel). Previous injuries may lead to fibrosis and formation of adhesions, which may limit joint movement, consequently predisposing the athlete to repeating the injury or predisposing the athlete to compensatory injuries at other sites (Caine et al., 2008).

For a young athlete, a proper diet and adequate nutrition are critical to the future development and growth of the child. According to Hecimovich (2004), it is noted that it is possible for athletes to feel pressured to achieve a prototypic body for the sport of choice. This pressure can encourage atypical eating patterns and habits, which can lead to various types of eating disorders. Another physical consequence of early sport specialization involves sexual maturation. Early intensive training has also been associated with a slower rate of sexual maturation among athletic females as they tend to experience menarche at a later age (Baker et al., 2009; Hecimovich). Poor nutrition, stress, and low levels of body fat have been discussed as possible reasons for the delay. Prolonged amenorrhea may cause diminished bone mass from associated decrease in estrogen secretion, augmenting the risk for stress fractures (Hecimovich).

Psychological Consequences

According to Caine et al. (2008), life stress has been shown as a strong predictor of injury. An obvious concern with early sport specialization among the literature is a decreased enjoyment for athletics and while physical consequences of early sport specialization are highlighted, it is equally important to investigate psychological consequences. According to Baker et al. (2009), early sport specialization is associated with disappointment and

encouragement as children often feel pressure to win and experience situations that lead to low self-esteem and low self-confidence. Burnout, social isolation, and overdependence are just a few of the additional psychological concerns linked to early sport specialization (Smucny et al., 2015).

Burnout is not a sudden development, but rather evolves over an extended period of time (Malina, 2010). Burnout syndrome, which is associated with changes in a young athlete's cognitive and mood profile, can be a consequential deterrent from all forms of athletics as the young athletes mature (Mostafavifar et al., 2013). Baker et al. (2009) note burnout is becoming increasingly prevalent in youth sport settings, and particularly among athletes in individual sports such as tennis and swimming. Malina explains many negative factors are involved in burnout, but there are three primary: negative performance evaluations, mixed messages, and overtraining. All three factors foster feelings of lack of control and a sense of powerlessness. The athlete's perception becomes he or she cannot meet the demands and expectations placed upon them (Malina, 2010).

Studies have shown that athletes highly involved in training and competition demonstrate less helping and sharing behavior and greater antisocial tendencies. In addition, early sport specialization athletes have cited social isolation, rivalry, a sacrificed lifestyle, a lack of free time, and missed social opportunities as consequences of their sport development path (Baker et al., 2009). According to Malina (2010), focusing on a single sport and the associated time commitment linked to sport specialization may foster isolation from age and sex peers, especially during adolescence, and may alter relationships with peers and family.

The lives of young athletes aiming for elite status tend to be highly regulated by adults surrounding them. This may lead to overdependence on others and in many cases loss of control

by the athlete for their own lives (Malina, 2010). According to Smucny et al. (2015), the constant scheduling of activities by adult influences and an over exaggeration of self-worth has potential negative effects for young athletes as they grow and mature.

Early Sport Specialization vs. Diversification

There is an increased push for early sport specialization by parents and coaches based on the assumption that a specific training regimen is the most efficient means to skilled performance, and that early diversification is delaying the optimization of talent. According to Sagas (2013), the strongest support for early sport specialization is found in sports in which peak performance usually occurs in early adolescence, such as women's gymnastics and women's figure skating. Another theory in support of early sport specialization states early success and rewarded performance may increase the child's self-esteem and promote intrinsic motivation as the child continues to advance within the sport (Burgess & Naughton, 2010; Sagas).

However, beyond the couple of theories in support of the model, there is growing evidence on the contrary. Still, the empirical basis for these assumptions for early sport specialization have not been supported among the literature (Baker, 2003). According to Wojtys (2013), the goal of sport specialization at an early age is to optimize the opportunities to develop athletic skills in one sport to enhance the chance of competing at the next level. Wojtys points out that while parents are often the ones who initially encourage and initiate sports participation, it is the coaches who emphasize sports specialization and single out individuals for advanced play. Therefore, the young athletes who may develop or learn the game at a slower pace are often left behind or cut from the team (Wojtys). So where does this leave the majority of young athletes? What is the alternative to early sport specialization? Diversification.

The diversification approach focuses on enjoyment in a variety of playful sporting activities during childhood (Cote & Hay, 2002). Research literature has shown that there are benefits to this approach instead of specialization at a young age. According to Baker and Cote (2006), during early phases of growth and biological maturation, a diversified approach to sports and recreation may stimulate generic physiological and cognitive adaptations, which lay the groundwork for specialized capacities necessary for future expertise. Beyond physical development benefits gained from diverse athletic participation, psychological and social development can be enhanced (Mostafavifar et al., 2013). For example, a wide interest in multiple sports during youth can promote diverse relationships and experiences, and once adults, their multiple sport background can expand their physical activity and social options (Mostafavifar et al., 2013). In addition, research from the field of cross-training supports the conclusion that elements of physical conditioning can transfer across similar sports (Baker et al., 2009). Indeed Baker et al. (2009) point out that the literature is unanimous in agreeing that diversification alone will not lead to elite development of skills. However, broad and extensive involvement during the “sampling years” or early ages in sports appears to better augment skills within a primary sport later in life based on the athlete’s maximized physical and psychological adaptations while diversifying. With that evidence, it is not surprising that most athletes who achieved elite status, such as playing collegiate athletics or in the Olympics, played multiple sports when they were young (Sagas, 2013).

Guidelines and Recommendations for Providers Assessing and Treating Pediatric Athletes

What is the role of healthcare providers in the growing phenomenon of early sport specialization? A policy statement from the American Academy of Pediatrics (2000) concluded

that young athletes should be discouraged from specialization in a single sport before adolescence to avoid physical and psychological damage. It is important for healthcare professionals to be informed on the topic of early sport specialization in order to properly and accurately educate athletes, parents, coaches and organizations of the potential risks and benefits (Ferguson & Stern, 2014). First and foremost, the concept of “pushing through the pain” should not be mandated in youth athletics. It is essential for clinicians to understand the differences in youth and adult physiology, particularly during the adolescent growth-spurt when injury risk is high. A child complaining of pain should seek medical attention (Smucny et al., 2015) and it is the clinician’s role to advocate for the child, for the patient, with his or her best long- term interest in mind.

Once the clinician has the child in the office, a thorough assessment must be standardized. The Pre-participation Physical Exam is widely used to detect potentially life-threatening medical conditions and to screen for risk factors that may predispose athletes to injuries (Smucny et al., 2015). The health of a young athlete involved in intense training should be monitored regularly by pediatric providers at each visit as specific attention should be focused on serial measurements of body composition, weight, height; cardiovascular findings, sexual maturation, and evidence of emotional stress (Hecimovich, 2004). Red flags during the history portion of the in-office assessment of the single sport athlete include decreased performance despite weeks to months of recovery, mood disturbances, lack of enjoyment in sport, weight loss, anorexia, sleep disturbances, presences of triggers such as high demands, monotony of training, and excessive number of competitions (Smucny et al.). The intensely trained, specialized athlete needs ongoing assessment of nutritional intake, with particular attention to total calories, a balanced diet, and intake of calcium and iron (Hecimovich, 2004). Red flags on the physical

exam portion of the assessment include muscle tightness, ligamentous laxity, and valgus knee collapse on single leg squat test (Hecimovich; Smucny et al.).

As stated earlier, education with accurate content for both the athlete and the parents is crucial to help prevent physical and psychological consequences for young athletes. It is recommended by the American Academy of Pediatrics that young athletes should have at least 7 hours of sleep each night, are limited to one sporting activity 5 days a week with at least one day off from organized activity (Smucny et al., 2015), and also young athletes take 2-3 months away from their sport each year to allow recuperation of their bodies and minds from the intense sports seasons (Hill & Andrews, 2011). According to Hoang and Mortazavi (2012), as more children and adolescents play on multiple teams or are involved in year-round training, the consequence of overuse injuries are far more serious than in adults, and so the ability to identify individuals who are at risk for injuries is the key in order to provide the proper education, prevention, early diagnosis, or treatment.

In the absence of excessive physical stress markers, providers should strive for early recognition, prevention, and treatment of overuse injuries (Anderson et al., 2000). According to Anderson et al., if the treatment options only include rest or time off, then the instructions are unlikely to be followed by the committed child athlete. Clinicians must be more creative and willing to listen to the needs of the young athlete when devising treatment plans that will be faithfully followed. It is also the job of the healthcare provider to monitor the conditions of the child athlete's intense training by asking questions to the athlete and from there properly educating the athlete and family about strategies for prevention (Anderson et al.). As Malina (2010) explains, young sport participants, including talented athletes, are children and adolescents with the needs of children and adolescents whose goal is to "grow-up" – biologically

grow and mature and behaviorally develop. Children should be encouraged to participate in sports at a level consistent with their abilities and interests and pediatricians should work with parents to ensure that the child athlete is being coached by persons who are knowledgeable not only about the sport, but more importantly about coaching young competitors (Committee on Sports Medicine and Fitness, 2000).

Chapter 3

Discussion

Although this is a relatively new topic within the literature, I have uncovered some recurrent and undeniable themes. According to Ford et al. (2012), recent literature sees participation in sports and physical activity as a life-long continuum. As a consequence, youth sports must be viewed as more than helping young athletes achieve an elite status or scholarships or a professional athletic career (Ford et al.). Youth sports has the capability to be used as a vehicle to further promote healthy, active lifestyles for all children, both now and as they age. As stated earlier, a component of the conception of early sport specialization in our society was the desire for young athletes, and their families, to pursue college scholarships or athletic careers. This pursuit is often sought after by the athletes who were labeled “elite” or “great” when they were young children. Developing athletes, parents, and coaches seek to develop and hone skills faster, gain a competitive edge, and be recognized for talent (Ferguson & Stern, 2008). However, as biological maturation occurs, much can change about a child’s body, both for the benefit of the child’s athletic development as well as to the detriment. Meanwhile, the children who were told they were not good enough to pursue a competitive athletic activity may stop participating in sports all together and then lose out of building positive physical and emotional habits through playing sports.

This point can be further examined and appreciated by examining another study. According to Lykissas, Eismann, and Parikh (2013), the number of acute pediatric sports-recreational injuries has decreased by 12.4% from 2000-2010 for children ages 5-14 years old. Although the study does not establish the causality for the decrease in number of injuries, there

are several speculations. One reason could be the decrease in youth participating in sports overall. As more competitive, organized sports are encouraged, the fewer deliberate play opportunities are available for children and adolescents. Another theory is while the number of acute injuries has decreased, the severity of the injuries among pediatric athletes has increased. Similarly, this study did not take into account overuse injuries, which would not fall into acute injuries (Lykissas et al.). Ultimately, understanding the trends of pediatric sport injuries can aid health care providers in correctly diagnosing, formulating effective treatment options, and offering valuable education in order to prevent future injuries.

As a result of Ericsson's study in 1993, the early sport specialization model increased in popularity and was adopted by many athletic organizations. However since that study, several factors have proven Ericsson's study may have the same correlation in sports that it had to music or math. According to Ferguson and Stern (2008), Ericsson never mentioned or indicated how to become an expert athlete in his study; he only specifically mentioned musicians, mathematicians, and chess players. Ericsson's study attributed expertise to only engagement in deliberate practice and simply dismissed the role of genetic ability, biological maturation, familial support, degree of coaching, and basic skills such as physical fitness (Sagas, 2013). Overtime, newer investigations have demonstrated athletics often require diverse skill sets and relies more on appropriate physical development than musicians or mathematicians (Ferguson & Stern; Sagas). Similarly, genetics cannot be ruled out of the equation when evaluating what it takes for a child to develop into a great athlete. While physical requirements for each sport vary, no amount of practice or sport specialization can compensate for genetic make-up (Kaleth & Mikesky, 2010).

While there is no direct research or evidence suggesting that there are greater physiological benefits of early sport specialization compared to the diversified approach,

multiple sources of evidence do show that high-intensity training associated with specific, repetitive movements greatly increases the risk of overtraining and sustaining an injury (Kaleth & Mikesky, 2010). In fact, there have been lists of associations, organizations, and medical authorities, such as the American Medical Society for Sports Medicine, the American Academy of Pediatrics, the International Society for Sports Psychology, and the World Health Organization, have printed position statements on early sport specialization, and all statements have stated there is no evidence to support early sport specialization leads to improved outcomes in athletics (Ferguson & Stern, 2008). If this fact is established in the literature, then healthcare providers must make a point of emphasis to carefully and thoroughly evaluate every child involved in sport-related activities. Just as a provider would question a child using drugs because studies show drugs can be harmful to a child's health, providers must question children involved in sports to help tailor their medical care. Clinicians have a responsibility to properly and effectively educate the patient, the family, the coach, and the athletic body as a whole to promote the well-being for children and adolescents, both now and for their future.

Chapter 4

Conclusion

The purpose of this literature review was to investigate the epidemiology of early sport specialization, understand the biological maturation that occurs throughout childhood and adolescence, examine risk factors for overuse and burnout, recognize the potential physical and psychological outcomes for the athletes, and to determine the current recommended guidelines for health care providers in order to determine the most effective treatment and education for pediatric athletes. After reviewing the literature, in my opinion, early sport specialization can have negative consequences for the child, both now and later in life. Diversification should be the promoted model for its positive impact on physical and psychological development for the child. This topic and growing literature evidence is relevant to the physician assistant profession because our main focus as providers should first and foremost be the health and safety of our patients. As health professionals who may see pediatric athletes in the emergency department or in the urgent care setting or as their primary care providers for yearly sport physicals, we must take each and every opportunity to evaluate the child, both physical and psychological, and we must be willing to advocate for the patient's overall health citing the current literature as evidence-based medicine. If we can keep children excited and engaged in physical activity, we may help them adopt healthier lifestyles now and promote a better sense of total health in the future once they become adults.

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Abstract

Objective:

This review investigated the epidemiology of early sport specialization, the biological maturation of pediatric athletes, risk factors for overuse and burnout, the potential physical and psychological outcomes, and the current guidelines for providers in an effort to determine the most effective treatment and education.

Method:

The databases primarily used for the article include MEDLINE, PubMed, and Google Scholar. The main search terms used were early sport specialization, pediatric burnout, pediatric overuse, overuse injuries, sport injuries, overtraining, biological maturation, growth patterns, diversification, history, prevention, guidelines, and treatment.

Result:

While the evidence shows the number of pediatric sport-related injuries is decreasing, the severity of the injuries is increasing. At this point in the literature, the unproven benefits of early sport specialization do not outweigh the real risks.

Conclusions:

The model of diversification must be promoted and providers must evaluate every child for possible physical and psychological consequences of sports.