

## FIMS International Perspectives

### Early Sports Specialization: An International Perspective

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Is early sports specialization bad? Or could early sports specialization really have positive outcomes for young athletes?

## **Introduction**

The physical activity required for most sports has numerous health benefits – physical, mental, and academic (5,22,35). Some young athletes specialize in a single sport, while others play multiple sports throughout adolescence. Primary reasons to specialize early include enjoying that single sport, lifestyle access to a particular sport such as running (34), hope for financial or other special success, or parental pressure. Regions with few resources expect organized sports may provide a safer environment for physical activity than the outdoor neighborhood (*e.g.*, South Africa and Brazil) or increase government-supplied resources to youth sports organizations based on the number of children enrolled (Australia (1)).

Recent concerns by sports medicine experts have sparked debate about the wisdom of early sports specialization (3,4,5,6,21,36), but virtually no solid data have been published to inform caregivers, coaches, and families about possible risks and benefits. Sports specialization below the age of 18 years has been suggested to increase injury risk, decrease social opportunity, and impair life satisfaction (4,16). Additional review articles (23,24) and consensus statements by major sports medicine organizations (3,4,5,8,21,36) suggest that early specialization is a culprit potentially leading to adults with history of excessive injuries and limited social opportunity, even suggesting dire consequences (24). However, research supporting these statements is minimal or absent.

## **Critique of peer-reviewed research**

Few studies have examined the role of early sports specialization among youth athletes while adjusting for confounding parameters such as age, body size, skill level, or training and competition exposure. None has also examined cross-training, neuromuscular coordination, or strength training. We are not aware of any English-language published article that both gives their specialization definition and uses methodology other than recall-biased questionnaires completed by the young athlete without the assistance of a parent or coach. Investigators struggle even to define early specialization.

### *Training threshold and specialization definition*

Training volume thresholds may relate to injury incidence, but do they also define early sports specialization? Early research focused on male United States (U.S.) baseball players ages 14 to 20 years. Pitching competitively more than 8 months a year, or more than 80 pitches per game, increased the likelihood of shoulder or elbow injuries (26). The 8-month annual maximum for a single sport – a safety guideline developed for young pitchers – was extrapolated to other sports without supportive data. This exposure time is part of the Jayanthi sports specialization definition: a highly specialized youth athlete trains in a single sport more than 8 months per year, participates only in that sport, and has given up other sports (18).

Months per year alone do not define specialization. For example, a study of sub-elite child and adolescent male Portuguese soccer players who trained and competed more

than 8 months per year and completed about 6 to 10 hours per week of organized soccer (6), included no information on other sports activity done by those athletes. Their exposure hours were much lower than those of young competitive gymnasts, dancers, or figure skaters, so comparisons among “specialized” athletes are difficult by the 8-month definition alone. If they had always played only soccer, by the Jayanthi definition they would be “moderately specialized.” If, however, they previously played another sport even just an hour or two a week, they would be considered “highly specialized.” If they currently played on both the soccer team and the rugby team during the year, they would be “low specialized.” This example highlights the difficulties of defining the term early specialization.

#### *Injury incidence relative to sports specialization*

A 2016 systematic review only found three English-language, peer-reviewed research studies of children under 18 years of age that examined the relationship between sports specialization and injury incidence, finding no prospective studies (11). All three studies suffered from considerable selection and recall bias. Jayanthi et al. (18) in a questionnaire study of 7 to 18-year-old U.S. athletes found that higher specialization was related to increased overuse but not acute injury incidence, independent of age and hours of weekly participation, but they did not identify the athletes’ sports. The age at sports specialization did *not* differ between the cases and controls, who were not matched by age or sex. Further information about this cohort (28) indicates that 26% participated in a single sport for >8 months per year, and 47% were tennis players, 30% gymnasts, and 26% dancers, suggesting the lack of generalizability of the study. The second study,

based on questionnaires completed by tennis players ages 10 to 18 years who were followed during a 4-week tournament season, found that 4% of that potentially biased group (self-selected volunteers) had medical withdrawal from matches, with no difference in the player's sex, age, or age at specialization to tennis (17). The third study considered an athlete specialized if the youth played only one sport, even if that sport was played just a few months of the year and the athlete had played only a single season ever (14), a definition typically not considered "specialized." The female athletes in jumping or kicking sports had retrospectively determined incidence of anterior knee pain, higher among the taller, heavier, or older girls, and single-sport players. Not included in the 2016 systematic review (11), a Wisconsin US group used the Jayanthi definition to study several regional cohorts, all using a recall questionnaire completed by young athletes unaccompanied by a coach, parent, or anyone else who might recall their health history (2,29,30). Post et al. (30) concluded that highly specialized athletes are more likely than low specialized athletes to report an injury in the previous year.

### *Mental health of junior elite athletes*

The benefits of physical activity in youth have been correlated with improved mental health and academic performance (9,35). Children and adolescents also experience health changes related to puberty, nutrition and energy management, mood and anxiety stressors, and sleep disorders. Young athletes face challenges and stresses related to balancing school and sport, early separation from their families for training, significant travel, and complicated relationships with coaches and competitors. Preliminary research

suggests that the athlete's coping strategies and surrounding emotional, coaching, and parental climate may impact the outcome (10,13).

Studies of junior elite athletes have generally focused on negative attributes such as depression and burnout, problems that might be mitigated (3,5,8,10,13,20). Ten years after the Women's Tennis Association introduced progressively staged tournament and media exposure by young players, early retirement had decreased and length of playing career had increased significantly (27). Although a study of adult elite athletes suggests they have similar incidence of depression to non-athletes (32), a similar study of young athletes is just beginning (10). Sports are a mechanism for increasing physical activity among youth, potentially improving mental health, but the short- and long-term mental health outcomes are unknown.

### **International Vision for Youth Sports**

The ideal youth athlete would optimize personal physical health, with minimal injury and lifelong enjoyment of physical activity. Ideally, the youth athlete would mature with a healthy mind, with resilience and other leadership qualities, including presence, self-assuredness, time management skills, and ability to manage performance anxiety to optimize different types of performance in life. The youth athlete would overall enjoy the training and competitive/performance aspects of sport, with positive spiritual and emotional outcomes.

There is both anecdotal and scientific evidence to suggest that young Olympians and Paralympians who achieve great performance can inspire nations (7). For example, Ellie Simmonds, a five-time Paralympic Champion in swimming, won her first Paralympic medal at the age of 13 in Beijing in 2008. She and other young Paralympians have helped bring about societal change and alter perceptions of disability.

Concerns about physical injury and burnout may be mitigated by specific programs designed for gradual increase in the physical and emotional exposure of the young athlete to high-level sport demands (27). The Youth Olympic Games, for athletes 14 to 18 years old, promote safe sport with programs supporting healthy body image and safeguards against harassment and abuse (19). The Youth Olympic Games now include injury and illness surveillance during the Games, but these data do not yet tackle many questions around early sports specialization (15).

### **Focus on Future Research**

Up to now, the research on early sports specialization cited in this Perspective has typically been done by individuals with little or no outside funding. Although major organizations have recommended further research in their consensus statements, funding for the suggested research has been scarce. We suggest that organizations such as the International Olympic Committee, national Medical Research Councils, and International Federations of sports prioritize funding to evaluate risks and benefits of early sports specialization.

Studies should evaluate the continuum from the elite athlete to the youth who does not reach national or international competitive level. A training program designed primarily to produce a few Olympic champions likely differs in risks and benefits from one designed to promote a love for different sports and optimal public health (31).

Prospective surveillance will allow further understanding of health problems developing in adulthood that relate to early sports specialization or training volume.

The research needed to safely support youth sport and early specialization is yet to be done. For example, what is the rate of *all* injuries of children and adolescents who specialize early compared with those who do no sports, or only recreational sports? The young athlete who trains 15 to 25 hours weekly has fewer hours available for other risky activities and may sustain fewer significant acute injuries outside of sport. Scientifically rigorous studies might include a control group of youth doing only free play, multi-sport athletes, and single-sport athletes, all with the same number of exposure hours. Control for skill level, age, size, skeletal maturity, and other physical training is needed. Future studies should be prospective, with careful and frequent monitoring, to minimize recall bias and improve diagnostic specificity.

Since these young, specialized athletes probably do sustain more injuries from repetitive microtrauma, are there long-term repercussions from these injuries? Or can these young, growing athletes use injury recovery time to improve their overall fitness and

coordination, and even performance skills? How does this type of injury affect the athlete long-term, if at all?

Should those caring for young athletes monitor their growth and development to minimize injury related to very rapid growth and to optimize development of more mature neuromuscular patterns? Can this approach prevent injury, perhaps while improving performance?

Does early sports specialization impact adult quality of life? Are early specialists more or less likely than others to be pleased by their adult occupations and range of life choices? Does early sports specialization impact an athlete's future physical activity level? Is the early specialist more or less likely to develop cardiovascular disease, pain, arthritis, or osteoporotic fracture in adulthood?

## **Conclusions**

Early sports specialization is necessary for skill acquisition required for competitive success in many sports (5). With the exception of boys' baseball, no published data provide useful guidance regarding positive or negative, short- or long-term outcomes for the young athlete relative to early specialization. Before making sweeping recommendations against early sports specialization, solid data are needed. Only research done with rigorous methodology will provide answers. Our goal as sports medicine scientists and clinicians should be to help each young athlete optimize sports skills and performance, and also develop into a well-balanced, healthy, fit adult. Perhaps early

sports specialization may hinder achievement of these goals, but it may actually *enhance* the young athlete's life.

## References

1. Australian Sports Commission. The future of sports in Australia: 2009. [cited 2017 Sept. 13]. Available from: [https://www.health.gov.au/internet/main/publishing.nsf/Content/aust\\_sport\\_path/\\$file/aust\\_sport\\_path.pdf](https://www.health.gov.au/internet/main/publishing.nsf/Content/aust_sport_path/$file/aust_sport_path.pdf).
2. Bell DR, Post EG, Trigsted SM, Hetzel S, McGuine TA, Brooks MA. Prevalence of sport specialization in high school athletics: a 1-year observational study. *Am J Sports Med.* 2016;44(6):1469-74.
3. Bergeron MF, Mountjoy M, Armstrong N, et al. International Olympic Committee consensus statement on youth athletic development. *Br J Sports Med.* 2015;49(13):843-51.
4. Brenner JS. Overuse injuries, overtraining, and burnout in child and adolescent athletes. *Pediatrics.* 2007 (reaffirmed 2014); 119:1242-5.
5. Brenner JS, Council on Sports Medicine and Fitness. Sports specialization and intensive training in young athletes. *Pediatrics.* 2016;138(3),e20162148.
6. Brito J, Malina RM, Seabra A, et al. Injuries in Portuguese youth soccer players during training and match play. *J Athl Train.* 2012;47(2):191-7.
7. Coates J, Vickerman PB. Paralympic legacy: exploring the impact of the games on the perceptions of young people with disabilities. *Adapted Physical Activity Quarterly.* 2016;33(4):338-57.

8. DiFiori JP, Benjamin HJ, Brenner JS, et al. Overuse injuries and burnout in youth sports: a position statement from the American Medical Society for Sports Medicine. *Br J Sports Med.* 2014;48(4):287-8.
9. Donnelly JE, Hillman CH, Castelli D, et al. Physical activity, fitness, cognitive function, and academic achievement in children: a systematic review. *Med Sci Sports Exerc.* 2016; 48(6):1197–222.
10. Elbe AM, Nylandsted Jensen S. Commentary: comparison of athletes' proneness to depressive symptoms in individual and team sports: research on psychological mediators in junior elite athletes. *Frontiers in Psychology.* 2016; 7:1782.
11. Fabricant PD, Lakomkin N, Sugimoto D, Tepolt FA, Stracciolini A, Kocher MS. Youth sports specialization and musculoskeletal injury: a systematic review of the literature. *Phys Sportsmed.* 2016;44(3):257-62. DOI:10.1080/00913847.2016.1177476.
12. Goldstein JD, Berger PE, Windler GE, Jackson DW. Spine injuries in gymnasts and swimmers. An epidemiologic investigation. *Am J Sports Med.* 1991; 19(5):463-8.
13. Gustafsson H, Sagar SS, Stenling A. Fear of failure, psychological stress, and burnout among adolescent athletes competing in high level sport. *Scand J MedSci Sports.* 2016; Nov 23. doi: 10.1111/sms.12797. [Epub ahead of print]
14. Hall R, Foss KB, Hewett TE, Myer GD. Sports specialization is associated with an increased risk of developing anterior knee pain in adolescent female athletes. *J Sport Rehabil.* 2001; 24:31-5.
15. International Olympic Committee. IOC injury and illness surveillance study: protecting the athletes' health. [cited 2017 Sept. 14]. Available from:

<https://www.olympic.org/news/ioc-injury-illness-surveillance-study-protecting-the-athletes-health>.

16. Jayanthi N, Brenner J. Caring for the young athlete: past, present and future. *Br J Sports Med*. 2017; 51(3):141.
17. Jayanthi N, Dechert A, Durazo-Arivu R, Luke A. Training and specialization risks in junior elite tennis players. *J Med Sci Tennis*. 2011;16:14-20.
18. Jayanthi NA, LaBella CR, Fischer D, Pasulka J, Dugas LR. Sports-specialized intensive training and the risk of injury in young athletes: a clinical case-control study. *Am J Sports Med*. 2015;43(4):794-801.
19. Judge L, Petersen J, Lydum M. The best kept secret in sports: The 2010 Youth Olympic Games. *International Review for the Sociology of Sport*. 2009;44(2-3):173-91.
20. Kriz PK, MacDonald JP. The youth sports machine: destructive juggernaut or vehicle for success? *Curr Sports Med Reports*. 2017;16(4):227-9.
21. LaPrade RF, Agel J, Baker J, et al. AOSSM early sport specialization Consensus Statement. *Orthopaedic J Sports Med*. 2016;4(4):1-8.
22. Merkel DL. Youth sport: positive and negative impact on young athletes. *Open Access J Sports Med*. 2013; 4:151-60.
23. Myer GD, Jayanthi N, Difiori JP, et al. Sport specialization, part I: does early sports specialization increase negative outcomes and reduce the opportunity for success in young athletes? *Sports Health*. 2015; 7(5):437-42.

24. Myer GD, Jayanthi N, Difiori JP, et al. Sport specialization, part II: alternative solutions to early sport specialization in youth athletes. *Sports Health*. 2015; 8(1):65-73.
25. Nixdorf I, Frank R, Beckmann J. Comparison of athletes' proneness to depressive symptoms in individual and team sports: research on psychological mediators in junior elite athletes. *Frontiers in Psychology*. 2016;7:893.
26. Olsen SJ 2nd, Fleisig GS, Dun S, Loftice J, Andrews JR. Risk factors for shoulder and elbow injuries in adolescent baseball pitchers. *Am J Sports Med*. 2006;34(6):905-12.
27. Otis CL, Crespo M, Flygare CT, et al. The Sony Ericsson WTA Tour 10 year age eligibility and professional development review. *British J Sports Med*. 2006; 40(5):464-8.
28. Pasulka J, Jayanthi N, McCann A, Dugas LR, LaBella C. Specialization patterns across various youth sports and relationship to injury risk. *Phys Sportsmed*. 2017;45(3):344-52.
29. Post EG, Bell DR, Trigsted SM, et al. Association of competition volume, club sports, and sport specialization with sex and lower extremity injury history in high school athletes. *Sports Health*. 2017; Jun 1:1941738117714160. doi: 10.1177/1941738117714160. [Epub ahead of print]
30. Post EG, Trigsted SM, Riekens JW, et al. The association of sport specialization and training volume with injury history in youth athletes. *Am J Sports Med*. 2017; 45(6):1405-12.
31. Reider B. Too much? Too soon? *Am J Sports Med*. 2017;45(6):1249-51.

32. Rice SM, Purcell R, De Silva S, Mawren D, McGorry PD, Parker AG. The mental health of elite athletes: a narrative systematic review. *Sports Med.* 2016;46(9):1333-53. doi: 10.1007/s40279-016-0492-2.
33. Saluan P, Styron J, Ackley JF, Prinzbach A, Billow D. Injury types and incidence rates in precollegiate female gymnasts: A 21-year experience at a single training facility. *Orthop J Sports Med.* 2015; 3(4):2325967115577596.
34. Santos-Lozano A, Lucia A, Ruilope L, Pitsiladis YP. Born to run: our future depends on it. *Lancet.* 2017;390(10095):635-6.
35. Smedegaard S, Christiansen LB, Lund-Cramer P, Bredahl T, Skovgaard T. Improving the well-being of children and youths: a randomized multicomponent, school-based, physical activity intervention. *BMC Public Health.* 2016;16(1):1127.
36. Valovich McLeod TC, Decoster LC, Loud KJ, et al/. National Athletic Trainers' Association Position Statement: prevention of pediatric overuse injuries. *Journal of Athletic Training.* 2011; 46(2):206-20.