Youth Sport Specialization: How to Manage Competition and Training?

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A prevailing theory (and practical application) is that elite performance requires early childhood skill development and training across various domains, including sport. Debate continues whether children specializing early (ie, training/competition in a single sport) have true advantage compared with those who sample various sports early and specialize in a single sport later (adolescence). Retrospective data and case studies suggest either model yields elite status depending upon the sport category (ie, situational: ball games, martial arts, fencing; quantitative: track and field, swimming, skiing; or qualitative: gymnastics, diving, figure skating). However, potential risks of early specialization include greater attrition and adverse physical/emotional health outcomes. With the advent of the IOC Youth Olympic Games, increased emphasis on global youth competition has unknown implications but also represents a potential platform for investigation. Modification of youth competition formats should be based upon multidisciplinary research on psychophysiological responses, and technical-tactical behaviors during competition. The assumption that a simple scaled-down approach of adult competitions facilitates the development of technical/tactical skills of youth athletes is not necessarily substantiated with field-based research. Relatively little evidence exists regarding the long-term effects of rigorous training and competitive schedules on children in specific sports. It is clear that more prospective studies are needed to understand the training dose that optimally develops adaptations in youth without inducing dropout, overtraining syndrome, and/or injury. Such an approach should be sport specific as well as gender based. Until such evidence exists, coaches and sport administrators will continue to rely upon their sport-specific dogma to influence programmatic development of our most vulnerable population.

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Sport specialization is operationally defined as the age or point in time in an athlete’s development when sports training and competition is restricted to and focused upon a single sport in the pursuit of elite performance. The issue of whether children should participate in multiple sports before their period of rapid growth/development versus specializing “early” (< age 12) to acquire motor skills remains a critical area for investigation.
skills that enhance the likelihood of achieving elite status has been the subject of much discussion over the years. The model by Ericsson that 10,000 h of deliberate practice is requisite for elite performance (across various domains, including sport) has garnered much attention. Case studies of famous elite athletes who grew up training in a single technical/tactical sport lend credible support for this view. Conversely, there is growing support within the sport sciences to recommend early diversification over specialization to aid important transfer of general locomotor and psychological skills. As an example, The International Society of Sport Psychologists recently published a Position Stand on the topic: “To Sample or to Specialize,” describing seven postulates of early sport diversification that promote sustained participation in sport as well as elite performance. Moreover, there are also case studies of athletes that become elite in another sport after a previous career in a different discipline. Instead of debating the evidence for or against early specialization, it is important to understand how to manage training and competition in youth sports. Specifically, these questions remain: what is the evidence for the appropriate training volume in specific youth sports? How should competition be adapted for children to promote health, safety, and development of sport skills? And importantly, how can evidence be obtained to adequately inform practitioners in youth sport programs and those organizations that are key stakeholders (sport federations, International Olympic Committee)?

Training of the Child Athlete: How Much?

Knowledge regarding health outcomes related to the influence of training volume in children who specialize “early” is limited by the paucity of prospective randomized controlled trials. A recent consensus statement suggests that, for most youth athletes, early specialization (before adolescence) is not recommended. Concerns regarding early specialization are based on the potential for injury as well as psychological burnout against the backdrop of a host of other potential sociological issues. While limits for pitch counts, games, and pitch types have been published for baseball, no limits on training for other sports are available. Although it is recommended that youth athletes take off 1 mo of training every 6 mo (and 2 mo every year), the evidence for this recommendation is lacking. Even children who participate in multiple sports (as recommended) would find the “one month off” recommendation virtually impossible as contemporary youth sports encroach increasingly across traditional “seasons.” So while the potential risks of early specialization are appreciated, evidence-based recommendations are lacking. Conclusions are drawn primarily from retrospective recall studies of elite, subelite, and nonelite athlete cohorts’ training. This cross-sectional approach represents a major limitation in deriving conclusions. Youth athletes do not represent a normal distribution of the population because of the attrition and natural selection that occur as part of the success paradigm. Genetically gifted athletes may possess the inherent characteristics that facilitate positive adaptations (vs maladaptation) to the training loads which they are exposed to throughout growth and maturation. The ability for Michael Phelps to rigorously train daily from the age of 11 (for >12 y, spanning three Olympiads) combined with anatomical advantages (above-average height coupled with exceptional wingspan, large hands/feet, and hypermobile joints) suggests that youth who “survive” early sport specialization exemplify a Darwinian selection process.
Recently, Moesch et al.\textsuperscript{11} retrospectively examined elite (defined as top 10 in the World or a European Championship medalist) versus “near-elite” Danish male and female athletes from quantitative sports measured in centimeter, grams, or seconds to ascertain differences in cumulative practice hours in the main sport during childhood through attainment of National Team. Involvement in other sports at a young age did not predict success or differ between groups, but elite athletes specialized at a later age and trained significantly fewer hours in their main sport up through age 15. By age 18, near-elite and elite accumulated similar hours of practice (about 4,100 h) indicating a greater trajectory for practice time in the elite group. This is similar to other reports\textsuperscript{12–15} where early sampling in a wide variety of motor experiences was beneficial. The initial age of discipline-specific practice varies markedly between and within many Olympic sports with a large percentage of elites beginning training after the traditional “timing” of talent identification (8–12 y) with a negative correlation between early training and later success ($r = –.6$).\textsuperscript{16} Therefore, in quantitative sports, career planning with early exposure to the sport but later intensified training in mid to late adolescence appears critical. The question remains, however, what factors lead to a lower practice trajectory in the near-elite group as teenagers.\textsuperscript{11} Although elite status in sports where peak performance is reached after maturity appears to be achieved with approximately 4,000 h of sport-specific training,\textsuperscript{5} little is known about the intensity or quality of training. Furthermore, these data cannot be extrapolated to situational or qualitative sports where early motor development coupled with biomechanical advantages before maturity are critical. It is clear that more prospective studies are needed to understand the upper limit of training dose (duration, frequency, intensity) and the proper progression to enhance training quality that optimally promote adaptations in youth. Such an approach should be sport-specific as well as gender-based since most studies combine results from boys and girls due to limited statistical power.

### Youth Competitions: What Model?

In general, children involved in sport academies start competing around 8 y of age with the examination of youth athletic success and competitive behavior considered crucial for talent detection, selection, and monitoring of athletic development.\textsuperscript{17–19} Logically at novice level, youth competitions should be based on a progression, where demands are sequentially linked to meet physiological and psychological characteristics of young athletes, to facilitate the development of technical-tactical skills, and to prevent injuries during physical growth and biological maturation when athletic skills are not fully developed.\textsuperscript{16,17,20,21} Unfortunately, youth competitions are organized according to the gender and chronological age of the athlete, not considering biological maturation and behavioral development. Thus, the selection of young talented athletes is often biased in favor of those with an early maturity status who likely receive greater opportunities for expert coaching and training throughout childhood and adolescence.\textsuperscript{16,17,22–25}

In considering that young athletes could be exposed to an excessive psycho-physiological strain, recently the International Olympic Committee recommended international federations and national sports bodies to monitor the volume and intensity of training and competition regimens.\textsuperscript{21} Accordingly, the majority of
sport bodies governing youth competitions at regional, national, and international levels adhere to the main principle to scale down adult competition models in relation to the age of the young athlete. However, it remains to be ascertained whether scaled youth competition codes are suitable for children to develop their discipline-specific skills. To provide information on the actual requirements of youth competitions and increase the relevance and applicability of scientific results, athletes need to be examined in their competitive settings, which vary considerably between sports. This represents a major challenge since sport rules severely restrict opportunities for data collection and the pressure and hectic atmosphere accompanying competition generally do not promote cooperation from coaches and parents of young athletes.

Recently, the availability of noninvasive lightweight equipment (ie, heart rate monitors with internal memory, wearable global positioning systems, portable blood lactate analyzers, saliva collectors, video recording) and the cooperation with sport federations allowed a multidisciplinary approach to examine physiological, technical-tactical and psychological contributions to individual and team sport athletes early in their competitive career. Independent from competition duration, pitch/playing surface dimension or simplified rules, findings indicate that youth competitions pose a high physiological load on youth athletes, similar to that observed in elite athletes. Conversely, notational and match analyses that consider a wide multiplicity of movement patterns and decision-making components proved to be more effective in highlighting considerably different situational and contextual aspects between competitions played by young and elite athletes. In particular, technical and tactical parameters showed a better cooperation between 8- to 11-year-old soccer players when playing 5 vs 5 and 7 vs 7 codes on small pitches. However, opposite findings emerged when two youth water polo codes were compared. In fact, a drastic reduction of pitch and goal dimensions, number of players, and ball size in 14-year-old athletes resulted in a high fragmentation in play and swimming patterns different from those reported for adult water polo. Furthermore in individual sports, youth athletes showed tactical strategies opposite to that observed in elite athletes, probably due to the shorter duration or distance of their competitions. Therefore, the hypothesis that scaled competitions facilitate the development of sport-specific technical and tactical skills of athletes is not always substantiated and further research is strongly encouraged.

The examination of stress-related psycho-biological responses of young athletes to competition is particularly relevant to establish the recovery interval needed between events during tournaments or championships. Although children athletes show better psychological profiles with respect to sedentary peers, overscheduling has been the subject of interorganizational meetings with scientists noting the need of specific guidelines especially relevant when environmental conditions are thermally stressful. In fact, in a heat environment a second “competitive” type bout had been perceived more demanding with respect to the previous one despite adequate rehydration. Furthermore, 1 h of rest was insufficient to restore precompetition cortisol values in taekwondo athletes. Therefore, it is possible that tournament scheduling does not permit adequate recovery in children unless policies are clear and safety is prioritized over a “game on” mentality.
Development of Talented Athletes: Sport Versus Education?

Organizational structures that administer youth sports varies around the globe ranging from government ministries of sport to other models such as the United States with no central governing body overseeing youth sports. Furthermore, in the United States sport is embedded in the educational system that provides also scholarships for athletes, whereas in Europe competitive sport is generally practiced in private clubs having no or limited relationship with the educational system. Thus, in reconciling a top-level sport and education “dual career” European youth athletes often face obstacles, which could determine sport dropout or weaken future transition from sport into the labor market. Thus, within the 2009 Strategic Choices for the Implementation of the New EU Competence in the Field of Sport, the dual career has been considered a crucial issue. In considering that training, competition, and school demands vary considerably in typology, volume, intensity, and organization, it is challenging to accommodate the complex policy context of the 27 EU Member States. In such a variable national system, since 2004 the European Athlete as Student (EAS) network aims to identify and exchange the best practices between countries and institutions in the field of sport and education, and to present suggestions to the decision makers at local, national, and EU levels about the conditions for improving high performance sport and education. At a global level, the EAS network could also foster cross-national cooperation for the identification of optimal policies for the development of the youth athlete. This is a formidable task requiring adequate research funding combined with clear lines of communication among relevant global scientific societies and the IOC and sport governing bodies.

Conclusions

The few existing studies on youth sport training and competitions indicate that no single variable is sufficient to effectively evaluate youth sport performance. Furthermore, no single model can be applied to design training and competitions for children that “like their shoes, should fit perfectly and feel comfortable.” Therefore, sport scientists must apply innovative and multidisciplinary approaches to interface the unique demands of youth competition and training with the physiological and psychological capacity of child athletes. Furthermore, cross-national comparisons including social, political, economical, organizational, and economical variables are strongly encouraged. In particular, the recent establishment of the Youth Olympic Games in 2010 could offer a platform to potentially begin a coordinated effort to examine prospectively the complexities of youth sport performance with the overarching goals to aid and protect the child athlete, and to guide coaches in executing proper strategies that enhance sport skill development, relevant to encourage sport commitment throughout the lifespan.

As sport scientists, it becomes incumbent then upon us to lead global, multisector (ie, government, sporting and scientific organizations, and education) efforts to pursue prospective qualitative and quantitative studies, which can inform athletes and coaches of the best practices to manage training and the modification of com-
petition formats for youth athletes. This is not an easy task and may be met with some initial resistance. Yet, without such evidence, coaches will continue to rely upon traditional rules for competition and training dogma to influence the programmatic development of our most vulnerable athletic population.

References


