An Analysis of Sports Specialization in NCAA Division I Collegiate Athletics

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Background: Youth sports specialization has become more prevalent despite consequences such as increased injury rates and burnout. Young athletes, coaches, and parents continue to have misconceptions about the necessity of sports specialization, giving athletes the encouragement to focus on a single sport at a younger age.

Purpose: To characterize the motivations for specialization and determine when elite athletes in various individual and team sports made the decision to specialize.

Study Design: Cross-sectional study; Level of evidence, 3.

Methods: A Likert-style survey was developed and distributed to athletes from two National Collegiate Athletic Association (NCAA) Division I institutions. The survey’s Flesch-Kincaid grade level was 6.3. Statistical analysis was performed via the Student t test, where a P value less than .05 was considered significant.

Results: A total of 303 athletes with a mean ± SD age of 19.9 ± 1.52 years across 19 sports were surveyed; 94.7% of specialized athletes had previously played another organized sport prior to college, and 45% of athletes had played multiple sports up to age 16 years. The mean age of specialization was 14.9 years, with a significant difference between athletes competing in team (15.5 years) and individual (14.0 years) sports (P = .008). Males in individual sports specialized earlier than those in team sports (P < .001). Nearly one-fifth (17.4%) of athletes reported specializing at age 12 years or earlier. Personal interest, skill level, time constraints, and potential scholarships were the most important reasons for specialization overall. For individual sports, the motivations for specialization were similar, but collegiate (P < .001) or professional (P < .001) ambitions were significantly larger contributing factors.

Conclusion: Early sports specialization is uncommon among NCAA Division I athletes for most team sports, whereas individual sports tend to have athletes who specialize earlier and are more motivated by professional and collegiate goals. This study characterized the timing of specialization among elite athletes, providing a basis for understanding the motivations behind youth sports specialization. Physicians should be prepared to discuss the misconception that early sports specialization is necessary or common among most team-focused collegiate-level athletes. Knowing the motivations for sports specialization will guide clinicians in their discussions with youth athletes.

Keywords: sports specialization; youth sports; collegiate athletics

Early sports specialization (ESS) has had increased coverage in both the media and within the medical community because of the recent increase in the number of athletes choosing to specialize at increasingly younger ages.11,13,16 Although the reasoning behind specialization may be complex and multifactorial, much of the decision may be secondary to a widespread belief that early, single sport participation will heighten the chances of excelling or playing at an elite level. However, the increasing number of youth focusing on a single sport is of concern to medical professionals because of the potential negative psychological and physical effects imparted on young athletes.13,14,17

Sports participation among all age groups in the United States has increased within the past 20 years. Approximately 45 million youth aged 6 to 18 years played an organized sport in 1997, and this number increased to 60 million in 2008.1 With these data come a concomitant increase in the number of young athletes specializing in a single sport and an overall decrease in the age at which this decision is made.5,12 Across 1190 surveyed athletes in a study conducted by Jayanthi et al,13 almost 30% were highly specialized in a single sport. High school athletic directors...
have also noticed this increasing trend toward single sport specialization, with more than 70% of 150 surveyed athletic directors perceiving an increase in specialization over the past 10 years.\textsuperscript{11,12} This pattern of specialization is complemented by the increasing number of travel leagues accepting participants at increasingly younger ages.\textsuperscript{12,14}

Numerous definitions of ESS are detailed in the lay press and within medical journals; however, a consensus has been difficult to obtain given the variable training volumes and competitive levels that compose adolescent athletics.\textsuperscript{10,12} Although multiple definitions exist for ESS, it typically refers to prepubertal children (12 years or younger) and is most commonly defined as intensive training for 8 or more months in a single sport while excluding other sports.\textsuperscript{17} Data suggest that early specialization negatively affects the developing musculoskeletal system of young athletes and may exacerbate psychological stress, leading to exhaustion and future injury. Because adolescents' musculoskeletal systems are developing, they are more prone to injury caused by the extensive number of hours dedicated to sports activities per week.\textsuperscript{13,14,17} In addition, focusing on a single sport can have psychosocial consequences as children risk isolation from peers, thus negatively affecting their social development and increasing the likelihood of psychological stress.\textsuperscript{13,14} Although further investigation remains in terms of identifying youth specialization as a true risk factor for the aforementioned effects, clinical recommendations urge parents and coaches to be cautious when advising young athletes to engage in a single sport year-round because of the potential consequences.\textsuperscript{5,8,12,18}

The trend in ESS is fueled by the notion that early youth sports involvement is required to obtain elite status.\textsuperscript{5,21} Psychological studies on performance, however, note that rather than focusing on repetitions or the amount of time spent on activity, improved performance and skill acquisition can be obtained through "deliberate practice" predicated on a feedback-driven, iterative process for fine-tuning training methods.\textsuperscript{3} The current study looks to further investigate factors that contribute to sports specialization in young athletes by (1) identifying motivations for sports specialization among National Collegiate Athletic Association (NCAA) Division I athletes participating in individual and team sports and (2) determining the time of ESS and its effect on participation in Division I athletics. By clarifying the factors and motivations associated with sports specialization and gaining insight into the perceptions driving athletes within an elite athletic community, we hoped to encourage informed discussions with young athletes, parents, and coaches about the potential risks as well as address the potential athletic outcomes associated with ESS.

METHODS

After institutional review board approval was obtained, a survey instrument was developed by an interdisciplinary team, including orthopaedic surgeons, physical therapists, athletic trainers, and sports medicine physicians. A 50-question, Likert-style survey, using numerical ratings from 0 to 10, was distributed to NCAA Division I collegiate athletes at 2 institutions receiving orthopaedic care from medical professionals within our practice. Athletes participating in all offered sports were included in the investigation, and all respondents were older than 18 years. Inclusion in the study required that participants be active team members from participating Division I institutions. Individuals who solely participated in an intramural or recreation league were excluded.

Sports specialization was defined as year-round training and participation in a single sport at the exclusion of other sports.\textsuperscript{12} After consent was obtained, the survey was administered to participants to inquire further about their decision to specialize and the time of specialization. The survey consisted of sections focusing on demographic data and information about the influences affecting sports specialization. Demographic variables included current age, age of specialization, sex, whether an athlete specialized in his or her current sport, prior sports played, and level of competition. Information about influences affecting sports specialization included the presence of parental and psychosocial factors, time commitments, extrinsic pressures, environmental conditions, access to equipment or facilities, economic factors, future aspirations, and associated injuries for a given sport. Survey items also collected data on emotional responses and reactions associated with the decision to specialize.

The survey was distributed in an electronic format via an email provided by each university's respective athletic trainers using a secure link. Incomplete responses were excluded from the final analysis.

Statistical Analysis

Responses were collected by use of independent survey software (2018 Qualtrics LLC). Continuous data and
RESULTS

Of 325 athletes, 303 participants (93.2%) across 19 NCAA Division I sports at 2 collegiate institutions (18 and 14 sports teams, respectively) fully completed the administered surveys. The mean (±SD) age of the studied cohort was 19.9 ± 1.52 years (range, 13-26 years), and 57.4% (n = 174) were females. Track and field and rowing athletes made up the greatest proportion of studied participants (42; 14.9%) followed by football (36; 12.8%) and swimming and diving (24; 8.5%). Of the studied population, 281 athletes (92.7%) met the definition for sports specialization. Demographic data for the examined cohort are depicted in Table 1.

Sports Specialization

The mean (±SD) age at the time of specialization was 14.9 ± 3.06 years (range, 4-19 years). Track and field athletes made up the largest proportion of athletes meeting the definition for sports specialization (42; 14.9%) followed by rowing and football (36 each; 12.8%). On average, athletes involved in team sports specialized at age 15.5 ± 1.52 years, while athletes involved in individual sports specialized at a mean age of 14.0 ± 1.98 years (P < .05). Males participating in individual sports specialized at a significantly earlier age than those competing in team sports (P < .001). Of the specialized athletes, 94.7% reported playing another organized sport prior to entering college.

Specifically, individual sports such as tennis, swimming/diving, and fencing had the lowest average ages of specialization, at 11.6, 12.4, and 12.8 years, respectively. These 3 sports also had the highest percentage of athletes who specialized at age 12 or earlier. Team sports such as lacrosse, football, and field hockey had the highest average ages of specialization, at 17.2, 17.2, and 16.8 years. None of the athletes in these sports reported specializing in a single sport at age 12 or earlier. Team sports such as tennis, swimming/diving, and fencing had the lowest average ages of specialization, at 11.6, 12.4, and 12.8 years, respectively. These 3 sports also had the highest percentage of athletes who specialized at age 12 or earlier. Team sports such as lacrosse, football, and field hockey had the highest average ages of specialization, at 17.2, 17.2, and 16.8 years. None of the athletes in these sports reported specializing in a single sport at age 12 or earlier, and only 17.4% of athletes overall reported specializing at such an early age.
Factors Influencing Specialization

Overall, personal interest, skill level at 1 sport, time constraints, and potential scholarship opportunities were rated as the most important reasons for youth to specialize at an early age. For individual sports, the motivations for specialization were similar, with the exception of coach and parental influence being more of a factor in the decision-making process, although this was not statistically significant. Time constraints \((P = .019)\), desire for college scholarship \((P < .001)\), and professional aspirations \((P < .001)\) had statistically significant influences on individual sport athletes compared with team sport athletes. Complete analysis of motivations influencing specialization are depicted in Table 4 and Figure 2.

DISCUSSION

The increasing trend of single sport participation across adolescents is a subject of ongoing concern within the medical community.1,4,5,8,14 Overuse has been reported as the primary cause of most athletic injuries in youths, but despite the reported risks, specialization remains prevalent as the drive, pressure, and aspiration to play at an elite level continue to remain at the forefront.7,25 Given the changing climate and rapid expansion of extensive youth competitive leagues and programs, physicians should be prepared to discuss the misconception that ESS is necessary to participate in college athletics. Knowledge of the motivations behind sports specialization will help guide clinicians in their discussions with youth athletes.

Across a population of NCAA Division I collegiate athletes, the average age of specialization was 14.9 years; athletes participating in individual sports committed to their sport of choice at a significantly earlier age \((14.0 \pm 1.98\) years) than those involved in team sports \((15.5 \pm 1.52\) years). Overall, 17.4% of the studied cohort reported sole participation in their respective sport prior to age 12; however, 45% of athletes reported multisport participation up
to the age of 16. Specifically, males competing in individual sports specialized at a significantly younger age than those playing team sports. The primary drivers of specialization, across all athletes, included personal interest in a given sport, skill level, time constraints associated with competitive play or practice, and the prospect of potential scholarship opportunities. Team-based sports had similar factors influencing specialization, but coaching and parental pressures, although not statistically significant, carried more weight in the decision-making process for athletes competing in individual sports. Time constraints and the prospects of competing at the collegiate and professional level were found to have significantly greater influence on the decision to specialize for athletes of individual sports versus team sports. Despite the ongoing increase in ESS and the perseverance to improve one’s chances of elite athletic achievement, our investigation found that across a large variety of sports, only a minority of Division I collegiate athletes specialized in a single sport as an early adolescent.

The association between sports specialization and the risk of injury has been an ongoing subject of concern that has led to recent position statements, consensus statements, and clinical reports by the American Orthopaedic Society for Sports Medicine, International Olympic Committee, and American Academy of Pediatrics. A case-control study by Post et al found that highly specialized athletes were more likely to have endured prior injuries. In addition, athletes who trained in a single sport for more hours per week than their age in years were more likely to report a history of overuse injuries compared with patient cohorts with lower training volumes. In a similarly designed study, Jayanthi et al identified sports-specialized training in adolescents as an independent risk factor for overall injuries and overuse injury, with similarly elevated risks of injury in athletes participating in more hours of sports per week than their respective age in years. Additionally, when comparing injured and uninjured athletes, Myer et al reported greater odds of sustaining significant overuse injuries with increasing degrees of specialization, even when accounting for hours per week of sports exposure and age. Despite the plethora of studies analyzing risk factors for injury in specialized adolescents, few have investigated the underlying mechanisms that affect the decision to specialize.

Our investigation provides insight into the factors that drive youth sports specialization from a population of individuals currently competing at a highly competitive level. Aspirations to obtain college scholarships are commonly mentioned as a driver for early participation and focus on a single sport across adolescents, and our study found this to be of significant influence for those competing in individual sports. The likelihood of competing at an elite level is relatively small; a reported 3.3% to 6.8% of high school athletes attain the goal of participating at the collegiate level, and an even smaller percentage reach the professional level. Across the college athletes surveyed, the mean age of specialization for this population in an urban, northeastern setting is comparable with what has been cited in previous literature.

Post et al previously investigated sports specialization at the high school level across Division I athletes at a single institution. Their study produced the similar result that early specialization was not necessary to ultimately compete at a collegiate level. Furthermore, the authors found no difference in sports specialization based on sex. Across a cohort primarily composed of football players and team sports as a whole, Post et al found that personal enjoyment, the opportunity to obtain a college scholarship, and skill level most often influenced the decision to specialize, with parental influence having little effect. Although
In a survey of high school and adolescent athletes, Padaki et al\textsuperscript{21} found that 60% of athletes played a single sport for 9 or more months per year, and one-third of athletes reported experiencing pressure by a coach to focus on a single sport. This increased dedication to sports was found to limit academic performance as adolescents became older, further adding to the negative sequelae of ESS.\textsuperscript{21} External pressure imparted by a coach or trainer is a point of concern in youth sports. Our study found a statistically nonsignificant difference in the effect that parents and coaches can have on the decision to specialize; however, their influence on youth athlete specialization cannot be understated, as parents of highly specialized athletes self-report directly, and actively, influencing their children’s decision. To help their child gain a competitive advantage, some parents hire elite coaches or personal trainers when there are collegiate or professional aspirations.\textsuperscript{20}

Based on our results, this focus and potential obsession to compete at a high level are significant drivers for individual sport athletes. The increase in training sessions and participation in competitive leagues only adds to the issue of specialization as exposure and the risk of injury further increase.\textsuperscript{20} As such, providers should be wary of the internalization and promotion of unrealistic expectations for adolescents to ultimately perform at a collegiate or professional level.\textsuperscript{15} Across a poll of professional athletes, 61.7\% believed that specialization was helpful in allowing adolescents to compete at an elite level, but only 22.3\% said that they would want their own children to specialize in a single sport if given the opportunity.\textsuperscript{6} This point offers a unique viewpoint as to whether specialization is necessary or is worth the associated risks from the perspective of parents who were able to compete at the highest level athletically.

This study has several limitations. The survey instrument was created solely for this study and has yet to be validated. A multitude of health care professionals were included in the survey development process; however, we remain limited in the ability to obtain specific data regarding the rationale behind the motivations leading to specialization. Additionally, the results of our investigation are based on two Division I collegiate institutions in the same geographic region of the United States, which may limit the external validity of our results. Further investigation to capture the influences of other areas of the country would be of benefit to produce more widely generalizable findings.

Additionally, at the selected institutions, relatively smaller numbers of athletes participating in sports such as water polo or archery met the proposed definition for specialization. Notably, gymnastics was not offered as a Division I sport at either institution, and thus information on the motivations for specialization among these athletes could not be evaluated despite the higher associated rates of injury within gymnastics.\textsuperscript{22} Pasulka et al\textsuperscript{22} found gymnastics to have a high proportion of athletes who specialized in a single sport. The same study found gymnasts to specialize at the earliest age within a cohort of adolescent athletes. Given the pervasive effects of specialization on gymnastics, information from collegiate gymnasts regarding their motivations for early specialization would be valuable; however, these data could not be obtained within our study population. Given this limitation, we are unable to make strong or generalizable claims on the respective motivations for specialization in water polo, archery, and gymnastics. Furthermore, our study did not evaluate the effects of participation costs on the decision to specialize; the financial constraints related to travel, equipment, and overall participation could prohibit playing in more than 1 sport in a given school year and could potentially influence the early selection of a single sport.

Although our investigation was able to identify motivations for specialization and the differences in specialization between team and individual sports, we were unable to comment on the benefits of specialization, as this would require a comparison of player performance between specializers and nonspecializers. Our definition of “sports specialization” (year-round training and participation in a single sport at the exclusion of other sports) was proposed by Jayanthi et al\textsuperscript{12} to include a wide spectrum of athletes that would otherwise be limited by other definitions focused on the volume of training.\textsuperscript{13} Although definitions of specialization related to volume of training have been commonly used to elucidate the risks involved with specialization, our study focused on the underlying mechanisms and influences leading to specialization, so a more expansive cohort of individuals was desired.

Our study is subject to recall bias, as current collegiate athletes were asked to recollect sports participation history that may have extended as far back as middle school. Injury history or the relationship between specialized athletes and subsequent injury was not reported, as this was not a focus of our study. Last, to fully characterize the optimal balance of athletic participation in pediatric sports, outcome and biomechanical studies analyzing the physiological changes that occur with varying training intensities, practice schedules, and training regimens are required. These studies should stratify participants in each sport by age, fitness level, and psychological maturity to provide more objective data and better define guidelines for athletic play in the pediatric population.\textsuperscript{15} By clarifying the factors and motivations associated with sports specialization and gaining insight into the perceptions of ESS within the elite athletic community, we hope to encourage informed discussions with young athletes, parents, and coaches about the potential risks of youth sports specialization, including injury and psychological burnout.

**CONCLUSION**

Early sports specialization is uncommon among NCAA Division I athletes for most team sports, while individual sports such as swimming, tennis, and fencing tend to have athletes who specialize earlier and are more motivated by collegiate and professional ambitions.
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