

# Early Single-Sport Specialization

## A Survey of 3090 High School, Collegiate, and Professional Athletes

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**Background:** Youth participation in organized sports in the United States is rising, with many athletes focusing on a single sport at an increasingly younger age.

**Purpose:** To retrospectively compare single-sport specialization in current high school (HS), collegiate, and professional athletes with regard to the rate and age of specialization, the number of months per year of single-sport training, and the athlete's perception of injury related to specialization.

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

**Methods:** A survey was distributed to HS, collegiate, and professional athletes prior to their yearly preparticipation physical examination. Athletes were asked whether they had chosen to specialize in only 1 sport, and data were then collected pertaining to this decision.

**Results:** A total of 3090 athletes completed the survey (503 HS, 856 collegiate, and 1731 professional athletes). A significantly greater percentage of current collegiate athletes specialized to play a single sport during their childhood/adolescence (45.2% of HS athletes, 67.7% of collegiate athletes, and 46.0% of professional athletes;  $P < .001$ ). The age of single-sport specialization differed between groups and occurred at a mean age of  $12.7 \pm 2.4$  (HS),  $14.8 \pm 2.5$  (collegiate), and  $14.1 \pm 2.8$  years (professional) ( $P < .001$ ). Current HS (39.9%) and collegiate athletes (42.1%) recalled a statistically greater incidence of sport-related injury than current professional athletes (25.4%) ( $P < .001$ ). The majority (61.7%) of professional athletes indicated that they believed specialization helps the athlete play at a higher level, compared with 79.7% of HS and 80.6% of collegiate athletes ( $P < .001$ ). Notably, only 22.3% of professional athletes said they would want their own child to specialize to play only 1 sport during childhood/adolescence.

**Conclusion:** This study provides a foundation for understanding current trends in single-sport specialization in all athletic levels. Current HS athletes specialized, on average, 2 years earlier than current collegiate and professional athletes surveyed. These data challenge the notion that success at an elite level requires athletes to specialize in 1 sport at a very young age.

**Keywords:** sports specialization; youth; single sport; injury

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An increasing number of youth athletes in today's society are choosing to specialize to play only 1 sport at a young age. This trend of increasing specialization within youth sports has generated significant attention, both within the lay press as well as within the medical community.<sup>9,10,18,19</sup> Sport specialization has been theorized by the general public to enhance performance and increase the likelihood of participation in that sport at an elite level. However, many in the sports medicine and medical communities have raised concern with regard to single-sport specialization and the potential for increased risk of injury and burnout.

In 2017, the topic of single-sport specialization remains poorly defined, with many unanswered questions. Numerous definitions of sports specialization exist within the

literature; however, it remains unclear what factors are most critical for inclusion in such a definition and where the tipping point lies for an individual athlete to become “overspecialized.” One current, commonly accepted definition popularized by Jayanthi et al<sup>14,15</sup> that captures many of the important factors of sports specialization is “intense, year-round [8+ months/year] training in a single sport with the exclusion of other sports.”

Certainly, the decision to specialize at a young age is made with the hopes of achieving greater future success in that sport, often in the form of collegiate scholarships and professional contracts. Unfortunately, data from the National Collegiate Athletic Association (NCAA) suggest that the likelihood of an individual athlete attaining elite status is quite small—with only 3.3% to 6.8% of high school (HS) athletes aspiring to play collegiate athletics in men’s basketball, women’s basketball, football, baseball, and men’s soccer able to achieve their goal.<sup>20</sup> Similarly, the NCAA suggests that the likelihood of a HS athlete playing professionally in those same sports is 0.03% to 0.5%.<sup>6</sup> Furthermore, the benefits of attaining a college scholarship are often not as great as may be perceived by many athletes and their families. In 2008, the average athletic scholarship was \$10,000; a substantial amount of money, but only a fraction of many collegiate tuitions.<sup>21</sup>

Numerous authors have attempted to investigate the role of specialization on enhanced performance and progression to an elite level in order to determine if there is any benefit to specialization. Interestingly, multiple authors have studied elite athletes ranging from Swedish tennis players to German Olympians and have reported that elite athletes actually specialized to play their sport *later* in life, not earlier.<sup>7,10,15,23</sup> Such consistency of findings over multiple decades within multiple populations argues against the common belief that early sports specialization provides athletes with enhanced performance and/or a greater likelihood of progression to an elite level.

Furthermore, the medical, psychological, and societal implications of early single-sport specialization remain poorly defined. Mounting evidence suggests associations between early single-sport specialization and overuse injuries, psychological burnout, and decreased involvement and participation in sports.<sup>3,15</sup> As a result, multiple medical associations and societies have been prompted to issue consensus statements urging parents, coaches, and clinicians to guide children to engage in multiple sporting activities and to avoid early specialization in a single sport.<sup>2,13,16</sup>

Our study seeks to further investigate the phenomenon of single-sport specialization by surveying current HS, collegiate, and professional athletes. We hypothesized that more current HS students specialized to a single sport at an earlier age than current collegiate and professional athletes. Specifically, we sought to determine (1) the prevalence of single-sport specialization among the surveyed athletes, (2) the age of specialization for those athletes who specialized in a single sport as well as their rationale for specialization, and (3) if these athletes felt their decision to specialize in a single sport had resulted in injury. We believe that understanding the prevalence of single-sport specialization, as well as the age of specialization, will help

physicians to better understand this current trend and to better counsel their patients and parents in order to mitigate or avoid the negative outcomes potentially associated with specialization, most notably injury.

## METHODS

A survey was distributed over 1 calendar year (2015-2016) to HS, collegiate, and professional athletes prior to their yearly preparticipation physical examination by the certified medical training staff associated with each team. The survey consisted of questions related to demographics, current sport commitment, recollection of injury that interrupted sport participation and required specific treatment, future athletic plans, and perspectives on specialization. If the athlete indicated that he or she specialized to play a single sport during childhood/adolescence, then details pertaining to that decision were obtained. The survey did not specify an age of “adolescence” for this question. This study was approved by the institutional review board of our institution and was given exemption status because no identifying information was being collected.

Participants were recruited from HSs, colleges, and professional teams that have their orthopaedic care provided by athletic trainers and physicians from our large subspecialty orthopaedic practice. HS teams surveyed were school-based teams, not club based. Our practice is centered in an urban environment, but we also have offices in suburban areas, where we take care of numerous HS sports teams. We administered this survey to athletes during preparticipation physicals in both Pennsylvania and New Jersey. The survey was administered to athletes at 12 different HSs and collegiate athletes at 2 Division I and 6 Division III colleges that receive care from our practice. Additionally, we surveyed and are the orthopaedic providers for 2 major sports teams in our metropolitan city (Major League Baseball, National Hockey League). This diversity in our practice environment allowed for a large number of responses from athletes with a wide range of sports backgrounds.

The survey was distributed in paper format to HS and collegiate athletes. Attached to the survey was a letter explaining to the athlete that the survey was voluntary, anonymous, and would not affect their sport participation in any way. A number was assigned to each athlete’s survey for analysis purposes, but no identifying personal information was collected. Athletes took the survey in groups among their peers, but not under the influence or direction of their parents, coaches, or trainers. We distributed the survey to all athletes who were present but did not examine the full roster of each team we were surveying, raising the possibility that we did not survey the entire team. However, all participants present at the preparticipation physical responded to the survey.

To be eligible for the survey, the participant must have been a member of the HS, collegiate, or professional team that was being surveyed. At the HS and collegiate level, all male and female sports were included from 23 HS and 17 collegiate sports. For HS athletes, the survey

TABLE 1  
Summary of Survey Demographics

	High School	Collegiate	Professional	P Value
No. of surveys	503	856	1731	
No. of sports represented	23	17	2	
Age, y, mean ± SD	15.3 ± 1.4	19.6 ± 1.3	23.6 ± 3.5	<.001
Sex (male/female), %	53.3/46.7	60.4/39.6	100/0.00	<.001
At what age did you begin playing competitive sports? mean ± SD	7.5 ± 3.1	7.6 ± 3.2	6.0 ± 2.2	<.001

did not ask whether participation was at the junior varsity or varsity level of their sport. At the collegiate level, both Division I and Division III programs were surveyed. The same process existed for professional athletes, with the exception that the survey was distributed in an electronic format and answers were collected via an online survey tool (SurveyGizmo.com). The survey for professional athletes was distributed via their physical therapists/athletic trainers during spring training for Major League Baseball athletes and during preseason physicals for National Hockey League athletes, on mobile electronic devices or laptop computers at the discretion of the organization.

Data were collected in a retrospective fashion and were transcribed into electronic format for HS and collegiate athletes and combined with the professional data for analysis. Demographic information, details of current sport commitment, and future athletic plans were collected. Questions asked required answers such as yes/no, age, or number of months. Athletes were asked if they specialized to focus on only 1 sport, and if so, data were then collected pertaining to when, how, and why this decision was made. Continuous data were analyzed using 1-way analysis of variance ( $P < .05$ ), and continuous variables between groups were compared using Kruskal-Wallis and Mann-Whitney tests. Categorical variables (all yes/no questions) were compared using chi-square analysis ( $P < .05$ ).

## RESULTS

The overall demographics of the study group are shown in Table 1. A total of 3090 athletes completed the survey (503 HS, 856 collegiate, and 1731 professional athletes). Collegiate athletes surveyed were from both Division I and Division III programs, and professional athletes surveyed were from Major League Baseball (1673 athletes) and the National Hockey League (58 athletes). The mean age of respondents was 15.3 ± 1.4 years for HS athletes, 19.6 ± 1.3 years for collegiate athletes, and 23.6 ± 3.5 years for professional athletes ( $P < .001$ ).

The survey responses with respect to single-sport specialization and injury history are presented in Table 2.

TABLE 2  
Summary of Survey Specialization and Injury History Results

	High School	Collegiate	Professional	P Value
Did you quit other sports to focus on 1 sport? % yes	45.2	67.7	46.0	<.001
If yes, what age did you quit other sports? y, mean ± SD	12.7 ± 2.4	14.8 ± 2.5	14.7 ± 2.4	<.001
At the age of specialization, how many months/year did you train for your sport? mean ± SD	8.5 ± 3.4	10.0 ± 2.6	8.8 ± 3.3	<.001
At the age of specialization, how many months/year did you compete in your sport? mean ± SD	6.1 ± 3.3	7.2 ± 3.2	7.8 ± 2.5	<.001
Did you ever sustain an injury that you attributed to specializing in 1 sport? % yes	39.0	42.3	25.4	<.001

A significantly higher percentage of current collegiate athletes specialized to play a single sport during their childhood/adolescence (45.2% of HS athletes, 67.7% of collegiate athletes, and 46.0% of professional athletes,  $P < .001$ ). The age of single-sport specialization differed between groups and occurred at a mean age of 12.7 ± 2.4 (HS), 14.8 ± 2.5 (collegiate), and 14.7 ± 2.4 (professional) years, respectively ( $P < .001$ ). Additionally, current HS (39.0%) and collegiate athletes (42.3%) recalled a statistically higher incidence of sport-related injury when compared with current professional athletes (25.4%) ( $P < .001$ ).

The athletes' responses to perspectives on single-sport specialization are shown in Table 3. In all, 61.7% of professional athletes indicated that they believed specialization helps that athlete play at a higher level, versus 79.7% of HS and 80.6% of collegiate athletes ( $P < .001$ ). Notably, only 22.3% of professional athletes said they would want their own child to specialize to play only 1 sport during childhood/adolescence. However, looking back, most athletes who did specialize to play only 1 sport were glad they did (84.2% of HS athletes, 83.7% of collegiate athletes, and 89.4% of professional athletes,  $P = .006$ ).

A subgroup analysis of the athletes' responses when broken down by type of sport (team or individual based) and sex (male or female) are shown in Table 4. Team-based sports included baseball, basketball, cheerleading, field hockey, football, ice hockey, lacrosse, soccer, rugby, softball, volleyball, and water polo. Individual-based sports included crew, cross country, bowling, dance, diving, golf,

TABLE 3  
Summary of Athletes' Perspectives  
on Single-Sport Specialization

	High School	Collegiate	Professional	P Value
Looking back, are you glad you focused on only 1 sport at the age you did? % yes	84.2	83.7	89.4	.006
Do you think specializing in 1 sport helps an athlete play their sport at a higher level? % yes	79.7	80.6	61.7	<.001
Do you want your children to specialize in only 1 sport during their childhood/adolescent years? % yes	30.56	27.4	22.3	<.001

rowing, swimming, tennis, track and field, and weightlifting. Among current HS students surveyed, there was no difference in the percentage of athletes who specialized to play 1 sport based on type of sport (43.9% for team vs 52.2% for individual,  $P = .233$ ) or based on sex (49.6% for males vs 40.2% for females,  $P = .058$ ). Similarly, there was no difference in the age that specialization occurred within the same 2 subgroups (type of sport and sex) of the HS cohort.

However, among the current collegiate athletes surveyed, there was a statistically higher percentage of athletes who specialized and played an individual- versus a team-based sport (81.1% vs 66.4%,  $P = .0004$ ). A current collegiate athlete who played an individual sport was more than twice as likely to specialize than one who played a team sport (odds ratio [OR], 0.46; 95% CI, 0.29-0.71). Additionally, those who played an individual sport specialized at a statistically earlier age when compared with those who played a team-based sport (14.3 vs 14.9 years,  $P = .0308$ ). Among the current collegiate athletes surveyed, a higher percentage of female athletes specialized to play only 1 sport (72.4% vs 64.7%,  $P = .0265$ ), but they did not do so at a significantly different age than their male counterparts (14.5 vs 15.0 years,  $P = .1191$ ).

Athletes' responses where professional data were available were also compared within the sports of baseball and ice hockey (Table 5). Within the sport of baseball, a statistically higher percentage of current HS and collegiate athletes specialized to play 1 sport when compared with their current professional athlete counterparts (60.0% and 73.3% vs 45.4%,  $P < .001$ ). Current college baseball players were 2.6 times more likely to specialize when compared with current professional baseball players (OR, 2.6; 95% CI, 1.5-4.8). Current HS baseball players also specialized at a significantly earlier age than current collegiate or professional baseball players (12.3 vs 15.4 and 14.9 years,

$P < .001$ ). There was no statistically relevant difference among collegiate or professional ice hockey players in the percentage of athletes who specialized (70.8% vs 87.5%,  $P = .1068$ ) or the age at which they did so (13.3 vs 13.4 years,  $P = .6506$ ). No HS ice hockey players were surveyed in our cohort.

## DISCUSSION

To our knowledge, this study of 3090 HS, collegiate, and professional athletes represents the largest study to date examining the topic of single-sport specialization. We sought to examine 3 different populations of athletes who have achieved varying levels of athletic success in order to report on and compare their survey responses pertaining to single-sport specialization.

### Prevalence and Age of Specialization

Our results suggest that current HS athletes who specialize are choosing to do so at a statistically earlier age than current collegiate and current professional athletes did. A higher percentage of current collegiate athletes specialized to play a single sport; however, they did so at an older age when compared with HS athletes.

Additionally, close to half of all HS athletes surveyed had chosen to specialize to play 1 sport. Earlier specialization may reflect the current assumption by HS athletes that early sport specialization is necessary for advancement to collegiate and more elite levels of competition. However, this finding may also reflect the current-day emphasis on sport specialization within youth sports and society as a whole.

We also noted important findings from the demographic results of our study. First, we found that HS and collegiate athletes participated in numerous sports, while professional athletes from only 2 sports were surveyed. This difference in study populations could have affected our results. Second, the current professional athletes we surveyed began to compete in all types of competitive sports at a statistically earlier age compared with the HS and or collegiate athletes. However, while doing so, they competed in a wide variety of sports, not just a single sport.

### Injury Risk

We found that current HS athletes recalled a statistically higher incidence of sustaining an injury that they attributed to specializing in 1 sport when compared with current collegiate and current professional athletes. This may suggest that early sport specialization can be a potential factor in the occurrence of early sport-related injury, but there are, of course, multiple factors affecting the occurrence of injury with sport. It is important to emphasize that these data are a reflection of each surveyed athlete's ability to recall an injury that interrupted sports participation and required specific treatment, but we did not report on any actual injury data in our study.

TABLE 4  
Summary of Subgroup Analysis Pertaining to Type of Sport and Sex

	No. of Responses	% Specialized	P Value	Age of Specialization, y, Mean ± SD	P Value
High school					
Type of sport			.233 <sup>a</sup>		.7829
Team	421	43.9 (176/401)		12.7 ± 2.41	
Individual	67	52.2 (35/67)		12.6 ± 2.25	
Sex			.058 <sup>b</sup>		.9046
Female	213	40.2 (84/209)		12.9 ± 2.15	
Male	239	49.6 (116/234)		12.7 ± 2.44	
College					
Type of sport			.0004 <sup>c</sup>		.0308
Team	657	66.4 (436/657)		14.9 ± 2.39	
Individual	159	81.1 (129/159)		14.3 ± 2.63	
Sex			.0265 <sup>d</sup>		.1191
Female	331	72.4% (233/322)		14.5 ± 2.70	
Male	505	64.7% (323/499)		15.0 ± 2.27	

<sup>a</sup>OR, 0.72; 95% CI, 0.41-1.24.

<sup>b</sup>OR, 1.46; 95% CI, 0.99-2.17.

<sup>c</sup>OR, 0.46; 95% CI, 0.29-0.71.

<sup>d</sup>OR, 0.70; 95% CI, 0.51-0.96.

TABLE 5  
Summary of Responses Across the Sports of Baseball and Hockey

	No. of Responses	% Specialized	P Value	Age of Specialization, y, Mean ± SD	P Value
Baseball					
High school	20	60 (12/20)	<.001 <sup>a</sup>	12.3 ± 2.3	<.001
College	60	73.3 (44/60)		15.4 ± 1.9	
Professional (USA)	1178	45.4 (535/1178)		14.9 ± 2.23	
Ice hockey					
High school	0				
College	24	70.8 (17/24)	.1068 <sup>b</sup>	13.3 ± 2.9	.6506
Professional (USA)	58	87.5 (49/56)		13.4 ± 3.2	

<sup>a</sup>OR for specialization, 2.64; 95% CI, 1.50-4.79.

<sup>b</sup>OR for specialization, 0.35; 95% CI, 0.090-1.36.

The relationship between sport specialization and injury risk, especially overuse injury, remains debated in the literature. Overtraining is a known risk factor for youth sports injury, with up to 54.4% of injuries seen in a typical sports medicine clinic for patients 6 to 18 years of age due to overuse injury.<sup>12,14,15,17,22</sup> Indeed, numerous studies have demonstrated that the risk of injury increases with exposure hours per week for immature athletes.<sup>15,22</sup> Furthermore, work by Jayanthi et al<sup>14</sup> suggests that specialized athletes, while not necessarily more likely to sustain acute injuries, have additional risk of sustaining these overuse and serious overuse injuries, and that specialization itself is an independent risk factor for such injury. More specifically, in a study of 546 female athletes in basketball, soccer, and volleyball, Hall et al<sup>12</sup> reported that single-sport athletes had an increased rate of anterior knee pain compared with multisport athletes.<sup>12</sup> As such, these studies suggest that early sport specialization may increase the risk of injury in youth athletes.

Physiologically, it has long been clear that young athletes are not the equivalent of adults, as youth pay a higher

metabolic cost for running, have lower aerobic and anaerobic capacity via measures such as VO<sub>2</sub>max, and have more difficulty with thermoregulation.<sup>6,23</sup> Furthermore, the immature musculoskeletal system does not possess the same mechanical properties as an adult. During growth, the appendicular skeleton grows faster than the surrounding muscle-tendon units, possessing relative inflexibility and generating a mismatch, which can predispose to injury such as traction apophysitis or apophyseal avulsion fracture. Simultaneously, the immature physis is at particular risk during rapid longitudinal growth, as an abundance of metabolically active chondrocytes possesses less ability to resist forces such as traction, shear, and compression.<sup>1,7,8,11</sup> Furthermore, the risk of acute fracture appears higher during this period as well.<sup>5</sup> Clinical evidence of this is suggested by Backous et al,<sup>4</sup> who studied summer soccer camp injuries and found that injuries for both male and female participants peaked during adolescence (14 years). Year-round sport participation does not allow the adolescent body the time it often needs to rebuild, recover, or repair after strenuous activity. Intensive sport activity and

training appears to put the adolescent body at risk precisely at the time of significant physiologic vulnerability.

### Athlete Perspectives on Sport Specialization

We noted several trends in our study population with regard to perspectives on single-sport specialization. First, >80% of athletes from all study groups (HS, collegiate, and professional) reported that they were glad they focused on 1 sport at the age they did. Interestingly, current professional athletes indicated a statistically higher likelihood of “not encouraging their children to sport specialize” as compared with both collegiate and HS athletes. This could suggest that professional athletes may not feel that early sport specialization is beneficial or necessary. However, this perspective comes after having successfully achieved elite level status in their sport, and most (>89%) reported being glad they specialized to play 1 sport, making these data somewhat contradictory.

### Subgroup Analysis

Subgroup analysis revealed that among collegiate athletes surveyed, a higher percentage of athletes who played individual-based sports specialized at an earlier age than those who played team sports. In fact, we found that a college athlete playing an individual sport was more than twice as likely to specialize than an athlete playing a team-based sport. Of note, this was not true for HS athletes surveyed. This distinction of team versus individual-based sport is an important area of future study. Additionally, within the sport of baseball, current HS athletes specialized to play baseball at the exclusion of other sports at an average age of 12.3 years, compared with 15.4 and 14.9 years for collegiate and professional athletes, respectively. With the potential cumulative effect of pitching and overhead throwing on the athlete’s arm, this trend toward earlier specialization within baseball is concerning.

Our study addressed multiple questions pertaining to the topic of single-sport specialization, and yet, many more remain unanswered. The debate continues with respect to numerous additional aspects of single-sport specialization, such as the ratio of training time to competition time; the intensity of accompanying conditioning, including strength, flexibility, endurance, and cardiovascular fitness; the specific sport in which the athlete participates (gymnastics, baseball, ice hockey, golf, tennis, etc); the physiologic age of the athlete; and the psychosocial maturity of the athlete. These all are undoubtedly important aspects of single-sport specialization that can affect an athlete’s ability to advance in a sport and possibly incur a sport-related injury. Consensus on all aspects of the definition of single-sport specialization is essential in order to standardize continued research efforts.

### Strengths and Limitations

We feel our study has multiple strengths that allow our results to add to the current literature on single-sport specialization. First, we presented a large group of 3090

athletes for analysis. Second, our group of HS and collegiate athletes included a wide breadth of different sports surveyed (23 different HS sports and 17 different collegiate sports). Third, we surveyed a large number of professional athletes that allowed for an important comparison group for the HS and collegiate respondents.

The limitations of the current study include its cross-sectional nature in studying different groups of athletes at different ages in their athletic careers. Certainly, the current landscape of youth sports is different today than in previous decades, and likely places more emphasis on sport specialization. It is possible that current competition for HS athletes may be more intense than it was for the surveyed collegiate and professional athletes when they were of similar age. Next, HS athletes surveyed were from their school-based sport, not a club-based sport team. In today’s landscape, many coaches and scouts consider the club or Amateur Athletic Union season the time to watch the best talent compete against each other, and thus many athletes consider that their “primary season.” It is possible that by surveying school-based athletic programs, we missed these superspecialized HS athletes who only play on club-based teams and did not capture their responses with our study design. However, anecdotally, we feel most club athletes also play on their school team, so overall, this study design allowed us to capture a larger number of athletes. This may affect some sports more than others where the competition schedules prohibit an HS athlete from participating in both their club- and school-based team. Furthermore, we did not define the topic of “sport specialization” for the athlete in our survey, but rather allowed him or her to interpret what that question meant in the context of his or her background. We asked if the athlete quit multiple sports to play only 1 sport, but this could have been interpreted differently by each athlete.

Additional variability comes as a result of different proportions of sports among the various subgroups. Other than for baseball and ice hockey, we did not break down the survey by sport-specific specialization or account for the fact that injury patterns and training commitments for different sports vary. Additionally, we did not obtain the full roster of each team we surveyed, raising the possibility that athletes were missed in our survey process. However, all athletes were required to participate in a preparticipation physical, and all athletes present for their physicals chose to answer this survey. Also, it was necessary to translate the survey for non-English-speaking athletes from Major League Baseball, allowing for potential, unintended differences in the interpretation of questions. Major League Baseball does, however, have decades of experience translating for its non-English-speaking players. Finally, as noted above, all the athletes who completed the survey were subject to recall bias, potentially affecting our results.

Continued research on single-sport specialization and its consequences for the young, developing athlete is necessary. Biomechanical evaluations of specific sport techniques are needed to better define the differences between youth and adult athletes. Basic science evaluations of tissue properties and healing capabilities in youth and adults may allow better strategies of management of sports

injuries sustained at different ages. We need to better understand the possible psychosocial burnout some athletes encounter from increased pressure to perform at a young age. The development of a standardized sports specialization survey tool is critical for greater comparison of data collected at different institutions and at different times. Future research should develop a standardized definition of sport specialization that includes the most critical factors that contribute to specialization. Finally, we should also continue to examine the other end of the spectrum—the youth athlete who overtrains (especially in total number of hours training/competing) in multiple sports throughout the year, which may result in similar consequences or effects as overtraining in a single sport. We must continue to educate parents, coaches, medical caregivers, and athletes on this topic. It is our responsibility as medical professionals to create the safest environment possible for sports participation for our future athletes.

## CONCLUSION

High school athletes in this study specialized at an earlier age than current collegiate or professional athletes surveyed. These HS athletes also recalled a higher incidence of sports-related injury that they attributed to specialization. Additionally, current professional athletes specialized to a single sport at a lower frequency and at an older age than current HS athletes, suggesting that early single-sport specialization may not be related to professional advancement. Continued research is necessary in order to establish evidence-based strategies that will optimize the sport experience for youth athletes while minimizing sport-related injury.

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