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# Prevalence of Sport Specialization in High School Athletics

## A 1-Year Observational Study

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*Investigation performed at the University of Wisconsin–Madison, Madison, Wisconsin, USA*

**Background:** The prevalence of sport specialization in high school athletes is unknown. This information is needed to determine the scope of this issue in an active population.

**Purpose:** To determine the prevalence of sport specialization in high school athletes and to determine if specialization is influenced by classification method, year in school, sex, and school size. A secondary purpose was to determine if highly specialized athletes would be more likely to report a history of lower extremity injuries.

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

**Methods:** High school athletes between the ages of 13 and 18 years from 2 local high schools completed both a sport specialization survey and an injury history survey. Athletes were classified into low, moderate, or high specialization groups using a recently developed 3-point system and were also classified using a self-classification method.

**Results:** A total of 302 athletes completed the surveys and were classified as low specialization ( $n = 105$ , 34.8%), moderate specialization ( $n = 87$ , 28.8%), or high specialization ( $n = 110$ , 36.4%). Athletes from the small school were more likely to be classified in the low specialization group (low, 43%; moderate, 32%; high, 25%) compared with those from the large school (low, 26%; moderate, 26%; high, 48%) ( $P < .001$ ). Athletes in the high specialization group were more likely to report a history of overuse knee injuries ( $n = 18$ ) compared with moderate ( $n = 8$ ) or low specialization ( $n = 7$ ) athletes ( $P = .048$ ). Athletes who trained in one sport for more than 8 months out of the year were more likely to report a history of knee injuries (odds ratio [OR], 2.32; 95% CI, 1.22-4.44;  $P = .009$ ), overuse knee injuries (OR, 2.93; 95% CI, 1.16-7.36;  $P = .018$ ), and hip injuries (OR, 2.74; 95% CI, 1.09-6.86;  $P = .026$ ). Using the self-classification method, more participants self-classified as multisport ( $n = 213$ , 70.5%) than single sport ( $n = 89$ , 29.5%). Athletes from the small school were more likely to classify themselves as multisport ( $n = 128$ , 86%) ( $P < .001$ ) than those from the large school ( $n = 85$ , 56%). There were no differences in the history of hip, knee, or ankle injuries between athletes who self-classified as single sport (hip:  $n = 10$ , 3%; knee:  $n = 19$ , 6%; ankle:  $n = 35$ , 12%) versus those who self-classified as multisport (hip:  $n = 45$ , 8%; knee:  $n = 23$ , 15%; ankle:  $n = 98$ , 33%) ( $P > .370$ ).

**Conclusion:** Classification method and school size influenced the prevalence of specialization in high school athletes. Highly specialized athletes were more likely to report a history of overuse knee or hip injuries. Participating in a single sport for more than 8 months per year appeared to be an important factor in the increased injury risk observed in highly specialized athletes.

**Keywords:** adolescent; overuse injury; youth athlete; specialization

A physical activity- or sports-related injury accounts for 1 in every 5 injury episodes for persons between 5 and 24 years of age.<sup>3</sup> To reduce activity-related injuries, a better understanding of risk factors is needed. One of the “hot topics” in sports medicine today is sport specialization, which is so concerning that medical organizations have released position statements warning of this practice.<sup>1,4</sup> Despite these warnings, anecdotal evidence suggests that this advice is being ignored and that adolescents continue

specializing in a single sport. The results of this practice may partially explain the recent increase in the frequency of pediatric musculoskeletal injuries.<sup>14</sup> However, there is a significant gap in empirical evidence that directly ties sport specialization to the increased risk of injuries.<sup>1,4</sup> Only one retrospective study has observed that female athletes who participated in a single sport are at a greater risk of developing anterior knee pain (incidence rate ratio [IRR], 1.5) and other chronic knee injuries (IRR of Osgood-Schlatter disease, 4.0) compared with those who played 2 sports.<sup>8</sup> However, this method of allowing athletes to self-classify may miss key factors related to specialization.<sup>10</sup>

A survey of sport specialization has been recently developed by Jayanthi et al<sup>10</sup> to classify athletes along a continuum

of specialization (low, moderate, high). Previous research validating this classification method has established that sport specialization results in an increased frequency of injuries and that specialization is a risk factor independent of training volume and growth.<sup>10</sup>

The application of this scale in the high school setting is warranted because there is a gap in knowledge regarding the prevalence of sport specialization in typical high school athletes. Additionally, if the risk of injuries is greater in specialized athletes, then injury history may prove informative about the type of injuries that those athletes have sustained during their athletic career. Therefore, the primary purpose of this study was to determine the prevalence of sport specialization in a high school athletic population. A secondary purpose was to determine if specialization is influenced by sex, year in school, classification method (self-classification method vs the recently developed 3-point scale), and school size. Finally, we wanted to determine if highly specialized athletes would be more likely to report a history of lower extremity injuries. We hypothesized that specialization rates would be high but that they would be dependent on factors such as sex, year in school, classification method, and school size. Additionally, we theorized that highly specialized athletes would be more likely to report a history of overuse/chronic lower extremity injuries.

## METHODS

### Participants

Participants were recruited from 2 local high schools as part of a larger study. The 2 high schools were chosen based on their large difference in size, with 1 large high school (total school enrollment:  $n = 2141$ ) and 1 small high school (total school enrollment:  $n = 603$ ). These schools were also selected in part because of their location, which was necessary for repeated testing sessions and transportation of large testing equipment and personnel. Testing occurred at each high school in a rotating, station-based testing format before the start of the competitive season. Participants were tested in a group setting with the rest of their team but filled out their surveys independently from teammates, coaches, or parents. Participants were recruited from 4 different sports: soccer, basketball, tennis, and volleyball (female only). These sports were chosen because of their elevated risk of sustaining a lower extremity injury. The school, coaches, and athletic trainers at the schools agreed to participate. To be eligible for the study, participants had to be between 13 and 18 years of age and be a current player on a freshman, junior varsity, or varsity team at one of the schools. A total of 302 participants (180 females: mean height,

$167.2 \pm 6.7$  cm; mean weight,  $63.4 \pm 10.4$  kg; mean age,  $15.5 \pm 1.2$  years; 122 males: mean height,  $177.6 \pm 9.1$  cm; mean weight,  $69.1 \pm 11.7$  kg; mean age,  $15.7 \pm 1.1$  years) completed the survey during the 2014-2015 academic year. This study was approved by the Institutional Review Board of the University of Wisconsin–Madison. Informed written assent/consent was obtained from the athlete and parent or guardian before participation.

### Questionnaires

Participants completed a sport specialization survey and a lower extremity injury history survey. The prevalence of sport specialization between the 2 methods was compared. One method was what will be referred to from this point forward as the self-classification method. Athletes were asked whether they classified themselves as a “single-sport” or “multisport” athlete. The other classification method was a 3-point scale classification method that was taken from previous research.<sup>10</sup> These 3 questions are based on the definition of sport specialization as “year-round intensive training in a single sport at the exclusion of other sports”<sup>10</sup> and were as follows: “Have you quit other sports to focus on one sport?”, “Do you train more than 8 months out of the year in one sport?” and “Do you consider your primary sport more important than other sports?” A categorical classification system was used to assess the sport specialization questions (yes = 1, no = 0), with a score of 3 considered high specialization, a score of 2 considered moderate specialization, and a score of 0 or 1 considered low specialization. Finally, a lower extremity injury history questionnaire asked respondents about any history of sports-related injuries to specific body parts (hip, upper leg, knee, lower leg, ankle, or foot), the mechanism of injury (overuse, contact, noncontact, or other), and the number of days of sport participation missed because of injuries. Responses were reviewed with each participant by a certified athletic trainer to ensure completeness of data and proper classification of the injury description within these categories.

### Statistical Analysis

Data are summarized as means  $\pm$  SDs, frequencies and percentages, and odds ratios (ORs) with 95% CIs. The prevalence of specialization by classification method was reported using frequencies and percentages, and a direct comparison of the classification methods was carried out using a Chi-square test. Chi-square tests were used to investigate associations of specialization category by sex, year in school, school size, and injury history. Significance was set at  $P < .050$ , and all analyses were performed with SPSS statistical software (v 21.0; IBM Corp).

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TABLE 1  
Comparisons of Sex and Year in School Between the Sport Specialization Classification Methods<sup>a</sup>

	3-Point Scale Classification <sup>b</sup>			Self-classification <sup>c</sup>	
	Low Specialization	Moderate Specialization	High Specialization	Single Sport	Multisport
Sex					
Male	44 (36.1)	33 (27.0)	45 (36.9)	27 (22.1)	95 (77.9)
Female	61 (33.9)	54 (30.0)	65 (36.1)	62 (34.4)	118 (65.6)
Year in school					
Freshman	23 (26.7)	28 (32.6)	35 (40.7)	16 (18.6)	70 (81.4)
Sophomore	38 (36.2)	27 (25.7)	40 (38.1)	37 (35.2)	68 (64.8)
Junior	21 (36.8)	13 (22.8)	23 (40.4)	17 (29.8)	40 (70.2)
Senior	23 (42.6)	19 (35.2)	12 (22.2)	19 (35.2)	35 (64.8)

<sup>a</sup>Values are reported as n (%).

<sup>b</sup>Sex by 3-point classification:  $\chi^2 = 0.33$ ,  $P = .850$ ; year in school by 3-point classification:  $\chi^2 = 8.66$ ,  $P = .190$ .

<sup>c</sup>Sex by self-classification:  $\chi^2 = 5.30$ ,  $P = .020$ ; year in school by self-classification:  $\chi^2 = 7.41$ ,  $P = .060$ .

## RESULTS

### 3-Point Scale

Approximately one-third of athletes were classified into each of the 3 levels of specialization, with 36.4% ( $n = 110$ ) of athletes classified in the high specialization category, 28.8% ( $n = 87$ ) classified in the moderate specialization category, and 34.8% ( $n = 105$ ) classified in the low specialization category. Sexes were equally distributed across the 3 different classifications using the 3-point scale ( $P = .850$ ). Year in school did not influence the distribution between the high, moderate, and low specialization athletes ( $P = .190$ ) (Table 1).

However, there was a significant association between specialization categorization and school size ( $P < .001$ ), with athletes from the small school more likely to be classified in the low specialization group (low:  $n = 65$ , 43%; high:  $n = 37$ , 25%) compared with athletes from the large school (low:  $n = 40$ , 26%; high:  $n = 73$ , 48%). Moderate specialization was consistent between schools (Figure 1).

Sixty-four (21.2%) participants reported a history of knee injuries, 33 (10.9%) reported a history of overuse knee injuries, and 33 (10.9%) reported a history of hip injuries. Those with a history of overuse knee injuries were more likely to be in the high specialization group and less likely to be in the low specialization group compared with athletes with no history of overuse knee injuries ( $P = .048$ ). Athletes who responded "yes" to training more than 8 months out of the year were more likely to report a history of any type of knee injury (OR, 2.32; 95% CI, 1.22-4.44;  $P = .009$ ), a history of overuse knee injuries (OR, 2.93; 95% CI, 1.16-7.36;  $P = .018$ ), and a history of hip injuries (OR, 2.74; 95% CI, 1.09-6.86;  $P = .026$ ).

### Self-classification

Participants were more likely to self-classify as a multisport athlete ( $n = 213$ , 70.5%) than a single-sport athlete ( $n = 89$ , 29.5%). However, a greater proportion of female athletes self-classified as single sport compared with

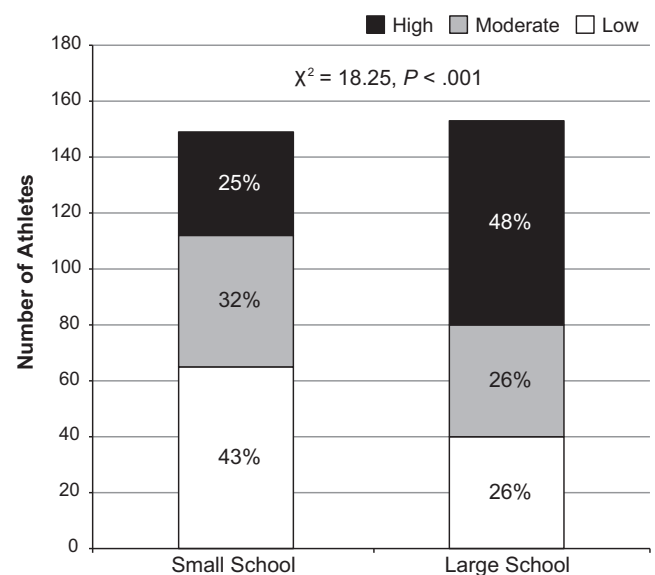
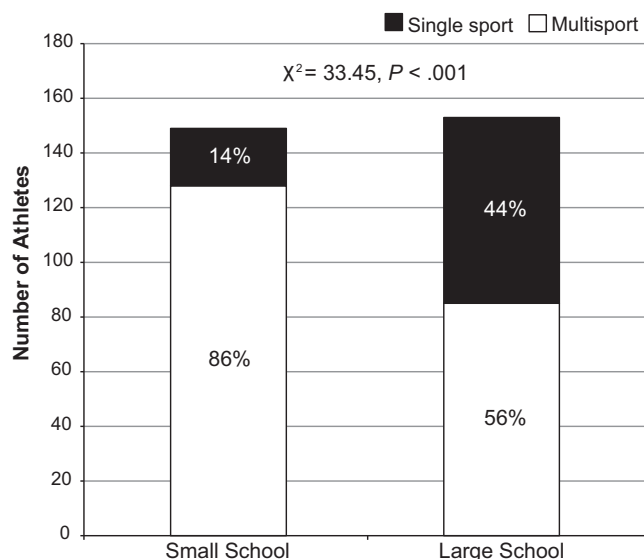


Figure 1. Frequency of sport specialization by school size using the 3-point specialization scale.

male athletes ( $\chi^2 = 5.30$ ,  $P = .020$ ) (Table 1). Year in school did not influence the distribution between single-sport and multisport athletes; however, there was a trend toward a higher proportion of athletes self-classifying as multisport in the first year of high school ( $P = .060$ ). School size also influenced the self-classification method, with athletes from the small school more frequently self-classifying as multisport ( $n = 128$ , 86%) than athletes from the larger school ( $n = 85$ , 56%) ( $\chi^2 = 33.45$ ,  $P < .001$ ) (Figure 2).

However, there was no association between self-classification method and reporting a history of lower extremity injuries ( $P > .050$ ). A direct comparison of the 2 classification methods showed no significant association between the self-classification method and the 3-point scale ( $\chi^2 = 2.05$ ,  $P = .360$ ) (Table 2).



**Figure 2.** Frequency of sport specialization by school size using the single-sport/multisport self-classification method.

## DISCUSSION

To our knowledge, this study is the first to report on the prevalence of sport specialization in adolescent athletes recruited in the high school rather than clinic-based setting. The most important finding of this study is that the prevalence of sport specialization varied from 22% to 48% but was dependent on factors such as school size, sex, and classification method. When the self-classification system was used, a smaller proportion of athletes self-classified as single sport, year in school was not a significant factor, and sex influenced these results. However, this method was unable to identify any association with injury history. When the 3-point scale was applied to the same population, a greater proportion of highly specialized athletes were observed, the results were not influenced by sex or year in school, and there was an association between classification category and reporting a history of knee and hip injuries.

### Prevalence of Specialization

Our results indicate that the classification method used to determine the level of sport specialization can have a large effect on the observed prevalence. Previous research has typically classified specialization using the number of sports played during the year, with single-sport athletes considered to be more specialized than multisport athletes.<sup>7,8,10</sup> However, this system may not accurately categorize the entire spectrum of specialization, such as athletes who only participate in one sport but do so casually to spend time with friends or athletes who focus intensely on one sport year-round while playing other sports sporadically throughout the year.<sup>9,10</sup> The questions that compose the 3-point scale aim to more accurately classify specialization using the previously accepted definition of sport

**TABLE 2**  
Frequency of Participants According to Sport Specialization Classification Method<sup>a</sup>

Self-classification	3-Point Scale Classification		
	Low Specialization	Moderate Specialization	High Specialization
Single sport	26 (8.6)	26 (8.6)	37 (12.3)
Multisport	79 (26.2)	61 (20.2)	73 (24.2)

<sup>a</sup>Values are reported as n (%).

specialization as “year-round intensive training in a single sport at the exclusion of other sports.”<sup>9,10</sup>

Interestingly, there was not a significant association between the 2 classification methods in this study. The 2 classification methods agreed on 38% of athletes, with only 12.3% both self-classifying as single sport and being categorized as highly specialized according to the 3-point scale. Conversely, 26.2% of athletes self-classified as multisport and were categorized as low specialization according to the 3-point scale. Interestingly, 26 (8.6%) athletes self-classified as single sport but were placed in the low specialization category based on the 3-point scale, while 73 (24.2%) athletes self-classified as multisport but were categorized as highly specialized by the 3-point scale. The level of disagreement between the 2 methods illustrates the difficulty of classifying athletes based on the level of specialization. It also highlights that most high school athletes perceived themselves as multisport athletes, even though the 3-point scale classified them differently. Based on our results, the 3-point scale may be a more accurate measure for classifying specialization and may be a better tool to use because of its ability to detect injury history.

It appears that using the single-sport/multisport self-classification method may underestimate the prevalence of sport specialization. In our sample, 29.5% of athletes self-classified as single sport, while 36.4% of athletes were classified as highly specialized using the 3-point scale. A limitation of using the self-classification method is that there is little information about the degree of specialization for those classified as multisport athletes. The majority of athletes self-classified as multisport, but within that group, there may be large differences in the degree of specialization. Using the 3-point scale, those nonspecialized athletes can be further classified into low and moderate specialization categories.

### School Size

Athletes from the larger school were more likely to be classified as highly specialized than those from the smaller school. It is believed that the most common motivations for early sport specialization come from parents, coaches, and organizational pressure to gain early mastery of the sport skills necessary to obtain a college scholarship or professional contract.<sup>4,5,9,12</sup> However, school size may play a large but previously unrecognized role in the decision to specialize in one sport. Athletes at larger schools face



much more competition for sport roster spots than those at small schools and therefore may be forced to choose one sport at the exclusion of others to gain the skills necessary to make the team. This may force all but the most athletically gifted students to specialize in one sport over others that they may want to participate in but cannot. Conversely, athletes at small schools may have more freedom to sample from a variety of sports throughout the school year because of less competition for roster spots or an increased need for players to field a competitive team.

### Injury History

Athletes in the high specialization group were more likely to report a history of overuse knee injuries than athletes in the low specialization group. This is in agreement with previous research that identified single-sport athletes at an increased risk of chronic conditions such as anterior knee pain and Osgood-Schlatter disease.<sup>8</sup> Theoretically, early sport specialization may lead to a repetition of specific movement patterns, which may result in the early adoption of certain neuromuscular patterns. Over time, the lack of diversity in movement patterns could increase the risk of injuries without proper injury prevention interventions.<sup>4</sup> However, our results did not reveal a difference in the injury history between athletes who self-classified as single sport versus those who self-classified as multisport. This may be because sport specialization appears to occur along a spectrum and is more accurately classified using a scale measure.<sup>9,10</sup> Our results are in agreement with those of Jayanthi et al,<sup>10</sup> who observed that highly specialized athletes are more likely to suffer serious overuse injuries, independent of participation volume.

One of the 3 questions that compose the specialization scale, training more than 8 months out of the year in one sport, appears to be most related to a history of lower extremity injuries. The connection between training volume and overuse injuries is well established.<sup>4,6,11,12</sup> Olsen et al<sup>11</sup> observed that adolescent baseball players who pitched competitively for more than 8 months out of the year were 5.05 times more likely to sustain an arm injury than players who pitched for less than 8 months out of the year. This is consistent with our results that the odds of reporting a hip and overuse knee injury were 2.74 and 2.93 times higher, respectively, in athletes who competed in one sport for more than 8 months out of the year. Our results support the recommendations that youth athletes should not play a single organized sport for more than 8 months per year and should schedule breaks from their sport throughout the year.<sup>2,10,13</sup> However, our results should be interpreted with caution as we used a pre-existing scale that utilized this time point within the question. We did not establish this cutoff using more rigorous methodology, and therefore, we cannot account for differing cutoff points (6 vs 7 months, etc). Additionally, another aspect of volume that needs further investigation is the number of hours per week in which an athlete participates in sport. Current recommendations state that youth athletes should not participate in sport for more hours per week than their age.<sup>10</sup> We did not investigate hours per week of participation in this study, but future research should consider this as a factor of volume

that may be independent and as equally important as the number of months per year of participation.

There are additional factors that could influence specialization including athletes who sustain an injury in a sport and decide to specialize or change sports as a result of these injuries. Additionally, athletic excellence, personal intensity, or personal enjoyment may also independently influence the decision to specialize in a specific sport. Finally, we were unable to observe a relationship between sport specialization and a history of acute knee injuries. However, this is mainly because of our low number ( $n = 25$ , 8.3%) of acute knee injuries. Future prospective research is needed to directly examine the relationships between specialization, training volume, and overuse or acute injuries.

### Limitations

This study has several limitations. First, only select sports at 2 schools were surveyed, which may limit the generalizability of our findings. However, we believe that these schools are representative of the small to large schools in our local area because of their sport division classification from the state high school athletic association. Additionally, the "small" school ( $n = 603$ ) selected for this study could be considered quite large compared with some private and rural schools, which may have much smaller populations and therefore potentially even lower rates of sport specialization. We also did not compare the prevalence of specialization across different sports. Further stratification based on sport may have limited our generalizability and statistical power because of the relatively small number of schools and sports utilized in this study. Future studies are needed with larger samples that focus on specific sports. Recall bias is another limitation of this study in that athletes were asked to recall their injury history. However, we attempted to mitigate these issues by having a certified athletic trainer review the survey answers with each athlete. We were also not able to examine other potential factors that influence specialization in this study, such as personal interest of the youth athlete and parent or coach influence. Future research should examine the effect of these factors on specialization. Some sports that are ubiquitous in the United States, such as American football, were not included because these sports were not included in the larger previous study. Future research should sample a larger number of schools, in a variety of geographic locations, with different sizes, socioeconomic circumstances, and sport offerings. Finally, while cross-sectional study designs can reveal associations, these studies cannot prove causation.

### CONCLUSION

School size influenced the prevalence of sport specialization. Athletes from the larger high school were more likely to be highly specialized than athletes from the smaller high school, which may be a response to increased competition for roster spots. As youth athletes were much more likely to self-classify as multisport athletes than single-sport athletes, using the 3-point specialization scale may more

accurately represent the true prevalence of sport specialization based on its definition as intense, year-round competition in a single sport at the exclusion of other sports. Athletes who reported a history of overuse knee injuries were more likely to be highly specialized and less likely to have low specialization compared with those without a history of overuse knee injuries. Athletes who trained in one sport more than 8 months out of the year were more likely to report a history of knee and hip injuries. A better understanding of the prevalence and risk factors of early sport specialization can aid athletes, parents, clinicians, and coaches in making decisions for the long-term benefit of the athlete.

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