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Original Research

Sport Specialization, Club Sport Participation, Quality of Life, and Injury History Among High School Athletes

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Context: Many factors can affect the injury risk and quality of life among high school athletes. Early sport specialization and club sport participation may be components to consider when assessing the injury risk and quality of life.

Objective: To investigate patient-reported quality-of-life and injury-history measures among adolescent athletes at different sport-specialization levels and to compare these measures between those who did and those who did not report participating in club sports.

Design: Cross-sectional study.

Setting: High school athletic facility.

Patients or Other Participants: High school student athletes 13 to 18 years of age were recruited and tested during their annual preseason athletic physical examinations.

Main Outcome Measure(s): Our primary grouping variables were sport-specialization level (classified as low, moderate, or high) and club sport participation (organized sport outside of traditional school athletics). Our outcome variables were the Patient-Reported Outcome Measurement Information System Pediatric Profile-37 rating, Severity Measure for Depression–Child score, and injury history.

Results: A total of 97 individuals participated (mean age = 15.2 ± 1.1 years; 38% female). Relatively similar proportions of individuals reported participating at each level of sport specialization (low = 34%, moderate = 40%, high = 26%). Forty-six (48%) participants stated they participated in club sports. No differences were evident in quality of life (P values = .15–.92 across domains), depression ($P = .60$), or injury history ($P > .70$) among the specialization groups. Those who described participating in club sports had a higher proportion of time-loss musculoskeletal injuries (63% versus 29%; $P = .002$) and of injuries requiring imaging, injection, a cast, a brace, or crutches (72% versus 46%; $P = .013$) than those who did not.

Conclusions: Although no injury-history differences were found among the sport-specialization groups, a higher proportion of club sport athletes than nonclub sport athletes reported a history of injury. Club sports are generally seen as more competitive, and the higher number of injuries seen in this setting could be related to a higher level of play among club sport athletes.

Key Words: pediatric sports medicine, youth sports, musculoskeletal injury, PROMIS

Key Points

- Compared with high school athletes, a greater proportion of club sport athletes described a history of musculoskeletal injury.
- No injury-history differences were present among the levels of sport specialization.
- Patient-reported quality-of-life outcomes were not associated with sport-specialization level or club sport participation.

Based on recent epidemiologic evidence, sports injuries among adolescent athletes appear to be increasing, yet the factors responsible for this rise remain unclear.[1] Over the past decade, a growing number of adolescent athletes have elected to focus on and increase their training in a primary sport (ie, *sport specialization*) to enhance their skill level and participate in higher levels of competition.[2] As a result, concern is growing that early sport specialization among adolescent athletes is a risk factor for sustaining injuries and reduced psychological wellbeing.[3–5]

Sport specialization has recently been categorized into low, moderate, and high levels.[6] Previous researchers[6–8] noted that highly specialized athletes were more likely to report a history of lower extremity injuries, severe overuse injuries, and knee injuries. The reasons for these increased injury risks have not yet been well delineated. Some authors[2] observed that participation in athletic activity for more than 16 hours per week, regardless of the number of sports played, increased the injury risk. Furthermore, other investigators[8] highlighted an association between lower extremity injury and training in 1 sport for 8 or more months annually. In addition, after controlling for age and training volume, sport specialization was independently associated with an elevated injury risk among high school athletes.[6]

A paucity of research has addressed early sport specialization and club sport athletes, as most of the current literature focused on high school athletics. Club sports are organized outside of the traditional school athletic department and typically require athletes to train with their team throughout the year. Post et al[7] found that athletes who

participated in both high school and club sports were more likely to report previous lower extremity injuries than athletes participating only in high school athletic programs who had lower competition volumes. Thus, due to many potential factors such as high training volumes and organizational demands, those engaged in club sports may be more likely to specialize and sustain injuries than those involved in traditional high school sports alone.

Overall, healthy adolescent athletes tend to report a higher quality of life than their nonathlete counterparts,[9,10] yet after injury, many athletes describe increased feelings of anxiety and stress.[11] Furthermore, specialized athletes may be more likely to experience psychological burnout and social isolation than nonspecialized athletes.[2–4] Ice hockey players who spent more time training off the ice at earlier ages were more likely to drop out of the sport later in life relative to their peers who trained with lower time demands.[12] Olympic rhythmic gymnasts who increased their training volume at an earlier age reported having less fun in their sport and lower perceived health quality compared with non-Olympic elite rhythmic gymnasts.[13] Therefore, the associations between training volumes in highly specialized or club sport athletes may help to better delineate the risk of injury, as well as the effects of sport on quality of life.

Our study had 2 purposes. First, we investigated patient-reported quality-of-life measures and injury-history characteristics between adolescent athletes who described low, medium, or high sport-specialization levels. Second, we investigated patient-reported quality-of-life measures and injury-history characteristics between those who did and those who did not describe participating in club sports. We hypothesized that athletes with a high sport-specialization classification would be more likely to compete in club sports, would report a greater proportion of prior musculoskeletal injuries, and would have lower quality-of-life ratings than athletes with a low sport-specialization classification. We also hypothesized that club sport athletes would have higher training volumes and report a greater proportion of past injuries than nonclub sport athletes.

METHODS

Study Design and Participants

We conducted a cross-sectional investigation of high school athletes as a part of a preseason physical examination during May 2018. Before the study began, the institutional review board and local school district approved the protocol. All volunteers and their parents or legal guardians provided written informed assent or consent, respectively, to participate in the study. Recruits were included if they were between the ages of 13 and 18 years and had received full clearance to participate in sport (in the event of a recent time-loss injury) at the time of the examination. To reduce the potential effects of confounding variables on our quality-of-life and injury-history outcomes, participants were excluded if they had any of the following: neurologic disorder, seizure disorder, or ongoing symptoms from a recent concussion. During their physical examination, all participants filled out questionnaires documenting aspects of their medical history and personal characteristics. They reported their sex, age, grade, number of hours per week participating in their primary sport, and level of competition (ie, varsity, junior varsity). Parents were available to assist if necessary in providing the number of hours per week of sport participation or answering other survey questions for younger athletes. Information from the physical examination, such as height and weight, was also obtained by athletic trainers or physical therapists and included in further analysis.

Grouping Variables

Our grouping variables were sport-specialization level and club sport participation. Participants completed a brief questionnaire about their personal sports history. To identify their sport-specialization level, they were asked 3 questions that have been used in prior research[6,8]: (1) "Do you consider your primary sport more important than other sports?" (2) "Do you play or train for a single sport more than 8 months per year?" and (3) "Have you ever quit a sport to focus on a single sport?" We then calculated the level of sport specialization as the sum of *yes* responses to the 3 questions, where *yes* = 1 and *no* = 0. Specialization was classified based on the calculated score as high specialization (3), moderate specialization (2), or low specialization (1 or 0). To assess club sport participation, we asked participants if they played club sports and grouped their responses by whether they stated *yes* or *no*.

Outcome Variables

We assessed quality of life, depression, and injury history as our primary outcome variables. To assess participant quality of life, we used the Patient-Reported Outcome Measurement Information System (PROMIS; version 1.1) Pediatric Profile-37.[14,15] This profile instrument contains a fixed number of questions in 6 domains: physical function mobility, anxiety, depressive symptoms, fatigue, peer relationships, and pain interference along with a single question about pain intensity. Each question is answered based on the past 7 days and is intended for self-reporting by individuals 8 to 17 years of age. Each question had 5 response options, ranging from 0 to 4 for 6 questions, except for the pain scale, which was rated from 0 (*no pain*) to 10 (*worst pain you can think of*). The total raw score in each domain was calculated as the sum of all responses (range = 0 to 24), where a higher score represents more of the concept being measured (ie, 0 = *with no trouble* or *never*, 4 = *not able to do* or *almost always*). Each of the 6 domains we assessed has demonstrated an acceptable level of reliability using the static pen-and-paper short-form assessment (test-retest reliability correlation range = 0.75–0.77), except for pain interference (test-retest reliability correlation = 0.62).[15]

To assess depression, we used the Severity Measure for Depression–Child Age 11–17 (Patient Health Questionnaire-9 modified for adolescents).[16] For this scale, participants were asked how often they were bothered by 9 common depressive symptoms in the past 7 days. Each score was rated from 0 (*not at all*) to 3 (*nearly every day*). The sum of the responses was calculated as the total raw score, which was used for further analysis. Total raw scores are classified by the severity of depressive disorder as *none* (0–4), *mild* (5–9), *moderate* (10–14), *moderately severe* (15–19), and *severe* (20–27). This instrument has comparable diagnostic validity relative to a clinical evaluation,[16]

Table 1. Participants' Primary Sport Stratified By Sex

Sport	No. (%)	
	Males (n = 61)	Females (n = 36)
American football	36 (59)	0 (0)
Baseball	3 (5)	0 (0)
Basketball	6 (10)	2 (5)
Cheerleading/poms	2 (3)	8 (22)
Cross-country	4 (7)	1 (3)
Field hockey	0 (0)	1 (3)
Golf	0 (0)	2 (5)
Gymnastics	0 (0)	2 (5)
Lacrosse	2 (3)	0 (0)
Rugby	0 (0)	1 (3)
Soccer	5 (8)	4 (11)
Softball	0 (0)	4 (11)
Swimming/diving	0 (0)	2 (5)
Tennis	0 (0)	3 (8)
Track and field	0 (0)	4 (11)
Volleyball	0 (0)	3 (8)
Water polo	1 (2)	0 (0)
Wrestling	1 (2)	0 (0)

high sensitivity and specificity (89.5% and 77.5%, respectively) to detect adolescents meeting the criteria for depression,[17] and excellent internal reliability (Cronbach $\alpha = 0.89$).[18]

So that we could assess their previous injuries, participants filled out a standardized questionnaire as a part of their preparticipation physical examination. The questions in the current study were (1) "Have you ever had an injury to a bone, muscle, ligament, or tendon that caused you to miss a practice or a game?" (2) "Have you ever had any broken or fractured bones or dislocated joints?" (3) "Have you ever had an injury that required x-rays, [magnetic resonance] imaging, [computed tomography] scan, injections, therapy, a brace, a cast, or crutches?" and (4) "Have you ever had a stress fracture?" Each question was answered as either *yes* or *no*.

Statistical Analysis

Continuous outcome variables were assessed for normality using the Shapiro-Wilk test. Given the nonnormal distribution of the outcome variables, they are presented as medians and interquartile ranges. We compared continuous outcome variables between sport-specialization groups using Kruskal-Wallis tests and between club sport groups using Mann-Whitney *U* tests. Categorical variables are presented as the number and corresponding percentage and were compared using the Fisher exact test or χ^2 analysis, depending on the observed sample size in each cell. To assess any age-related effects on sport-participation volume or injury history, we also compared the number of hours per week athletes reported participating in sport and previous injuries using the Kruskal-Wallis and Fisher exact tests, respectively. All statistical tests were 2 sided and evaluated with a significance level of $P < .05$. All statistical analyses were conducted using Stata (version 15; StataCorp, College Station, TX).

RESULTS

A total of 111 participants were enrolled in the study, of whom 97 completed the questionnaires specific to our investigation. Thirty-five (36%) stated they had quit a sport to focus on a single sport, 65 (67%) played or trained for a single sport more than 8 months per year, and 78 (80%) considered their primary sport more important than other sports. Accordingly, 33 (34%) were classified as a low, 39 (40%) as a moderate, and 25 (26%) as a high level of specialization. The primary sports of the participants varied, with most reporting American football or cheerleading or poms (Table 1).

The 3 specialization groups were of similar ages, proportions of females to males, and time spent in their sport per week (Table 2). No differences were demonstrated in any of the participant-reported PROMIS domains, depression severity, or history of injury among the specialization groups (Table 3).

Forty-six (48%) respondents reported involvement in club sports. Adolescent athletes did not differ in age, weekly time training in their sport, or the proportion of females or varsity athletes based on whether or not they participated in club sports (Table 4). Those who reported involvement in club sports had a higher proportion of prior time-loss musculoskeletal (MSK) injuries and of injuries requiring imaging, injection, a cast, a brace, or crutches (Table 5). Neither quality of life nor depression severity differed between club and nonclub sport adolescent athletes (Table 5).

Age did not affect sport-participation or injury-history measures. Specifically, although the number of hours athletes reported participating in sports per week increased (age 13 = 9.9 hours, age 14 = 9.7 hours, age 15 = 10.8

Table 2. Participants' Demographic Characteristics by Specialization Level[a]

Variable	Specialization Level			*P* Value
	Low	Moderate	High	
	Median (Interquartile Range)			
Age, y	14.6 (14.2–15.5)	15.1 (14.3–16.1)	15.7 (14.4–16.4)	.14
Height, cm	170.2 (165.0–180.3)	167.6 (161.3–179.7)	171.5 (162.9–177.2)	.96
Weight, kg	61.2 (55.6–74.3)	58.8 (51.9–72.8)	58.2 (50.8–75.5)	.80
Time in sport, h/wk	11 (8–15)	10 (9–14)	10 (8–14)	.43
	No. (%)			
Sex, female	8 (30)	13 (37)	9 (43)	.63
Varsity athlete	7 (21)	14 (39)	12 (48)	.10
Club sport athlete	11 (34)	20 (51)	15 (23)	.08

[a] Categorical variables were compared using χ^2 analysis. Continuous variables were compared using Kruskal-Wallis tests.

Table 3. Patient-Reported Quality-of-Life and Injury-History Outcomes By Specialization Level[a]

Variable	Specialization Level			*P* Value
	Low	Moderate	High	
	Median (Interquartile Range)			
Patient-Reported Outcome Measurement Information System				
Physical function mobility	0 (0–0)	0 (0–0)	0 (0–0)	.62
Anxiety	1 (0–2)	1.5 (0–5)	2 (0–6)	.46
Depressive symptoms	0 (0–2)	0.5 (0–2)	0 (0–2)	.79
Fatigue	1 (0–3)	2 (0–3)	1 (0–4)	.54
Peer relationships	23 (19–24)	23 (20–24)	24 (21.5–24)	.15
Pain interference	0.5 (0–3)	0 (0–2)	0 (0–4)	.92
Pain intensity	1 (0–2)	0 (0–3)	0 (0–2)	.78
Patient Health Questionnaire-9 depression score	1 (0–2)	0 (0–1)	0 (0–1)	.60
	No. (%)			
History				
Time-loss musculoskeletal injury	15 (45)	18 (46)	11 (46)	.99
Fracture	14 (42)	15 (38)	11 (46)	.84
Injury requiring imaging, injection, a cast, a brace, or crutches	19 (58)	22 (56)	14 (58)	.99
Stress fracture[b]	2 (6)	4 (10)	1 (4)	.70

[a] All other categorical variables were compared using χ^2 analysis. Continuous variables were compared using Kruskal-Wallis tests.
[b] Categorical variable compared using the Fisher exact test.

hours, age 16 = 13.2 hours, age 17 = 14.4 hours), the differences were not significant ($P = .07$). Similarly, the proportion of athletes who reported a prior time-loss MSK injury or fracture did not vary by age (age 13 = 46%, age 14 = 62%, age 15 = 46%, age 16 = 67%, age 17 = 50%; $P = .57$).

DISCUSSION

A higher proportion of club sport athletes reported past time-loss MSK injuries than nonclub sport athletes, whereas no differences in specialization level were observed for measures of injury history. Furthermore, no differences in quality of life were detected based on comparisons by specialization level or club sport participation. Over the past decade, the rate and awareness of sport specialization among adolescent athletes have increased substantially. As a result, many recent authors have focused on this rise in early sport specialization. Our study contributes a unique perspective on adolescent sport specialization in comparing athletes by degree of sport specialization and between those who did or did not compete in club sports on several health outcome measures. Despite the lack of differences in level of specialization in our study, the literature to date and our data suggest that clinicians should continue to monitor training volumes among adolescent athletes, as highly specialized athletes or club sport participants may be at increased risk for sport-related injuries. However, our findings should be interpreted with caution, as many club sport athletes do not participate in high school sports, leading to some degree of selection bias in our investigation.

Table 4. Participants' Demographic Characteristics By Club Sport Participation[a]

Variable	Club Sport Athletes	Nonclub Sport Athletes	*P* Value
	Median (Interquartile Range)		
Age, y	14.6 (14.2–15.7)	15.1 (14.4–16.3)	.15
Height, cm	168.3 (162.6–180.3)	172.1 (161.3–179.7)	.98
Weight, kg	58.1 (50.8–64.8)	61.5 (53.8–74.7)	.14
Time in sport per week, h	10 (8–14)	12 (8–15)	.07
	No. (%)		
Sex, female	13 (35)	16 (36)	.91
Varsity athlete	12 (26)	19 (39)	.19

[a] Categorical variables were compared using χ^2 analysis. Continuous variables were compared using Mann-Whitney *U* tests. The number of hours in sport per week represents the overall volume of sport participation, whether or not it was in club sports.

The relative distributions of high school athletes who reported low, moderate, or high specialization are similar. The high-specialization group was the smallest overall percentage, indicating that, in this population of high school athletes, the majority (74%) were not highly specialized. Given this distribution, our investigation may not have been appropriately powered to identify statistically significant differences among groups, and thus, our results should be considered preliminary and in the context of existing work in this area. Interestingly, the highest proportion of club athletes (51%) was in the moderate-specialization group, whereas the lowest proportion of club athletes (23%) was in the high-specialization group. Based on prior work, we expected the largest number of club athletes to be classified as highly specialized athletes.[7] Yet our sample of participants may partially explain this alternate finding. Many highly competitive club teams in the area currently require athletes to discontinue participating in high school athletics to focus on the club team. Therefore, many high-level club athletes may not have been present for the high school sports physicals if they were no longer participating in high school athletics, potentially explaining the relatively low proportion of highly specialized athletes who reported participating in club sports.

Table 5. Outcomes By Reported Participation in Club Sports[a]

Variable	Club Sports	Nonclub Sports	*P* Value
	Median (Interquartile Range)		
Patient-Reported Outcome Measurement Information System			
Physical function mobility	0 (0–0)	0 (0–0)	.47
Anxiety	2 (0–4.5)	1 (0–4.5)	.84
Depressive symptoms	0 (0–2)	0 (0–2)	.72
Fatigue	1 (0–4)	1 (0–3)	.86
Peer relationships	23 (20–24)	23 (19–24)	.63
Pain interference	1 (0–3)	0 (0–3)	.35
Pain intensity	1 (0–3)	0 (0–2)	.42
Patient Health Questionnaire-9 depression score	0 (0–1)	0 (0–2)	.66
	No. (%)		
History			
Time-loss musculoskeletal injury	29 (63)	14 (29)	.001[b]
Fracture	23 (50)	16 (33)	.10
Injury requiring imaging, injection, a cast, a brace, or crutches	33 (72)	22 (46)	.011[b]
Stress fracture[c]	4 (9)	3 (6)	.71

[a] All other categorical variables were compared using χ^2 analysis. Continuous variables were compared using Mann-Whitney *U* tests.
[b] Club sport participation was significantly associated with a greater proportion of participants reporting a history of time-loss musculoskeletal injury and injury requiring imaging, injection, a cast, a brace, or crutches.
[c] Categorical variable compared using the Fisher exact test.

Previous researchers[2–4] have demonstrated that highly specialized athletes may be more likely to experience psychological stress than athletes with moderate or low levels of specialization. When using a general patient-reported quality-of-life outcome measure, we found no differences by specialization level or club sport participation. Among the 3 specialization groups, we did not identify any difference in patient-reported quality of life or depression severity. Such a lack of differences may arise from the constructs being measured by the PROMIS Pediatric-37 questionnaire. One primary aspect of sport specialization that contributes to psychological distress is burnout due to overtraining, whereby athletes no longer participate in an activity that was once enjoyable.[4] In contrast, the PROMIS assesses constructs such as physical function, anxiety, depression, and fatigue,[16] which may be similar to burnout, but they are not directly assessed in this battery of questions. Future evaluation of the factors underlying psychological distress in adolescent athletes using more focused questionnaires will allow clinicians to have evidence-based conversations regarding sport participation with athletes and parents.

Although not statistically significant, a higher proportion of nonclub sport athletes than club athletes participated at the varsity level. In addition, nonclub sport athletes reported spending slightly more hours per week training for their sport (12) compared with club athletes (10), though this association was also not significant. However, we observed that our club sport athletes had a greater proportion of previous time-loss MSK injuries than did nonclub sport athletes despite similar training volumes, ages, and female-to-male ratios. Furthermore, our findings regarding club sport athletes align with previously reported data,[7] as approximately half of our participants stated they were on a club team. Taken together, it appears that a variety of factors are associated with a history of time-loss MSK injuries in high school athletics, but club sport participation may be one contributing factor.

Many researchers[6–9] have found that young athletes who specialized in a primary sport had an increased injury risk compared with athletes who participated in multiple sports. We did not identify any difference in history of time-loss MSK injury; history of fracture; or injury requiring imaging, injection, a cast, a brace, or crutches among the low-, moderate-, and high-specialization groups. Thus, specialization level was not associated with past injury in our population. Of note, participation in club sports was a statistically significant risk factor for a history of a time-loss MSK injury or an injury requiring imaging, injection, a cast, a brace, or crutches. Club sports often demand a higher level of play and competition than high school athletics. This higher level of play, as well as the additional burdens of club sports, such as training volumes and travel schedules,[7] could account for club athletes' increased risk of significant injury compared with their peers who participated only in high school athletics. Future assessment of these risks to club athletes is needed to help educate club sport athletes, parents, and coaches about the relative risks of club sport participation.

Study Limitations

We conducted a study among a unique adolescent athlete population of high school athletes who did or did not participate in club athletics. However, our study has several limitations, and our findings should be interpreted accordingly. We used a cross-sectional design, whereby we assessed injury history based solely on a historical questionnaire that did not account for factors such as the severity or timing of fractures, other MSK injuries sustained before enrollment, or retirement from sport. Furthermore, the injury data did not distinguish the type of injury sustained or the cause of injury (ie, sport related or not). Future prospective studies of injury incidence rates based on sport-participation levels will build on our findings. In addition, we studied a relatively small sample

of individuals and excluded potential participants with existing injuries. Age-related effects in this small sample related to overall number and exposure to sports across the lifetime could not be fully accounted for in our study. Furthermore, our definition of *club sport participation* was not formal, potentially leading to misinterpretation by participants. Finally, the subjective ratings provided in our outcome measures may have been prone to ceiling or floor effects in typically healthy adolescent athletes. Although this limitation may have been mitigated by using age-appropriate patient-reported outcome measures, future work to identify factors responsible for injury and psychological distress in this population is warranted.

CONCLUSIONS

The level of sport specialization among high school athletes was not associated with differences in overall quality-of-life or injury-history measures in the domains of physical function, anxiety, depression, fatigue, peer relationships, or pain. However, participation in a club sport was associated with a greater proportion of time-loss MSK injuries. Athletic trainers in secondary school or club sport settings may consider the effects of training type and sport-participation level as factors when evaluating injury risk. Also, parents should consider the relative risks and benefits of both sport specialization and club sport involvement when discussing participation options with their children.

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