

Sport-Related Concussion: Knowledge and Reporting Behaviors Among Collegiate Club-Sport Athletes

Erica Beidler, PhD, ATC*; Abigail C. Bretzin, MS, ATC†; Colin Hanock†; Tracey Covassin, PhD, ATC, FNATA†

*Duquesne University, Pittsburgh, PA; †Michigan State University, East Lansing

Context: Previous literature on sport-related concussion (SRC) knowledge and reporting behaviors has been limited to high school and National Collegiate Athletic Association collegiate athletes; however, knowledge regarding collegiate club-sport athletes is limited.

Objective: To determine the level of SRC knowledge and reporting behaviors among collegiate club-sport athletes and to investigate differences between athletes in traditional and nontraditional sports.

Design: Cross-sectional study.

Setting: Survey.

Patients or Other Participants: A total of 410 athletes (247 males, 163 females) involved in traditional ($n = 244$) or nontraditional ($n = 165$) collegiate club sports.

Main Outcome Measure(s): The survey consisted of demographics, recognition of SRC signs and symptoms, general SRC knowledge, and reasons why athletes would not report SRCs. The independent variable was sport type. Sport-related concussion signs and symptoms and general knowledge were assessed by the frequency of correct answers to SRC signs and symptoms and general knowledge questions. Sport-related concussion-reporting behavior frequencies were evaluated by

asking participants to indicate reasons why they did not or would not report an SRC.

Results: The SRC signs and symptoms knowledge score was 23.01 ± 3.19 and general SRC knowledge score was 36.49 ± 4.16 (maximal score = 43). No differences were present for SRC signs and symptoms knowledge ($F_{1,408} = 1.99, P = .16$) or general SRC knowledge ($F_{1,408} = 3.28, P = .07$) between athletes in traditional and nontraditional collegiate club sports. The most common reason for not reporting an SRC was not recognizing it as a serious injury ($n = 165, 40.3\%$). Chi-square tests demonstrated significant relationships between sport type and 5 reasons for not reporting an SRC.

Conclusions: The participants displayed moderate to high levels of knowledge of SRCs but indicated they had failed to or would fail to report SRCs for a variety of reasons. The lack of sports medicine coverage and disconnect between knowledge and injury recognition may make collegiate club-sport athletes more likely to participate while concussed.

Key Words: traumatic brain injuries, injury nondisclosure, university, physical activity

Key Points

- Collegiate club-sport athletes were knowledgeable about sport-related concussions but had failed or would fail to disclose a potential injury because they did not recognize concussion signs and symptoms as serious.
- Future sport-related concussion research and initiatives should address the unique needs of the medically underserved collegiate club-sport population, as these athletes may be at risk for injury mismanagement.

A sport-related concussion (SRC) is an invisible injury to the brain that is characterized as “a traumatic brain injury induced by biomechanical forces.”¹ Sport-related concussions are associated with a number of short- (eg, headache, decreased reaction time) and long-term (eg, postconcussion syndrome, clinical depression) problems that can negatively affect quality of life.^{1–3} To increase SRC awareness, a number of national and state legislative initiatives (ie, Youth Sports Concussion Safety Laws, Centers for Disease Control and Prevention HEADS UP, National Football League Concussion public-service announcements) have focused on educating athletes, parents, coaches, referees, and school officials about the signs, symptoms, and dangers of playing with an SRC. Although mandatory SRC education training is starting to become common practice in organized youth, high school, and National Collegiate Athletic Association (NCAA) collegiate varsity sports, this structure is lacking

for those individuals participating in or associated with collegiate club sports.^{4–7}

The National Intramural-Recreational Sports Association defines *club sports* as student-led groups “that are voluntarily organized to further their common interests in an activity through participation and competition.”^{8,9} Although the annual participation rate in collegiate club sports is unknown, high school sport participation continues to rise each year, with 7.8 million participants during the 2014–2015 school year.¹⁰ Of those, only 6.2% will move on to compete on a varsity team at an NCAA institution.¹¹ This leaves a large portion of high school athletes who may choose to pursue club sports to continue their athletic careers or fulfill their physical activity needs throughout their collegiate years. Club sports are not only attractive to those who previously participated in traditional high school sports (eg, basketball, football, soccer), but they also provide opportunities for those who wish to pursue

nontraditional avenues of physical activity (ie, cycling, martial arts, quidditch). Due to the unique self-governing nature of collegiate club sports, more study is needed to determine the athletes' current level of SRC knowledge and reporting behaviors.

Previous literature on SRC knowledge (ie, basic injury awareness, related signs and symptoms, and potential health repercussions) has been limited to high school and NCAA varsity collegiate athletes. Results from several studies^{12–14} suggested that high school athletes were relatively knowledgeable about the general signs and symptoms of SRC (ie, headache, confusion, and dizziness); however, a gap persisted regarding less familiar signs and symptoms of SRC. Despite increasing educational initiatives to promote knowledge and awareness, SRCs at the high school and collegiate levels continue to go unreported as athletes persist in prioritizing sport participation over their own health.^{14–16} Approximately 40% of high school and collegiate athletes did not report a concussive event to an authority figure (eg, athletic trainer [AT], coach).^{13–15} Common reasons why both high school and collegiate student-athletes did not report a suspected SRC were that they did not think it was a serious injury, they did not know it was an SRC at the time, they did not want to be removed from competition, and they did not want to let their teammates down.^{12–15}

This choice between health preservation or sport participation becomes more challenging for club-sport athletes when only 35% of campus recreation directors reported having access to an on-campus certified AT for their club and intramural sport programs.¹⁷ Without consistent access to sports medicine care and injury care recommendations, collegiate club-sport athletes and player-coaches become responsible, in most instances, for their own game-time return-to-play decisions without performing formal SRC assessments. Although interventions have been established in some athletic settings, currently little evidence is available on SRCs in collegiate club-sport athletics and no national standards exist for club-sport SRC management. To develop specialized SRC education and management programs for these athletes, it is vital to first identify their knowledge of SRCs and their current reporting practices. Therefore, the aim of our study was to determine the knowledge of SRC signs and symptoms, general SRC awareness including potential risks or complications of SRCs, and SRC reporting behaviors among a sample of collegiate club-sport athletes. A secondary aim was to identify any differences in these outcomes between traditional and nontraditional club-sport athletes.

METHODS

Participants

We conducted a cross-sectional survey study of collegiate club-sport athletes. A convenience sample of collegiate club-sport athletes was recruited from 4 institutions in Michigan and Pennsylvania. We recruited male and female traditional and nontraditional collegiate club-sport athletes. *Traditional collegiate club sports* were defined as those eligible to compete in a postseason NCAA championship (ie, football, gymnastics, hockey, lacrosse, soccer, softball,

volleyball, and wrestling). However, although fencing is an NCAA sport, we felt it was better suited for the nontraditional category due to its low number of participants at the NCAA level and club-sport status at the high school level. Boxing, cheerleading, cycling, fencing, ice skating, martial arts, quidditch, and rugby represented *nontraditional club sports* in this study.

Instrumentation

A one-time survey served as the instrument for this study. The survey took 10 to 15 minutes to complete and consisted of sections on demographic information, SRC knowledge, and SRC reporting behaviors.

The demographic information collected for this study was sex, year in college, race, and club-sport participation. An additional item asked participants if they had access to an AT as club-sport athletes at their institutions.

Sport-related concussion knowledge was assessed using an instrument that was originally developed by Register-Mihalik et al in 2013.¹⁴ An additional 8 signs and symptoms of SRC were added to the original 35-item survey to update the instrument for consistency with the current advances in SRC identification and management. The modified 43-item survey assessed symptom knowledge by asking participants to identify SRC symptoms from a list. The list provided 29 symptoms; 15 were correct and 14 were incorrect distractors. One point was awarded for selecting a correct SRC symptom or not selecting an incorrect distractor symptom. The remaining 14 items comprised questions pertaining to general SRC knowledge and complications related to multiple concussive injuries and returning to sport activities while still experiencing symptoms. General SRC knowledge scores ranged from 0 to 43, with a higher score representing greater knowledge. The original instrument had a Cronbach α of 0.72 and acceptable test-retest reliability, with scores ranging from 0.60 to 1.00.¹⁴ After modifying the instrument with the additional 8 signs and symptoms of SRC, we calculated the Cronbach α at 0.65.

Sport-related concussion-reporting behaviors were assessed using a method established by McCrea et al in 2004.¹⁶ We used a version adapted by Wallace et al¹³ that included questions regarding the reasons why athletes have not reported or would not report SRC symptoms to others. Participants were asked to indicate all the reasons why they have not reported or would not report a possible SRC to an AT, coach, parent, or teammate. The instrument had 12 possible reasons for not reporting an SRC: eg, they did not want to miss playing time or appear weak to teammates or coaches.

Procedures

Institutional Review Board approval was obtained for this study. The contact information of coaches for each sport was obtained, and the principal investigator (E.B.) contacted coaches and player-coaches to arrange meeting times for participant recruitment. After providing informed consent, participants completed the paper-and-pencil survey during a team practice or meeting. All responses were anonymous. Participants were informed that they could skip questions they did not wish to answer and terminate the survey at any time without repercussions. After data

collection, each paper-and-pencil response was entered into the Qualtrics (Provo, UT) online survey software. The data were then exported into an SPSS (version 23; IBM Corp, Armonk, NY) file for statistical analysis.

Data Analysis

To gain a better understanding of the participants, we calculated frequencies for sex, year in college, race, and club-sport activity. Frequency statistics were used to determine the scores for knowledge of SRC signs and symptoms, general SRC knowledge, and SRC reporting behaviors. Differences between traditional and nontraditional collegiate club-sport athletes' SRC symptom knowledge scores and general SRC knowledge scores were investigated using an analysis of variance with effect-size calculations for the mean differences between the groups. The Cohen effect-size recommendations were used for interpretation, with 0.20 or less being a *small effect*; approximately 0.25, a *moderate effect*; and 0.80 or greater, a *large effect*.¹⁸ Chi-square analyses were used to determine if there were any relationships between collegiate club-sport type (traditional versus nontraditional) and the 11 possible reasons for not reporting a potential SRC to others. We conservatively estimated that a moderate effect size (0.25) between groups, assuming an a priori α level of .05 and statistical power of 0.80, would require a total of 128 participants (64 per group) to successfully measure statistically significant differences between groups.¹⁹ All analyses were done using SPSS with the significance level set at $P \leq .05$.

RESULTS

Participant Demographics

Of the 2358 collegiate club-sport athletes approached for study participation, 410 (17.4%) completed the survey. The study sample consisted of 247 male (60.2%) and 163 female (39.8%) collegiate club-sport athletes who were predominantly white ($n = 361$, 88.0%). The athletes were fairly evenly distributed by class: freshmen ($n = 117$, 28.5%), sophomore ($n = 112$, 27.3%), junior ($n = 78$, 19.0%), and senior ($n = 88$, 21.5%). An additional 3.2% ($n = 13$) were graduate students. The largest numbers of participants competed in ice hockey ($n = 76$, 18.5%), lacrosse ($n = 56$, 13.7%), soccer ($n = 43$, 10.5%), and volleyball ($n = 42$, 10.2%). More participants were involved in traditional collegiate club sports ($n = 244$, 59.5%) than in nontraditional sports ($n = 165$, 40.2%). The favorite nontraditional club sports were ice skating ($n = 37$, 9.0%), cheerleading ($n = 26$, 6.3%), fencing ($n = 24$, 5.9%), and martial arts ($n = 24$, 5.9%). Only 5.6% ($n = 23$) of our study sample reported that they had access to an AT during their collegiate club-sport participation; the majority were unsure if they had access ($n = 351$, 85.6%). Complete demographic information for the sample is shown in Table 1.

Sport-Related Concussion Knowledge

Scores for knowledge of SRC signs and symptoms ranged from 6 to 29 out of 29 (23.01 ± 3.19) with higher scores indicating greater knowledge. Headache ($n = 380$,

Table 1. Participant Demographics (N = 410)

Demographic	Frequency (%) ^a
Sex	
Female	163 (39.8)
Male	247 (60.2)
Year in college	
Freshman	117 (28.5)
Sophomore	112 (27.3)
Junior	78 (19.0)
Senior	88 (21.5)
Graduate	13 (3.2)
Not reported	2 (0.5)
Race	
White	361 (88.0)
African American	9 (2.2)
American Indian	1 (0.2)
Asian	20 (4.9)
Hispanic/Latino	6 (1.5)
Other	12 (2.9)
Not reported	1 (0.2)
Traditional club sport^b	
Football	6 (1.5)
Gymnastics	1 (0.2)
Ice hockey	76 (18.5)
Lacrosse	56 (13.7)
Soccer	43 (10.5)
Softball	11 (2.7)
Volleyball	42 (10.2)
Wrestling	9 (2.2)
Nontraditional club sport^b	
Boxing	22 (5.4)
Cheerleading	26 (6.3)
Cycling	16 (3.9)
Fencing	24 (5.9)
Ice skating	37 (9.0)
Martial arts	24 (5.9)
Quidditch	6 (1.5)
Rugby	10 (2.4)
Access to an athletic trainer?	
Yes	23 (5.6)
No	36 (8.8)
Unsure	351 (85.6)

^a Percentage of total sample.

^b Traditional club sports were defined by National Collegiate Athletic Association inclusion.

92.7%), confusion ($n = 377$, 92.0%), sensitivity to light ($n = 370$, 90.2%), and loss of consciousness ($n = 369$, 90%) were the most commonly recognized symptoms of SRC. Neck pain ($n = 113$, 27.6%) and irritability ($n = 173$, 42.2%) were the least recognized symptoms of SRC. Individual frequencies of SRC signs and symptoms knowledge are presented in Table 2. General SRC knowledge scores ranged from 19 to 43 out of 43 (36.49 ± 4.16). A total of 84.1% ($n = 345$) of collegiate club-sport athletes correctly answered, "If you are experiencing any signs and symptoms of concussion after a blow to the head or sudden movement of the body, you should not return to play." Paralysis was incorrectly identified as a complication of returning to sport while still experiencing the signs and symptoms of an SRC by 50% ($n = 205$) of athletes. Individual frequencies for the general SRC knowledge score questions are provided in Table 2.

Table 2. Sport-Related Concussion Knowledge of Club-Sport Athletes (N = 410)

Athlete Knowledge Item ^a	Frequency of Answering Correctly (%) ^b
Recognition of sport-related concussion signs and symptoms	
Skin rash (false)	394 (96.1)
Headache (true)	380 (92.7)
Chest pain (false)	378 (92.2)
Confusion (true)	377 (92.0)
Fever (false)	376 (91.7)
Sensitivity to light (true)	370 (90.2)
Loss of consciousness (true)	369 (90.0)
Bleeding from the mouth (false)	368 (89.8)
Blurred vision (true)	367 (89.5)
Joint stiffness (false)	366 (89.3)
Dizziness (true)	366 (89.3)
Abnormal sense of smell (false)	359 (87.6)
Black eye (false)	355 (86.6)
Memory loss (true)	354 (86.3)
Abnormal sense of taste (false)	347 (84.6)
Difficulty breathing (false)	328 (80.0)
Balance difficulty (true)	328 (80.0)
Nausea (true)	328 (80.0)
Back stiffness (false)	327 (79.8)
Fogginess (true)	324 (79.0)
Nosebleed (false)	305 (74.4)
Bleeding from the ears (false)	302 (73.7)
Numbness in arms (false)	301 (73.4)
Sensitivity to sound (true)	294 (71.7)
Ringing in the ears (true)	284 (69.3)
Sleep disturbances (true)	267 (65.1)
Neck muscle weakness (false)	234 (57.1)
Irritability (true)	173 (42.2)
Neck pain (true)	113 (27.6)
General knowledge	
A concussion only occurs if you lose consciousness. (False)	387 (94.4)
A concussion is an injury to the _____. (brain)	377 (92.0)
If you are experiencing any signs and symptoms of concussion after a blow to the head or sudden movement of the body, you should not return to play. (True)	345 (84.1)
Multiple concussions: What are possible complications of sustaining multiple concussions?	
No complications exist (false)	409 (99.8)
Increased risk of further injury (true)	325 (79.3)
Brain damage (true)	383 (93.4)
Joint problems (false)	346 (84.4)
Memory problems (true)	368 (89.8)
I don't know	396 (96.6)
Returning to play: What are complications of returning to sporting activity while still experiencing possible concussion symptoms?	
No complications exist (false)	408 (99.5)
Increased risk of further injury (true)	362 (88.3)
Paralysis (false)	205 (50.0)
Brain damage (true)	370 (90.2)
Joint problems (false)	333 (81.2)
I don't know	389 (94.9)

^a The correct response for each item is indicated in parentheses.

^b Indicates the frequencies and percentages that represent the proportion of the sample responding correctly to each item.

Between traditional and nontraditional collegiate club-sport athletes, we found no differences for SRC signs and symptoms knowledge ($F_{1,408} = 1.99, P = .16$) or general SRC knowledge ($F_{1,408} = 3.28, P = .07$) scores. Although the result was not significant, the nontraditional collegiate club-sport group scored slightly higher for both SRC signs and symptoms knowledge (23.31 ± 2.98 , 95% confidence interval [CI] = 22.81, 23.81) and total SRC knowledge (36.99 ± 3.87 , 95% CI = 36.34, 37.63) compared with the traditional collegiate club-sport group (SRC signs and symptoms knowledge score = 22.84 ± 3.29 , 95% CI = 22.44, 23.23; general SRC knowledge = 36.21 ± 4.30 , 95% CI = 35.69, 36.72). Both analyses showed small effect sizes between traditional and nontraditional collegiate club sports: 0.15 for SRC signs and symptoms knowledge and 0.19 for general SRC knowledge.

Sport-Related Concussion-Reporting Behaviors

For our collegiate club-sport athlete sample as a whole, the most common reasons why they have not reported or would not report an SRC were that they did not think it was a serious injury ($n = 165, 40.3\%$), did not want to lose playing time ($n = 127, 31.3\%$), did not know at the time it was an SRC ($n = 93, 22.7\%$), and did not want to let their team down ($n = 85, 20.8\%$). Chi-square tests showed significant relationships between collegiate club-sport type (traditional versus nontraditional) and 5 reasons for not reporting an SRC. Collegiate club-sport athletes who participated in more traditional sports were less likely than nontraditional club-sport athletes to report an SRC to a coach, parent, or teammate due to the following reasons: they did not want to lose playing time ($\chi^2_{1,408} = 12.59, P < .001$), they did not want to have to go to the doctor ($\chi^2_{1,409} = 5.18, P = .02$), they did not think it was a serious injury ($\chi^2_{1,408} = 4.39, P = .04$), and it was the end of the season and they did not want to miss a game ($\chi^2_{1,408} = 3.79, P = .05$). Conversely, nontraditional club-sport athletes were less likely to report an SRC than traditional club-sport athletes because they thought their parents would get upset ($\chi^2_{1,408} = 3.70, P = .05$). The additional reasons for not reporting an SRC were not significantly different between the collegiate club-sport types. See Table 3 for additional information regarding SRC reporting behaviors.

DISCUSSION

To our knowledge, we are the first to investigate SRC knowledge and reporting behaviors among a cohort of traditional and nontraditional collegiate club-sport athletes. The athletes demonstrated scores of 79.6% for SRC signs and symptoms and 85.1% for general SRC knowledge, with the most commonly recognized signs and symptoms being headache, confusion, sensitivity to light, and loss of consciousness. The least recognized SRC symptoms were neck pain and irritability. Collegiate club-sport athletes who played traditional sports did not differ from nontraditional athletes in SRC knowledge. However, traditional athletes were less likely to report SRCs for several reasons, which included not wanting to lose playing time, not wanting to go to the doctor, and not wanting to miss a game.

Table 3. Sport-Related Concussion Nondisclosure by Club-Sport Type

Reason for Not Reporting a Sport-Related Concussion	Frequency of Reasons for Not Reporting a Sport-Related Concussion, No. (%) ^a			$\chi^2_{1,408}$ Value	P Value
	Traditional (n = 268)	Nontraditional (n = 141)	Total (n = 409)		
I did not want to lose playing time.	99 (36.9)	28 (19.9)	127 (31.3)	12.59	<.001 ^b
I did not want to have to go to the doctor.	52 (19.4)	15 (10.6)	67 (16.4)	5.18	.02 ^b
I did not think it was serious.	118 (44.0)	47 (33.3)	165 (40.3)	4.39	.04 ^b
It was the end of the season; I didn't want to miss a game.	55 (20.5)	18 (12.8)	73 (17.8)	3.79	.05 ^b
I thought my parents would be upset.	8 (3.0)	10 (7.1)	18 (4.4)	3.70	.05 ^b
I did not want to let the team down.	62 (23.1)	23 (16.3)	85 (20.8)	2.61	.11
I did not know at the time it was a concussion.	66 (24.6)	27 (19.1)	93 (22.7)	1.58	.21
I do not have health insurance and could not go to the doctor.	2 (0.7)	2 (1.4)	4 (1.0)	0.43	.51
I thought my coach would get mad.	14 (5.2)	9 (6.4)	23 (5.6)	0.23	.63
I thought my teammates would think I'm weak.	16 (6.0)	10 (7.1)	26 (6.4)	0.19	.66
I thought my coach would think I'm weak.	16 (6.0)	10 (7.1)	26 (6.4)	0.19	.66

^a Indicates frequencies and percentages that represent the proportion of the sample groups that selected each statement as a reason for why they did not or would not report a concussion.

^b $P \leq .05$

Sport-Related Concussion Knowledge

Our results suggest that collegiate club-sport athletes' knowledge scores were consistent with the results of studies on high school and youth athletes that headache was the most commonly recognized SRC symptom.^{12–14,20} The club-sport athlete sample appeared to have greater level of knowledge and recognition of confusion and sensitivity to light as SRC symptoms than participants in other studies.^{13,14} However, sleep disturbance was recognized by only two-thirds of the athletes in this study. The recognition of sleep disturbance as an SRC product has generated mixed results from previous researchers. An early report¹⁴ indicated sleep problems were frequently identified by high school athletes (83.8%), yet a more recent investigation¹³ indicated that only 54% of high school athletes with access to an AT recognized sleep problems as a symptom of an SRC. Even more concerning was that only one-third of high school athletes (35%) without an AT recognized sleep disturbance as a symptom of SRC.¹³ Therefore, information regarding sleep problems after an SRC may be a beneficial addition to future educational interventions and a focus of future research.

Our findings suggest that the levels of club-sport athletes' general knowledge and knowledge of multiple SRCs were high. More than 94% of collegiate club-sport athletes correctly chose *false* for “a concussion only occurs if you lose consciousness” and agreed that concussions were injuries to the “brain” and possible complications of multiple SRCs included “brain damage” and “memory problems.” These results are consistent with previous research that indicated high school athletes were also aware that an SRC is a brain injury and it is not necessary to lose consciousness in order to sustain one.^{13,14} It appears that athletes, regardless of playing level (ie, high school, college, club), now understand that SRC is a serious injury with serious consequences.

Sport-Related Concussion-Reporting Behaviors

Although SRC education has increased in recent years, more than 50% of athletes were still not reporting their suspected SRC to an authority figure.^{13,14} We could assume that an increase in SRC knowledge would translate into

increased SRC-reporting behaviors, yet our results and those of previous researchers^{13,14} suggest that SRC knowledge did not reflect an increase in recognition and reporting behaviors. Similar reasons^{13–15} indicate that collegiate club-sport athletes did not or would not report their SRC because they did not think it was serious, did not want to let their teammates down, and were fearful of losing playing time. Even though athletes were knowledgeable about the signs and symptoms of SRC and dangers of playing with an SRC, “I did not think it was serious” was the most common reason for nondisclosure in our study. The percentage of high school athletes who stated that they did not think that it was serious enough fell from 70% in 2013¹⁴ to 34% in 2017,¹³ yet a greater shift in SRC culture is still needed. Not wanting to lose playing time (31.2%) was the second most frequently reported reason for nondisclosure, which was similar to high school athletes (36.5%).¹⁴ This reason was even more prevalent among NCAA collegiate varsity athletes: almost 80% of retired athletes with a previous undisclosed self-reported SRC gave not wanting to leave a game or practice as their strongest motivation.¹⁵

Although it is important to consider reporting behaviors in all settings, more research is needed on athletic populations that lack consistent access to on-field medical care (eg, collegiate club sports, youth sports). As mentioned previously, the self-governing nature of collegiate club sports adds another layer of intricacy to the already complicated process of identifying and managing SRCs, as the athletes are essentially acting as their own medical providers. This population lacks the luxury of evaluation by a trained sports medicine professional immediately after an injury, so they must make game-time decisions using their own best judgment formed by their current knowledge and previous experiences. From our results, it was clear that the collegiate club-sport sample had knowledge about SRCs but unclear if they used that knowledge to recognize a concussive injury. In fact, 22.7% responded that they did not report an SRC because they did not initially recognize it as a concussive injury. The lack of sports medicine coverage and disconnect between knowledge and injury recognition may make collegiate club-sport athletes more likely to participate while concussed and not follow the

recommended SRC management and return-to-play guidelines. Therefore, it is imperative that this unique sport population is not overlooked when SRC education, prevention, and management initiatives are developed.

Traditional Versus Nontraditional Club Sports

In the current sample, SRC signs and symptoms knowledge and general SRC knowledge between traditional and nontraditional athletes did not differ. However, reporting behaviors between traditional and nontraditional collegiate club-sport athletes were different. Specifically, not wanting to lose playing time, not wanting to go to the doctor, and not thinking it was a serious injury were the strongest motivators for traditional collegiate club-sport athletes to not report a suspected SRC. These results are similar to those in high school and collegiate athletes, which suggests that athletes participating in traditional sports may be highly motivated by competition.^{13,15} Furthermore, the stakes of the game may also affect the decision to not report a suspected SRC. An early study²¹ of high school rugby players suggested that 27% believed a player should remain in an important game (eg, final) even if he was suspected of having an SRC. Moreover, 76% reported witnessing a teammate with a suspected SRC remain in the game. Similarly, at the NCAA varsity level, 24% of athletes stated that they would have reported the suspected SRC if it occurred during a less important game or practice.¹⁵ These findings suggest that the risk of an SRC may not outweigh the risk of lost playing time, especially in a high-stakes game.

Similar to lost playing time, external motivations to remain in sport (eg, pressures from coaches or teammates) may also be evident at the collegiate club-sport level. In NCAA collegiate varsity sports, athletes reported that the strongest pressure to continue playing after an SRC came from coaches and teammates.²² Although we did not investigate SRC history, 21% of our club-sport athletes cited not wanting to let their team down as a reason for why they did not or would not report an SRC. These results were similar to those reported at the high school level.^{13,14} It is possible that increased pressures are also heightened at more competitive levels, as 72% of NCAA collegiate varsity athletes reported their motivation for nondisclosure was not wanting to let their team down¹⁵ compared with only 20% in the high school athletic setting.¹⁵ Thinking their coach would be angry or others would think they were weak were among the least likely reasons for not reporting a suspected SRC, which is probably due to the self-governing nature of collegiate club sports. In addition, these athletes are not in jeopardy of losing their scholarship status or considering the possibility of being drafted professionally.

Limitations

This study was not without limitations. One limitation was the lack of data collection on club-sport athletes' SRC history. With data on SRC history, we might have been able to evaluate knowledge gaps between those with and those without a history of SRC. It would also have been ideal to have captured the number of undisclosed or undiagnosed SRCs participants had sustained in the past. This information could have aided in the interpretation of the SRC-

reporting behaviors results. Follow-up investigators should address (1) the reasons behind previously sustained but undisclosed SRCs and (2) hypothetical reasons why they would not report a concussive injury in the future. Additionally, previous sport participation and previous SRC education information was not collected. Therefore, it was unclear if club-sport athletes were provided with SRC education in high school or while playing nonscholastic club sports. Moreover, we were not able to determine if high schools had mandatory SRC education because the athletes were from different states. However, collegiate club-sport athletes had a moderate to high level of knowledge about SRCs. Another limitation was the lack of data collected on their understanding of the SRC-management process and return-to-play protocols, which should be a focus of future research. Finally, this study had a small sample size of nontraditional athletes, and data were collected at only 4 institutions. Hence, the results should be interpreted cautiously, and further investigation in larger, more diverse populations is warranted.

CONCLUSIONS

Our results fill a gap in the literature on SRC knowledge and reporting behaviors among collegiate club-sport athletes. Although these athletes demonstrated a moderate to high level of knowledge about SRC, especially in identifying signs and symptoms, they may not fully understand the seriousness of SRCs, which could result in the failure to report an SRC or a premature return to participation. Based on these results, researchers can focus on the strengths and weaknesses of this population and develop appropriate educational tools that can be used in the future for best management practices. Because many high school athletes do not go on to participate in collegiate varsity-level sports but in club sports after graduation, our findings are important in establishing a foundational knowledge of SRC at this level. We hope to use this knowledge to help clinicians provide medical coverage to these athletes and direct educational programs toward this population.

REFERENCES

1. McCrory P, Meeuwisse W, Dvořák J, et al. Consensus statement on concussion in sport—the 5th international conference on concussion in sport held in Berlin, October 2016. *Br J Sports Med.* 2017;51(11):838–847.
2. Carman AJ, Ferguson R, Cantu R, et al. Expert consensus document: mind the gaps- advancing research into short-term and long-term neuropsychological outcomes of youth sports-related concussions. *Nat Rev Neurol.* 2015;11(4):230–244.
3. Broglio SP, Cantu RC, Gioia GA, et al. National Athletic Trainers' Association position statement: management of sport concussion. *J Athl Train.* 2014;49(2):245–265.
4. O'Donoghue EM, Onate JA, Van Lunen B, Peterson CL. Assessment of high school coaches' knowledge of sport-related concussions. *Athl Train Sports Health.* 2009;1(3):120–132.
5. Faure CE, Pemberton CLA. An examination of Idaho high school football coaches' general understanding of concussion. *Sport J.* 2011;14(1):1–9.
6. Shenouda C, Hendrickson P, Davenport K, Barber J, Bell KR. The effects of concussion legislation one year later—what have we learned: a descriptive pilot survey of youth soccer player associates. *PM R.* 2012;4(6):427–435.

7. Chrisman SP, Richardson LP. Prevalence of diagnosed depression in adolescents with history of concussion. *J Adolesc Health*. 2014; 54(5):582–586.
8. Roberts T, Miller T, Wells J. *Sports Clubs: a Resource Guide*. Corvallis, OR: National Intramural and Recreational Sports Association; 2003.
9. Lifschutz L. Club sports: maximizing positive outcomes and minimizing risks. *Recreat Sports J*. 2012;36(2):104–112.
10. High school sport participation increases for 25th consecutive year. National Federation of High School Sports Web site. <http://www.nfhs.org/articles/high-school-participation-increases-for-25th-consecutive-year/>. Accessed April 6, 2017.
11. Student-athlete participation—1981-82–2015-16 NCAA sports sponsorship and participation rates report. National Collegiate Athletic Association Web site. <http://www.ncaapublications.com/productdownloads/PR1516.pdf>. Accessed April 6, 2017.
12. Wallace J, Covassin T, Beidler E. Sex differences in high school athletes' knowledge of sport-related concussion symptoms and reporting behaviors. *J Athl Train*. 2017;52(7):682–688.
13. Wallace J, Covassin T, Nogle S, Gould D, Kovan J. Knowledge of concussion and reporting behaviors in high school athletes with or without access to an athletic trainer. *J Athl Train*. 2017;52(3):228–235.
14. Register-Mihalik JK, Guskiewicz KM, Valovich McLeod TC, Linnan LA, Mueller FO, Marshall SW. Knowledge, attitude, and concussion-reporting behaviors among high school athletes: a preliminary study. *J Athl Train*. 2013;48(5):645–653.
15. Kerr ZY, Register-Mihalik JK, Kroshus E, Baugh CM, Marshall SW. Motivations associated with nondisclosure of self-reported concussions in former collegiate athletes. *Am J Sports Med*. 2016;44(1):220–225.
16. McCrea M, Hammeke T, Olsen G, Leo P, Guskiewicz K. Unreported concussion in high school football players: implications for prevention. *Clin J Sport Med*. 2004;14(1):13–17.
17. Schneider RC, Stier WF Jr, Kampf S, Gaskins B, Haines SG. Club sport legal liability practices at NIRSA institutions. *Recreat Sports J*. 2008;32(1):62–76.
18. Cohen J. *Statistical Power Analysis for the Behavioural Sciences*. Hillsdale, NJ: Lawrence Erlbaum Associates; 1988.
19. Faul F, Erdfelder E, Buchner A, Lang AG. Statistical power analyses using G*Power 3.1: tests for correlation and regression analyses. *Behav Res Methods*. 2009;41(4):1149–1160.
20. McAllister-Deitrick J, Covassin T, Gould DR. Sport-related concussion knowledge among youth football players. *Athl Train Sports Health*. 2014;6(6):280–284.
21. Sye G, Sullivan SJ, McCrory P. High school rugby players' understanding of concussion and return to play guidelines. *Br J Sports Med*. 2006;40(12):1003–1005.
22. Kroshus E, Garnett B, Hawrilenko M, Baugh CM, Calzo JP. Concussion under-reporting and pressure from coaches, teammates, fans, and parents. *Soc Sci Med*. 2015;134:66–75.

Address correspondence to Erica Beidler, PhD, ATC, Duquesne University, 118 Health Sciences Building, 600 Forbes Avenue, Pittsburgh, PA 15282. Address e-mail to johnsone1@duq.edu.