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Factors that influence concussion knowledge and self-reported attitudes in high school athletes

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Abstract

BACKGROUND—Many organizations and health care providers support educating high school (HS) athletes about concussions to improve their attitudes and behaviors about reporting. The objectives of this study were to determine if previous education, sport played, and individual factors were associated with better knowledge about concussion and to determine if more knowledge was associated with improved self-reported attitudes toward reporting concussions among HS athletes.

METHODS—We conducted a survey of HS athletes aged 13 years to 18 years from two large, urban HSs. Players were recruited from selected seasonal (fall and winter) as well as men and women's sports. During preseason, each participant was given a survey asking about his or her previous education, current knowledge, and self-reported attitudes and behaviors about reporting concussions. Bivariate and multivariate linear regression was used to evaluate the association of age, sex, sport, and previous concussion education with knowledge and self-reported attitudes and behaviors about reporting concussions.

RESULTS—Surveys were completed by 496 athletes. The median age was 15 years, and 384 (77.4%) were male. A total of 212 (42.7%) participated in football, 123 (24.8%) in soccer, 89 (17.9%) in basketball, and 72 (14.5%) in wrestling. One hundred sixteen (23.4%) reported a history of concussion. Improved knowledge regarding concussions was not associated with improved self-reported behaviors ($p = 0.63$) in bivariate regression models. The multivariate model demonstrated that older age ($p = 0.01$) and female sex ($p = 0.03$) were associated with

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AUTHORSHIP

Each author has made substantial contributions to the study design, implementation, analysis, and write-up. All authors accept responsibility for reported research, and all authors have participated in the concept and design, analysis and interpretation of data, as well as drafting or revising of the manuscript and have approved the manuscript as submitted.

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better knowledge. Younger age ($p = 0.01$), female sex ($p = 0.0002$), and soccer participation ($p = 0.02$) were associated with better self-reported behaviors around reporting concussions.

CONCLUSION—Previous education on concussions was less predictive of knowledge about concussions when controlling for other factors such as sport and sex. Younger age, female sex, and soccer participation were more likely to be associated with better self-reported behaviors. Future studies need to focus on the development of interventions to improve concussion-specific knowledge and behaviors.

LEVEL OF EVIDENCE—Epidemiologic study, level III.

Keywords

Concussion; sports; adolescents; knowledge

Forty-four million US children participate in at least one sports team,[1] with an estimated 3.8 million sports/recreation-related concussions occurring annually.[2] Seventy percent of sports/recreation–traumatic brain injuries occur in adolescents between ages 10 years and 19 years. Although most individuals recover within 2 weeks to 4 weeks after a concussion, an estimated 10% to 33% of individuals have persistent symptoms beyond 1 month to 3 months after injury.[3–6] Long-term complications can occur and range from mild-to-severe cognitive and behavioral problems. Concussions can also be complicated by second impact syndrome (SIS) as well as severe brain injury caused by repeated concussions in close succession, which may lead to sudden brain swelling, brain herniation, and death.[7–10] If the initial concussion is recognized early and the athlete is removed from participation, SIS can be prevented; therefore, immediate removal from participation is recommended by concussion consensus statements if a concussion is suspected.[11–15]

There has been a strong emphasis on concussion education for coaches, trainers, and parents; however, high school athletes may not be receiving adequate information about concussions and, as a result, may have different attitudes about reporting concussive symptoms.[16–22] High school athletes are more vulnerable to concussion because their brains are still developing; therefore, it is important for high school athletes to recognize and report their concussions to prevent long-term deficits or SIS. One study found that only 47.3% of high school football players reported their concussions during the season.[18] The most common reasons for not reporting concussions included the following: the player did not think the injury was serious enough to warrant medical attention, the player was motivated not to report so he would not to be withheld from competition, and lack of awareness of probable concussion.[18] In a cross-sectional study, Register-Mihalik et al.[23] found that both concussion knowledge and attitudes play a role in concussion-reporting behaviors. The 167 high school athletes evaluated in this study indicated only moderate agreement with the belief that concussions are serious and believed reporting concussions may be somewhat embarrassing.

Previous literature has demonstrated that athletes' knowledge and attitudes influenced concussion-reporting behaviors; however, these studies have often evaluated relatively small groups or only one particular sport. To our knowledge, previous studies have not evaluated

the influence of individual factors (e.g., previous education, sport played, age, or sex) on concussion knowledge and behaviors. Better elucidation of factors that influence concussion knowledge and behaviors would potentially improve the development of targeted education and behavioral interventions.

The objective of study was to determine characteristics associated with better knowledge and attitudes related to concussion in a large sample of high school student athletes who participated in higher-risk contact sports. We hypothesized that previous education about concussion, type of sport played, and sex would be associated with better knowledge and self-reported behaviors. In addition, we hypothesized that better knowledge about concussions would be associated with improved self-reported behaviors about reporting concussions.

PATIENTS AND METHODS

Design

This was a cross-sectional preseason survey of adolescent student athletes' knowledge and self-reported behaviors about reporting concussions. The study was conducted according to criteria for Strengthening the Reporting of Observational Studies in Epidemiology (STROBE).[24,25] The setting was two large, suburban high schools located in the same community. Institutional reviewed board approval was obtained before initiation of the study.

Participants

Student athletes were recruited from two large public high schools that are part of the same school district in the suburbs of Cincinnati, Ohio. Each participating high school had an enrollment of approximately 2,500 students. The racial and ethnic composition of the participating schools was 74.5% white/non-Hispanic, 10.3% black, 5.9% Asian or Pacific Islander, 4.8% Hispanic, 4.4% multiracial, and 0.2% American Indian or Alaskan Native.[26] Enrollment into the study occurred during preseason training for fall and winter sports from August through December 2012. Sports included football (boys only), soccer (boys and girls), basketball (boys and girls), and wrestling (boys and girls [1 female participant]). A letter describing the procedure and the nature of the study was provided to each participant and his or her parent/guardian. The participants and their parents were given the option to decline participation by returning an opt-out form. If the opt-out form was not returned, consent was implied, and the participating athletes were enrolled.

Measures

A questionnaire was developed to assess an athlete's knowledge about concussions and his or her attitudes and behaviors about his or her willingness to report or stop activity after sustaining a concussion during play (Tables 2 and 3). The questionnaire also asked about demographics, previous education about concussions, and history of concussion. Questions for this instrument were adapted from the Center of Diseases Control (CDC) heads-up program[27] questions used in previous studies evaluating concussion knowledge and preventative practices in soccer players,[28] and a concussion knowledge questionnaire was

used in the state of Arizona to assess concussion knowledge of all high school athletes.[29] The questionnaire was divided into knowledge-based and self-reported attitude and behavioral–based questions. The knowledge-based questions consisted of true-false questions about the definition of concussion, symptoms of concussion, typical course recovery, complications of concussion, and current recommendations of concussion management. The self-reported attitude and behavior questions consisted of statements that participants would answer using a three-point Likert scale with choices of never, sometimes, or always. The correct response for each statement was either never or always, depending on the individual statement. The questions were reviewed by members of the study team and piloted for understanding and ease of response with a focus group of high school athletes before administration in the study. All questionnaires were completed with paper and pencil, and results were entered into a secure, deidentified database.

Questionnaire Administration

The questionnaire was administered during the preseason training of the respective sports of the participants. Through consultation with each school's athletic trainer, the questionnaire was administered on 1 day that accommodated the team's training schedule for the particular sport. Approximately 1 week to 2 weeks before the scheduled administration of the questionnaire, a description of the study was provided to the athletes with the opt-out form to be taken home. The questionnaire was handed out by the study's research coordinator during a break in each team's preseason training. Participants completed the questionnaire immediately and returned completed questionnaires to the research coordinator. The research coordinator was available to answer any questions participants had while completing the questionnaire. Testing was completed only on 1 day for each sport. Demographics are only available for individuals that completed the survey. All surveys were anonymous. A master log of participants who completed the questionnaire was created to ensure that individuals who participated in more than one sport (e.g., football and wrestling) did not complete the questionnaire twice (e.g., once during their fall sport and once during their winter sport).

Statistical Analysis

Descriptive statistics were used to characterize the baseline demographics of the population, previous concussion education, and the results of the questionnaire. Bivariate linear regression using the SAS General Linear Models function was used to evaluate the association of age, sex, sport played, previous concussion education with knowledge and self-reported attitudes related to concussion for each factor individually. Multivariate linear regression models were also developed to assess combined influence of these factors on knowledge and self-reported behaviors after concussion. Significance was defined as a $p < 0.05$. All data analyses were performed using SAS software version 9.3 (SAS Institute, Cary, NC).

RESULTS

Participant Demographics

The survey was completed by 496 student athletes. No potential participants returned opt-out forms. Table 1 shows the demographics of the participants. The median age was 15 years, and 384 (77.4%) were male. Two hundred eighty-nine athletes (58.3%) reported receiving previous education about concussion.

Questionnaire Results

Tables 2 and 3 show the number and percentage of participants answering the knowledge-based and self-reported behavior questions appropriately. The average percent correct for the knowledge-based questions was 68.6% and was 44.5% for the self-reported behavior questions. Only 201 athletes (40.5%) answered that they would “always” immediately tell a coach or athletic trainer that they had a headache, fogginess, or dizziness after getting hit in the head during a game or in practice, and 252 athletes (50.9%) reported that they would “always” report a concussion to a coach or athletic trainer if they knew it meant they would have to sit out a practice or two.

Association of Individual Factors With Knowledge and Self-Reported Behavior Questions Using Bivariate Linear Regression

Older age ($p = 0.002$), female sex ($p = 0.05$), basketball participation ($p = 0.002$), soccer participation ($p = 0.03$), and previous concussion education ($p = 0.03$) were associated with improved knowledge (Table 4). Younger age ($p = 0.004$), female sex ($p \leq 0.0001$), and soccer participation ($p = 0.0003$) were associated with improved self-reported behaviors. Better knowledge was not associated with better self-reported behaviors ($p = 0.63$).

Multivariate Linear Regression

When including age, sex, sport, previous concussion education, and history of concussion in multivariate models, older age ($p = 0.01$) and female sex ($p = 0.03$) were associated with better knowledge, and younger age ($p = 0.01$), female sex ($p = 0.0002$), and soccer participation ($p = 0.02$) were associated with better self-reported behaviors (Table 5).

DISCUSSION

From our survey of high school athletes, we found that various factors are associated with better concussion knowledge and self-reported behaviors in student athletes. In agreement with our hypothesis, multivariate models demonstrated that older student age and female sex were associated with better concussion knowledge. Our analysis also showed that younger age, female sex, and soccer participation were associated with better self-reported behaviors. Contrary to our hypothesis, improved knowledge and previous education regarding concussions were not associated with better self-reported behaviors.

In addition to state legislative efforts and referee/coach mandates to pull young athletes with suspected concussions from sports participation, findings from this study highlight the need for educational and behavioral intervention programs directed toward student athletes. It is

important for these interventions to not only focus on improving knowledge about concussions, but also to improve attitudes and behavior around reporting concussions. Older adolescents, males, and those participating in contact sports other than soccer may have the greatest benefit from an educational and behavioral intervention. Our findings also suggest that other factors besides previous concussion knowledge, such as sex, age, and sport, are more likely to be associated with improved behaviors and attitudes about concussion.

Our relatively large study not only validates information learned from other studies but also provides new information on factors that affect concussion knowledge and behaviors of adolescent student athletes. Consistent with previous work,[30] our study showed that female sex was associated with improved knowledge. However, our findings further demonstrated that female sex was associated with improved self-reported behaviors, indicating not only that females may have improved knowledge but also that they are more likely to report symptoms during an athletic competition. In agreement with previous work, older age was associated with better knowledge,[30] but our study also suggests that younger age is associated with better self-reported behaviors. Older adolescent athletes may perceive that reporting injuries may have larger adverse effects on their sports participation,[18] and they may view concussion as less critical compared with younger adolescents.[31] Future studies need to be performed to elucidate potential reasons for this discrepancy. In addition, when controlling for other factors, soccer participation was associated with better self-reported behaviors, indicating that the culture of reporting concussion symptoms may differ among various sports. To our knowledge, other studies have not evaluated potential differences in knowledge and behavior among participants in different sports. Future studies that evaluate the culture created within certain sport teams or groups that lead to better behaviors are needed.

Because many states are now requiring that student athletes, parents, and coaches receive education regarding concussion, studies are needed to determine the efficacy of these programs. Similar to other studies,[30,32–34] this study highlights that previous education about concussion may increase an athlete's knowledge, but few studies have evaluated the effects of education on changes in behavior. Our study demonstrates that improved knowledge and previous concussion education are not associated with improved self-reported behaviors. This is similar to findings in other adolescent populations.[35] Relatively smaller studies of concussions in student athletes reported improved reporting behaviors after education in youth hockey[32] and soccer[28] players; however, larger studies across a range of sports and ages have not been performed previously. Implementing educational programs is an important step to increasing knowledge and awareness, but it is critical to develop programs that will positively impact behavior as well. It is especially concerning that teens with good knowledge may not choose to report concussion symptoms. Future research focused on behavioral and attitude change will be critical. Cognitive engagement and motivational techniques in education may improve translation of knowledge into better attitudes and behaviors.[36,37]

Participants in our study reported receiving previous education about concussion from a variety of sources, including physicians, athletic trainers, school staff, coaches, and family members. Previous studies have focused on concussion education for these groups; however,

to our knowledge, previous work has not focused on training individuals from these groups on optimal techniques to improve concussion knowledge and behavior and attitudes in student athletes. Future studies focused on the development, implementation, and assessment of potentially beneficial educational and behavioral interventions across a variety of settings and offered by a variety of individuals will be critical. Furthermore, because almost a third of the participants reported receiving education from physicians, the development of interventions that may be integrated into standard medical care is also important.

Limitations

This is one of the larger studies that has assessed knowledge and self-reported behaviors of student athletes; however, participants were only from one large school district in the suburbs of Cincinnati, Ohio, and were predominantly male. We were unable to evaluate for local, regional, or national differences of concussion knowledge and self-reported behaviors. Broad generalization of the findings should be considered with caution. In addition, our study focused on self-reported behaviors, and we were unable to evaluate the significance of direct reporting rates. This study also focused on fall and winter sports; therefore, conclusions regarding athlete's participating in spring sports such as baseball, softball, and lacrosse are not possible. We were unable to determine the nature and extent of education received by individuals previously. The type and characteristics of education provided may influence the extent that knowledge and behaviors are improved. In addition, because of the cross-sectional nature and opt-out consent procedures of the study, responses were limited to those present at the time of preseason testing. Furthermore, the questionnaire used in the study has not been formally validated; however, to our knowledge no formally validated questionnaires were available during the conduct of this study.

CONCLUSION

Our findings demonstrate that there are various factors that are associated with improved concussion knowledge and self-reporting behaviors in adolescent student athletes. Younger student age, female sex, and soccer participation were more likely to be associated with better self-reported behaviors. Previous education on concussion was less predictive of knowledge when controlling for other factors such as sport and sex. In addition, level of knowledge about concussion and previous education were not associated with improved self-reported concussion behaviors. Our findings suggest that older adolescents, males, and football players are likely to have poorer concussion-related behaviors and attitudes.

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TABLE 1

Characteristics of Participants

Demographics	**n (%)***
Total participants	496
Sex	
Male	384 (77.4)
Female	112 (22.6)
Age, y	
13	10 (2.0)
14	115 (23.2)
15	147 (29.6)
16	114 (22.0)
17	100 (20.2)
18	10 (2.0)
Sport	
Football	212 (42.7)
Soccer	123 (24.8)
Wrestling	72 (14.5)
Basketball	89 (17.9)
Sport season	
Fall	335 (67.5)
Winter	161 (32.5)
Grade level	
9th	152 (30.7)
10th	139 (28.0)
11th	107 (21.6)
12th	98 (19.8)
History of concussion	116 (23.4)
Past education about concussions	289 (58.3)
Source of past concussion education (allowed to select all that apply)	
Physician	153 (30.9)
Athletic trainer	150 (30.2)
School staff	135 (27.2)
Coach	110 (22.2)
Family	108 (21.8)
Other	13 (2.6)

* Percentages may not add up exactly to 100% because of rounding.

TABLE 2

Knowledge Questions

Questions (Correct Response)	Correct Responses, n (%)
Check the following signs and symptoms that you believe a person is likely to experience after a concussion	
Emotional changes (true)	200 (40.3)
Neck pain (false)	228 (46.0)
Hallucinations (false)	278 (56.1)
Vomiting (true)	301 (60.7)
Tingling in feet (false)	350 (70.6)
Sensitivity to noise (true)	364 (73.4)
Nausea (true)	391 (78.8)
Difficulty concentrating (true)	403 (81.3)
Sensitivity to light (true)	413 (83.3)
Slower reaction time (true)	433 (87.3)
Difficulty remembering (true)	440 (88.8)
Confusion (true)	446 (89.9)
Headache (true)	477 (96.2)
A concussion is any injury to the head (false)	119 (24.0)
An athlete should not continue to play sports while having a concussion (true)	456 (92.0)
There is a higher risk of death if a second concussion occurs before the first one has healed (true)	421 (86.9)
A person can only get a concussion if hit in the head (false)	289 (58.3)
Imaging of the brain, such as MRIs and CT scans, show visible physical damage to the brain after a concussion (false)	92 (18.6)
If a person gets >3 concussions ever, they are not allowed to play sports ever again (false)	362 (73.0)
If a person gets one concussion, they are more likely to get another (true)	332 (67.0)
Being knocked out causes permanent damage to the brain (false)	289 (58.3)
Majority of symptoms last for at least 1 mo (false)	215 (43.4)
Athletes must complete a gradual return to play before returning to sports (true)	459 (92.6)
What is the current treatment for a person with a concussion	394 (79.4)
There is not any (false)	
Play video games, watch movies, and text friends (false)	
Complete brain rest (true)	
Carry on with life as if nothing is wrong (false)	

CT, computed tomography; MRI, magnetic resonance imaging.

TABLE 3

Behavior and Attitude Questions

Questions (Correct Response Among Choices of Never, Sometimes, Always)	Correct Responses, n (%)
I would immediately tell a coach or athletic trainer that I had a headache, fogginess, or dizziness after getting hit in the head during a game or in practice (always)	201 (40.5)
I would report having a concussion to a coach or athletic trainer if I knew it meant I would have to sit out a practice or two (always)	252 (50.9)
I would report having a concussion to a coach or athletic trainer if I knew it meant I would have to sit out of a game (always)	175 (35.3)
If my teammate told me they thought they had a concussion, I would report it to a coach or athletic trainer (always)	192 (38.8)
I would continue playing a sport while having a headache that resulted from a minor bump to the head (never)	38 (7.7)
I would play through any condition or injury for our team to win (never)	40 (8.1)
I feel that it is important to be thoroughly evaluated by a medical personnel after an injury to make sure I recover completely (always)	323 (65.1)
I feel that getting a concussion is not a big deal and actually proves that I am tough (never)	423 (85.3)
I feel that if a star athlete gets a concussion during a state tournament game they should return to the game since it could be their last one of the season (never)	300 (60.5)
During a championship game, you get injured. It hurts but does not really hinder your ability to play. Knowing that it would result in a more severe injury, I would report the injury to a coach or athletic trainer (always)	105 (21.2)
It is OK for an athlete to continue playing in a game in which they have suffered a concussion (never)	372 (75.0)

TABLE 4

Bivariate Linear Regression of Factors Associated With Performance on (A) Knowledge Based and (B) Self-Reported Behaviors and Attitudes Questions

Factor	t Value	*p*
A. Knowledge		
Age	3.10	0.002
Female sex	1.97	0.05
Sport		
Basketball	3.69	0.0002
Football	1.70	0.09
Soccer	2.21	0.03
Wrestling	Reference	Reference
Previous concussion education	2.23	0.03
History of concussion	0.72	0.47
Behaviors and Attitudes	−0.49	0.63
B. Behaviors and Attitudes		
Age	−2.93	0.0035
Female sex	5.38	<0.0001
Sport		
Basketball	1.72	0.09
Football	0.26	0.80
Soccer	3.60	0.0003
Wrestling	Reference	Reference
Previous concussion education	1.03	0.30
History of concussion	1.36	0.18
Knowledge	−0.49	0.63

TABLE 5

Multivariable Model of Factors Associated With (A) Knowledge and (B) Behaviors and Attitudes

Independent Variable	Estimate	SE	t Value	*p*
A. Knowledge				
Age	0	0.0040	2.18	0.005
Sex (female)	0.0262	0.0121	2.18	0.03
Sport (soccer versus other)	−0.0028	0.0117	−0.24	0.81
Previous concussion education (no)	−0.0165	0.0093	−1.79	0.07
History of concussion (no)	−0.0023	0.0107	−0.22	0.82
Behaviors and attitudes	−0.0115	0.0220	−0.52	0.60
B. Behaviors and Attitudes				
Age	−0.0212	0.0081	−2.60	0.01
Sex (female)	0.0920	0.0245	3.75	0.0002
Sport (soccer versus other)	0.0575	0.0238	2.41	0.02
Previous concussion education (no)	0.0010	0.0191	0.05	0.96
History of concussion(no)	0.0238	0.0219	1.09	0.28
Knowledge	−0.0485	0.0929	−0.52	0.60