

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 are to determine if prior education, sport played, age, and/or gender are associated with better knowledge about concussion, and to determine if more knowledge is associated with improved self-reported attitudes toward reporting concussions among a large sample of HS athletes.

Methods: Participants included 496 athletes aged 13-18 years from two large, urban high schools. Players were recruited from fall and winter and men and women's sports considered higher risk for concussion. During preseason, each participant was given a survey, developed by study investigators, which asked about their previous education, current knowledge, and self-reported attitudes and behaviors about reporting concussions. Bivariate and multivariate linear regression were used to evaluate the association of age, gender, sport, and prior concussion education with knowledge about concussions and self-reported attitudes and behaviors about reporting.

Results: Better knowledge was not associated with better self-reported behaviors ($p=.63$) in bivariate regression models. Multivariate models that included age, gender, sport, prior concussion education, and history of concussion demonstrated that older age ($p=.01$) and female gender ($p=.03$) were associated with better knowledge and younger age ($p=.01$), female gender ($p=.0002$), and soccer participation ($p=.02$) were associated with better self-reported behaviors.

Conclusions: Findings suggest that prior education on concussion is less predictive of knowledge when controlling for other factors such as sport and gender. Older age, female gender, and soccer participation were more likely to be associated with better self-reported behaviors. Future studies need to focus on development beneficial interventions to not only improve concussion specific knowledge, but also improve behaviors.

Level of evidence: III

Key Words: Concussion; adolescents; knowledge; behavior and attitudes.

BACKGROUND:

Forty-four million U.S. 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-TBIs occur in adolescents between ages 10 and 19 years. Although most individuals recover within 2-4 weeks after a concussion, an estimated 10-33% of individuals have persistent symptoms beyond 1-3 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), severe brain injury caused from 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, 12).

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 (13-19). 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 (15). The most common reasons for not reporting concussions included: 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 be withheld from competition, and lack of awareness of probable concussion (15). In a cross-

sectional study, Register-Mihalik et al. found that both concussion knowledge and attitudes play a role in concussion-reporting behaviors (20). The 167 high school athletes in this study indicated only moderate agreement with the belief that concussions are serious and believed reporting concussions may be somewhat embarrassing

Past 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, prior studies have not evaluated the influence of individual factors (e.g., prior education, sport played, age, or gender) 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 prior education about concussion, type of sport played, and gender would be associated with better knowledge and self-reported behaviors. Additionally, we hypothesized that better knowledge about concussions would be associated with improved self-reported behaviors about reporting concussions.

METHODS:

Design: This was a cross sectional pre-season 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) (21, 22). The setting was two large, suburban high schools located in the same community. Institutional reviewed board approval was obtained prior to 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 (23). 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/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 participating athletes were enrolled.

Measures: A questionnaire was developed to assess an athlete's knowledge about concussions and his/her attitudes and behaviors about their 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 prior history of concussion. Questions for this instrument were adapted from the Center of Diseases Control (CDC) heads up program(24) questions used in a previous studies evaluating concussion knowledge and preventative practices in soccer players (25), and a concussion knowledge questionnaire used in the state of Arizona to assess concussion knowledge of all high school athletes (26). 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 3 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 prior to administration in the study. All questionnaires were completed with paper and pencil, and results were entered into a secure, de-identified, 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 one day that accommodated the team's training schedule for the particular sport. Approximately 1-2 weeks prior to the scheduled administration of the questionnaire, a description of the study was provided to 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 one day for each sport. Demographics are only available for individuals that completed the survey. All surveys were anonymous. A master log was created of participants that completed the questionnaire to ensure that individuals that 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).

Analysis: Descriptive statistics were used to characterize the baseline demographics of the population, prior concussion education, and the results of the questionnaire. Bivariate linear regression using the Statistical Analysis System (SAS) General Linear Models function was used to evaluate the association of age, gender, sport played, prior concussion education on 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-value of <0.05. All data analyses were performed using SAS software version 9.3 (SAS Institute, Cary, North Carolina).

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 (58.3%) athletes reported receiving prior education about concussion.

Questionnaire results: Table 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 self-reported behavior questions was 44.5%. Only 201 (40.5%) athletes answered they would “always” immediately tell a coach or athletic trainer that they had a headache, foginess, or dizziness after getting hit in the

head during a game or in practice, and 252 (50.9%) athletes reported 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 (Table 4): Older age ($p = .002$), female gender ($p = .05$), basketball ($p = .002$), soccer ($p = .03$), and prior concussion education ($p = .03$) were associated with improved knowledge. Younger age ($p = .004$), female gender ($p < .0001$), and soccer participation ($p = .0003$) were associated with improved self-reported behaviors. Better knowledge was not associated with better self-reported behaviors ($p = .63$).

Multivariate linear regression (Table 5): When including age, gender, sport, prior concussion education, and history of concussion in multivariate models, older age ($p = .01$) and female gender ($p = .03$) were associated with better knowledge and younger age ($p = .01$), female gender ($p = .0002$), and soccer participation ($p = .02$) were associated with better self-reported behaviors.

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 gender were associated with better concussion knowledge. Our analysis also showed that younger age, female gender, and soccer participation were associated with better self-reported behaviors. Contrary to our hypothesis, improved knowledge and prior 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 towards student athletes. These interventions are important for student athletes not only to 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 prior concussion knowledge, such as gender, age, and sport, are more likely to be associated with improved behaviors and attitudes about concussion.

Our relatively large study 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 prior work (27), our study showed that female gender was associated with improved knowledge. However, our findings further demonstrated that female gender was associated with improved self-reported behaviors, indicating that females may not only have improved knowledge, but they are also more likely to report symptoms during an athletic competition. In agreement with prior work, older age was associated with better knowledge (27), 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 (15), and they may view concussion as less critical compared to younger adolescents (28). Future studies need to be performed to elucidate potential reasons for this discrepancy. Additionally, 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 is 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 (27, 29-31), this study highlights that prior 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 prior concussion education are not associated with improved self-reported behaviors. This is similar to findings in other adolescent populations (32). Relatively smaller studies of concussions in student athletes reported improved reporting behaviors after education in youth hockey (29) and soccer (25) 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 (33, 34).

Participants in our study reported receiving prior education about concussion from a variety of sources, including physicians, athletic trainers, school staff, coaches, and family members. Prior studies have focused on concussion education for these groups; however, to our knowledge, prior 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, OH 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. Additionally, 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. Additionally, 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 gender, and soccer participation were more likely to be associated with better self-reported behaviors. Prior education on concussion was less predictive of knowledge when controlling for other factors such as sport and gender. Additionally, level of knowledge about concussion and prior 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.

Authors' Contribution: Each author has made substantial contributions to 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, drafting or revising of the manuscript, and have approved the manuscript as submitted

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Tables

Table 1: Characteristics of participants

Demographics	n(%)*
Total Participants	496
Gender	
Male	384(77.4)
Female	112(22.6)
Age (years)	
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	
9 th	152(30.7)
10 th	139(28.0)
11 th	107(21.6)
12 th	98(19.8)
History of prior 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% due to 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 MRI's and CT scans, show visible physical damage to the brain after a concussion (false)	92(18.6)
If a person gets more than 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 month (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 There isn't 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)	394(79.4)

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 in order 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'm 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 doesn't 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 questions and (B) self-reported behaviors and attitudes.

Factor	t-value	p-value
A. Knowledge		
Age	3.10	.002
Female gender	1.97	.05
Sport		
Basketball	3.69	.0002
Football	1.70	0.09
Soccer	2.21	.03
Wrestling	reference	reference
Prior concussion education	2.23	.03
History of concussion	.72	.47
Behaviors and Attitudes	-0.49	0.63
B. Behaviors and attitudes		
Age	-2.93	.0035
Female gender	5.38	<.0001
Sport		
Basketball	1.72	.09
Football	0.26	.80
Soccer	3.60	.0003
Wrestling	reference	reference
Prior concussion education	1.03	.30
History of concussion	1.36	.18
Knowledge	-0.49	0.63

Table 5: Multivariable model of factors associated with (A) knowledge and (B) behaviors and attitudes.

Independent Variable	Estimate	Standard Error	t- value	p- value
A. Knowledge				
Age	.0111	.0040	2.18	.005
Gender (Female)	.0262	.0121	2.18	.03
Sport (soccer versus other)	-.0028	.0117	-0.24	.81
Prior concussion education (no)	-.0165	.0093	-1.79	.07
History of concussion (no)	-.0023	.0107	-0.22	.82
Behaviors and attitudes	-.0115	.0220	-0.52	.60
B. Behaviors and attitudes				
Age	-.0212	.0081	-2.60	.01
Gender (female)	.0920	.0245	3.75	.0002
Sport (soccer versus other)	.0575	.0238	2.41	.02
Prior concussion education (no)	.0010	.0191	0.05	.96
History of concussion(no)	.0238	.0219	1.09	.28
Knowledge	-.0485	.0929	-0.52	.60