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An Examination of Four Questions Assessing Self-Reported Concussions among High School Students Participating in Team Sports

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Abstract

Current prevalence estimates of youth sports-related concussions are inconsistent because of variation in methodology and potentially unreported concussions. In 2013, Connecticut, Ohio, and Utah each added different questions that assessed self-reported concussions to the Youth Risk Behavior Survey. Two questions referenced recognition of a concussion by the student, one referenced identification by a doctor, and one referenced suspicion by a coach. Chi-square analyses were used to identify if there was an association between demographic characteristics and the concussion questions among high school students who played on at least one sports team. The percentage of students who reported concussions ranged from 17.6% to 20.1%. These estimates are higher than rates of concussions diagnosed in emergency departments or reported by athletic trainers, but were similar across the four questions. The field would benefit from a better understanding of the impact of question wording and format on estimates of concussion prevalence.

Keywords

concussion; high school; athletes

Introduction

An estimated 70% of sports- and recreation-related traumatic brain injury (TBI) emergency department (ED) visits are made each year by those aged 19 years or younger.[1] The

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prevalence of concussions among high school athletes is unclear because of variation in measures and methodology,[2] and underreporting of concussion symptoms among young athletes.[3, 4] For example, the rate of diagnosed sports- and recreation-related TBI ED visits among youth aged 10 to 14 was 622.5 visits per 100,000 population in 2012.[1] A large study of high school and college athletes participating in a variety of sports estimated that the rate of concussion based on athletic trainer reports was 1.8 per 100 athletes during an average season.[5] A study of high school students nationwide found that 21.4% of athletes who played on at least one sports team self-reported one or more sports- or physical activity-related concussions in the preceding 12 months. [6]

Understanding concussion prevalence among demographic subgroups facilitates the development of targeted interventions. For example, some studies have shown that prevalence is highest among male athletes;[6–8] whereas other studies have shown higher prevalence among female athletes for some sports in which both males and females participate.[9, 10] Few studies have examined differences across racial/ethnic subgroups. National survey data suggest the prevalence of sports- and physical activity related concussions is higher among Black male high school students compared to Hispanic male high school students.[8]

This study examined four questions assessing self-reported concussions among high school students in Connecticut, Ohio, and Utah for variability by question wording and variation by sex, grade, and race/ethnicity among students who played team sports.

Methods

Sample and Survey Administration

The Youth Risk Behavior Surveillance System includes a national school-based Youth Risk Behavior Survey (YRBS) conducted by the Centers for Disease Control and Prevention (CDC) and state, territorial, tribal, and large urban school district YRBSs conducted by education and health agencies.[11] The YRBS is conducted biennially. States, territories, tribes, and large urban school districts may add a limited number of questions to their YRBS; in 2013 Connecticut, Ohio, and Utah each added different questions about concussions to their YRBS. Those data were used for this study.

For each survey year, an independent two-stage cluster sample design is used to obtain representative samples of students in grades 9 through 12 in that state. In Connecticut (N=2405, response rate = 67%) and Utah (N=2195, response rate = 67%), the sampling frame consists of public schools. In Ohio (N=1455, response rate = 63%), the sampling frame consists of both public and private schools. Students complete an anonymous, voluntary, paper-and-pencil questionnaire during a regular class period after following local parental permission procedures. CDC's Institutional Review Board (IRB) has determined that CDC-funded state and local YRBSs are public health practice and do not receive IRB review at CDC. State and local health and education agencies follow local IRB policies and procedures.

Variables

In Connecticut and Ohio, students were asked, 'During the past 12 months, did you suffer a blow or jolt to your head while playing with a sports team (either during a game or during practice) which caused you to get 'knocked out,' have memory problems, double or blurry vision, headaches or 'pressure' in the head, or nausea or vomiting?' Response options in Connecticut were 'I did not play on a sports team during the past 12 months,' 'Yes,' 'No,' and 'Not sure.' Response options in Ohio were 'Yes,' 'No,' and 'Not Sure.' In both states, students who responded 'Not Sure' (Connecticut, n = 70; Ohio, n = 58) were excluded from this analysis. In Connecticut, students who responded they had not played on a sports team were excluded (n=704). In Ohio, sports team participation was determined with a separate question.

The Utah questionnaire defined a concussion[1] and then asked, 'During the past 12 months, how many times did a doctor tell you that you had a concussion or symptoms of a concussion after playing sports or doing other physical activities[2]?' and 'During the past 12 months, how many times were you taken out of a game, practice, or workout because your coach thought you might have a concussion?' Response options included 'I did not play sports or do other physical activities[2] during the past 12 months,' '0 times,' '1 time,' '2 or 3 times,' '4 or 5 times,' or '6 or more times.' A dichotomous response category was created: 0 versus ≥1 time. Students who responded, 'I did not play sports or do other physical activities during the past 12 months' or 'I did not take part in a game, practice or workout during the past 12 months' were excluded from the analysis. Sports team participation was determined with a separate question.

Statistical Analysis

Prevalence estimates were computed by sex (male, female), grade (9, 10, 11, 12), and race/ethnicity (non-Hispanic white ['white'], non-Hispanic black ['black'], and Hispanic [which could be of any race]). Chi-square analyses were used to identify associations. Statistical software that accounted for the complex sampling design, and sampling weights, which adjusted for school and student nonresponse, was used to conduct all statistical analyses.

Results

Among students who played on at least one sports team, the percentage who had suffered a blow or jolt to the head while playing with a sports team during the 12 months before the survey that caused symptoms consistent with a concussion was 20.1% in Connecticut and 17.6% in Ohio. In both states, the prevalence was significantly higher among male students than female students (Connecticut, 24.1% vs 15.3%, p =<.001; Ohio, 21.4% vs 13.0%, p = .01).

[1]The definition was 'A concussion is a forceful bump, blow or jolt to your head. Symptoms of a concussion include dizziness, headaches, double or blurry vision, sensitivity to light or noise, feeling sluggish or foggy, difficulty concentrating, forgetting things, drowsiness, confusion, or blacking out. You can get a concussion without getting 'knocked out.''

[2]'Physical activities' was not defined.

In Utah, among students who played on at least one sports team, 18.7% were told by a doctor during the 12 months before the survey that they had a concussion or symptoms of a concussion after playing sports or doing other physical activities (Table 2). The prevalence was significantly higher among male students than among female students (20.9% vs 15.8%, p = .04). Additionally, 17.6% of students were taken out of a game, practice, or workout during the 12 months before the survey because their coach thought they might have a concussion.

Discussion

This study found that 17.6% to 20.1%, of student athletes may have had a concussion during the 12 months before the survey. Consistent with other studies of sports-related concussions, [6–8] the rates were higher among male students than female students for three of the four questions examined. The estimates found in this study are higher than those using ED data[1] and reported by athletic trainers.[5] Concussions are often treated outside of the ED,[12] and athletic trainers miss students who play sports in schools that do not employ athletic trainers full-time, which is common.[13] Both sources of data miss individuals who do not report concussion symptoms.[4] The higher rates found in this study may reflect increased awareness[2] and reduced concerns about consequences of reporting (e.g., removal from play), but also may include some unknown amount of false-positives; athletes may have recalled concussions that occurred more than 12 months before the survey;[14] and some concussion symptoms, such as headache, occur without a concussion.[15]

Research is needed to explore the impact of question wording when using self-report to estimate concussion prevalence. Given concerns about underreporting,[4] one might expect the estimates found in Utah, which relied on doctor-identified and coach-suspected concussions, to be lower than those found in Connecticut and Ohio; however, the percentage of students reporting a concussion in this study was similar across the four different questions used in three different states. Additionally, although many who had a doctor-identified concussion also had a coach-suspected concussion, there was not complete overlap. Finally, the doctor-identified question asked students about playing sports and other physical activities, and it is possible that some of these concussions were unrelated to team sports.

Limitations

First, data were collected in three states among high school students and limited to students who played on a sports team; the findings may not be generalizable to other states or elementary and middle school students, students not enrolled in school, those enrolled in alternative schools, or in Connecticut and Utah, those enrolled in private schools. Additionally, some students played on more than one team in the two states that asked about the number of sports teams on which athletes played, and playing on more than one sports team likely increases the risk for concussion.[6] Finally, these concussions were not verified by medical records.

Conclusion

The findings of this study suggest that many previous estimates of youth sports-related concussions underestimate the burden. In order to produce accurate estimates and explore demographic differences further, additional research is required to understand the impact of question wording and format on tracking concussion prevalence.

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Abbreviations

TBI	Traumatic Brain Injury
ED	Emergency Department
YRBS	Youth Risk Behavior Survey
CDC	Centers for Disease Control and Prevention
IRB	Institutional Review Board

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Implications for Policy and Practice

- Previous estimates of youth sports-related concussions may underestimate the burden. Survey research suggests higher concussion prevalence than healthcare administrative data or studies that employ athletic trainers. Informing athletic trainers about these findings can aid in setting expectations about the potential burden of concussion among athletes.
- The impact of question wording and format on concussion-related questions is not well understood. Qualitative research with athletes of varying levels of health literacy could clarify interpretation of survey questions as well as help to guide future intervention development.
- When developing survey questions about concussions, it is important to be clear about whether the respondent should report suspected or diagnosed concussions, and, if possible, consider asking about each in separate questions.

Table 1:

Demographics of the sample and the percentage of high school students who suffered a blow or jolt to their head that caused symptoms consistent with a concussion while playing with a sports team* and percentage of high school students who played on a sports team* and were told by a doctor they had a concussion or symptoms of a concussion or were removed from a game, practice or workout by a coach due to a suspected concussion† —Connecticut, Ohio, and Utah, 2013

	Connecticut		Ohio		Utah		
	Sample N (%)‡,§	Suffered a blow or jolt to their head % (95% CI)	Sample N (%)‡,§	Suffered a blow or jolt to their head % (95% CI)	Sample N (%)‡,§	Told by a doctor of a concussion or symptoms of concussion % (95% CI)	Sample N (%)‡,§	Removed from game or practice by a coach due to a suspected concussion % (95% CI)
Overall	1579 (100.0)	20.1 (18.2–22.2)	789 (100.0)	17.6 (15.1–20.3)	1261 (100.0)	18.7 (15.7–22.0)	1194 (100.0)	17.6 (15.0–20.6)
Sex								
Female	736 (46.5)	15.3 (13.6–17.2)	418 (47.3)	13.0 (9.4–17.8)	611 (44.2)	15.8 (12.7–19.6)	575 (43.8)	16.3 (13.5–19.5)
Male	837 (53.5)	24.1 (21.3–27.2)	367 (52.7)	21.4 (18.5–24.6)	649 (55.8)	20.9 (17.1–25.4)	618 (56.2)	18.7 (15.2–22.8)
p-value		0.00		0.01		0.04		0.27
Grade								
9th	378 (25.1)	20.5 (16.6–25.0)	230 (28.4)	21.6 (17.2–26.9)	293 (26.1)	17.0 (12.3–23.0)	275 (26.0)	19.8 (15.1–25.4)
10th	459 (26.1)	22.3 (19.4–25.4)	191 (24.9)	16.3 (11.5–22.6)	479 (25.6)	22.0 (19.1–25.3)	457 (25.7)	16.9 (13.2–21.5)
11th	464 (26.2)	17.9 (14.4–22.1)	217 (23.8)	13.6 (7.6–23.1)	275 (25.2)	18.2 (14.9–22.1)	261 (25.2)	15.2 (11.8–19.4)
12th	259 (22.7)	19.3 (15.0–24.5)	149 (22.9)	18.1 (11.1–28.2)	194 (22.8)	17.1 (9.6–28.6)	184 (22.8)	18.6 (12.2–27.3)
p-value		0.11		0.50		0.30		0.49
Race/Ethnicity								
White, non-Hispanic	1040 (67.0)	18.9 (16.9–21.0)	516 (79.4)	17.5 (14.6–20.8)	979 (82.2)	17.6 (15.1–20.4)	927 (82.2)	17.1 (14.5–19.9)
Black, non-Hispanic	104 (12.2)	20.7 (12.0–33.4)	161 (13.1)	16.3 (11.3–23.0)	16 (0.9)	N/A‖	14 (0.8)	N/A‖
Hispanic	246 (15.5)	21.6 (15.6–29.1)	42 (2.9)	21.8 (11.7–37.0)	142 (11.5)	20.1 (13.0–29.6)	132 (11.3)	15.7 (11.3–21.5)
p-value		0.71		0.73		0.54		0.60

*Either during a game or during practice, which caused them to get “knocked out,” have memory problems, double or blurry vision, headaches or “pressure” in the head, or nausea or vomiting during the past 12 months.

†The questionnaire included the following definition: “Symptoms of a concussion include dizziness, headaches, double or blurry vision, sensitivity to light or noise, feeling sluggish or foggy, difficulty concentrating, forgetting things, drowsiness, confusion, or blacking out during the past 12 months. You can get a concussion without getting ‘knocked out.’”

‡Among students who played on at least one sports team and answered the concussion-related question.

§Unweighted sample sizes and weighted percentages are presented. N’s will not sum to the overall N when there are missing data. The racial/ethnic distribution does not add up to 100% because the sample sizes for other racial/ethnic subgroups were too small for meaningful inferential analysis and are not presented here.

‖Not applicable; the sample size was too small for meaningful inferential analysis.