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Sports- or Physical Activity–Related Concussions and Feelings of Sadness or Hopelessness Among U.S. High School Students: Results From the 2017 Youth Behavior Risk Survey

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Abstract

For this study, we explored the association between high school students' reported history of sport- or physical activity–related concussions and persistent feelings of sadness or hopelessness. Data from the 2017 national *Youth Risk Behavior Survey* (YRBS; $N = 14{,}765$) was used for this analysis. YRBS is administered to high school students throughout the country every 2 years. Findings from this study demonstrate that the prevalence of persistent feelings of sadness or hopelessness was 36.4% among students who reported sustaining one or more concussions. Compared to students who did not report having sustained a concussion, the odds of persistent feelings of sadness or hopelessness were significantly higher among students who had sustained one or more concussions (AOR = 1.41). These findings support the need for continued efforts by school nurses and other health care providers to identify students with a history of concussion and assess their mental health needs.

Keywords

concussion; sport; sadness; hopeless; student; mental health

A concussion, sometimes referred to as a mild traumatic brain injury (mTBI), is caused by an impact to the head or a transmitted force to the head from a blow to the body (Centers for Disease Control and Prevention [CDC], 2017b; Giza & Hovda, 2014; McCrory et al., 2017; National Institute of Neurological Disorders and Stroke, 2002). Recent estimates

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Author Contributions

S. Everett Jones and G. F. Miller contributed to acquisition, analysis, and interpretation of the data, while the manuscript was drafted by K. Sarmiento. All authors contributed to the conception of the manuscript, critical revisions, gave final approvals, and agreed to be accountable for all aspects of work ensuring integrity and accuracy.

Authors' Note

The findings and conclusions in this manuscript are those of the authors and do not necessarily represent the official position of the Centers for Disease Control and Prevention.

Declaration of Conflicting Interests

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suggest that as many as 2.5 million high school students have sustained at least one sport- or recreation-related concussion within the previous 12 months. Approximately, 1 million of those high students sustained two or more concussions during the same time frame (Depadilla et al., 2018).

Concussions may lead to a range of symptoms such as headache, feeling more emotional than usual, difficulty concentrating, and problems with sleep (CDC, 2017a; McCrory et al., 2017). Following a concussion, most children and adolescents are asymptomatic within 1–3 months, with approximately 40% asymptomatic at 1 month, 89% at 3 months, and 98% at 1 year after the injury (Barlow et al., 2010). However, those with a history of more than one concussion may experience a longer recovery and more severe symptom burden (e.g., loss of consciousness and greater likelihood of problems with light and noise sensitivity, verbal memory, and reaction time; Castile et al., 2012; Covassin et al., 2013; Curry et al., 2019; Guskiewicz et al., 2003; McCrory et al., 2017; Miller et al., 2016; Moser & Schatz, 2017).

Concussion symptoms may evolve over the course of recovery. Studies suggest that emotional problems are more likely to appear later in recovery and may be challenging for health care providers and parents to detect (Ayr et al., 2009; Brent & Max, 2017; Eisenberg et al., 2014; Yeates et al., 2012). Multiple studies have found an association between moderate and severe TBI among youth and adults and emotional and psychiatric outcomes (Andelic et al., 2018; Grauwmeijer et al., 2018; Slomine et al., 2006). As such, it is important to also explore the risk of the onset or increase in emotional symptoms following a concussion (Brent & Max, 2017; Ellis et al., 2015; Stazyk et al., 2017; Stein et al., 2017). Ellis and colleagues analyzed the health outcomes for 174 pediatric patients diagnosed with a sports-related concussion. In that study, almost half (49%) of the patients reported at least one emotional symptom following the injury. For a subset of these patients, their symptoms are believed to have contributed to the development of a novel psychiatric disorder (e.g., attention-deficit, hyperactivity disorder, depression, and anxiety disorders; Ellis et al., 2015).

A 2019 position statement released by the National Association of School Nurses (2019) outlines the critical role school nurses play in supporting early recognition, care-seeking behaviors, and positive behavioral health outcomes for students with mental health concerns. Similarly, recent guidelines on concussion in sports include a focus on behavioral and mental health and encourage health care providers to assess for and identify patients who may be at increased risk of developing psychological or emotional problems following a concussion (Giza et al., 2013; McCrory et al., 2017). However, there is limited research and guidance for school nurses and other health care providers on the likelihood of emotional sequelae among high school students with a history of concussion. To expand on existing knowledge in this area, we explored the association between sport- or physical activity–related concussions and persistent feelings of sadness or hopelessness reported by high school students who completed the 2017 *Youth Risk Behavior Survey* (YRBS).

Method

Sample and Survey Administration

The YRBS is a cross-sectional, school-based survey administrated every 2 years. In each survey cycle, the YRBS uses a three-stage cluster sample design to identify a representative sample of public and private school students (Grades 9–12) across the United States. Following local procedures regarding parental permission, students voluntarily complete the YRBS questionnaire. All responses to the survey are recorded anonymously on a computer scannable answer sheet. CDC's Institutional Review Board approved the protocol for the national YRBS. Additional details regarding the YRBS methodology are described elsewhere (Brener et al., 2002; Brener et al., 2013). The school response for the 2017 YRBS was 75%, the student response rate was 81%, the overall response rate (the product of the school response rate and the student response rate) was 60%, and the unweighted sample size was 14,765.

Self-reported sports- or physical activity–related concussion during the 12 months preceding the survey was the primary independent variable of this analysis. The questionnaire provided the following definition of concussion: "A concussion is when a blow or a jolt to the head causes problems such as headaches, dizziness, being dazed or confused, difficulty remembering or concentrating, vomiting, blurred vision, or being knocked out." Then students were asked, "During the past 12 months, how many times did you have a concussion from playing a sport or being physically active?" Response options were "0 times," "1 time," "2 times," "3 times," and "4 or more times." The sample sizes of two or more concussions were small (approximately 6% of respondents) and precluded power to analyze these separately. To improve statistical power, "1 time," "2 times," "3 times," and "4 or more times" were collapsed into one category, "1 or more times." Students were also asked about persistent feelings of sadness or hopelessness using the question, "During the past 12 months, did you ever feel so sad or hopeless almost every day for 2 weeks, or more in a row that you stopped doing some usual activities?" Response options were "yes" and "no."

Analysis

To produce nationally representative estimates, a weighting factor was applied to each record to adjust for school and student nonresponse and oversampling of Black and Hispanic students. The prevalence of persistent feelings of sadness or hopelessness among students with a sport- or physical activity–related concussion was computed overall and by sex (female, male), grade (9, 10, 11, 12), and race/ethnicity (non-Hispanic White [White], non-Hispanic Black [Black], and Hispanic). The number of students in other racial/ethnic subgroups was too small for meaningful analysis; therefore, those data are not presented but were retained in the analytic sample. We used a series of logistic regression models to examine the association between having had a sport- or physical activity–related concussion and persistent feelings of sadness or hopelessness, overall and for each sex, racial/ ethnic, and grade category. The overall model controlled for sex, grade, and race/ethnicity, and each of the other models controlled for the demographic characteristics for which the data were not stratified (e.g., the model examining the association among female students controlled

for race/ethnicity and grade). Missing data were not imputed. SAS-callable SUDAAN Version 11.0.1 (Research Triangle Institute: Research Triangle Park, NC) was used to conduct all statistical analyses. This allowed for the authors to account for the complex sampling design and weights. Estimates were considered statistically significant when $p < .05$.

Results

Overall, the prevalence of persistent feelings of sadness or hopelessness was 36.4% among students who reported sustaining one or more sports- or physical activity–related concussions in the preceding 12 months compared to 30.5% among those who had not sustained one or more sport- or physical activity–related concussions (Table 1). The odds of persistent feelings of sadness or hopelessness were significantly higher among students who had experienced one or more of these injuries (AOR = 1.41) compared to those who had not (Table 2).

The association between sports- or physical activity–related concussions and persistent feelings of sadness or hopelessness differed across some subgroups. Among females and males, the odds of persistent feelings of sadness or hopelessness were significantly higher among students who had experienced one or more sport- or physical activity–related concussions (AOR = 1.54 and 1.28, respectively) compared to those who had not. Among White students, the odds of persistent feelings of sadness or hopelessness were significantly higher among those who experienced one or more sport- or physical activity–related concussions (AOR = 1.54) compared to students who did not. Likewise, among 9th-, 10th-, and 12th-grade students, the odds of persistent feelings of sadness or hopelessness were significantly higher among those who had sustained one or more sport- or physical activity–related concussions (AOR = 1.50, 1.55, and 1.63, respectively) compared to those who did not. Persistent feelings of sadness or hopelessness was not associated with having sustained a sport- or physical activity–related concussion among Black, Hispanic, and 11th-grade students.

Discussion

This study found an association between self-reported sport- or physical activity–related concussions and experiencing persistent feelings of sadness or hopelessness. These findings support the need for continued efforts by school nurses and other health care providers to identify students with a history of concussion and assess their mental health needs (Chrisman & Richardson, 2014).

Findings from this study are consistent with previous studies that examined an association between mTBI and concussion history and mental health conditions (Chrisman & Richardson, 2014; Massagli et al., 2004; M. N. Yang et al., 2019; Zatzick & Grossman, 2011). Chrisman and Richardson (2014) found that youth with a history of concussion (from all causes) were at an increased risk of having a concurrent diagnosis of depression. Another study by Massagli and colleagues (2004) found that 30% of youth who sustained a mild TBI were diagnosed with a psychiatric illness within 3 years of the injury. In contrast, only 20%

of healthy controls followed as part of that study were diagnosed with a psychiatric illness during the same time frame (Massagli et al., 2004).

Among students who reported experiencing one or more sport- or physical activity–related concussions, the prevalence of persistent feelings of sadness or hopelessness was 2 times higher among female than male students. Other studies have reported differences in concussion symptoms and experiences among male and female athletes (Chandran et al., 2019; Merritt et al., 2019; J. Yang et al., 2015). A study of high school soccer athletes found that the likelihood of receiving a concussion diagnosis was 84% higher among female athletes than male athletes (Chandran et al., 2019). Although female athletes are more likely to report concussion symptoms than male athletes, there is limited research on health outcomes among male and female athletes following concussion (Merritt et al., 2019). Further research might examine the role of sex differences on emotional symptomology and outcomes to help inform whether sex-based assessment and treatment strategies for concussion are needed (Merritt et al., 2019).

Previous studies show higher rates of multiple concussions (four or more concussions within a 12-month time frame) among Black and Hispanic students (Depadilla et al., 2018). In this study, we found that White students who reported persistent feelings of sadness or hopelessness were more likely to also report having had one or more sport- or physical activity–related concussions. However, we did not find any association for these variables among Black and Hispanic students. Future research could explore this further and assess whether willingness to self-report concussion history and risk factors for mental health conditions may vary by race.

The CDC Pediatric Mild TBI Guideline recommends that when a concussion occurs, health care providers closely monitor each patient and counsel patients to resume a gradual schedule of activity following the first several days of the injury to avoid exacerbating any concussion symptoms (Lumba-Brown et al., 2018). In addition, the CDC Guideline states that health care providers may assess whether pediatric patients with mTBI or concussion would benefit from additional social support, including emotional support (Lumba-Brown et al., 2018). Social support, such as through support groups, may be associated with improved outcomes for students, reduced emotional symptomology (e.g., irritability, anxiety, depression, affective lability), and avoidance of a perception of poor quality of life (McCauley et al., 2001). For students who report feeling sad or hopeless, or are having other emotional symptomology, ongoing monitoring by school nurses and other health care providers may help with early identification of the development of a psychiatric disorder (Ellis et al., 2015). Students who report persistent or worsening feelings of sadness and hopelessness may benefit from a referral to care from a mental health specialist (Ellis et al., 2015; National Association of School Nurses, 2019).

The findings of this study also support the recommendations found in other studies to integrate symptom-based concussion assessments, as well as screening for depression (Stazyk et al., 2017; J. Yang et al., 2015), into preseason physical exams. Overall, 30.5% of students who had not sustained a sport- or physical activity–related concussion during the 12 months before the survey reported experiencing persistent feelings of sadness or

hopelessness. As many concussions among youth occur outside of sports- and physical activity–related activities (Haarbauer-Krupa et al., 2018), preseason assessments not only document any history of concussion (from all causes) and any current mental health conditions among students but also provide baseline data that will help health care providers understand whether mental health conditions followed a concussion or were already present (McCrory et al., 2017; J. Yang et al., 2015).

Limitations

There are at least four limitations for this study. First, this study is based on self-report. Neither persistent feelings of sadness or hopelessness nor sports- or physical activity–related concussions reported among students were confirmed through health care provider diagnosis or medical record review. Thus, there may be some over- or underreporting of the data. Second, these data apply only to youth who attend school and therefore are not representative of all persons in this age-group. In 2019, approximately 5% of high school–aged youth (ages 14–17 years) were not enrolled in school (Institute of Education Sciences, 2019). The data are not representative of those not enrolled in high school or in other age groups. Third, the data are from a cross-sectional survey; thus, it is unclear whether persistent feelings of sadness or hopeless were present before or after a sport- or physical activity–related concussion. Finally, while a previous study found that questions (including that on persistent feelings of sadness or hopeless) within YRBS have good test-retest reliability (Brener et al., 2002; Brener et al., 2013), the question used to measure sport- or physical activity–related concussion is new to the survey and its reliability has not yet been assessed.

Implications for School Nursing

Although most students with a concussion will have a good recovery and symptoms will resolve over time, for some, concussion symptoms may lead to emotional sequelae that affect them psychologically and academically during their recovery (Arbogast et al., 2013; Babikian et al., 2011; Barlow et al., 2010; Davis et al., 2017; Riglin et al., 2013; Yeates et al., 2009). School nurses have a unique and critical role in early recognition and referral of students with potential mental health conditions that either existed prior to or following their concussion to evidence-based interventions (National Association of School Nurses, 2019). A review by Fazel and colleagues (2014) suggests that when integrated into an educational system, school-based efforts that address mental health conditions may lead to improved outcomes for students. Mental health interventions that include a whole-school, classroom-level, and individual-level approach are considered most beneficial (Fazel et al., 2014). Improved access to educational training opportunities for school nurses and other school staff on addressing mental health conditions in the school setting may help with integrating such an approach (Fazel et al., 2014).

Conclusion

We found an association between self-reported sport- or physical activity–related concussion and experiencing persistent feelings of sadness or hopelessness among high school students. School nurses and other health care providers can use preseason physical exams to assess

student athletes' social support and mental health needs (Lumba-Brown et al., 2018; J. Yang et al., 2015). Students who report persistent or worsening feelings of sadness and hopelessness may benefit from a referral to a mental health specialist (Ellis et al., 2015; National Association of School Nurses, 2019).

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Table 1.

Percentage of High School Students Who Had Persistent Feelings of Sadness or Hopelessness, Among Students With Zero or One or More Self-Reported Sport- or Physical Activity–Related Concussions.

	Percentage of High School Students Who Had Persistent Feelings of Sadness or Hopelessness	
Variable	**0 Concussions [95% CI]**	**≥ 1 Concussion % [95% CI]**
Total	30.5 [28.5, 32.7]	36.4 [33.6, 39.4]
Sex		
Female	39.6 [35.7, 43.6]	50.4 [46.7, 54.2]
Male	20.4 [18.6, 22.2]	25.1 [21.5, 29.2]
Race/Ethnicity[a]		
White[b]	29.0 [25.9, 32.4]	36.7 [32.3, 41.4]
Black[b]	28.5 [25.6, 31.7]	32.1 [25.2, 39.8]
Hispanic	33.1 [31.3, 35.0]	35.2 [31.5, 39.0]
Grade		
9th	28.9 [26.5, 31.4]	35.5 [30.5, 40.9]
10th	31.2 [28.0, 34.7]	37.4 [32.6, 42.5]
11th	32.2 [29.1, 35.5]	33.0 [29.2, 37.0]
12th	29.8 [27.5, 32.2]	39.5 [33.5, 45.8]

Source: National Youth Risk Behavior Survey, 2017.

Note. CI = confidence interval.

[a]Students in other racial/ethnic subgroups was too small for meaningful analysis; therefore, those data are not presented.

[b]Non-Hispanic.

Table 2.

Odds (Adjusted) of High School Students Having Persistent Feelings of Sadness or Hopelessness, by Students With One or More Self-Reported Sports- or Physical Activity–Related Concussions.

	Percentage of High School Students Who Had Persistent Feelings of Sadness or Hopelessness	
Variable	**0 Concussions AOR [95% CI]**	**≥ 1 Concussion AOR [95% CI]**
Total	1.0 (ref)	**1.41 [1.22, 1.63]**
Sex		
Female	1.0 (ref)	**1.54 [1.29, 1.85]**
Male	1.0 (ref)	**1.28 [1.03, 1.58]**
Race/Ethnicity[b]		
White[c]	1.0 (ref)	**1.54 [1.22, 1.94]**
Black[c]	1.0 (ref)	1.33 [0.92, 1.93]
Hispanic	1.0 (ref)	1.16 [0.95, 1.42]
Grade		
9th	1.0 (ref)	**1.50 [1.20, 1.89]**
10th	1.0 (ref)	**1.55 [1.19, 2.02]**
11th	1.0 (ref)	1.06 [0.82, 1.37]
12th	1.0 (ref)	**1.63 [1.26, 2.11]**

Source: National Youth Risk Behavior Survey, 2017.[a]

Note. Estimates were considered statistically significant when $p < 0.05$. AOR = adjusted odds ratio; CI = confidence interval.

[a]Models were adjusted for sex, grade, and race/ethnicity overall, and as appropriate for each demographic group.

[b]Students in other racial/ethnic subgroups was too small for meaningful analysis; therefore, these data are not presented.

[c]Non-Hispanic.