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The Association between School District-Based Policies Related to Concussions and Concussions Among High School Students

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Abstract

BACKGROUND: Little is known about the effectiveness of school district concussion policies on reducing the concussion prevalence among students.

METHODS: Data from the 2016 School Health Policies and Practices Study and 2017 Youth Risk Behavior Survey for 10 school districts were linked. The outcome variable was having a sports- or physical activity-related concussion during the 12 months before of the survey. Exposure variables were two district policies, including district-funded professional development and prioritizing return to the classroom before returning to athletics. Logistic regression models estimated the odds of a concussion among students in districts with one, both, or neither policy (referent).

RESULTS: In districts with district-funded professional development, the odds of students self-reporting ≥ 2 sports- or physical activity-related concussions were 1.4 times higher than in districts with neither policy. In districts with a policy prioritizing a return to the classroom before returning to athletics, the odds of students self-reporting ≥ 2 concussions were significantly lower (OR=0.6) than in districts with neither policy.

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Human Subjects' Approval

SHPPS 2016 was reviewed by the Institutional Review Boards (IRB) at both the CDC and ICF International (contractor who conducted fieldwork for the study) and determined to be exempt. IRB reviews for the district YRBSs are handled by the individual districts.

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CONCLUSION: School district concussion policies may have positive effects by identifying and reducing multiple concussions among students.

IMPLICATIONS FOR SCHOOL HEALTH: Expansion of involvement of athletic trainers, education opportunities, and concussion management teams may improve policy uptake.

Keywords

Concussions; TBI

Sports- or physical activity-related concussion are a common injury among youth in the United States.[1] The 2017 Youth Risk Behavior Survey (YRBS) reported that an estimated 2.5 million high school students self-reported having had at least one sports- or physical activity-related concussion during the proceeding12 months of the survey.[2] Of those students, approximately 1 million self-reported having two or more concussions.[2]

For most youth, concussion symptoms resolve within one to three months.[6] However, there is growing concern about the long-term effects on the brain of youth who experience multiple concussions. Youth with a history of multiple concussions are more likely to have a prolonged recovery,[4, 7] and experience more severe symptom presentation following the injury.[9] Furthermore, youth with a history of multiple concussions have a greater likelihood of being medically disqualified from sport participation following their most recent concussion.[7]

Due in part to concerns about youth sustaining multiple concussion, especially within a short timeframe,, by 2014, all 50 states and the District of Columbia (DC) passed a law related to youth sports concussion response and management.[10, 11] These laws, commonly referred to as Return to Play (RTP) laws, require medical clearance from a healthcare provider before an athlete with a concussion can return to sports or other physical activity.[10] Building upon these policies, 10 states and DC added provisions to their RTP laws to address return to school (RTS). RTS provisions generally include education or professional development requirements for school professionals and require academic support for students returning to school following concussion.[12–14]

Managing students' return to school following a concussion is important due to the potential negative effects these injuries may have on students' school performance.[15] Appropriately managing students' return to school reduces the potential for extended absences from school, declines in school performance, and feelings of isolation that students may experience after their injury.[16, 17] The authors of a systematic review of studies that addressed students' return to school following a concussion assert that schools should have a policy that specifically addresses return to school following a concussion, and that schools should offer individualized academic accommodations during a student's recovery.[18]

The decision to adopt state-based policies is made at the school district level. Studies show that some districts have adopted policies addressing continuing education or professional development and medical clearance to comply with state RTP and RTS laws.[12–14] Still, there is limited literature describing the extent to which school districts implement these

concussion-related policies. Further, little is known about whether these policies improve identification of students with a concussion and whether they reduce the risk for concussion (including repeat concussions) among students. Thus, using data from both the 2016 School Health Policy and Practices Study (SHPPS) and the 2017 YRBS from 10 school districts, this paper assessed the association between two district-level concussion-related policies and self-reported sports- or physical activity-related concussions among high school students. We hypothesized that policies focused on professional development and education may increase the amount of reported concussions as identification and awareness improve. On the other hand, policies that focus on removing students from risky situations (i.e., removal from sports) may decrease the amount of reported concussions.

METHODS

Sample and survey administration: school district-level data

School district-level data were obtained from the 2016 SHPPS. SHPPS was a cross-sectional study conducted periodically by the Centers for Disease Control and Prevention (CDC) at the state, district, school, and classroom levels. SHPPS 2016 used a stratified random sample to identify public school districts from the 50 States and DC. This cross-sectional analysis used 2016 data from 10 large urban school districts that also had representative student-level data from the 2017 YRBS as described below.

SHPPS collected data using both web-based (94% of respondents) and mailed (6% of respondents) questionnaires that addressed a variety of policies related to school health components found in with the Whole School, Whole Community, Whole Child (WSCC) model. SHPPS 2016 was designed to assess components of the Whole School, Whole Community, Whole Child model at the district level. During recruitment, the superintendent or other district-level contact was asked to designate a respondent for each component-specific questionnaire who had primary responsibility for or was the most knowledgeable about the component of school health. For this analysis, data were drawn from responses to the Physical Education and Physical Activity District Questionnaire. SHPPS 2016 was reviewed by the Institutional Review Boards (IRB) at both the CDC and ICF International (contractor who conducted fieldwork for the study) and determined to be exempt. More detailed descriptions of the methods used in SHPPS have been published previously.[19]

Sample and survey administration: student-level data

Student-level data were obtained from YRBSs conducted in 2017 among representative samples of high school students in 10 school districts funded by CDC during that survey year. These surveys are part of the CDC's Youth Risk Behavior Surveillance System, which includes surveys conducted biennially by state, territorial, tribal, and local education and health agencies, with technical assistance from CDC, to monitor the prevalence of priority health risk behaviors among high school students. In each participating school district, a two-stage sample design was used to produce a representative sample of students in grades 9 through 12 who attended public high schools in that district.

Student participation in the survey was anonymous and voluntary, and local parental permission procedures were followed. Students completed the self-administered paper-and-pencil questionnaire during a regular class period and recorded their responses directly on a computer-scannable answer sheet. In 2017, across the 10 districts included in this analysis, school response rates ranged from 84% to 100%, student response rates ranged from 63% to 89%, and overall response rates ranged from 61% to 89%. Student sample sizes ranged from 938 to 5934. IRB reviews for the district YRBSs are handled by the individual districts. More detailed descriptions of YRBS methods have been published previously.[20]

Variables

The YRBS questionnaire defined concussion as "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 respondents 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."

From SHPPS 2016, two questions were used to assess whether school districts had enacted policies related to concussions. The first question was, "During the past two years, has your district provided funding for professional development or offered professional development to those who teach physical education on how to prevent, recognize, and respond to concussions among students?" (hereafter "district-funded professional development"). The second question was, "Has your district adopted a policy stating that student athletes who required medical clearance by a healthcare provider after a suspected concussion must successfully return to the classroom before returning to athletic participation?" (hereafter "prioritizing a return to the classroom before returning to athletics"). For both questions, response options were yes or no.

Covariates from the YRBS included grade (9th, 10th, 11th, and 12th), sex, and race/ethnicity (non-Hispanic [NH] White, NH Black, and Hispanic (which could be of any race). Other racial/ethnic subgroups were excluded from the race/ethnicity subgroup chi-square analysis as they may be too small for meaningful analysis, but those data remained in the analytic sample for all other analyses. One additional covariate, "physical activity," was derived from two questions including "During the past 7 days, on how many days were you physically active for a total of at least 60 minutes per day?" and "During the past 12 months, on how many sports teams did you play? (Count any teams run by your school or community groups.)" Physical activity was treated as a binary variable (yes or no), with yes reflecting at least 5 days of physical activity or playing on at least one sports team. Previous literature has demonstrated an association between sports and physical activity related concussions and demographic characteristics, including physical activity and sports teams.[2, 21]

Statistical Analysis

The 2016 SHPPS data were merged with the 2017 YRBS data among the 10 districts that administered the Physical Education and Physical Activity questionnaire, had responses to the two SHPPS policy questions related to concussions, and included the YRBS variable

about concussions on their YRBS. There were 25,110 unique student observations in those 10 districts.

SAS-callable SUDAAN version 11.0.1 (Research Triangle Institute: Research Triangle Park, NC), which took into account the nesting of schools within districts and sampling weights, was used to conduct all statistical analyses. First, chi-square was used to identify associations between student characteristics and having had 0, 1, and 2 or more concussions. To calculate adjusted odds ratios, two logistic regression models were used to examine the association between school district policies and student reporting of only 1 and then 2 or more sports- and physical activity-related concussions, controlling for student sex, grade, race/ethnicity, and physical activity. Two models were used to compare 0 concussions to 1 and 0 concussions to 2 or more concussions. Only significant findings are presented below.

RESULTS

Overall, 84.4% of students self-reported 0 sports- or physical activity-related concussions, 8.2% reported 1, and 7.4% self-reported 2 or more during the 12 months before the survey (Table 1). The number of sports- or physical activity-related concussions varied by sex, grade, race/ethnicity, and physical activity.

Among the 10 districts, 7 provided funding for professional development to those who teach physical education on preventing, recognizing, and responding to concussions (data not shown). Additionally, 7 districts adopted policies stating that student athletes who required medical clearance by a healthcare provider after a suspected concussion must return to the classroom before returning to athletics. Six districts had both policies and 2 districts had neither.

Among students in districts with district-funded professional development, the adjusted odds of self-reporting ≥ 2 sports- or physical activity-related concussions were 1.4 times higher than among students in districts with neither policy (Table 2). In contrast, among students in districts with a policy prioritizing a return to the classroom before returning to athletics, the odds of self-reporting ≥ 2 concussions were significantly lower (AOR=0.5) than among students in districts with neither policy. Finally, among students in districts with both policies, the adjusted odds of self-reporting 1 concussion were significantly lower (AOR=0.8) than among students in district with neither policy.

DISCUSSION

School staff, particularly coaches and physical education staff, play an integral part in early identification and management of concussion and reducing the likelihood of repeat concussions among students.[15] To support concussion prevention and management, most school districts in this study had in place at least 1 of the district-level concussion policies examined. Findings from this study also indicate that these policies were associated with some positive outcomes. Among students in districts with both polices; that is, district-funded professional development and prioritizing return to the classroom before returning to athletics, students reporting 1 concussion was significantly lower than among students in districts with neither policy.

Among students in districts with a policy that prioritized a return to the classroom before returning to athletics, students were less likely to self-report having had two or more sports- or physical activity-related concussions. There are several possible explanations for this finding. First, following a concussion, there is a window of vulnerability in which the brain is more susceptible to repeat injury.[4] As participation in sports increases the risk for concussion,[2] prioritizing a return to the classroom before returning to athletics may help delay sports participation during this timeframe. Second, monitoring a student's recovery and ensuring they have medical clearance prior to returning to sports- or physical activity generally entails coordination between school professionals, the student's parents, and the student's healthcare provider.[15, 22, 23] A student recovering from a concussion may have school accommodations in place that may evolve from day-to-day or from class-to-class.[15] As such, schools with return to school policies that require returning to the classroom before returning to athletics may have more robust efforts to address and prevent concussion. On the other hand, it is possible that the lower prevalence of concussion in districts with policies prioritizing a return to the classroom before returning to athletics is linked to under-reporting. Students concerned about being kept out of sports due to a concussion may be less likely to report a concussion and hide their symptoms.[24] Although possible, for this study, this explanation seems less likely given that students self-reported concussions through an anonymous survey and outside the context of a game or practice in which sports participation would have been impacted. Future research that identifies which components of concussion policies are most effective, including strategies related to return to school and medical clearance, may help schools with decision-making and resource allocation to support concussion safety among their students.

District-funded professional development for physical education staff was associated with higher odds of students self-reporting two or more sports- or physical activity-related concussions during the 12 months before the survey. Prior research has found similar increases in concussion rates following passage of RTP laws that include education components.[25, 26] Increases in concussion rates in these studies were attributed to increased identification, reporting, and care-seeking behaviors.[25, 26] A similar phenomenon may be present in the current study; however, SHPPS and YRBS data are cross-sectional and, therefore, cannot be used to determine whether similar factors contributed to the increase in concussion prevalence found herein. While educational materials and trainings focused on concussion have demonstrated success in improving concussion knowledge and attitudes among participants,[27–33] additional research is needed to explore the potential outcomes associated with professional development related to concussion management.

Most studies on concussion among young athletes have focused on the high school age population and have found, similar to the findings of this study, differences in concussion prevalence across demographics.[2] It is unclear the extent to which middle and elementary schools successfully implement concussion policies. The field would benefit from studies that separately examine concussion policies and their effects in elementary and middle school settings, as well as barriers and facilitators to their implementation. Further, concussions policies often focus on sports- and physical activity-related concussions. This is consistent with research that shows concussions in the school setting are most likely to occur during organized sports activities, especially among those who are high school

age.[34, 35] Elementary school age students are at increased risk for concussion during playground activities.[20] Still, within the school setting, concussions may occur outside of sports or physical activity, such as when a student slips and bumps their head in the classroom or in the hallway.[34] Or, concussions may occur outside of school as a result of a fall at home or a motor vehicle crash.[36] It is unclear if concussion policies related to professional development and those that prioritize return to the classroom before returning to athletics also improve identification and prevention of repeat concussions from non-sports- or physical activity-related related causes.

Limitations

There are at least six limitations for this study. First, findings from the YRBS are based on self-report. The number of sports- or physical activity-related concussions reported among students were not confirmed through healthcare provider diagnosis or medical record review. Thus, there may be some over or under reporting of concussions. Second, the question used to measure sport- or physical activity-related concussion is new to the survey. Its reliability has not yet been assessed. Third, these data apply only to youth who attend school in the 10 school districts included in the study and are not generalizable to high school students nationwide. Fourth, although the school district policies may have applied to all school levels, this study included data about sports- or physical activity-related concussions among only high school students. The findings are not generalizable to schools or students in other grade levels (i.e., middle and elementary school). Fifth, SHPPS did not assess whether district level policies were implemented at the school level. Finally, this study did not evaluate concussion prevalence before policies were implemented and causality cannot be implied.

CONCLUSION

Lowering the prevalence of sports- or physical activity-related concussions among high school students is an important public health challenge. School district concussion policies related to professional development for physical education teachers and prioritizing return to the classroom before returning to athletics following a concussion could be strategies to reduce the risk for multiple concussions among high school students. Having a district-level policy that prioritizes return to the classroom before returning to athletics following a concussion was negatively associated with sport- or physical activity-related concussions. In contrast, district-funded professional development was positively associated with students self-reporting two or more concussions, which is consistent with better identification and awareness of this injury among students.

REFERENCES

1. Sarmiento K, Thomas KE, Daugherty J, et al. Emergency Department Visits for Sports- and Recreation-Related Traumatic Brain Injuries Among Children - United States, 2010–2016. MMWR. 2019;68(10):237–242.
2. Depadilla L, Miller GF, Jones SE, Peterson AB, Breiding MJ. Self-Reported Concussions from Playing a Sport or Being Physically Active Among High School Students—United States, 2017. MMWR. 2018;67(24):682. [PubMed: 29927909]

3. Chrisman SPD, Lowry S, Herring SA, et al. Concussion Incidence, Duration, and Return to School and Sport in 5- to 14-Year-Old American Football Athletes. J Pediatr. Dec 12 2018;doi:10.1016/j.jpeds.2018.11.003
4. Guskiewicz KM, McCrea M, Marshall SW, et al. Cumulative effects associated with recurrent concussion in collegiate football players: The NCAA concussion study. JAMA. 2003;290(19):2549–2555. [PubMed: 14625331]
5. Curry AE, Arbogast KB, Metzger KB, et al. Risk of Repeat Concussion Among Patients Diagnosed at a Pediatric Care Network. J Pediatr. 2019; 210:13–19. [PubMed: 31101406]
6. Barlow KM, Crawford S, Stevenson A, Sandhu SS, Belanger F, Dewey D. Epidemiology of postconcussion syndrome in pediatric mild traumatic brain injury. Pediatrics. 2010;126(2):e374–e381. [PubMed: 20660554]
7. Castile L, Collins CL, McIlvain NM, Comstock RD. The epidemiology of new versus recurrent sports concussions among high school athletes, 2005–2010. Br J Sports Med. 2012;46(8):603–10. [PubMed: 22144000]
8. Giza CC, Hovda DA. The Neurometabolic Cascade of Concussion. J Athl Train. Sep 2001;36(3):228–235. [PubMed: 12937489]
9. McPherson AL, Nagai T, Webster KE, Hewett TE. Musculoskeletal Injury Risk After Sport-Related Concussion: A Systematic Review and Meta-analysis. Am J Sports Med. Jun 2019;47(7):1754–1762. [PubMed: 30074832]
10. Harvey HH. Reducing traumatic brain injuries in youth sports: youth sports traumatic brain injury state laws, January 2009–December 2012. AJPH. 2013;103(7):1249–1254.
11. Harvey HH, Koller DL, Lowrey KM. The four stages of youth sports TBI policymaking: engagement, enactment, research, and reform. J Law Med Ethics. 2015;43(1_suppl):87–90.
12. Sullivan L, Harvey HH, Smith GA, Yang J. Putting Policy Into Practice: School-Level Compliance With and Implementation of State Concussion Laws. JPHMP. 2020;26:S84–s92. [PubMed: 32004226]
13. Coxe K, Hamilton K, Harvey HH, Xiang J, Ramirez MR, Yang J. Consistency and Variation in School-Level Youth Sports Traumatic Brain Injury Policy Content. JAH. 2018;62(3):255–264.
14. Davies S, Coxe K, Harvey HH, Singichetti B, Guo J, Yang J. Qualitative evaluation of high school implementation strategies for youth sports concussion laws. J Athl Train. 2018;53(9):873–879. [PubMed: 30284457]
15. Halstead ME, McAvoy K, Devore CD, Carl R, Lee M, Logan K. Returning to learning following a concussion. Pediatrics. Nov 2013;132(5):948–57. [PubMed: 24163302]
16. Arbogast KB, McGinley AD, Master CL, Grady MF, Robinson RL, Zonfrillo MR. Cognitive rest and school-based recommendations following pediatric concussion: the need for primary care support tools. Clin Pediatr. 2013;52(5):397–402.
17. Lowry R, Haarbauer-Krupa JK, Breiding MJ, Thigpen S, Rasberry CN, Lee SM. Concussion and academic impairment among US high school students. AJPM. 2019;57(6):733–740.
18. Davis GA, Anderson V, Babl FE, et al. What is the difference in concussion management in children as compared with adults? A systematic review. Br J Sports Med. 2017;51(12):949–957. [PubMed: 28455361]
19. Centers for Disease Control and Prevention. Results from the School Health Policies and Practices Study 2014. 2015. https://www.cdc.gov/healthyyouth/data/shpps/pdf/SHPPS-508-final_101315.pdf
20. Brener ND, Kann L, Shanklin S, et al. Methodology of the Youth Risk Behavior Surveillance System--2013. MMWR. 2013;62(Rr-1):1–20.
21. DePadilla L, Miller GF, Jones SE. An Examination of 4 Questions Assessing Self-reported Concussions Among High School Students Participating in Team Sports. JPHMP. 2020;26(2):E23–E27.
22. Gioia GA. Medical-school partnership in guiding return to school following mild traumatic brain injury in youth. J Child Neurol. 2016;31(1):93–108. [PubMed: 25535055]
23. McAvoy K, Eagan-Johnson B, Dymacek R, Hooper S, McCart M, Tyler J. Establishing Consensus for Essential Elements in Returning to Learn Following a Concussion. JOSH. 2020;90(11):849–858.

24. Chrisman SP, Quitiquit C, Rivara FP. Qualitative study of barriers to concussive symptom reporting in high school athletics. JAH. 2013;52(3):330–335. e3.
25. Arakkal AT, Barón AE, Lamb MM, Fields SK, Comstock RD. Evaluating the effectiveness of traumatic brain injury state laws among high school athletes. Inj Epidemiol. 2020;7(1):1–11. [PubMed: 32127051]
26. Yang J, Comstock RD, Yi H, Harvey HH, Xun P. New and Recurrent Concussions in High-School Athletes Before and After Traumatic Brain Injury Laws, 2005–2016. AJPH. 2017;107(12):1916–1922.
27. Sarmiento K, Mitchko J, Klein C, Wong S. Evaluation of the Centers for Disease Control and Prevention's concussion initiative for high school coaches:"Heads Up: Concussion in High School Sports". JOSH. 2010;80(3):112–118.
28. Daugherty J, DePadilla L, Sarmiento K. Assessment of HEADS UP online training as an educational intervention for sports officials/athletic trainers. J Safety Res. 2020;74:133–141. [PubMed: 32951774]
29. Daugherty J, DePadilla L, Sarmiento K. Effectiveness of the US Centers for Disease Control and Prevention HEADS UP coaches' online training as an educational intervention. Health Educ J. 2019;78(7):784–797. [PubMed: 31530957]
30. Glang A, Koester MC, Beaver S, Clay J, McLaughlin K. Online training in sports concussion for youth sports coaches. Int J Sports Sci Coach. 2010;5(1):1–11. [PubMed: 20640175]
31. Glang AE, Koester MC, Chesnutt JC, et al. The effectiveness of a web-based resource in improving postconcussion management in high schools. JAH. 2015;56(1):91–97.
32. McCart M, Glang AE, Slocumb J, Gau J, Beck L, Gomez D. A quasi-experimental study examining the effects of online traumatic brain injury professional development on educator knowledge, application, and efficacy in a practitioner setting. Disabil Rehabil. Aug 2020;42(17):2430–2436. doi:10.1080/09638288.2019.1578423 [PubMed: 30978108]
33. Graff DM, Caperell KS. Concussion Management in the Classroom. J Child Neurol. 2016;31(14):1569–1574. [PubMed: 27591004]
34. Yaramothu C, Goodman AM, Alvarez TL. Epidemiology and Incidence of Pediatric Concussions in General Aspects of Life. Brain Sci. Sep 27 2019;9(10).
35. Haarbauer-Krupa J, Arbogast KB, Metzger KB, et al. Variations in Mechanisms of Injury for Children with Concussion. J Pediatr. 2018;197:241–248. [PubMed: 29627189]
36. Centers for Disease Control and Prevention. Surveillance Report of Traumatic Brain Injury-related Emergency Department Visits, Hospitalizations, and Deaths—United States, 2014. . National Center for Injury Prevention and Control, Centers for Disease Control and Prevention, U.S. Department of Health and Human Services; 2019.
37. Romm KE, Ambegaonkar JP, Caswell AM, et al. Schoolteachers' and Administrators' Perceptions of Concussion Management and Implementation of Return-to-Learn Guideline. JOSH. 2018;88(11):813–820.
38. Pryor RR, Casa DJ, Vandermark LW, et al. Athletic training services in public secondary schools: a benchmark study. J Athl Train. 2015;50(2):156–162. [PubMed: 25689559]
39. Kroshus E, Rivara FP, Whitlock KB, Herring SA, Chrisman SPD. Disparities in Athletic Trainer Staffing in Secondary School Sport: Implications for Concussion Identification. Clin J Sport Med. Nov 2017;27(6):542–547. [PubMed: 28742604]
40. Wallace J, Covassin T, Moran R. Racial Disparities in Concussion Knowledge and Symptom Recognition in American Adolescent Athletes. J Racial Ethn Health Disparities. 2018;5(1):221–228. [PubMed: 28389906]
41. 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. [PubMed: 24601910]
42. Hartnett KP, Kite-Powell A, DeVies J, et al. Impact of the COVID-19 Pandemic on Emergency Department Visits - United States, January 1, 2019-May 30, 2020. MMWR. 2020;69(23):699–704. [PubMed: 32525856]

IMPLICATIONS FOR SCHOOL HEALTH

Research suggests that school district can comply with and successfully implement concussion policies.[12] However, schools may face barriers that inhibit successful implementation. Examples of barriers include lack of buy-in regarding education requirements (e.g., perceived lack of importance of concussions), resistance from the community (e.g., belief that implementing RTS protocols are burdensome and time consuming), and concerns about the financial burden for families related to the cost of medical clearance requirements.[37,13] This may point to the need for a more comprehensive approach to school-based concussion policy implementation and clear guidance on policy implementation.[13] Below are three examples of actions school districts may consider to address potential barriers and improve uptake and support for concussion policies.

1. Involve athletic trainers in concussion management and RTP protocols.
    - At the high school level, approximately 70% of schools have access to a full-time, part-time, or per diem athletic trainer.[38] Research shows that access to athletic trainers not only improves concussion identification among athletes, but may reduce health equities related to concussion education.[39, 40] When available, athletic trainers are able to evaluate athletes with a concussion and assist in the post-injury management, such as the RTP and RTS decision-making process, within the school setting.[41] As such, greater involvement of athletic trainers may help reduce barriers related to access to healthcare providers (such as those in rural areas) and concerns about cost of care. Further, access to care at school for an injured athlete may be especially important during the COVID-19 pandemic as some may not seek care or may delay care due to concerns about exposure to the COVID-19 virus in the emergency department setting.[42]
2. Use available no-cost concussion trainings to promote professional development opportunities for non-physical education teachers.
    - Most concussion policies focus on athletic staff at schools, such as coaches.[10, 11] However, non-physical education teachers play an important role in concussion safety and many recognize the importance of learning about concussions to support a student's return to school.[15, 37] Still, they may not feel prepared to respond to a concussion among one of their students, and fidelity to concussion policies may vary based on their perceptions of concussions and involvement in sports activities.[37] An evaluation of a training for school professionals found that participants demonstrated significant gains in knowledge and self-efficacy, immediately and 30 days following completion of the training.[32] Thus, to expand access to concussion education for school professionals, CDC recently

released an online training for non-physical education teachers and other school professionals, available at no cost, that school districts may use to comply with concussion policies: https://www.cdc.gov/headsup/schoolprofessionals/training/index.html. Further, through its HEADS UP campaign (https://www.cdc.gov/headsup), CDC has resources school districts may share with parents about concussion safety.

3. Encourage school administrators to establish concussion management teams, including identifying a point person at their school who is trained and knowledgeable about concussion management.[22, 23]

   - To limit the burden on parents and other school staff, prior studies note that the establishment of a school concussion management team may be beneficial.[13] A school point person (such as a school nurse or teacher), who is part of the concussion management team, may also be identified for each individual student.[22, 23] This person serves as the primary point of contact for a student with a concussion, their family, their medical provider, and other school professionals who are on the concussion management team or in regular contact with the student. A school point person may also facilitate professional development opportunities on concussion prevention, detection, and management for other school staff that support concussion policy implementation.

Table 1:

Characteristics of High School Students and Associations Between Characteristics and Sports- or Physical Activity-Related Concussions[a] —10 School Districts, Youth Risk Behavior Surveillance System, 2017[b]

Characteristic	Overall Respondents	Number of Sports- or Physical Activity-Related Concussions			
		0	1	≥2	
	n (%)[c]	n (%)[d]	n (%)[d]	n (%)[d]	P value[e]
Observations	25110	19055 (84.4)	1993 (8.2)	1733 (7.4)	
Sex					<.001
Female	13039 (49.4)	10425 (87.3)	938 (6.9)	683 (5.8)	
Male	11824 (50.6)	8535 (82.0)	1027 (9.5)	982 (8.5)	
Grade					<.001
9	6499 (27.5)	4801 (82.6)	568 (9.0)	483 (8.5)	
10	6818 (25.7)	5092 (83.0)	554 (8.8)	477 (8.2)	
11	6056 (23.9)	4744 (86.3)	445 (7.4)	379 (6.3)	
12	5356 (22.8)	4222 (86.9)	385 (7.4)	337 (5.8)	
Race/ethnicity [f]					<.001
White, non-Hispanic	2729 (16.1)	2283 (87.3)	230 (8.7)	97 (4.0)	
Black, non-Hispanic	8822 (29.1)	6368 (84.4)	653 (7.6)	626 (8.0)	
Hispanic	10323 (48.1)	8055 (83.9)	832 (8.4)	726 (7.7)	
Physically Active [g]					<.001
Yes	12743 (62.6)	10046 (81.2)	1305 (9.7)	1108 (9.1)	
No	8245 (37.4)	7344 (90.4)	528 (6.2)	325 (3.4)	

[a] Concussion was defined as “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.” After the definition respondents were asked, “During the past 12 months, how many times did you have a concussion from playing a sport or being physically active?”

[b] Unweighted sample sizes and weighted percentages are presented. Weighted percentages may not total 100 due to rounding.

[c] Column percentages are presented.

[d] Row percentages are presented.

[e] Chi-square tests were used to examine differences across categories.

[f] Other racial/ethnic subgroups were excluded from the race/ethnicity subgroup chi-square analysis as they may be too small for meaningful analysis, but those data remained in the analytic sample.

[g] Physical activity was derived from two questions including “During the past 7 days, on how many days were you physically active for a total of at least 60 minutes per day?” and “During the past 12 months, on how many sports teams did you play? (Count any teams run by your school or community groups.)” Physical activity was treated as a binary variable (yes or no), with yes reflecting at least 5 days of physical activity or playing on at least one sports team.

Table 2:

Adjusted Odds Ratios of High School Students Self-Reporting 1 and 2 or More Sports- or Physical Activity-Related Concussions,[A] by District-Level Policies Among 10 School Districts, Youth Risk Behavior Surveillance System, 2017

Characteristic	1 concussion AOR (95% CI)[a]	≥ 2 concussions AOR (95% CI)[a]
District-Level Policies [b]		
Neither	Referent	Referent
District-funded professional development (only)	1.1 (0.8–1.5)	1.4 (1.1–1.8) **
Prioritizing a return to the classroom before returning to athletics (only)	0.7 (0.4–1.2)	0.5 (0.4–0.7) ***
Both	0.8 (0.7–1.0) *	1.0 (0.9–1.2)
Sex		
Female	Referent	Referent
Male	1.4 (1.2–1.6) ***	1.4 (1.3–1.6) ***
Grade		
9	Referent	Referent
10	1.0 (0.8–1.2)	1.0 (0.8–1.2)
11	0.8 (0.6–1.0)	0.7 (0.6–0.8) ***
12	0.8 (0.6–1.1)	0.7 (0.5–1.0) *
Race/Ethnicity [c]		
White, non-Hispanic	Referent	Referent
Black, non-Hispanic	0.9 (0.7–1.2)	2.1 (1.5–2.8) ***
Hispanic	1.0 (0.7–1.3)	1.8 (1.3–2.6) **
Physically Active [d]		
Yes	1.6 (1.4–1.9) ***	2.8 (2.5–3.2) ***
No	Referent	Referent

Note: AOR = adjusted odds ratios; CI = confidence intervals.

*** p<.001,

** p<.01.,

* p<.05.

[a] Concussion was defined as “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.” After the definition respondents were asked, “During the past 12 months, how many times did you have a concussion from playing a sport or being physically active?”

[b] District-funded professional development was derived from the question “During the past two years, has your district provided funding for professional development or offered professional development to those who teach physical education on how to prevent, recognize, and respond to concussions among students?” Prioritizing a return to the classroom before returning to athletics was derived from the question “Has your district adopted a policy stating that student athletes who required medical clearance by a healthcare provider after a suspected concussion must successfully return to the classroom before returning to athletic participation?”

[c] Other racial/ethnic subgroups are not presented as they may be too small for meaningful analysis, but those data remained in the analytic sample.

[d]Physical activity was derived from two questions including “During the past 7 days, on how many days were you physically active for a total of at least 60 minutes per day?” and “During the past 12 months, on how many sports teams did you play? (Count any teams run by your school or community groups.)” Physical activity was treated as a binary variable (yes or no), with yes reflecting at least 5 days of physical activity or playing on at least one sports team