HHS Public Access

Author manuscript

J Safety Res. Author manuscript; available in PMC 2021 September 01.

Published in final edited form as:

J Safety Res. 2020 September ; 74: 133–141. doi:10.1016/j.jsr.2020.04.015.

Assessment of HEADS UP online training as an educational intervention for sports officials/athletic trainers ☆

Jill Daugherty[a,*], **Lara DePadilla**[b], **Kelly Sarmiento**[a]

[a]Centers for Disease Control and Prevention, National Center for Injury Prevention and Control, Division of Injury Prevention, 4770 Buford Highway, Atlanta, GA 30341, United States

[b]Centers for Disease Control and Prevention, National Center for Injury Prevention and Control, Division of Overdose Prevention, 4770 Buford Highway, Atlanta, GA 30341, United States

Abstract

Background—Sports- and recreation-related concussions are a common injury among children. Sports officials (SOs) and athletic trainers (ATs) are integral to setting the stage for safe play and managing concussions when they occur, and significant numbers of both groups have completed the Centers for Disease Control and Prevention's HEADS UP online concussion training course. However, the utility of the course for these audiences has not been assessed. We hypothesized that sports officials' and athletic trainers' concussion-related knowledge, attitudes, and behavioral intentions will improve from pre- and posttest after completing CDC's HEADS UP online concussion training course.

Method—Respondents' concussion-related knowledge, attitudes, and behavioral intentions were assessed both before and after taking the training course. Differences between pre- and post-test scores were calculated based on the Wilcoxon Signed Rank Test Z-score or McNemar's test. Effect sizes were interpreted.

Results—The SOs and ATs who participated in the HEADS UP online training had a high level of concussion knowledge before taking the course: 90% or more of respondents could identify the correct response for at least seven of the 13 knowledge questions in the pre-test. Still, the course was effective at improving the respondents' knowledge about return-to-play protocols and concussion reporting. Further, SOs and ATs demonstrated improvement in their concussion-related attitudes and behavioral intentions between the pre- and post-test.

Conclusion—SOs' and ATs' concussion knowledge, attitudes, and behavioral intentions improved immediately following completion of the CDC HEADS UP online training. Future research could also focus on the long-term retention of this type of training.

☆**Special report from the CDC**: *The Journal of Safety Research has partnered with the Office of the Associate Director for Science, Division of Injury Prevention, National Center for Injury Prevention and Control at the CDC in Atlanta, Georgia, USA, to briefly report on some of the latest findings in the research community. This report is the 61st in a series of "From the CDC" articles on injury prevention.*

*Corresponding author: jdaugherty@cdc.gov (J. Daugherty).

Appendix A. Supplementary data

Supplementary data to this article can be found online at https://doi.org/10.1016/j.jsr.2020.04.015.

Practical Applications—This study provides insight into how to better focus concussion-related educational programs to fit SOs' and ATs' needs.

Keywords

Concussion; Youth athletes; Sports officials; Athletic trainers; Concussion education

1. Introduction

Concussions and other traumatic brain injuries (TBIs) that occur during sports- or recreation-related (SRR) activities disproportionately affect children under the age of 18 (Coronado et al., 2015). The Centers for Disease Control and Prevention (CDC) estimated that in 2016 more than 273,000 children aged 17 years and under sought care in U.S. emergency departments for an SRR-TBI, including concussions (Sarmiento et al., 2019). TBIs sustained in contact sports accounted for approximately 45% of all SRR-TBI emergency department visits among children between 2010 and 2016 (Sarmiento et al., 2019).

In order to help improve awareness about concussions and other TBIs, CDC has distributed educational materials and messages through its HEADS UP campaign for more than 15 years (Centers for Disease Control and Prevention, 2016; Sarmiento, Hoffman, Dmitrovsky, & Lee, 2014). The goal of the campaign is to "Protect kids and teens by raising awareness and informing action to improve prevention, recognition, and response to concussion and other serious brain injuries" (Centers for Disease Control and Prevention, 2016). The most accessed educational tool in the CDC HEADS UP campaign is an online training for youth sports coaches. Approximately 10,000 to 30,000 individuals complete the training each month (Sarmiento et al., 2014). First released in 2010, the CDC HEADS UP online training course for youth sports coaches includes learning objectives aimed at improving: (1) understanding of concussion and its potential consequences; (2) recognition of concussion signs and symptoms and how to respond; (3) coaches' ability to implement return to activity (sports and school) steps after a concussion; and (4) focus on concussion prevention and preparedness (Centers for Disease Control and Prevention, 2017).

In 2017, CDC updated the training and added pre-test and post-test modules (Centers for Disease Control and Prevention, 2017). The pre- and post-test modules were designed to help evaluate the effectiveness of the training on concussion knowledge, attitudes, and intentional behavioral intentions (e.g., likelihood of taking actions if a concussion is suspected) prior to and immediately following completion of the training. Although designed for youth sports coaches, the training is publicly available and commonly used by sports officials and athletic trainers. In fact, among the sample of over 200,000 respondents who took the training between November 2016 and November 2017, 2% were athletic trainers and 5% were sports officials. Additionally, the preponderance of concussion education and training available is for coaches. Therefore, if athletic trainers and sports officials are interested in educating themselves about concussion prevention and response best practices, they often need to take advantage of resources aimed at coaches.

Both sports officials and athletic trainers are integral to supporting athlete safety and injury prevention. However, their individual roles in addressing these issues are unique. Sports officials (also referred to as referees and umpires) are present at sports competitions and games to help maintain standards of play (Bureau of Labor Statistics, 2019). To support athlete safety, sports officials enforce the rules of the sport, assess penalties when necessary, and inspect sports equipment and facilities (Bureau of Labor Statistics, 2019). Sports officials are often in close proximity to athletes, allowing them to observe potential head impacts and associated signs of a concussion. If a concussion or other injury is suspected, sports officials can stop the game or competition and request medical attention for an athlete. A study of college football sports officials found that knowledge about concussion symptoms is associated with greater self-efficacy for calling an injury timeout for a possible concussion (Kroshus, Parsons, & Hainline, 2017). In 2014, CDC developed an educational handout for sports officials on concussion. However, to our knowledge there is no published literature on sports officials' concussion knowledge, attitudes, and behaviors at the youth sports level. In addition, there is no available research on the effectiveness of concussion educational materials or interventions developed specifically for sports officials at the youth sports level.

The role of athletic trainers and their positive contributions to concussion identification and response at the high school and college levels is well-documented (Broglio et al., 2014; Kroshus, Rivara, Whitlock, Herring, & Chrisman, 2017; McGuine et al., 2018). Athletic trainers conduct concussion evaluations, initiate plans for concussion management, and assist with concussion education and prevention (Broglio et al., 2014). The National Athletic Trainers' Association (NATA) recommends that sports programs have athletic trainers at both practices and games (Broglio et al., 2014). At the high school level, approximately 70% of schools have access to a full-time, part-time, or per diem athletic trainer (Pryor et al., 2015). Current estimates of youth sports program's access to athletic trainers at practices and competitions falls well short of this and the NATA recommendation, with only 53% of youth sports coaches in one study reporting having access to an athletic trainer at some or all games and practices (Sarmiento, Daugherty, & DePadilla, 2019). There are a limited number studies on educational tools and knowledge related to concussion among athletic trainers at the high school level (McGrath, McGrath, & Bastola, 2017; Naftel, Yust, Nichols, King, & Davis, 2014). However, as with sports officials, research on concussion knowledge, attitudes, and behaviors, or the effectiveness of interventions developed specifically for athletic trainers at the youth sports level, is not currently available.

The purpose of this paper is to present findings from an analysis of the CDC HEADS UP online training pre-test and post-test modules completed by participants who self-reported as an athletic trainer or sports official. Changes in knowledge, attitudes, and behavioral intentions related to concussion among these groups prior to and immediately after completing the training are examined. Findings from this manuscript can help CDC update the HEADS UP campaign content, including updates to future iterations of the training and other materials.

2. Methods

In response to the educational requirements included within many of the state-level concussion in sports laws (Harvey, 2013), coaches and others involved in youth athletics are often directed by their sports programs or schools to complete the CDC HEADS UP online training prior to the start of the sports season. The CDC HEADS UP training is offered at no cost and accessible to any individual through CDC's website (Centers for Disease Control and Prevention, 2017). Responses to the training's pre- and post-tests are recorded in a secure database using a unique code to protect the privacy of the participants. Data for this paper were collected between November 2016 and November 2017. The course took approximately 30–40 min to complete (the tests took approximately 10 min) and the participants received a certificate of completion upon passing the post-test. CDC determined that data collection was not subject to Institutional Review as the data were collected as part of the regular function of the training and designed for training improvement and evaluation.

2.1. Measures

Questions for the pre- and post-tests were generated based on knowledge gaps identified in the literature (Sarmiento, Donnell, & Hoffman, 2017), expert input and through formative testing completed as part of the CDC HEADS UP campaign. Questions were consistent with content presented in the training and were not written to assess specific domains other than general concussion knowledge, attitudes and behavioral intentions. Both the pre- and post-tests included 13 knowledge questions and 7 behavioral intention and attitude questions (see Tables 2 and 3 for question text and response types and the online appendix for complete survey).

2.2. Analysis

All 13 knowledge questions were re-coded for analysis such that correct responses = 1 and incorrect responses = 0. The seven behavioral intention and attitudes questions were each measured on a 5-point Likert scale ranging from "strongly disagree" to "strongly agree." Respondents received 1–5 points for each item, with higher scores indicating a greater level of agreement with each statement.

Descriptive statistics for study variables were computed using the sample of sports officials and athletic trainers who completed the pre-test and the post-test. Cases were excluded if either the pre-test or post-test was not completed ($n = 367$, 2.6%). Approximately 4.7% of the sample ($n = 650$) indicated that they were both a sports official and an athletic trainer. These cases were dropped from the analysis as we were interested in determining the difference between the two categories. The final sample included 9,864 sports officials and 3,463 athletic trainers. Medians were reported for the attitude and behavioral intentions items given the ordinal nature of the data. McNemar's tests were computed to detect statistically significant differences between pre- and post-test knowledge items while Wilcoxon signed rank tests for paired observations were used to compare pre- and post-test attitude and behavioral intention items. SAS version 9.3 was used to compute all statistics (http://www.sas.com).

Due to the large sample size and the associated possibility that reporting *p*-values alone might be misleading in regard to practical significance (Sullivan & Feinn, 2012), effect sizes were computed for each McNemar's and Wilcoxon signed rank test. Cohen's g was computed for each McNemar's test; a g of less than 0.15 is considered to have a small effect size, a g between 0.15 and <0.25 has a medium effect size, and a g of 0.25 or greater has a large effect size (Cohen, 1988). Effect sizes (r) were also computed for each Wilcoxon signed rank test using the Z-score and interpreted in accordance with Cohen (1988). An *r* of 0.1 represents a small effect size (low level of practical significance), an *r* of 0.3 represents a medium effect size (medium/moderate level of practical significance), and an *r* of 0.5 represents a large effect size (high level of practical significance; Cohen, 1988). Medium and large effects were considered to indicate a practical or substantive change between the pre-test and post-test. The number of missing responses was negligible for all questions, ranging from 0 to 108 to cases (0.0%–1.4%).

3. Results

The sports officials and athletic trainers who took the CDC HEADS UP training were involved with a variety of sports (Table 1). The most common sport for sports officials was soccer (50.2%), followed by baseball (31.9%), and basketball (23.0%). Soccer was also the most common sport among athletic trainers (35.9%), followed by football (27.7%), and basketball (25.7%). Most sports officials and athletic trainers worked with multiple age groups of children, but the most common age group that sports officials worked with was children aged 11–13 years (72.7%). The most common age group athletic trainers worked with were those aged 14–18 years (63.2%). About three-fourths of both sports officials (77.6%) and athletic trainers (73.4%) reported working with both boys and girls.

Table 2 displays the results of the changes in percentage of respondents who answered each pre- and post-test knowledge question correctly. Of the 13 questions, eight pre-test questions were answered correctly by 90% or more sports officials and seven questions were answered correctly by more than 90% of athletic trainers. All questions demonstrated statistically significant improvement from pre- to post-test, and most also had a medium or high level of practical significance as judged by Cohen's g. However, because of the large number of questions, only results related to the questions in which fewer than 90% of respondents knew the correct answer on the pre-test are presented here in the text (full results are available in Table 2).

About 88.6% of sports officials and 86.5% of athletics trainers knew that it was true that, "Athletes who have ever had a concussion are at increased risk for another concussion," in the pre-test. Those percentages improved to 94.6% and 93.5%, respectively, and both Cohen's g's for the differences indicate a large level of practical significance ($g = 0.31$ and 0.30, respectively). About 34.3% of sports officials and 34.5% of athletic trainers knew that it was true that, "Athletes who are removed from play because of a possible concussion should return to play only after they are back to their regular school activities," in the pre-test. In the post-test these percentages improved to 57.0% and 55.2%, respectively. The improvements were statistically significant ($p < 0.0001$) and the effect size indicated a large level of practical significance (Cohen's $g = 0.31$ and 0.28, respectively). About 6 in 10

sports officials (62.4%) and athletic trainers (59.1%) knew the correct response to the scenario asking what to do with an athlete who sustains a concussion during a game but wants to keep playing. In the post-test these percentages increased to 89.1% an 86.5%, respectively. The changes were statistically significant (both $p < 0.0001$) and had a large practical significance (both Cohen's $g = 0.44$). In the pre-test, 68.4% of sports officials and 66.4% of athletic trainers knew the correct response to "Most athletes with a concussion feel better [in what time frame]?" In the post-test, 81.4% of sports officials and 77.6% of athletic trainers answered it correctly. These differences were statistically significant (both $p < 0.0001$) and demonstrated a large level of practical significance (Cohen's $g = 0.26$) for sports officials and a medium level of practical significance (Cohen's $g = 0.22$) for athletic trainers. Finally, 45.0% of sports officials and 42.9% of athletic trainers knew the correct answer to the question, "What percentage of athletes do researchers think try to hide their concussion symptoms from their coach?" in the pre-test. These percentages improved to 63.9% and 58.7% in the post-test. Both of these improvements were statistically significant (both $p < 0.0001$) and had a medium level of practical significance (Cohen's $g = 0.24$ and 0.21, respectively).

The distribution and median score for the respondents' pre- and post-test attitudes are displayed in Table 3. Because all the changes between the pre- and post-test for the attitude items were statistically significant at $p < 0.05$, we instead focus on those changes that had a medium or high level of practical significance. For the item, "I am confident in my ability to recognize concussion symptoms in youth athletes," the median score for sports officials and athletic trainers both improved from a 4 to a 5. The difference for both also demonstrated a high level of practical significance ($r = -0.62$ and -0.55, respectively). While the median score for the item, "There are things I can do to help prevent concussion among my athletes," did not change between the pre- and post-test for either sports officials or athletic trainers, the difference had a medium level of practical significance for both sports officials ($r = -0.39$) and athletic trainers (-0.35), and the percentage who agreed or strongly agreed increased from the pre-test (90.6% and 92.3%, respectively) to the post-test (96.9% and 97.7%, respectively). The median score for the item, "I am confident in my ability to help an athlete with the return to play process," improved from 4 to 5 for both sports officials and athletic trainers. Both changes demonstrated a high level of practical significance ($r = -0.59$ and -0.50, respectively). For the item, "I talk with my athletes about concussion and encourage them to report concussion symptoms," the median score improved from a 4 to a 5 for sports officials but remained at a 5 for athletic trainers (however, the percentage who agreed or strongly agreed increased from 81.8% to 95.8%). The difference for sports officials had a high level of practical significance ($r = -0.51$) and a medium level of practical significance ($r = -0.48$) for athletic trainers.

Lastly, the median score for the item, "I plan to teach my athletes ways to prevent concussion," improved from a 4 to a 5 for sports officials but again remained at a 5 for athletic trainers (the percentage who agreed or strongly agreed increased from 93.9% to 98.4%). The difference between pre- and post-test demonstrated a medium effect size for both groups ($r = -0.46$ and -0.38, respectively).

4. Discussion

This study found that sports officials' and athletic trainers' concussion knowledge, attitudes, and behavioral intentions improved immediately following completion of the CDC HEADS UP online training. Reducing knowledge gaps among sports officials and athletic trainers is critical as both groups play an integral part in recognizing and responding to possible sports-related concussions among youth athletes. Sports officials can help set the tone for safe play, thereby decreasing athletes' risk for concussion (Harmon et al., 2019), while athletic trainers are often on the front lines in responding to and managing a concussion among athletes. Their roles are increasingly recognized as important to concussion safety. According to the National Conference of State Legislatures, several of the 50 state-level sports concussion laws that passed since 2009 explicitly mention a role for sports officials and athletic trainers in concussion protocols (National Conference of State Legislatures, 2018). Sports officials and athletic trainers can therefore be a critical partner to clinicians in being first responders to potential sports-related concussion among youth.

While most of the previous research assessing concussion knowledge has focused on coaches (Daugherty, DePadilla, & Sarmiento, 2019; McLeod, Schwartz, & Bay, 2007; Mrazik, Bawani, & Krol, 2011), and the athletes themselves (Cournoyer & Tripp, 2014; Kurowski, Pomerantz, Schaiper, & Gittelman, 2014; Register-Mihalik et al., 2013), this is one of the first studies to assess concussion knowledge and attitudes among sports officials and athletic trainers. This study showed that overall, sports officials and athletic trainers entered the training with strong baseline knowledge and attitudes consistent with concussion management strategies supported by research and consensus statements about concussion. For more than half of the knowledge questions, 90% of both sports officials and athletic trainers were able to answer the pre-test question correctly. All questions showed statistically significant improvement and 11 of the 13 demonstrated practical improvement between pre- and post-test based on effect size. The findings also show that the training is particularly effective in improving sports officials' and athletic trainers' knowledge regarding concussion protocols and recovery (such as when to return an athlete to play and the average time of concussion symptom resolution). For example, only about 60–68% of respondents answered the pre-test the questions on concussion protocols and recovery correctly. The percentages of correct responses improved to 80–90% in the post-test. These results demonstrate that first, education in these areas may be needed, and second, that the CDC HEADS UP training was effective in transmitting this information.

There were only two knowledge questions ("What percentage of athletes do researchers think try to hide their concussion symptoms from their coach?" and "Athletes who are removed from play because of a possible concussion should return to play only after they are back to their regular school activities") in which less than half of the participants responded correctly on the pre-test. Sports officials and athletic trainers in this study performed similarly to coaches when asked these same questions as part of a separate study of the effectiveness of the HEADS UP online training on coaches knowledge, attitudes, and behavioral intentions (Daugherty et al., 2019). That analysis found that only 43% of coaches answered the question about the percentage of athletes who try to hide their concussion symptoms from coaches correctly on the pre-test and only 32% of coaches answered the

question about athletes returning to play after they have resumed their normal school activities correctly (Daugherty et al., 2019). In the current study and the study of coaches, the percentage of correct responses improved by approximately 20 percentage points for each group between the pre- and post-test. Still, while participants in this study showed improvement in answering these two questions correctly after taking the training, there was a sizeable proportion of respondents who answered these questions incorrectly in the post-test. This could indicate a need for further, more in-depth education and training on these topics, including in the HEADS UP training, and clearly identifying why sports officials and athletic trainers should be aware of these issues.

Self-efficacy (i.e., confidence in one's ability to enact a behavior) has been theorized to be an important determinant of intentions and behaviors (Sheeran et al., 2016). Findings from this study suggest that the training led to improved concussion-related self-efficacy—with significant and practical improvements in responses to attitude-related questions immediately after taking the training. For example, the questions, "I am confident in my ability to recognize concussion symptoms in youth athletes," and, "I am confident in my ability to help an athlete with the return to play process," showed a high practical significance level of improvement immediately after taking the training as indicated by effect size. While these findings are promising, HEADS UP training could be expanded to include and examine additional components of health behavior theories, such as perceived benefits and barriers, to inform updates and potential improvements to the training (Sheeran et al., 2016). In addition, future updates to the HEADS UP online training could consider integrating adult learning theories to help ensure uptake of the information presented (Rice & Curtis, 2019).

Finally, this study was the first to examine the effectiveness of a large-scale educational intervention on sports officials' and athletic trainers' knowledge, attitudes, and intentional behavioral intentions. However, the online format of the training did not allow for an assessment of how real-life social and environmental factors, affect participants' concussion attitudes and behaviors (Sarmiento et al., 2017). Thus, to better understand how concussion recognition and response play out in real life situations, including among sports officials and athletic trainers, "CDC" is funding two large-scale research studies. The first study conducted by Seattle Children's Hospital and Georgia Southern University is assessing the effectiveness of pre-game safety huddles on concussion reporting and response (Seattle Pediatric Concussion Research Collaborative, 2019). Sports officials and athletic trainers are often involved in these huddles, which focus on values of sportsmanship (i.e., not engaging in dangerous and illegal collisions); and shared responsibility that no athlete play while concussed. The second study utilizes the Popular Opinion Leader model and will test an intervention focused on preventing concussion among middle school athletes across five sports (football, boys' soccer, girls' soccer, boys' basketball, and girls' basketball; Kerr et al., 2018). The goal of this study is to demonstrate the effectiveness of a local concussion prevention program on knowledge, attitudes, behaviors, and health outcomes in these youth sports. Once completed, the results from these studies will be incorporated into future refinements of the HEADS UP training.

4.1. Limitations

There are several limitations to this study. These pre- and post-test data are based on a convenience sample of sports officials and athletic trainers who are involved in youth athletics and took the CDC HEADS UP training. The findings are therefore not generalizable to other populations. Further, though used by a large number of sports officials and athletic trainers, this training was designed for use by youth sports coaches. It is possible that a training targeted specifically to these groups, with their unique roles in mind, would be more effective. Multiple choice questions, and particularly true/false questions, likely overestimate the level of knowledge of the respondents as recognition of the correct choice is all that is required and, additionally, they have a 25–50% chance of randomly guessing correctly. It is also likely that social desirability played a role in the respondents' answers, particularly to the attitude questions. They likely knew what the "correct" or socially desirable response was. This may inflate both the pre- and post-test agreement with these items, although it may not impact the change seen between the pre- and post-test. This evaluation focused on changes in knowledge, attitudes, and behavioral intentions immediately after completing the HEADS UP online training; thus, it is unclear if the improvements gained will be translated into on-field behaviors or actions. It was also unclear how much education the respondents had received prior to taking the HEADS UP training. Consequently, the results may minimize the improvement that could be seen for those receiving education of this type for the first time. Future studies may identify how knowledge, attitudes, and behavior improve when receiving concussion education for the first time. In addition, while this study attempted to capture attitudes using scenario questions, it was not able to examine real-life environmental and social factors that can influence decision-making regarding concussion during a sports practice or game.

4.2. Practical applications

This study found that sports officials' and athletic trainers' concussion knowledge, attitudes, and behavioral intentions improved immediately following completion of the CDC HEADS UP online training and identified gaps in knowledge that may require additional training. These results can be used by CDC and others developing and disseminating concussion educational efforts specifically tailored to athletic trainers and sports officials.

Supplementary Material

Refer to Web version on PubMed Central for supplementary material.

Biography

Jill Daugherty, PhD, MPH is an epidemiologist at the Centers for Disease Control and Prevention, National Center for Injury Prevention and Control, Division of Injury Prevention. She earned her doctorate in sociology from Emory University in Atlanta where she focused on social inequality. Her work at the CDC focuses on disparities in traumatic brain injury and concussion knowledge and prevention. Previously she was employed at CDC's National Center for Health Statistics in Maryland.

Lara DePadilla, PhD is a Senior Health Scientist in the Division of Overdose Prevention in the National Center for Injury Prevention and Control. She earned her doctorate in Public Health from Emory University in Atlanta where she focused on behavioral science. In her role she contributes to scientific review, planning and training. Prior to that, she was a Behavioral Scientist on the Traumatic Brain Injury (TBI) Team and served as the project lead for the development of a national concussion surveillance system.

Kelly Sarmiento, MPH is a public health advisor at the Centers for Disease Control and Prevention's (CDC) Injury Center in Atlanta, Georgia. Over the last 15 year at CDC's Injury Center, Kelly has worked on multiple national and award-winning educational campaigns and initiatives that focus on raising awareness and improving prevention, recognition, and management of traumatic brain injuries, including concussion. Kelly has a Master of Public Health from Yale University School of Epidemiology and Public Health, and a BA in Anthropology and a BA in Spanish from the University of California, Santa Barbara.

References

Broglio SP, Cantu RC, Gioia GA, Guskiewicz KM, Kutcher J, Palm M, & McLeod TCV (2014). National Athletic Trainers' Association position statement: Management of sport concussion. Journal of athletic training, 49(2), 245–265. [PubMed: 24601910]

Bureau of Labor Statistics (2019). Umpires, Referees, and Other Sports Officials Retrieved from https://www.bls.gov/ooh/entertainment-and-sports/umpires-referees-and-other-sports-officials.htm?view_full.

Centers for Disease Control and Prevention (2016). About Heads Up Retrieved from https://www.cdc.gov/headsup/about/index.html.

Centers for Disease Control and Prevention (2017). HEADS UP to Youth Sports: Online Training Retrieved from https://www.cdc.gov/headsup/youthsports/training/index.html.

Cohen J (1988). Statistical power analysis for the behavioral sciences. New York: NY Routledge.

National Conference of State Legislatures. (2018). Traumatic Brain Injury Legislation Retrieved from http://www.ncsl.org/research/health/traumatic-brain-injury-legislation.aspx.

Coronado VG, Haileyesus T, Cheng TA, Bell JM, Haarbauer-Krupa J, Lionbarger MR, ... Gilchrist J (2015). Trends in Sports- and Recreation-Related Traumatic Brain Injuries Treated in US Emergency Departments: The National Electronic Injury Surveillance System-All Injury Program (NeISS-AIP) 2001–2012. Journal of Head Trauma Rehabilitation, 30(3), 185–197. 10.1097/HTR.0000000000000156. [PubMed: 25955705]

Cournoyer J, & Tripp BL (2014). Concussion knowledge in high school football players. Journal of Athletic Training, 49(5), 654–658. [PubMed: 25162779]

Daugherty J, DePadilla L, & Sarmiento K (2019). Effectiveness of the US Centers for Disease Control and Prevention HEADS UP coaches' online training as an educational intervention. 0(0), 0017896919846185. doi:10.1177/0017896919846185

Harmon KG, Clugston JR, Dec K, Hainline B, Herring SA, Kane S, ... Roberts WO (2019). American Medical Society for sports medicine position statement on concussion in sport. Clinical Journal of Sport Medicine, 29(2), 87–100. 10.1097/jsm.0000000000000720. [PubMed: 30730386]

Harvey HH (2013). Reducing traumatic brain injuries in youth sports: Youth sports traumatic brain injury state laws, January 2009–December 2012. American journal of Public Health, 103(7), 1249–1254. [PubMed: 23678903]

Kerr Z, Register-Mihalik J, Haarbauer-Krupa J, Kroshus E, Go V, Gildner P, ... Marshall S (2018). Using opinion leaders to address intervention gaps in concussion prevention in youth sports: Key concepts and foundational theory. Injury Epidemiology, 5(1), 28 10.1186/s40621-018-0158-7. [PubMed: 29984386]

Kroshus E, Parsons J, & Hainline B (2017). Calling injury timeouts for the medical evaluation of concussion: Determinants of collegiate football officials' behavior. Journal of Athletic Training, 52(11), 1041–1047. [PubMed: 29140129]

Kroshus E, Rivara FP, Whitlock KB, Herring SA, & Chrisman SP (2017). Disparities in athletic trainer staffing in secondary school sport: Implications for concussion identification. Clinical Journal of Sport Medicine, 27(6), 542–547. [PubMed: 28742604]

Kurowski B, Pomerantz WJ, Schaiper C, & Gittelman MA (2014). Factors that influence concussion knowledge and self-reported attitudes in high school athletes. The Journal of Trauma Acute Care Surgery, 77(301), S12. [PubMed: 25153048]

McGrath SP, McGrath ML, & Bastola D (2017). Developing a concussion assessment mHealth app for certified Athletic Trainers. Paper presented at the AMIA annual symposium proceedings.

McGuine TA, Pfaller AY, Post EG, Hetzel SJ, Brooks A, & Broglio SP (2018). The influence of athletic trainers on the incidence and management of concussions in high school athletes. Journal of Athletic Training.

McLeod TCV, Schwartz C, & Bay RC (2007). Sport-related concussion misunderstandings among youth coaches. Clinical Journal of Sport Medicine, 17(2), 140–142. [PubMed: 17414483]

Mrazik M, Bawani F, & Krol AL (2011). Sport-related concussions: Knowledge translation among minor hockey coaches. Clinical Journal of Sport Medicine, 21(4), 315–319. [PubMed: 21694594]

Naftel KG, Yust EM, Nichols MH, King WD, & Davis D (2014). Knowledge and management of sports concussions among coaches and certified athletic trainers in Alabama. Southern Medical Journal, 107(7), 418–423. [PubMed: 25010582]

Pryor RR, Casa DJ, Vandermark LW, Stearns RL, Attanasio SM, Fontaine GJ, & Wafer AM (2015). Athletic training services in public secondary schools: A benchmark study. Journal of Athletic Training, 50(2), 156–162. [PubMed: 25689559]

Register-Mihalik JK, Guskiewicz KM, McLeod TCV, Linnan LA, Mueller FO, & Marshall SW (2013). Knowledge, attitude, and concussion-reporting behaviors among high school athletes: A preliminary study. Journal of Athletic Training, 48(5), 645–653. [PubMed: 23848520]

Rice T, & Curtis R (2019). Parental knowledge of concussion: Evaluation of the CDC's "Heads up to parents" educational initiative. Journal of Safety Research, 69, 85–93. 10.1016/j.jsr.2019.02.007. [PubMed: 31235239]

Sarmiento K, Daugherty J, & DePadilla L (2019). Youth and High School Sports Coaches' experience with and attitudes about concussion and access to athletic trainers by sport type and age of athlete coached. Journal of Safety Research, 69, 217–225. [PubMed: 31235231]

Sarmiento K, Donnell Z, & Hoffman R (2017). A scoping review to address the culture of concussion in youth and high school sports. Journal of School Health, 87(10), 790–804. [PubMed: 28876477]

Sarmiento K, Hoffman R, Dmitrovsky Z, & Lee R (2014). A 10-year review of the Centers for Disease Control and Prevention's Heads Up initiatives: Bringing concussion awareness to the forefront. Journal of safety research, 50, 143. [PubMed: 25142371]

Sarmiento K, Thomas KE, Daugherty J, Waltzman D, Haarbauer-Krupa JK, Peterson AB, ... Breiding MJ (2019). Emergency department visits for sports- and recreation-related traumatic brain injuries among children – United States, 2010–2016. Morbidity and Mortality Weekly Report, 68(10), 237–242. 10.15585/mmwr.mm6810a2.

Seattle Pediatric Concussion Research Collaborative (2019). Huddle up for concussion safety! Retrieved from https://concussionspaceorg/.

Sheeran P, Maki A, Montanaro E, Avishai-Yitshak A, Bryan A, Klein WM, ... Rothman AJ (2016). The impact of changing attitudes, norms, and self-efficacy on health-related intentions and behavior: A meta-analysis. Journal of Health Psychology, 35(11), 1178–1188. 10.1037/hea0000387.

Sullivan GM, & Feinn R (2012). Using effect size—or why the P value is not enough. Journal of Graduate Medical Education, 4(3), 279–282. 10.4300/JGME-D-12-00156.1. [PubMed: 23997866]

Table 1

Background characteristics of respondents of total sample of sports officials and athletic trainers who took the HEADS UP online training.

	Sports official		Athletic trainer	
Respondent's tole	**Frequency**	**Percent**	**Frequency**	**Percent**
Sports Official	9,864	100.0	N/A	
Athletic Trainer	N/A		3,463	100.0
Sport respondent is involved with[a,b,c]				
Soccer	4,944	50.1	1,235	35.7
Baseball	3,142	31.9	692	20.0
Football	1,698	17.2	952	27.5
Basketball	2,268	23.0	885	25.6
Softball	1,657	16.8	508	14.7
Ice Hockey	407	4.1	218	6.3
Volleyball	914	9.3	486	14.0
Track and Field	548	5.6	626	18.1
Lacrosse	309	3.1	260	7.5
Gymnastics	194	2.0	392	11.3
Wrestling	346	3.5	343	9.9
Tennis	219	2.2	269	7.8
Field Hockey	83	0.8	140	4.0
Diving	73	0.7	120	3.5
Rugby	77	0.8	106	3.1
Other	1,150	11.7	1,204	34.8
Age of children respondent works with[a,b,d]				
5 and younger	2,522	25.6	845	24.4
6–10	6,649	67.4	1,778	51.3
11–13	7,159	72.6	2,078	60.0
14–18	5,936	60.2	2,184	63.1
N/A	795	8.1	498	14.4
Sex of children respondent works with[a]				
Boys	1485	15.1	496	14.3
Girls	580	5.9	285	8.2
Both	7,654	77.6	2,542	73.4
N/A	145	1.5	140	4.0
Total	9,864	100.0	3,463	100.0

[a] Only includes respondents who selected one category of respondent, e.g. only athletic trainer or only sports official.

[b] Respondents were permitted to select more than one response; there were 13,327 unique respondents.

[c] 3,956 sports officials and 1,534 athletic trainers selected multiple sports.

[d] 7,269 sports officials and 2,056 athletic trainers selected multiple age groups.

Table 2

Pre- and post-test concussion-related knowledge questions for HEADS UP training.

	Sports officials				
	Pre-test	Post-test	Difference		
	Percent Correct[b]	Percent Correct	s score	*p*-value	Cohen's g
I need permission from an athlete's parent to remove him or her from play when a concussion is suspected (False)[a]	97.7	98.8	34.6	<0.0001	0.16
A concussion in a brain injury (True)[a]	97.6	98.7	39.7	<0.0001	0.18
When should you talk to an athlete's parents about the possible concussion she or he may have had?[c]	97.3	98.8	82.8	<0.0001	0.28
Consider the following scenario: One of your athletes went to the emergency department to get checked for a concussion after yesterday's practice. When he arrives at practice today, what do you do?[c]	96.6	98.6	137.9	<0.0001	0.34
There is a possible risk of death if a repeat concussion occurs before the first one has healed (True)[a]	96.5	93.7	31.9	<0.0001	0.10
Which of the following would be considered danger signs of the most serious type of head or brain injury and require rushing an athlete to the emergency department immediately?[c]	93.9	97.0	143.0	<0.0001	0.23
Athletes should have more than one concussion symptom before they are removed from play (False)[a]	91.7	94.8	105.0	<0.0001	0.17
An athlete who is experiencing the effects of a concussion performs the same as an athlete who doesn't have a concussion (False)[a]	91.4	92.5	13.0	0.0003	0.06
Athletes who have ever had a concussion are at increased risk for another concussion (True)[a]	88.6	94.6	366.7	<0.0001	0.31
Most athletes with a concussion feel better [in what time frame]?[c]	68.4	81.4	675.3	<0.0001	0.26
Consider the following scenario: It is the last quarter of the championship game and your best athlete is knocked down and you think she may have hit her head. She continues playing, but you notice that she is not acting right. You call a time-out to talk to her. She says she is fine and wants to keep playing. What do you do?[c]	62.4	89.1	2,341.3	<0.0001	0.44
What percentage of athletes do researchers think try to hide their concussion symptoms from their coach?[c]	45.0	63.9	907.0	<0.0001	0.24
Athletes who are removed from play because of a possible concussion should return to play only after they are back to their regular school activities (True)[a]	34.3	57.0	1,360.2	<0.0001	0.31
	Athletic trainers				
	Pre-test	Post-test	Difference		
	Percent Correct[b]	Percent Correct	s-score	*p*-value	Cohen's g
I need permission from an athlete's parent to remove him or her from play when a concussion is suspected (False)[a]	96.9	98.6	25.5	<0.0001	0.22
A concussion in a brain injury (True)[a]	96.3	98.1	23.7	<0.0001	0.19

When should you talk to an athlete's parents about the possible concussion she or he may have had?[c]	96.6	97.9	19.2	<0.0001	0.21
Consider the following scenario: One of your athletes went to the emergency department to get checked for a concussion after yesterday's practice. When he arrives at practice today, what do you do?[c]	96.4	98.2	33.9	<0.0001	0.27
There is a possible risk of death if a repeat concussion occurs before the first one has healed (True)[a]	95.0	91.6	39.2	<0.0001	0.17
Which of the following would be considered danger signs of the most serious type of head or brain injury and require rushing an athlete to the emergency department immediately?[c]	92.6	95.4	33.6	<0.0001	0.17
Athletes should have more than one concussion symptom before they are removed from play (False)[a]	90.9	94.3	37.9	<0.0001	0.16
An athlete who is experiencing the effects of a concussion performs the same as an athlete who doesn't have a concussion (False)[a]	88.5	89.7	4.9	0.03	0.06
Athletes who have ever had a concussion are at increased risk for another concussion (True)[a]	86.5	93.5	146.5	<0.0001	0.30
Most athletes with a concussion feel better [in what time frame]?[c]	66.4	77.6	174.2	<0.0001	0.22
Consider the following scenario: It is the last quarter of the championship game and your best athlete is knocked down and you think she may have hit her head. She continues playing, but you notice that she is not acting right. You call a time-out to talk to her. She says she is fine and wants to keep playing. What do you do?[c]	59.1	86.5	835.6	<0.0001	0.44
What percentage of athletes do researchers think try to hide their concussion symptoms from their coach?[c]	42.9	58.7	234.2	<0.0001	0.21
Athletes who are removed from play because of a possible concussion should return to play only after they are back to their regular school activities (True)[a]	34.5	55.2	395.2	<0.0001	0.28

[a] True/false item.

[b] The questions are displayed as the percentage of respondents who answered the question correctly (i.e. answered a true question as true or a false question as false or selected the correct response for the multiple choice item).

[c] Multiple choice item.

Table 3

Pre- and post-test concussion attitude questions[a] for HEADS UP training.

	Sports officials										
	Pre-test				Post-test				Difference		
	Frequency	Percent	Median	Interquartile range for median	Frequency	Percent	Median	Interquartile range for median	Z-score	*p*-value	r
Concussions are serious			5	5–5			5	5–5	−7.547	<0.0001	−0.08
Strongly agree	9,446	95.8			9,485	97.2					
Agree	393	4.0			270	2.8					
Neither agree nor disagree	13	0.1			3	0.0					
Disagree[b]	0	0.0			0	0.0					
Strongly disagree	11	0.1			0	0.0					
I am confident in my ability to recognize concussion symptoms in youth athletes			4	4–5			5	4–5	−61.064	<0.0001	−0.62
Strongly agree	3,604	36.5			7,255	74.4					
Agree	4,305	43.7			2,430	24.9					
Neither agree nor disagree	1,477	15.0			56	0.6					
Disagree	408	4.1			11	0.1					
Strongly disagree	69	0.1			6	0.1					
There are things I can do to help prevent concussion among my athletes			5	4–5			5	4–5	−38.185	<0.0001	−0.39
Strongly agree	4,945	50.1			6,985	71.6					
Agree	3,993	40.5			2,464	25.3					
Neither agree nor disagree	815	8.3			283	2.9					
Disagree	89	0.9			21	0.2					
Strongly disagree	21	0.2			4	0.0					
My athletes would tell me if they experienced			3	3–4			4	3–4	−26.705	<0.0001	−0.27

concussion symptoms											
Strongly agree	1,265	12.8			2,104	21.6					
Agree	2,943	29.8			3,435	35.2					
Neither agree nor disagree	3,858	39.1			2,737	28.1					
Disagree	1,583	16.1			1,296	13.3					
Strongly disagree	214	2.2			186	1.9					
I am confident in my ability to help an athlete with the return to play process			4	3–5			5	4–5	−58.439	<0.0001	−0.59
Strongly agree	3,151	32.0			6,303	64.6					
Agree	3,989	40.4			3,029	31.0					
Neither agree nor disagree	1,988	20.2			353	3.6					
Disagree	603	6.1			52	0.5					
Strongly disagree	132	1.3			21	0.2					
I talk with my athletes about concussion and encourage them to report concussion symptoms			4	3–5			5	4–5	−50.574	<0.0001	−0.51
Strongly agree	3,702	37.5			6,006	61.6					
Agree	3,351	34.0			2,912	29.8					
Neither agree nor disagree	2,283	23.2			775	7.9					
Disagree	437	4.4			55	0.6					
Strongly disagree	89	0.9			10	0.1					
I plan to teach my athletes ways to prevent concussion			4	4–5			5	4–5	−45.809	<0.0001	−0.46
Strongly agree	4,536	46.0			6,790	69.6					
Agree	3,805	38.6			2,504	25.7					
Neither agree nor disagree	1,390	14.1			448	4.6					
Disagree	103	1.0			14	0.1					

Strongly disagree	28	0.3			2	0.0					
	Athletic trainers										
	Pre-test				Post-test				Difference		
	Frequency	Percent	Median	Interquartile range for median	Frequency	Percent	Median	Interquartile range for median	Z-score	*p*-value	r
Concussions are serious			5	5–5			5	5–5	−4.863	<0.0001	−0.08
Strongly agree	3,341	96.5			3,350	98.1					
Agree	111	3.2			62	1.8					
Neither agree nor disagree	6	0.2			2	0.1					
Disagree[b]	0	0.0			0	0.0					
Strongly disagree	5	0.1			1	0.0					
I am confident in my ability to recognize concussion symptoms in youth athletes			4	4–5			5	5–5	−32.318	<0.0001	−0.55
Strongly agree	1,720	49.7			2,801	82.0					
Agree	1,215	35.1			592	17.3					
Neither agree nor disagree	407	11.8			19	0.6					
Disagree	109	3.2			2	0.1					
Strongly disagree	12	0.4			1	0.0					
There are things I can do to help prevent concussion among my athletes			5	4–5			5	5–5	−20.590	<0.0001	−0.35
Strongly agree	2,084	60.2			2,693	78.9					
Agree	1,111	32.1			642	18.8					
Neither agree nor disagree	226	6.5			71	2.1					
Disagree	32	0.9			4	0.0					
Strongly disagree	10	0.3			5	0.2					
My athletes would tell me if they experienced concussion symptoms			4	3–4			4	3–5	−13.898	<0.0001	−0.24

Strongly agree	757	21.9			1,038	30.4					
Agree	407	32.5			1,215	35.6					
Neither agree nor disagree	1,092	31.5			742	21.7					
Disagree	407	11.8			363	10.6					
Strongly disagree	82	2.4			57	1.7					
I am confident in my ability to help an athlete with the return to play process			4	4–5			5	4–5	−29.304	<0.0001	−0.50
Strongly agree	1,619	46.8			2,550	74.7					
Agree	1,243	35.9			779	22.8					
Neither agree nor disagree	453	13.1			58	1.7					
Disagree	125	3.6			16	0.5					
Strongly disagree	23	0.7			12	0.4					
I talk with my athletes about concussion and encourage them to report concussion symptoms			5	4–5			5	4–5	−27.774	<0.0001	−0.48
Strongly agree	1,771	51.1			2,538	74.3					
Agree	1,062	30.7			733	21.5					
Neither agree nor disagree	492	14.2			136	4.0					
Disagree	120	3.5			7	0.2					
Strongly disagree	18	0.5			1	0.0					
I plan to teach my athletes ways to prevent concussion			5	4–5			5	5–5	−21.968	<0.0001	−0.38
Strongly agree	2,227	64.3			2,803	82.1					
Agree	1,025	29.6			558	16.3					
Neither agree nor disagree	197	5.7			48	1.4					
Disagree	12	0.4			2	0.1					
Strongly disagree	2	0.1			2	0.1					

[a] For all attitude items, “strongly agree” = 5, “agree” = 4, “neither agree nor disagree” = 3, “disagree” = 2, and “strongly disagree” = 1.

[b] Because of a programming error, “disagree” was not offered as a response option for this item.