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Effectiveness of the US Centers for Disease Control and Prevention HEADS UP coaches' online training as an educational intervention

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Abstract

Background: Concussions are common among youth athletes. Responsibility for the recognition and management of concussion is often put on coaches. To equip coaches with appropriate knowledge and skills, the US Centers for Disease Control and Prevention (CDC) launched the HEADS UP: Concussion in Youth Sports online training.

Objectives: To determine whether HEADS UP coaches' training improves knowledge, attitudes and behavioural intentions.

Methods: Knowledge questions were grouped into scales by level of difficulty. Differences between pre-and post-test scores were calculated based on the Wilcoxon Signed Rank Test *Z*-score and effect sizes were interpreted.

Results: Coaches displayed a high level of knowledge in the pre-test. While lower difficulty questions did not show improvement from pre- to post-test, moderate and high difficulty questions did. Use of the training was associated with improved knowledge about symptom resolution, return-to-play recommendations and under-reporting of incidents of concussion. Coaches demonstrated improvement in five of the seven concussion-related attitude and behavioural intention items post training.

Conclusion: HEADS UP training improved coaches' knowledge on select topics and helped them feel more comfortable about responding to concussion among their athletes. This study provides insight into how to better focus future HEADS UP concussion health education efforts to fit coaches' informational needs.

Keywords

Concussion; injury prevention; traumatic brain injury; USA; youth sports

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Declaration of conflicting interest

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Supplemental material

Supplemental material for this article is available online.

Background

Thousands of young people and high school athletes sustain concussion each year and the number of emergency department visits for sports- and recreation-related concussion has increased in recent years (Coronado et al., 2015). Caused by a bump, blow or jolt to the head or body, a concussion is associated with chemical changes in the brain and may include stretching and damaging of nerve cells (Centers for Disease Control and Prevention [CDC], 2017). While concussions are more common in contact sports such as football and rugby, research has demonstrated that they can occur in any sport (Marar et al., 2012).

Access to athletic trainers or other medical providers on the sidelines for practice, games or events is limited among youth sports programmes (Pryor et al., 2015) and may vary by a community's socioeconomic status (Kroshus et al., 2017; Post et al., 2018). Consequently, much of the responsibility related to concussion identification and response for young athletes may fall on youth sports coaches. While coaches may be well positioned to identify concussion among their athletes, there are practical limitations to their capabilities in this role. Research that was conducted between 5 and 10 years ago demonstrated that youth sports coaches are not able to identify some concussion symptoms and are often unsure about when to remove an athlete from play (Bramley et al., 2012; Guilmette et al., 2007; McLeod et al., 2007; White et al., 2013). At the same time, between 2009 and 2014, sports concussion laws were passed in all 50 US states and the District of Columbia. Many of these laws include concussion education requirements for coaches (Harvey et al., 2015) and therefore in recent years, coaches may have more exposure to concussion-related education. The findings of a previous randomised controlled trial demonstrated that online concussion training can be effective in increasing coaches' knowledge and improving their attitudes and self-efficacy related to concussion management in their athletes (Glang et al., 2010). To help equip youth sports coaches with the information and guidance they need to help protect young athletes, the US CDC developed the HEADS UP: Concussion in Youth Sports initiative (Sarmiento et al., 2014). First launched in 2007, this awareness campaign aims to help improve identification and management of a possible concussion in youth athletes, and reduce the risk for the potentially devastating effects of this injury.

In support of this goal, in 2010 the CDC created an online training for youth sports coaches on concussion as part of its HEADS UP campaign (CDC, 2019). Online training is increasingly seen as an effective way to provide training to busy coaches (Stewart, 2006). This online training also was designed to help support sports programmes and schools in implementing the educational requirements for coaches included in many of the state-level sports concussion laws (Harvey, 2013; Harvey et al., 2015). The training is available through the CDC's website (www.cdc.gov/HEADSUP) and features interviews with leading experts, dynamic graphics, video scenarios and knowledge checks and pre- and post-test quiz questions. Accessible to coaches of any sport and others involved with youth sports (e.g. sports officials, high school sports coaches and parents), to date over 2 million individuals have completed HEADS UP online training through website (Sarmiento et al., 2014). CDC HEADS UP routinely evaluates the content and the campaign and preferred dissemination strategies for each audience.

To help ensure the training provides youth sports coaches with the information and guidance they need, in 2016 CDC updated the training to emphasise the importance of improving the culture of concussion safety and to include pre-test and post-test modules. The pre-test and post-test modules are designed to help evaluate changes in coaches' concussion knowledge, attitudes and behavioural intentions immediately following the completion of the training. In addition, the pre-test module includes questions about coaches' demographic information, experience with concussion, access to athletic trainers and use of concussion educational tools. HEADS UP training is targeted specifically for coaches and is delivered by a source (i.e. CDC) that is considered trustworthy, in line with recognised principles of knowledge transfer and exchange (Abernathy et al., 2001).

Objectives

This paper assesses whether the HEADS UP coaches' training alters coaches' concussion knowledge, attitudes and behavioural intentions shortly after its completion. A secondary goal was to evaluate whether the knowledge index used in the training pre-test and post-tests assessed multiple distinct dimensions of concussion knowledge.

Methods

Offered at no cost, coaches and others involved in youth athletics are typically directed to the HEADS UP online training through sports programmes that require concussion education prior to the start of sports season. Responses to the training's pre- and post-tests are recorded in the 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 minutes to complete (the test took approximately 10 minutes) and the participants received a certification of completion upon passing the final post-test. The CDC determined that data collection was not subject to Institutional Review Board or Office of Management and Budget approval as the data were collected as part of the regular function of the training and designed for training improvement and evaluation.

Measures

Questions for the pre- and post-tests were generated based on knowledge gaps identified in the literature (Sarmiento et al., 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 behavioural intentions. Both the pre- and post-tests included 13 knowledge questions and 7 behavioural intention and attitude questions. See tables below for question text and response types, and the Supplemental online appendix for the complete survey.

Analysis

All 13 knowledge questions were re-coded for analysis such that correct responses = 1 and incorrect responses=0. First, a hierarchical cluster analysis (Revelle, 1979) was conducted to assess dimensionality and identify any sub-groups of pre-test concussion knowledge items. This analysis was undertaken in order to identify sets of items that might be measuring

knowledge of an underlying construct, for example, if several items measured one particular aspect of concussion knowledge such as proper return to play procedures, to better assess changes in knowledge. This procedure was similar to the one conducted by Rosenbaum and Arnett (2010) for their concussion knowledge scale. This procedure was used given the binary nature of the items which violated the normality and variability assumptions of factor analysis (Tabachnick and Fidell, 2007).

The seven behavioural intention and attitudes questions were each measured on a 5-point Likert-type 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 youth and high school sports coaches who completed the pre-test and the post-test. A missing end date for either test indicated that the test was not completed. Cases were excluded if they were missing either a pre-test end date or a post-test end date (n = 8,332). Medians were reported for all the measures given the ordinal nature of the data (Dilorio, 2005). SAS version 9.3 was used to compute descriptive statistics (http://www.sas.com). SPSS (https://www.ibm.com/analytics/spss-statistics-software) was used to compute Wilcoxon signed rank tests for paired observations comparisons between pre- and post-tests for both the knowledge clusters and the attitude and behavioural intention items.

Due to the large sample size and the associated possibility that reporting p-values alone might be misleading in regard to practical significance (Sullivan and Feinn, 2012), effect sizes were computed for each Wilcoxon signed rank test using the Z-score and interpreted in accordance with Cohen (1988). An r of .1 represents a small effect size, an r of .3 represents a medium effect size and an r of .5 represents a large effect size. 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 29 to 3,012 cases.

Results

Background characteristics of sample

Out of a total of 179,469 coaches who completed the training and finished the pre-test and post-test, 154,807 were youth sports coaches, 13,043 were high school coaches and 11,619 were both youth and high school sports coaches (Table 1). Respondents reported coaching a variety of sports, with 56,565 of them reporting coaching multiple sports. Soccer (37.4%), baseball (28.6%) and football (22.1%) were the most common sports in which respondents coached. About 6 in 10 coaches (61.1%) worked with children 6–10 years of age and half (49.6%) coached children age 11–13. About half of respondents coached both boys and girls, 33.1% coached only boys and 19.7% coached only girls.

Cluster analysis for knowledge questions

Table 2 shows the variation in topics assessed by items within each cluster. The cluster analysis did not reveal theoretical constructs underlying the knowledge question clusters.

Instead, the items seemed to cluster on the basis of difficulty, or rather, the percentage of respondents who answered each item correctly.

Respondents' concussion knowledge

Table 2 presents the results of the knowledge question cluster analysis as well as the percentage of respondents who answered correctly for each question and the median score for each level of difficulty as indicated by the knowledge cluster. The median score for the questions in the index that was designated 'least difficult' was 4.0 (out of 4) for both the pre- and post-tests. Although there was a statistically significant difference in pre- and post-test scores, the effect size for the difference was small (r=−.12). Results were similar for the cluster of five low difficulty questions. The median score for both pre- and post-tests was 5.0 and while there was a statistically significant change in scores, the effect size for the difference was small (−.14).

Two questions comprised the moderate difficulty knowledge index. The median score in the pre-test was 1.0 and that improved to 2.0 in the post-test (i.e. both questions answered correctly) and there was a medium effect size for the difference (r=−.48) between pre- and post-test responses. In the pre-test, only 64.8% knew how to correctly handle the scenario presented regarding return-to-play and 69.4% knew the correct time frame for when most athletes feel better after sustaining a concussion. These percentages improved to 90.1% and 82.1%, respectively, in the post-test. For the two-item high difficulty knowledge index, while the medians for both the pre- and post-tests were both 1.0, the analysis showed that the improvement in this index also had a medium effect size (r=−.42). Only about one-third of respondents could correctly identify in the pre-test that a student with a concussion should return to play after he or she is back to his or her regular school activities and 43.2% knew the approximate percentage of athletes who, based on estimates from prior research, try to hide their concussion symptoms from their coach. These percentages increased to 53.3% and 60.6%, respectively, after completing the course.

Attitudes and behavioural intentions about concussion and concussion preparation

Table 3 presents the pre- and post-test responses to the seven concussion-related attitude and behavioural intentions items. Responses to the item 'concussions are serious' did not substantively change between the pre- and post-tests (r=−.04). The median score for the item 'I am confident in my ability to recognise concussion symptoms in youth athletes' increased from 4.0 ('agree') to 5.0 ('strongly agree') from the pre- to the post-test. The effect size for the difference (r=−.59) was large, indicating substantive improvement. There was also substantive improvement for the item 'there are things I can do to help prevent concussions among my athletes' as indicated by the medium effect size (r=−.37). While the median score for this item did not change, the percentage who agreed or strongly agreed increased from the pre-test (93.9%) to the post-test (98.1%). Coaches' agreement with the statement 'my athletes would tell me if they experienced concussion symptoms' did not substantively change between the pre- and post-tests (r=−.23).

There was a substantive improvement for the item 'I am confident in my ability to help an athlete with the return to play process' after taking the course as indicated by a large effect

size (r=−.56). The median score for this item increased from 4.0 (‘agree’) to 5.0 (‘strongly agree’). There was similar improvement for the item ‘I talk with my athletes about concussion and encourage them to report concussion symptoms’ (r=−.52). The median for this item also increased from 4.0 to 5.0. About 44% of coaches strongly agreed with this statement in the pre-test; the percentage increased to 70.2% in the post-test. Finally, the item ‘I plan to teach my athletes ways to prevent concussion’ substantively improved between the pre- and post-tests (r=−.41) even though the median remained at 5.0. About 58.1% of respondents strongly agreed with the statement in the pre-test and 78.6% strongly agreed in the post-test.

Discussion

Results of this study suggest that HEADS UP training may help improve concussion knowledge, attitudes and behavioural intentions among coaches of youth and high school sports shortly after taking the training. Since the passage of state-level sports concussion laws, concussion education that meets legislative requirements for coaches has increased significantly (Sarmiento et al., 2017). The CDC online training was created to support implementation of these laws, and the expanded use of concussion education is reflected in the large number of coaches who complete the training each year. In fact, on average, approximately 10,000–30,000 people take the online training every month (Sarmiento et al., 2014). Research suggests that the implementation of these laws, and their related components, are having a positive impact. Yang and colleagues recently reported that following the passage of sports concussion laws, the increase in concussion rates are likely attributable to increased identification and reporting (Yang et al., 2017). In addition, they found that rates of repeat concussions decreased among athletes, likely due to implementation of concussion safety protocols which require the removal of an athlete with a suspected concussion from play (Yang et al., 2017).

Coaches’ level of concussion knowledge as measured by the questions that assessed understanding of the content of the CDC HEADS UP training was high for many coaches in this study and may be indicative of historical increases in knowledge. However, an evaluation of the appropriateness of the questions in future versions of the HEADS UP training pre-test is warranted. For nine of the 13 concussion knowledge questions - two of the four clusters - approximately 90% of the respondents were able to choose the correct response prior to taking the training. Previous research has also found that many coaches’ have good general awareness of concussion, including the ability to identify many concussion symptoms (Naftel et al., 2014; Sarmiento et al., 2017). The cluster analysis showed similarities in the level of difficulty among these questions, consistent with the findings of the cluster analysis performed by Rosenbaum and colleagues. This will help to identify groups of questions that should be considered for replacement in the next version of the HEADS UP pre-test and post-test. Only two of the four clusters, for a total of four questions, showed statistically significant and practical improvements between the pre- and post-tests. It may be helpful to interpret the knowledge questions, and their corresponding clusters, through the lens of Bloom’s revised taxonomy (Anderson et al., 2001) which offers an ‘ordering of cognitive skills’ going from the lowest level of ‘remembering’ to the highest level of ‘creating’. Most of our least and low difficulty question assemble around the lower

levels of the taxonomy. For example, four of the nine least and low difficulty questions can be considered questions requiring the coaches to simply ‘remember’ information. On the contrary, the moderate and high difficulty questions are more likely to require the coaches to ‘understand’, ‘apply’ or ‘analyse’ information. This taxonomy may be helpful in updating the test to ensure that there are questions assessing all levels of cognitive skills.

This study identified areas in which concussion knowledge among coaches may need improvement. For example, only 32% of respondents in the pre-test and 53% in the post-test responded that athletes should only return to play after they have resumed their normal school activities. Historically, concussion educational materials, state laws and school policies have focused on return to play protocols, while limited information focuses on return to school information. For example, consistent distribution of discharge instructions by healthcare providers to patients with concussion is limited, and when provided, these instructions generally do not provide strategies for returning to school after a concussion (Arbogast et al., 2013; De Maio et al., 2014). In addition, the majority of US state return to play laws and/or sports programme concussion policies do not include return to school components (Baugh et al., 2014). Greater attention on return to school within concussion educational materials and policies may help improve coaches’ knowledge on this issue, as well as their implementation of appropriate return to play protocols.

Only 43% of coaches in the pre-test and 61% in the post-test knew that, based on previous research, 60%–70% of athletes try to hide their concussion symptoms from coaches. Most coaches believed the percentage to be much lower. This is consistent with research conducted by Rivara et al. (2014). In that study, researchers interviewed a group of almost 800 high school athletes during the course of a season and found that 69% of athletes with a possible concussion played with concussion symptoms. Among the concussed athletes, 40% said that their coaches were not aware that they had a possible concussion (Rivara et al., 2014). Coaches need to be aware of common symptoms of concussion and understand the reasons that an athlete may try to hide them in order to identify possible concussions and encourage athletes to report. The pre- and post-test results suggest that HEADS UP training needs to focus more attention on these areas. Young athletes depend on their coaches for guidance and need to feel comfortable in order to report their concussion symptoms (Chrisman et al., 2013). In fact, young athletes’ beliefs about their coaches’ expectations about reporting may be more influential than their own knowledge or intention to report a possible concussion (Chrisman et al., 2013; Register-Mihalik et al., 2013). Increased focus on communication with athletes in educational materials for coaches, as well as for parents, may help improve reporting behaviours.

The results of this study also show that the CDC HEADS UP training is effective at better aligning the coaches’ attitudes and behavioural intentions towards concussion management with best practices, at least in the period immediately after the training. Five of the seven attitude and behavioural intentions items showed statistically significant and substantive increases from pre- to post-test. After taking the training, coaches expressed greater agreement with being more confident in their ability to recognise concussion symptoms in young athletes, more likely to believe that there are things they can do to help prevent concussion among their athletes, more confident in their ability to help an athlete with the

return to play process, more likely to talk with their athletes about concussion and encourage them to report concussion symptoms and more likely to plan to teach their athletes ways to prevent concussion. These findings are consistent with those of other studies that suggest that exposure to concussion education improves coaches' ability to recognise concussion signs and symptoms and to feel comfortable deciding whether an athlete needs to be evaluated for a possible concussion (Chrisman et al., 2014; McLeod et al., 2007). However, it is important to note that one attitude item that did not substantively improve from pre- to post-test was 'My athletes would tell me if they experienced concussion symptoms'. This corresponds to the knowledge item regarding the percentage of athletes who hide their symptoms from their coach and further suggests the need to improve reporting behaviours among athletes and increase coaches' awareness about this issue.

Limitations

There are several limitations to this study. The pre- and post-test data are based on a convenience sample of coaches who are involved in youth athletics receiving the CDC HEADS UP training and are not intended to be generalisable to the wider population. Furthermore, the authors did not utilise a control group that did not undertake the training. 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% of randomly guessing correctly. Social desirability may also play a role in the respondents' answers to questions related to attitudes and behavioural intentions. It is likely that they know what the 'correct' response is or what they 'should' be answering (e.g. coaches know that they should say that they talk with their athletes about concussion and encourage them to report concussion symptoms). This may inflate both pre- and post-test agreement with these items, although it may not impact the change seen between the pre- and post-tests. In addition, a majority of coaches had completed a training about concussion prevention and preparedness before taking the HEADS UP course (Sarmiento et al., 2019). This likely also contributed to the coaches' high level of pre-test knowledge.

The percentage of coaches who agreed with the item 'I talk with my athletes about concussion and encourage them to report concussion symptoms' significantly changed between pre- and post-tests, despite the fact that there was little time between the administration of these two tests and thus unlikely that the coaches could have made that change in their coaching behaviour. It is likely a reflection of either their intention to talk to their athletes after taking the training or of social desirability, which may affect other questions in the quiz as well. It is also important to note that in most cases, the post-test was taken shortly after taking the CDC HEADS UP training. This analysis cannot determine whether these changes in knowledge, attitudes and behavioural intentions will persist over the long term and whether they will translate to changes in behaviour regarding concussion management. Future studies can assess whether these knowledge gains persist over time. In addition, we were unable to determine from the response categories of 'youth sports coach' and 'high school sports coach' whether these corresponded to community-based versus school-based sports and were therefore unable to assess potential systematic differences in knowledge between the two. Finally, a negligible number of the coaches also served as

athletic trainers (1.4% of youth sports coaches and 3.8% of high school sports coaches) or sports officials (2.8% of youth sports coaches and 6.5% of high school sports coaches) and therefore may have a different or higher level of knowledge about sports concussion management than those coaches who do not serve in those adjunct roles.

Conclusion

The CDC HEADS UP training improved youth and high school coaches' knowledge on select topics and helped them feel more comfortable about recognising and responding to a possible concussion in their athletes. While exposure to health education information, such as the online training offered here, facilitates widespread awareness of concussion, coaches still face challenges related to concussion safety. In particular, resource and information gaps regarding return to school protocols and reporting behaviours among athletes still exist. This study provides insight into how to better focus future HEADS UP concussion health education efforts to fit youth and high school coaches' informational needs.

Supplementary Material

Refer to Web version on PubMed Central for supplementary material.

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Table 1.

Background characteristics of respondents of total sample.

	Frequency	Percent
Respondent's role		
Youth Sports Coach	154,807	86.3
High School Sports Coach	13,043	7.3
Both	11,619	6.5
Sport respondent is involved with[a,b]		
Soccer	67,097	37.4
Baseball	51,223	28.6
Football	39,601	22.1
Basketball	31,683	17.7
Softball	21,583	12.0
Ice Hockey	8,688	4.9
Volleyball	8,797	4.9
Track and Field	7,449	4.2
Lacrosse	5,721	3.2
Gymnastics	5,571	3.1
Wrestling	4,816	2.7
Tennis	2,796	1.6
Field Hockey	1,354	0.8
Diving	703	0.4
Rugby	705	0.4
Other	22,156	0.4
Age of children respondent works with[a,c]		
5 and younger	37,878	21.1
6–10	109,496	61.1
11–13	88,996	49.6
14–18	56,749	31.7
Sex of children respondent works with		
Boys	59,429	33.1
Girls	35,268	19.7
Both	84,506	47.1
N/A	263	0.2
Total	179,463	100.0

[a]Respondents were permitted to select more than one response; there were 179,469 unique respondents.

[b]56,565 coaches selected multiple sports.

[c]80,054 coaches selected multiple age groups.

Table 2.

Pre- and post-test concussion-related knowledge questions.

	Pre-test			Post-test
	Percent Correct[a]	Median index score	Interquartile range for median	Percent correct
Least difficult knowledge questions		4.0	4.0–4.0	
A concussion is a brain injury (True)[b]	96.7			98.3
I need permission from an athlete's parent to remove him or her from play when a concussion is suspected (False)[b]	98.6			99.0
When should you talk to an athlete's parents about the possible concussion she or he may have had?[c]	98.6			99.1
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]	98.6			99.6
Low difficulty knowledge questions		5.0	4.0–5.0	
Athletes should have more than one concussion symptom before they are removed from play (False)[b]	94.3			96.7
Athletes who have ever had a concussion are at increased risk for another concussion (True)[b]	88.4			94.5
An athlete who is experiencing the effects of a concussion performs the same as an athlete who doesn't have a concussion (False)[b]	89.6			90.8
There is a possible risk of death if a repeat concussion occurs before the first one has healed (True)[b]	95.5			92.9
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]	94.6			97.3
Moderate difficulty knowledge questions		1.0	1.0–2.0	
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]	64.8			90.1
Most athletes with a concussion feel better [in what time frame]?[c]	69.4			82.1
High difficulty knowledge questions		1.0	0.0–1.0	
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)[b]	31.7			53.4
What percentage of athletes do researchers think try to hide their concussion symptoms from their coach?[c]	43.2			60.6

[a]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).

[b]True/false item.

[c]Multiple choice item.

Table 3.

Pre- and post-test concussion attitude and behavioural intention questions.[a]

	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			5.0	5.0–5.0			5.0	5.0–5.0	−17.2	<.001	−.04
Strongly agree	173,048	97.6			174,171	98.2					
Agree	4,064	2.3			3,098	1.8					
Neither agree nor disagree	86	0.1			54	0.0					
Disagree[b]	0	0.0			0	0.0					
Strongly disagree	178	0.1			53	0.0					
I am confident in my ability to recognise concussion symptoms in youth athletes			4.0	4.0–5.0			5.0	5.0–5.0	−247.3	<.001	−.59
Strongly agree	77,049	43.4			140,125	79.0					
Agree	74,472	42.0			36,511	20.6					
Neither agree nor disagree	20,582	11.6			624	0.4					
Disagree	4,866	2.7			75	0.0					
Strongly disagree	403	0.2			37	0.0					
There are things I can do to help prevent concussion among my athletes			5.0	4.0–5.0			5.0	5.0–5.0	−156.1	<.001	−.37
Strongly agree	102,483	57.8			138,163	77.9					
Agree	64,000	36.1			35,813	20.2					
Neither agree nor disagree	9,494	5.4			2,858	1.6					
Disagree	1,177	0.7			437	0.3					
Strongly disagree	216	0.1			99	0.1					
My athletes would tell me if they experienced			3.0	3.0–4.0			4.0	3.0–4.0	−96.0	<.001	−.23

	Pre-test				Post-test				Difference		
	Frequency	Percent	Median	Interquartile range for median	Frequency	Percent	Median	Interquartile range for median	*Z*-score	*p*-value	*r*
concussion symptoms											
Strongly agree	29,315	16.5			42,552	24.0					
Agree	54,752	30.9			63,567	35.8					
Neither agree nor disagree	62,837	35.4			44,023	24.8					
Disagree	26,517	15.0			23,569	13.3					
Strongly disagree	3,946	2.2			3,656	2.1					
I am confident in my ability to help an athlete with the return to play process			4.0	4.0–5.0			5.0	4.0–5.0	−237.8	‹.001	−.56
Strongly agree	69,201	39.0			127,242	71.7					
Agree	74,106	41.8			46,663	26.3					
Neither agree nor disagree	25,077	14.1			2,410	1.4					
Disagree	7,845	4.4			705	0.4					
Strongly disagree	1,135	0.6			344	0.2					
I talk with my athletes about concussion and encourage them to report concussion symptoms			4.0	4.0–5.0			5.0	4.0–5.0	−217.9	<.001	−.52
Strongly agree	78,998	44.5			124,510	70.2					
Agree	61,649	34.8			45,916	25.9					
Neither agree nor disagree	29,574	16.7			6,360	3.6					
Disagree	6,482	3.7			521	0.3					
Strongly disagree	658	0.4			54	0.0					
I plan to teach my athletes ways to prevent concussion			5.0	4.0–5.0			5.0	5.0–5.0			
Strongly agree	103,061	58.1			139,464	78.6			−173.9	<.001	−.41

	Pre-test				Post-test				Difference		
	Frequency	**Percent**	**Median**	**Interquartile range for median**	**Frequency**	**Percent**	**Median**	**Interquartile range for median**	***Z*-score**	***p*-value**	***r***
Agree	64,365	36.3			35,746	20.2					
Neither agree nor disagree	9,173	5.2			1,994	1.1					
Disagree	656	0.4			129	0.1					
Strongly disagree	105	0.1			27	0.0					

[a]For all attitude items, ‘strongly agree’=5, ‘agree’= 4, ‘neither agree nor disagree’= 3, ‘disagree’ = 2 and ‘strongly disagree’= I.

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