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ORIGINAL RESEARCH

Video Educational Intervention Improves Reporting of Concussion and Symptom Recognition

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Context: Concussion management is potentially complicated by the lack of reporting due to poor educational intervention in youth athletics.

Objective: Determine if a concussion-education video developed for high school athletes will increase the reporting of concussive injuries and symptom recognition in this group.

Design: Cross-sectional, between groups.

Setting: Athletes participating in South Carolina interscholastic athletics.

Patients or Other Participants: High school athletes (N = 68; males n = 42; females n = 26; mean age = 14.78 ± 1.38 years) participated in this study. The athletes were randomly assigned into 2 groups: concussion education (n = 34) and control (n = 34).

Main Outcome Measures: Participants were administered a survey before and after watching a video about concussion incidence, symptoms, and reporting conditions (intervention group) or a nutrition video (control group). Total symptom score and survey items served as dependent variables. Examination of group differences was performed through χ^2 analyses and repeated-measures analysis of variance (ANOVA) calculations in SPSS 19.0 (SPSS Inc, Chicago, IL). Significance levels were set a priori at .05.

Results: Of all participants, 70.5% (48/68) reported not knowing the signs and symptoms of concussion before the study, and 26.5% (n = 18) reported having had at least 1 prior concussion. A statistically significant difference existed between those reporting having vs. not having knowledge of the signs and symptoms of concussion on total symptom score at baseline ($t_{1,66} = 2.17$, $P = .038$). Repeated-measures ANOVA calculated a statistically significant difference for concussion symptom recognition before and after the intervention ($F_{1,66} = 7.47$, $P = .008$)

Conclusions: A large percentage of high school athletes do not know the signs and symptoms of concussion. After an educational video, participants' symptom knowledge and previous concussions reported increased. Education of those involved in athletics using a standardized tool may increase reporting and aid in the assessment and management of concussion in this population.

Key words: High school, education intervention, mild traumatic brain injury, athletes

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Video Educational Intervention Improves Reporting of Concussion and Symptom Recognition

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INTRODUCTION

Each year an estimated 7.7 million youths participate in high school sports.[1] The rising participation of adolescent athletes increases their risk for injury. In high school athletics, an estimated 300 000 head injuries occur annually, with 90% of these injuries classified as concussions.[2–5] It appears that athletes report their first concussion between the ages of 10.8 and 14.8 years, and by the start of high school, 53% of student-athletes are now reporting a history of at least 1 concussion.[6,7] Moreover, researchers[8] have found that more than 50% of athletes do not report concussions when they occur.

Several reasons have been suggested for this lack of reporting. First, the participants may not think a head injury is sufficiently serious based on teammates' prior head injuries.[8] Second, players may not want to be withheld from competition.[8] Third, players may have a lack of knowledge related to the risks and potential consequences of concussion.[8] McCrea et al[8] concluded that more than one-third of the players who failed to report their injury did not recognize that they had sustained a probable concussion based on their symptoms. When provided with a definition of concussion and description of injury signs and symptoms, the players admitted having sustained a concussion over the course of the football season.[8]

Kaut et al[9] found similar results in his study of high school students just before collegiate play. Of the 15.8% of football players actually diagnosed with a concussion, 25.2% failed to report dizziness to athletic trainers or coaches while playing.[9] Moreover, an examination of athletes' understanding of complications associated with a head injury revealed that 56% of all athletes studied, including female soccer athletes, reported no knowledge of the possible consequences after a head injury.[9]

The Consensus Statement from the First International Conference on Concussion in Sport[10] on concussion recognized that education of athletes, referees, administrators, parents, coaches, and health care providers is a mainstay of progress in this field. Since the 2004 Zurich meeting, numerous position statements from several professional organizations have supported the need for educational interventions.[10–13] This need for education has resulted in several organizations developing educational tools for multiple populations. Studies have been conducted to examine the knowledge of coaches,[14–16] administrators,[17] and parents regarding concussion.[6,16–18] However, little research has been conducted on interscholastic athletes' knowledge of concussion.[14–18]

The Centers for Disease Control and Prevention (CDC), along with partner organizations, created "Heads Up: Concussion in High School Sports."[19] This tool kit includes educational materials such as a video, a wallet card listing signs/symptoms, posters, fact sheets, and other concussion-related resources. Sarmiento et al[20] surveyed 1009 high school coaches (31% of all coaches) who requested the tool kit.[20] Eighty percent of the high school coaches who received the tool kit found it very helpful in the recognition and management of concussion in their high school.[19,20] Studies indicate that the least-used tool was the CD (59% of coaches used) and the most commonly used tools were the booklet (79%) and wallet card (60%).[19,20] Thirty-four percent of the coaches reported that they had learned something new from the tool kit, especially when it came to identification of symptoms of concussion, second-impact syndrome, and the length of recovery.[20]

In an attempt to standardize educational interventions, educational videos have been developed by the CDC, the National Academy of Neuropsychology, and the National Hockey League, in collaboration with the National Athletic Trainers' Association, to provide basic knowledge.[21,22] Regrettably, these videos (1) are the least used in the CDC tool kit, (2) focus on the catastrophic consequence of second-impact syndrome, and (3) use sport-specific (hockey) professionals and clinicians discussing basic knowledge and long-term ramifications of concussion. Unfortunately, many high school athletes do not believe that the catastrophic consequences of repeated injuries will happen to them, and without a similar environment and population, these athletes may disassociate from the facts of the injury the video is trying to address.

Researchers and clinicians are trying to identify a way to standardize concussion education for all involved in athletics. However, few studies have examined the effectiveness of any type of educational intervention, specifically those using a standardized video, as an educational method. Furthermore, the ideal type of educational intervention or delivery method for concussion education in high school athletes has not been established. The aim of this study was to determine if a concussion-education video developed for high school athletes would increase the reporting of concussive injuries and symptom recognition. It was hypothesized that the participants who watched the video would report more concussive injuries and identify concussive symptoms at higher frequencies than those in the control group.

METHODS

Participants

A convenience sample of high school athletes aged 13 to 18 completed a concussion-education survey during fall preseason in South Carolina. Inclusionary criteria included any gender, age 13 to 19, and participation in fall junior varsity and varsity athletics. Exclusionary criteria included English as a second language.

A total of 84 athletes were approached to participate in the study. These athletes were a sample of convenience from 3

local Division I high schools with interscholastic volleyball and football. Participants and guardians read and signed university-approved human subjects parental permission and minor assent forms before enrollment in the study.

Parental permission and minor assent forms were obtained from 68 athletes who were included in the study as participants. The participants were randomly assigned into 2 groups: concussion education (n = 34) and control (n = 34). The concussion-education group was administered a survey before and after watching a 9-minute video about concussion. The control group was taken from the same population and administered a survey before and after watching a nutrition video.

Instruments

Questionnaire. This questionnaire combined several previously used student-athlete surveys and was specifically designed to emphasize simplistic wording and ease of administration in the adolescent population[6,8,23,24] The questionnaire was developed to obtain basic information about the participants' knowledge of concussion symptoms, previous history of concussion, if and to whom they reported the concussion, and reasons for not reporting. This short questionnaire consisted of 14 items and a symptom recognition checklist. The questionnaire consisted of global demographic information, concussion history, and reporting questions, as well as the symptom recognition checklist. A specific item within the questionnaire asked, "Do you know the signs and symptoms of concussion?" to determine the athlete's self-awareness of concussion symptoms. In the symptom recognition checklist, participants were asked to select all signs and symptoms of concussion. Every correct symptom identified received 1 point, for a total maximum score of 17.

Content validity was evaluated during the revision of the initial questionnaire by administering the survey to 8 student-athletes (age = 14.23 ± 1.18 years; 5 boys and 3 girls) who were not included in the final assessment. No items were removed or changed because of the examination of content validity. The final questionnaire examined the number of years in the participant's sport, previous history of concussion, knowledge of symptoms associated with concussion, weight, height, date of birth, and symptoms of concussion. The questionnaire can be found in Figure 1.

Test-retest reliability calculations were performed on the questionnaire to enhance the validity of findings. A sample of 9 athletes (14.18 ± 1.23; 4 boys and 5 girls) from a different school system was used to assess reliability of the questionnaire. The questionnaire was administered after researchers read the instructions to obtain baseline data and then, to mimic the study design, administered 15 minutes later. Test-retest reliability was $r = 0.97$.

Concussion-Education Video. The concussion-education video was developed as a 9-minute video that covered topics such as:

- Epidemiology
- Mechanism of concussion
- Sports in which concussion occurs
- Signs and symptoms
- Reasons not to report
- Whom and when to report
- Potential long-term effects

This content was selected as pertinent for adolescent athletes following the First International Conference on Concussion in Sport Guidelines.[10] The video was constructed using an approximately 9-minute script created by the researchers. The video answered important questions many adolescent athletes might have pertaining to head injuries or concussions, such as:

- What is a concussion?
- How do concussions happen?
- How do I know I have a concussion?
- What are the signs and symptoms of concussion?
- What is the importance of reporting my injury?
- Whom should I report my injury to?
- What is the difference between just getting hit in the head and having a concussion?
- How are concussions managed?
- When will I be able to play again?

The video was created to flow through each aspect of concussion knowledge listed above. The investigators believed the flow of the information was the most logical to enable the high school athlete to stay engaged and learn from the video. However, the video was developed to provide more information than the questionnaire examined, and therefore the video and questionnaire were not linked in order of content or questions. See Table 1 for the abridged script.

Content validity was examined for the video. Content validity was established by providing the video to 12 certified athletic trainers to evaluate the format, flow of material, and whether the material provided the basic level of knowledge that adolescent athletes require. There was 100% agreement that the video provided age-appropriate basic knowledge of concussion.

Nutrition Video. The nutritional education video was a 10-minute script obtained from McGraw-Hill's Fitness Video Series This video does not have any reference to head injuries or concussion. There were no financial incentives or obligations for using the video in this study.

Data Collection Procedures

During fall preseason, the investigators attended athletic parent and team meetings and explained the research study, including the risks and benefits associated with the study. Questions regarding the study and participation in the study were answered and both guardians and students were given time to decide whether they would participate in the study. Once guardian permission and minor assent were obtained, the student was enrolled in the study. Once enrolled in the study, the participants were gathered into 1 classroom.

All participants were given the preintervention questionnaire and clearly read the instructions by the researchers. After all participants completed the questionnaire in a group setting,

Figure 1. Questionnaire which examined the number of years in the participant's sport, previous history of concussion, knowledge of symptoms associated with concussion, weight, height, date of birth, and symptoms of concussion.

Concussion Questionnaire

The purpose of this survey is to better understand your current knowledge of concussions. Please answer the following questions as accurately and as thoroughly as you can. Your answers are private and the information you provide will not be identified back to you or to anyone unless authorized by you.

Please provide us with some demographic information

Circle your grade for the 2007-2008 academic year. 9th 10th 11th 12th

What is your birth date? Month: _____ Day: _____ Year: 19 _____

Weight: _____

Height: _____

What position do you play? _____

How long have you been playing this sport? _____

What school will you attend during the 2007-2008 school year? _____

Please answer the following questions to the best of your ability.

1. Have you ever been diagnosed with a concussion? (Circle one) **YES** **NO**

2. How many concussions have you had in sports? _____ from non sports? _____

3. If you **HAVE** received a concussion, to whom did you report your concussion? (check all that apply)

_____ Athletic Trainer _____ Coach _____ Parent
_____ Teammate _____ Physician _____ Other (whom) _____
_____ No one

4. If you **HAVE** received a concussion and did not report it to anyone, check the reasons for not reporting your injury (check all that apply)

_____ Didn't think it was serious enough
_____ Didn't want my teammates to think I was weak
_____ My parent/coach has told me to play through my pain
_____ Didn't want to be taken out of the game/practice
_____ Didn't really know what happened
____ Other

5. How many times total were you ever "knocked out" or became unconscious, or "didn't feel right" after a blow to the head? _____

6. What is the year of your most recent concussion? _____ Year (skip if not applicable)

7. Do you know the signs and symptoms of concussion? (Circle one) YES NO

8. **Please check all signs and symptoms you think are related to having a concussion**

_____ Loss of consciousness _____ Confusion _____ Dizziness _____ Neck pain
_____ Endurance _____ Sleepiness _____ Hunger _____ Sensitivity to light
_____ Blurry Vision _____ Balance problems _____ Disorientation _____ Thirst
_____ Nausea/ Vomiting _____ Burst of energy _____ Fatigue _____ Headache
_____ Memory Loss

Thank you for your time in completing this questionnaire.

Table 1. Concussion-Education Video Script

This video is intended to educate all those working with and playing youth sports. It will explain what a concussion is, help athletes recognize signs and symptoms of concussion, discuss the dangers and potential long-term consequences of concussion, and help the athlete feel comfortable about reporting this type of injury to a parent, coach, athletic trainer, or doctor.
Concussions occur all the time in sports. A concussion is a brain injury that is caused by a bump, blow, or jolt to the head and alters your mental functioning. Concussions are sometimes called "dings," but a concussion is incredibly serious and can be fatal. It can change the way that your brain normally works and how you do things in your daily life. (Clip of the effect of concussion on others' lives.)
1.6 to 3.8 million concussions occur every year in the United States. Five to fifteen percent of athletes in contact sports will sustain a concussion each competitive season. For youth athletes, these numbers are much higher. An estimated 63 000 sports-related concussions occur in high school athletes each year. These athletes that sustain 1 concussion in a season are 3 times more likely to sustain a second concussion in that season. Understanding the likelihood of receiving a concussion is important but not as important as what a concussion is. (Clips of concussion-causing hits.)
Some of the most common symptoms associated with a concussion are headache, nausea, dizziness, balance problems, double/blurry vision, sensitivity to light or noise, feeling sluggish, feeling groggy, concentration or memory problems, and confusion. Now, yes, there are times when we have a headache or feel tired and groggy during practice. This can definitely occur without a concussion; however, anyone that experiences one or more of these signs and symptoms after a bump, blow, or jolt to the head must report it to their coach, athletic trainer, or parent. Remember, a concussion can occur without being knocked out, but each incidence of concussion is just as important as it will help determine if it is safe for you to participate in your sport again.
Concussions can happen to anyone, not just during sports; however, athletic environments provide a greater potential for concussions because collisions are common. An athlete may collide with another athlete, they may collide with a goal post, or an object such as a ball may collide with their head while standing still, all of which can cause a concussion. Concussions can occur in any sport, including baseball, basketball, equestrian, field hockey, football, gymnastics, ice hockey, lacrosse, rugby, soccer, softball, swimming and diving, track and field, tennis, volleyball, and wrestling. However, when the signs and symptoms are reported to the proper personnel, they can then use their knowledge to determine where these signs and symptoms are coming from, and properly refer you to a health care professional. You may not see signs and symptoms of a concussion. Each step in this process will insure your quick and safe return to play.
Some thoughts that might be going through your head are: "I don't want to sit out of the game," "I just want to play," "I don't think this injury is serious enough to say anything," or "I don't want to look weak in front of my coach or teammates." All athletes have these thoughts when an injury occurs. However, concussions are not something to hide or not report. There are return-to-play guidelines used by physicians and athletic trainers to ensure your safe play. The most commonly used guideline is being symptom free during rest and activity.
However, an allied health care professional may perform a physical examination, evaluate your mental andbalance abilities, and severity of your symptoms. This is typically done right after you report any of the previous signs and symptoms. This testing allows allied health care professionals to determine the presence of your concussion and whether or not you need to be referred to a physician immediately. These tests are also used after your concussion to determine your progress back to normal. However, all concussions need to be reported to your coach, athletic trainer, or parent for follow-up care. A physician will ultimately clear you for participation when you have healed enough to be able to return to play.
Now, you may be wondering, why do I have to sit out of practices and games? What could happen to me if I do not report my injury and I keep playing? Researchers have performed studies that suggest some of the deficits acquired by a concussion may last up to 1 year. This could include difficulties in concentration, attention, or trouble reading. Decreased performance in school and intelligence has also been reported. Repeated head injury over a short period of time can also be fatal. This means that if you return to play too early after your initial concussion, while your brain is trying to heal, you might suffer severe injuries and even die (also known as second-impact syndrome).
Now, there are things that athletes can do to prevent these outcomes. Although there are differences from sport to sport, you can protect yourself from concussion following these steps: follow coaches' rules for safety; use proper sports equipment; use equipment at all times; report symptoms to someone: coach, athletic trainer, parent; allow yourself and your brain time to recover; never underestimate a potential injury; listen to your body and report abnormal symptoms.
Remember that being healthy and safe during participation will result in your best performance. Concussions can occur to anyone and anywhere. Athletes are particularity at an increased risk and need to be educated about concussions. If you or your parents have any questions regarding concussions, feel free to ask your athletic trainer, coach, or doctor and they will obtain the information for you. Remember, early and proper reporting of symptoms may help save a life and prevent permanent damage to your mental functioning. Have fun, play safe, stay informed!

participants were randomly assigned into the following groups: concussion-education group (concussion video) and control group (nutrition video). The concussion-education group was asked to stay in the classroom and the control group was escorted to a second classroom. The respective videos were administered to each group, and immediately after the conclusion of each video, the participants were readministered the survey.

Table 2. Demographic Information Across Groups

Group	Age, Mean ± SD, y	Height, Mean ± SD, cm	Weight, Mean ± SD, kg	Time in Sport, Mean ± SD, y	Sport, % Volleyball (No. Football)	% Male (No. Female)	Ethnicity, % White
Control	14.72 ± 1.62	176.02 ± 8.38	72.74 ± 17.34	4.7 ± 0.5	35 (22)	65 (12)	76
Education intervention	14.92 ± 1.80	149.35 ± 7.36	75.19 ± 17.73	3.9 ± 0.8	42 (20)	58 (14)	77

Statistical Analysis

Descriptive statistics were calculated for demographic data. Frequencies of signs and symptoms were analyzed within the pre-post questionnaire design. All data were examined for outliers during the analysis of preintervention and postintervention main effects and interactions.

Examination of group relationships for the independent variables of year in school, ethnicity, gender, and school attended were assessed through χ^2 analyses. An independent-samples *t* test was calculated to determine differences between those who reported they knew and those who reported they did not know the signs and symptoms of concussion on total symptom score on the symptom recognition checklist at baseline. A repeated-measures analysis of variance (ANOVA) was used to determine group differences between groups and total symptom recognition score. Significance was set a priori at .05. All statistical techniques were computed using SPSS 19.0 (SPSS Inc, Chicago, IL).

RESULTS

Demographic Data

Sixty-eight participants (males n = 42; females n = 26; age = 14.78 ± 1.38 years) were included in this study (Table 2). Of the participants, 26.5% (n = 18) reported having a previous history of concussion during baseline testing. Athletes diagnosed with a concussion initially reported the concussion to (1) the athletic trainer (17%; n = 3), (2) the coach (22%; n = 4), or (3) no one (28%; n = 5). Of all of the participants, 70.5% (n = 48) reported having no knowledge of what concussion symptoms can occur during injury when asked, "Do you know the signs and symptoms of concussion?" An independent-samples *t* test revealed a statistically significant difference between those reporting yes and no to having knowledge of concussion signs and symptoms of concussion with regard to total symptom score on the symptom recognition checklist at baseline ($t_{1,66} = 2.17$, $P = .038$); those who said yes, they knew the signs and symptoms of concussion, did indeed have a higher total symptom score. Interestingly, all athletes who reported a history of concussion also reported yes to having knowledge of concussion symptoms at baseline. Table 3 lists the frequencies for identification of each symptom before and after the intervention.

Intervention

Participants were randomly divided into 2 groups of 34 each (concussion education and control). There were not significant differences between groups for year in school (χ^2_4 [N = 68] = 6.432, $P = .783$), ethnicity (χ^2_4 [N = 68] = 4.25, $P = .381$),

Table 3. Percentage of Symptoms Identified During Preintervention and Postintervention Questionnaire Across Groups

	Control, % (No.)		Education, % (No.)	
Concussion Symptoms	Preintervention	Postintervention	Preintervention	Postintervention
LOC	94.1 (32)	94.1 (32)	76.5 (26)	94.1 (32)
Endurance	17.6 (6)	14.7 (5)	14.7 (5)	17.6 (6)
Blurry vision	82.4 (28)	82.4 (28)	83.3 (29)	100 (34)
Nausea/vomiting	88.2 (30)	88.2 (30)	47.0 (16)	82.4 (28)
Memory loss	64.7 (22)	70.5 (24)	100 (34)	100 (34)
Sleepiness	52.9 (18)	52.9 (18)	50.0 (17)	85.2 (29)
Balance problems	94.1 (32)	94.1 (32)	70.5 (24)	100 (34)
Fatigue	52.9 (18)	70.5 (24)	47.0 (16)	73.5 (25)
Burst of energy	11.8 (4)	11.8 (4)	6.7 (3)	5.8 (2)
Confusion	94.1 (32)	94.1 (32)	94.4 (32)	100 (34)
Hunger	17.6 (6)	17.6 (6)	17.6 (6)	17.6 (6)
Disorientation	82.4 (28)	82.4 (28)	76.4 (26)	100 (34)
Headache	100 (34)	100 (34)	94.1 (32)	100 (34)
Neck pain	76.5 (26)	82.4 (28)	76.5 (26)	94.1 (32)
Dizziness	94.1 (32)	94.1 (32)	94.1 (32)	100 (34)
Sensitivity to light	64.7 (22)	64.7 (22)	58.8 (20)	76.5 (26)
Thirst	35.3 (12)	23.5 (8)	17.6 (6)	5.8 (2)

Abbreviation: LOC, loss of consciousness.

[a] Data are expressed as percentage (number of participants) who selected the item as a symptom of concussion. Correct concussion symptoms are in bold.

Table 4. Descriptive data for groups for total correct symptoms and reported concussion history.

	Total Symptoms, Mean ± SD		Concussion History, No. (%) Reported	
	Preintervention	Postintervention	Preintervention	Postintervention
Education	13.14 ± 2.19*	15.29 ± 1.50*	12 (35.3)**	15 (44.1)**
Control	13.53 ± 1.84	14.07 ± 1.60	6 (17.6)	6 (17.6)

* Denotes significant difference between groups ($P = .008$)
** Denotes significant difference between groups ($P = .034$)

gender (χ^2_2 [N = 68] = 2.68, $P = .291$) or school attended (χ^2_3 [N = 68] = 0.210, $P = .792$).

Previous History of Concussion

In the control group, 17.6% (n = 6) reported a previous history of concussion, while 35.3% (n = 12) of the educational intervention group reported a previous history of concussion. Although the educational intervention group reported more participants with a previous history of concussion, this difference was not statistically significant. This can be explained by the small sample sizes per cell, which limited power for this analysis (χ^2_2 [N = 68] = 2.72, $P = .168$, $\eta = 0.20$). There was a statistically significant difference in previous history of concussion before and after intervention, with the education intervention group reporting 12 concussions at baseline and 15 after the video intervention, whereas the control group remained at 6 reported concussions (χ^2_2 [N = 68] = 5.58, $P = .034$, $\eta = 0.286$; Table 4).

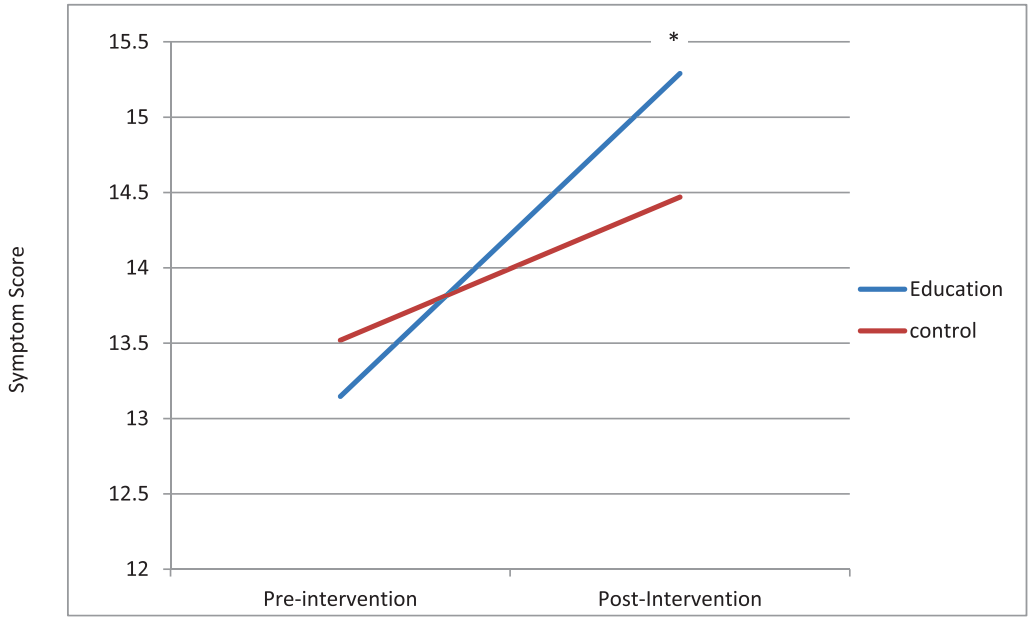
Symptom Recognition

For the 17 items comprising the symptom recognition portion of the questionnaire, the mean number of correct responses for each group is presented in Table 4. Repeated-measures ANOVA revealed a statistically significant difference for time (concussion symptom recognition before and after the intervention; $F_{1,66} = 49.05$, $P = .000$, $\eta^2 = 0.426$) and group (education versus control) by time interaction ($F_{1,66} = 7.47$, $P = .008$, $\eta^2 = 0.102$); but not group alone ($F_{1,66} = 0.340$, $P = .562$, $\eta^2 = 0.005$; Figure 2). This finding suggests that even though the control group started with a higher nonsignificant total symptom score, after the video intervention, the education group was able to correctly identify significantly more symptoms than the control group. Further examination of symptom recognition revealed that the educational intervention group recognized 77.3% of the concussion signs and symptoms at baseline and increased to recognizing 89.9% of the concussion signs and symptoms after the educational video. In the control group, 79.5% of the concussion signs and symptoms were recognized at baseline testing; this remained relatively constant after the nutrition video with 82.5% of the concussion signs and symptoms being recognized. Although this is not a statistically significant increase in percentage of concussion symptoms identified correctly, the ability to correctly identify more symptoms will aid the participant in recognizing a concussive injury and correctly reporting the injury to appropriate medical personnel.

DISCUSSION

We found that with use of a standardized concussion-educational video, high school athletes may be better able to correctly identify concussion signs and symptoms and

Figure 2. Total symptom score between groups preintervention and postintervention. *Denotes significant difference between preintervention and postintervention ($P = .000$). There was a significant group by time interaction ($P = .008$), with the control group having significantly lower scores than the education group after watching the video.



improve their reporting of concussion. This finding is supported by other researchers that examined concussion knowledge and educational interventions.[14,15,24] Bramley et al[25] found that high school soccer players with any education about concussion were more likely to report a concussion to a coach or athletic trainer compared to those athletes with no concussion education. Providing student-athletes with an appropriate definition of concussion that is easy to understand increases the number of recalled concussive injuries.

This study found that 26.5% of the participants reported a previous history of concussion. This is higher than commonly reported incidence rates of 5% to 15% in high school athletes.[7,8,26,27] These previous reports of incidence may be hindered by a lack of definition of concussion. Valovich-McLeod et al[6] described how athletes' ability to self-report history of concussion during preparticipation physicals was limited by the wording and definition of concussion. The use of terms like *ding*, *bell rung*, *concussion*, *mild traumatic brain injury*, etc, can alter identification and reporting of a head injury.[6] Having a clear definition and understanding of the meaning of concussion for youth and adolescents may impact reporting. A survey of adolescent coaches acknowledged that players infrequently report concussions, so they found that it was imperative that the education be focused on the players themselves.[14,20]

Even with the heightened media and awareness of concussion, we still found that before the intervention, when asked the question; "Do you know the signs and symptoms of concussion?" 70.5% of the high school athletes sampled did not know the signs and symptoms of concussion. Interestingly, those athletes who self-reported knowing the signs and symptoms at baseline scored significantly higher on the total symptom score during the symptom recognition checklist portion of the questionnaire. Kaut et al[9] had similar findings, reporting 56% of athletes indicated a lack of understanding of the signs and symptoms of concussion. These findings are alarming, as symptom presentation is the most common reason an athlete would report to an athletic trainer or coach. When surveyed, 85% of certified athletic trainers used symptom checklists as part of the concussion assessment battery.[28–30] Although the Kaut et al[9] study was published shortly after the release of the CDC's Heads Up program, in 2013 there are still signs that the dissemination of education has not been widespread among those involved with high school athletics.[9]

Despite the fact that a significant amount of athletes did not know the signs and symptoms of concussion before this study, we found that using a standardized educational video resulted in high school athletes' ability to identify significantly more concussion signs and symptoms. An athlete's lack of symptom knowledge associated with concussion, then, decreases the athlete's recognition of concussion and resultant failure to report the injury. Delaney et al[31] found similar concerns when only 20% of professional athletes who were experiencing a concussion actually realized that they had suffered the injury. The findings of Delaney et al[31] provide evidence that educational interventions supply information that athletes can use to report concussion. Although there was not a statistically significant increase in the number of correctly identified symptoms, having the knowledge of concussion symptoms and being able to recognize them correctly will aid athletes and clinicians in reporting. Enabling athletes to recognize the signs and symptoms of concussion increases their likelihood of reporting the concussion to appropriate personnel, which can decrease the risk of secondary consequences of concussion.

Few researchers have used a video education intervention in isolation. Echlin et al[17] examined an interactive computerized module and a preexisting hockey concussion DVD to educate hockey players about concussion. Many researchers have used a mixed delivery of education, including methods such as PowerPoint presentations, video segments, demonstrations, case studies, and personal testimonies from collegiate and professional athletes and question and answer periods; however, these methods require trained administrators and time.[17,25,32] In many athletic situations, the number of clinicians available to educate those working with athletics is limited, and thus, having a standardized video that can be played at any meeting or venue is useful. Moreover, although these researchers found improvement in knowledge scores over time, no conclusions have been reached about the most appropriate method of intervention or knowledge retention.

Basic concussion-educational literature is being disseminated and is trickling down to the clinicians who are ultimately responsible for the care of young athletes.[33] The method of intervention delivery, however, is still questionable for clinicians and educators. Provvidenza and Johnston[34] suggested that these educational models be representative of learning needs associated with the age of the participant and type of knowledge required.[34] We found that a standardized video improved reporting and symptom recognition in interscholastic athletes immediately after the intervention. These findings support using technology such as standardized videos as a viable option for educating patients by athletic training students and clinicians. However, additional research should be conducted to determine if a standardized educational video would be effective in long-term knowledge retention.

Clinical Implications

The seriousness of concussive injuries has recently come to light with heightened media coverage of high-profile professional and collegiate athletes' removal from participation due to concussion. Additionally, since the inception of the Washington State concussion law (Lystedt Law) for head injuries in adolescents, many state and federal legislation policies have been proposed and implemented. Currently, all 50 states plus the District of Columbia have passed some form of head injury legislation for adolescent athletes.[35] Although legislation in each state has different components and wording, all current legislation involves some educational component for parents, coaches, and student-athletes.[35]

A short video was developed to provide basic standardized concussion information specifically for high school athletes. Educating high school athletes regarding concussion increased the number of concussions reported. Use of a concussion-education video provides a standardized approach that is easy to administer and provides a message that crosses over gender and sport, using multiple learning styles including visual, verbal, and somatosensory to enhance knowledge of concussive injury.

Most education regarding concussion is completed because of experience or education provided by certified athletic trainers. When concussive injuries occur outside of athletics or at times when experienced health care providers are not accessible, relying on experience or health care professional–supported education may not be feasible. The video used in this study was well received by the coaches, athletic directors, and athletes regarding its usefulness and ease of implementation into high school athletics. Obtaining buy-in from all parties involved in athletics will help with implementation of educational interventions for concussion to keep athletics safe for youth.

Unfortunately, the ideal delivery mode and educational content for interventions appropriate to each group (such as youth, coaches, administrators, parents, etc) receiving educational interventions has yet to be identified. It may not be feasible for every school, clinician, and/or coach to develop population-specific videos. However, the goal should be to provide at least the basic information regarding concussion (what is a concussion; how do I know I [my child/my athlete] have/has a concussion; symptom recognition; whom to report to; and the consequences of the injury). When a population-specific video is not available, using commercially available videos can provide the same standardized basic information for each population. Although this study supports the use of a standardized video for concussion education, it is still acknowledged that there is a need to continue to refine available videos and develop new multimedia and technological formats that will capture most audiences and provide appropriate knowledge necessary for safe participation in sports. Additional research should be conducted to provide continuing education for clinicians to implement standardized video education in patient care.

Limitations

There are several limitations of this study that warrant some discussion. First, the sample included both male and female athletes. Sport choice was not limited and was not assessed as a confounder for concussion education. This study was completed during the fall, when football and volleyball are the prominent sports. Football is considered a high-impact–collision sport that represents an increased risk for concussive injuries and has received significant media attention. Volleyball, on the other hand, may receive less attention and participants may have less knowledge of concussion. Previous education due to sport participation may play a role that was not accounted for. Future studies should examine the role of the athletic trainer and previous sports knowledge in the education provided to athletes.

Second, survey research is limited to the time at which the survey was administered. Test-retest reliability was conducted with 15 minutes between testing sessions. During the data collection, the questionnaire was administered twice, once before and once immediately after a 9- or 10-minute video. No additional follow-up testing was conducted. The methodology of this study does not ascertain the nature of long-term recall of the information obtained from the video. Further, recalling concussion history throughout an interscholastic athlete's lifetime may prove difficult. Future research should be conducted to complete a more thorough validation of the mode of delivery for ultimate retention of the concussion intervention.

Third, the sample size was small, and although random assignment was conducted, differences existed at baseline for those with previous concussions. The subsample of adolescents who went through the intervention was participating within athletics at schools where athletic trainers were present at practices and games. Future research should be conducted to increase the sample size and ensure groups are equal at baseline testing within schools with and without athletic trainers to assess the educational intervention.

CONCLUSIONS

Education increases an athlete's knowledge of concussions, which has been found to influence the reporting of concussive injuries to medical personnel. This study found an increase in the reporting of concussion history and knowledge of symptoms after watching a concussion-education video. Although clinicians may be effective and efficient at educating athletes, because of limitations in time and resources in some settings, the availability of an in-person educational session for every team, season, meeting, or class may not be feasible. A standardized video ensures that the same information is provided every time and decreases the amount of resources necessary to conduct educational sessions for everyone involved in athletics.

Implementing a concussion-education video may prove valuable in the reporting, evaluation, assessment, and return-to-participation decisions for allied health care providers working in the high school athletic system. This research supports using a video to standardize the education provided by any clinician in an interscholastic setting. Athletic trainers and/or coaches should take a proactive approach to educate all athletes, parents, and school officials about concussive injuries. Standardized videos may be an appropriate medium to educate athlete, parents, students, and clinicians about concussions. This will aid in creating a plan, if and when concussive injuries do occur, for safer athletic practices in high school athletes.

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