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The Effectiveness of the CDCS Heads-Up Dvd on Coaching Education Students' Knowledge of Sports-Related Concussions

Elizabeth Saunders

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(Under the direction of Thomas Buckley)

ABSTRACT

According to the National Athletic Trainers' Association only 42% of high schools in the United States have an Athletic Trainer at their High School, therefore when athletes get injured the coaches are often the first responder. This is a challenging situation when it comes to concussions as previous investigations have identified numerous concussion related misconceptions by coaches. To educate the coaches about concussions, the CDC developed the "Heads-Up: Concussion in High School Sports" toolkit in 2005; however the effectiveness of this toolkit has surprisingly received limited investigation. Therefore, the purpose of this study was to assess coaching education students' concussion knowledge immediately following the CDC's Heads-Up DVD and four weeks later. A potential of 54 item electronic survey. Electronic survey on each schools' online course management system. The respondents (N= 169 age= 22.4 male= 76.9%) represented undergraduate and graduate coaching education students at two regional state universities. The survey was distributed online (host site surveymonkey.com), based on the CDC's Heads-Up DVD, and links to the survey were posted on each institution's course management website. There were three test dates: pre, post and a four week follow up.

There was no difference (F_1=1.64; P=0.202) in the mean overall score between pre ($\overline{x}$ =25.65±3.87), post ($\overline{x}$ =26.12±3.29), and follow up ($\overline{x}$ =25.32±3.97). There was no significant difference between subjects who had a history of concussion and those that had not (F_1=1.54; P=0.220); between delivery methods at any of the assessment time points (F_1=2.11; P=0.132); between student degree levels at the pre-assessment or post-assessment (F_1=0.00; P=0.992). There was no significant difference between the three assessment dates (F_1=2.85; P=0.067) for the mean number of correct responses for the 16-symptom checklist. We found that the CDC's Heads-Up DVD did not increase the coaching education students' knowledge of sports-related concussions. Even immediately after the coaching students watched the DVD there were no significant improvements. Therefore it is suggested that new informative measure be made to help educate coaches about concussions. This could include a new DVD with more current information and presented in a way that coaches can better understand and improve their concussion knowledge.

INDEX WORDS: Concussion, Symptoms, Heads-Up toolkit, Coaching students, Concussion prevention

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CHAPTER 1

INTRODUCTION

The Centers for Disease Control and Prevention (CDC) reports there are 1.6 - 3.8 million sports-related concussions in the United States annually.[1] Of this total, Shankar reports that about 57,000 concussions occur in high school football alone.[2] However, this likely underestimates the true incidence of concussions as McCrea indicated that only 47.3% of student-athletes reported their concussion during the 2003 football season.[3] Unreported concussions pose a substantial problem because if a concussed athlete returns to play while still symptomatic they are at an elevated risk for second impact syndrome (SIS). SIS, a potentially fatal condition, occurs when an athlete suffers a second blow to the head while still symptomatic from the initial concussion, frequently because the first one is either unrecognized or unreported.[3] Furthermore, Collins suggested that an athlete with a history of three or more concussions is 6.7 times more likely to experience LOC and 9.3 times more likely to show three or four abnormal markers of concussion severity as opposed to those who have no history of concussion.[4] Finally, emerging evidence suggests potential long term effects of concussions including risk of second impact syndrome, increase risk for sustaining more concussions, increase rate of depression, early onset of Alzheimer's, and chronic traumatic encephalopathy.[4-6]

Appropriate recognition and treatment of concussions by athletic trainers (AT) may help reduce many of these risks. Unfortunately, only 42% of high schools in the United States have access to an athletic trainer.[7] Therefore, when an athlete becomes injured the coaches are often the first responder and therefore responsible for the initial recognition and treatment of the injury. As most coaches are not specifically trained in the recognition and/or evaluation of athletic injuries, this responsibility is potentially problematic for both the coaches and injured

student-athletes.[8] The National Athletic Trainers Association's (NATA) position statement on the management of sports-related concussions highly recommends educating both the student-athlete and the coach about the signs and symptoms of concussions as well as the potential risk of playing while still symptomatic.[9] To assist with educating coaches about concussions, in 2005 the CDC devised an educational toolkit entitled "Heads-Up: Concussion in High School Sports".[10] This is the first time that a federal agency has not only developed, but also disseminated a concussion tool kit for high school coaches.[11] The CDC, working with noted professional medical, sport and educational organizations created the concussion toolkit to help coaches prevent, recognize, and manage concussion in high school sports.[10] The "Heads-Up: Concussion in High School Sports" toolkit, includes a VHS tape, a DVD, a poster, a clipboard with signs and symptoms on the back, an athlete reference sheet, and a parent reference sheet, as well as a pocket (wallet size) card with signs and symptoms (Appendix H).

It was the goal of the CDC to distribute Heads-Up to all high school coaches in the United States. Unfortunately, recent investigations suggest that only 12.5%-31% of youth and high school coaches have reported receiving the tool kit.[12-14] However, these studies have also found of those that received the toolkit, 59%-70% found it to be "very helpful" when learning about concussions, especially when a coach is unable to attend a coaching conference or did not attend a coaching education program.[11-12, 14] However, to our knowledge there has been limited assessment of the effectiveness of the toolkit. A recent study by Van Lunen tested the effectiveness of the CDC's Heads-Up pamphlet and informational, the coaches were asked to review the material as they deemed necessary and then were retested four weeks later.[15] Van Lunen found a statistical difference between concussion recognition and management and management and prevention for the pretest of the coaches' concussion knowledge; there was also

a statistical difference for the pretest to posttest overall as well.[15] While the handouts list the signs and symptoms of a concussion they do not inform the coaches about the misconceptions associated with concussions.

This educational effort is particularly important as previous investigations have identified numerous concussion related misconceptions amongst coaches.[12, 14, 16-19] These misconceptions must be effectively addressed to improve coaches' recognition and initial treatment of a concussion.[12, 18] Amongst the most disconcerting misconceptions, 26% of youth coaches reported they let a symptomatic youth athlete return to the same game thus potentially elevating the risk of SIS.[18] In order to appropriately treat a concussion, the coach must first recognize one has occurred and encouragingly, Valovich, reported that many of them correctly identified amnesia (94, 60.3%), confusion (139, 89.1%), dizziness (138, 88.5%), headache (121, 77.6%) and loss consciousness (125, 80.1%) as concussion symptoms.[18] However, these same coaches were also less likely to identify blurred vision (84, 53.8%), sleep disturbances (20, 12.8%) and nausea (87, 55.8%).[18] Furthermore, 42% of coaches thought that loss of consciousness (LOC) had to happen for a concussion to occur, suggesting the majority of these youth coaches realize that this is a misconception.[18] O'Donoghue reported that 43% of coaches endorsed the misconception that all athletes recover at the same rate.[14] The lack of symptom recognition by coaches and the willingness to allow symptomatic athletes to continue to participate may increase the risk of further injury and potentially SIS. These misconceptions amongst coaches are particularly important as students-athletes are not likely to adhere to return-to-play guidelines themselves.[20] Sports medicine professionals, parents and coaches need to be educate and make sure the athletes are following the recommended guidelines.[20]

In addition to the Heads-Up toolkit, there are several additional strategies to help educate coaches about concussions. Participation in an educational conference was found to be one of the most effective ways of educating coaches on concussions.[12] Previous investigations suggest that participation in a coaching education program results in coaches being more aware of signs and symptoms such as amnesia, confusion, dizziness, headache and loss of consciousness that are associated with concussions than those who do not have a background with a coaching program.[18] The American Sport Education Program (ASEP), recognized by multiple state organizations as a certifying body for coaches, and the National Federation of High Schools (NFHS) are two certification programs that coaches can be a part of and possibly in the future help with the distribution of concussion knowledge materials. Washington and Oregon have mandated concussion education for coaches, immediate removal of athletes from practice or games when a concussion is suspected, and the athlete must have proper medical clearance before allowing the athlete to return to play.[21] Several additional states are attempting to pass similar bills including Florida, Massachusetts, New Jersey, Idaho, and New York.[21]

By potentially helping to correct the misconceptions of coaches and increase their knowledge of concussions in regards to recognizing and managing concussions, there may be an increased awareness of concussions which could decrease SIS and long term sequale.[9] In turn, Guilmette suggests that high school football coaches who do not have access to an ATC need to be well informed about the recognition, assessment, and management of concussions.[12] Therefore, the CDC devised the "Heads-Up" toolkit to help with informing coaches about concussions with the goal of reducing the number of athletes who sustain SIS or return to play before appropriate clearance by a healthcare provider is given. However, to date there has been limited assessment of the effectiveness of the Heads-Up packet and no investigation of the DVD

specifically. Therefore, the purpose of this study was to assess concussion knowledge immediately following the CDC's Heads-Up DVD and again four weeks later, in order to identify if the Heads-Up DVD could be an effective starting place for educating coaches about concussions. We hypothesize that the post-assessment scores will be higher than the pre-assessment, coaches who have previously sustained a concussion will score significantly higher on the pre-assessment than those subjects who have never sustained a concussion, there will be a difference between coaching experience levels, there will be a difference between the face to face courses and the online courses, the graduate subjects will score significantly higher on concussion knowledge in the pre-assessment as opposed to the undergraduate subjects, and the four week follow up will be significantly higher than the pre-assessment.

CHAPTER 2

METHODS

Subjects

We recruited 258 coaching education students to participate in this study (Table 1). There were two primary inclusion criteria of the subjects; 1) college students enrolled in a coaching education course at two universities at Georgia Southern University or Central Michigan University and, 2) over the age of 18. The exclusion criteria included students under the age of 18. The subjects did not receive compensation or any extra incentives for their participation in the study. The subjects were provided written informed consent prior to participating in this study as approved by the University's Institutional Review Board.

Instrumentation

The three assessments were posted on the Internet (host: SurveyMonkey.com) and were based on the "Heads-Up: Concussion in High School Sports" DVD.

The "Heads-Up" DVD is 11 minutes and 38 seconds long and was produced in 2005 by the CDC.[22] The "Heads Up" DVD covers diverse components related to concussions including; what a concussion is, what sports concussion occur in, the underreporting of concussions, long term consequences, symptoms, return to play criteria, second impact syndrome, incorrect terminology, increased risks for concussions, and how to prevent a concussion. In addition to the video, the "Heads-Up" packet includes a clipboard with concussion signs and symptoms on the back, a wallet guide, information sheets for both parents and student-athletes, as well as a poster.[10]

The pre assessment has a potential total of 56 questions; however the exact number of questions provided was dependent on the answers provided. The post and follow up assessment have a potential total of 33 questions as the post and follow up assessments do not ask demographic questions. The assessment is subdivided into four different categories; 1) subject demographics, 2) concussion prevention, 3) concussion recognition, and 4) concussion management. All assessments were coded so the three assessments could be compared.

Procedures

During the online classes, the subjects participated in this study on their own time. On their respective online course management system the procedure for the study was provided and, if the potential subject agreed to participate, they clicked on a link that led to the pre-assessment. Upon completion of the pre-assessment, the subject clicked on a link to view the "Heads-Up" DVD. They were not able to ask any questions while the DVD is playing and the setting prevented the subjects from going back to the pre-assessment to change any answers. Once the DVD was completed the subject clicked on the next link which will let them take the post-assessment. Four weeks after they watched the DVD the subjects took the follow up-assessment. Once again the link to the follow up assessment was posted on their respective online course management system and the subjects took the follow up assessment on their own time.

During the traditional face-to-face courses, the subjects were in a university computer lab to participate in the study. Those who chose not to participate sat at the desk and completed other school assignments. The subjects were explained the procedure and have the opportunity to ask questions. Once this was completed the computerized pre-assessment was given. After completing the pre-assessment, the DVD from "Heads-Up: Concussion in High School Sports"

was viewed in front of the classroom so all subjects can watch it simultaneously. The subjects then took the computerized post-assessment. The subjects took the follow up-assessment 4 weeks later. The follow up assessment was available on their respective online course management system for the subjects to complete on their own time.

Pilot study

The subjects that were used for the pilot study were undergraduate athletic training students at a local university with a CAATE accredited athletic training education program. The 25 pilot subjects, 15 male and 10 female, ranged from sophomores to seniors. Eleven of the earlier subjects watched the video and fourteen were the control subjects. Each subject took the pre assessment, if they were a control they waited 12 minutes then took the post assessment, all others watched the video then took the post assessment. Cronbach's α for Recognition Pre is .57 and Post is .66.

Data analysis

The demographic, concussion knowledge, and the true/false questions can be found in Appendix F. The answers were graded correct or incorrect; if an answer was left blank it was marked incorrect. The total score, maximum of 33 points, was then calculated for each assessment. A second score, signs and symptoms (page 15 question 1 Appendix C and page 5 question 1 Appendix D), was calculated by adding up the correct answers, it was also be found for all three testing sessions. A third score for the true/false questions was calculated for each of the questions for all three testing sessions. The correct answers can be found in Appendix E.

Statistical analysis

Descriptive statistics were calculated for the subjects' age, gender, years in school, and years in coaching. The data was analyzed using a two-way ANOVA with repeated measures and a one-way ANOVA with repeated measures. The two-way ANOVA was used to test for the effect of gender, delivery method, history of concussion, and student degree level on the total score. The one-way ANOVA was used to examine the overall effect for the total score and the sign and symptom score as well as the overall effect of the true false questions. A one sample t-test was run to compare our symptom scores to the scores found by Van Lunen and Valovich. The alpha level was set at $p<0.05$.

CHAPTER 3
RESULTS

We recruited 258 subjects, 169 completed at least part of the assessments for a response rate of 65.5%. A total of 169 subjects completed the pre-assessment, 160 completed the post, and 69 subjects completed the four-week follow up. Demographic responses for subjects can be found in Table 2. Subjects reported they coached 12 different sports; the three most common ones are football, baseball, and basketball (Table 3).

Overall

There was no difference (F_1=1.64; P=0.202) in the mean overall score between pre ($\overline{x}$ =25.65±3.87), post ($\overline{x}$ =26.12±3.29), and follow up ($\overline{x}$ =25.32±3.97) (Figure 1). There was no significant difference from pre to post (F=1.62; P=0.208) or post to follow up (F=3.46; P=0.067). When compared those who took just the pre-assessment ($\overline{x}$ =25.99±3.31) and the post-assessment ($\overline{x}$ =26.01±3.44) there was also no difference (F_1=0.005; P=0.946).

Between groups

There was no significant difference between subjects who had a history of concussion and those that had not (F_1=1.54; P=0.220) (Figure 2). There was no significant difference between genders at any of the three assessment time points (F_1=.225; P=0.764) (Figure 3). Further, there was no significant difference between delivery methods at any of the assessment time points (F_1=2.11; P=0.132) (Figure 4). Finally, there was no significant difference between student degree levels at the pre-assessment or post-assessment (F_1=0.00; P=0.992) (Figure 5).

Signs and symptoms score

There was no significant difference between the three assessment dates (F_1=2.85; P=0.067) for the mean number of correct responses for the 16-symptom checklist between pre ($\overline{x}$

=11.94±2.17), post ($\bar{x}$ =11.72±2.36), and follow up ($\bar{x}$ =11.33±2.45). Between only the subjects who completed the pre (x=12.31±2.06) and post ($\bar{x}$ =11.79±2.30) there was a significant decrease in the post assessment scores (F_1=10.07; P=0.002). Table 4 lists the descriptive data for each symptom. Out of a possible 16 points on the symptom scale, the subjects' scores ranged from 7-16 with 5 subjects receiving a perfect score of 16. When comparing our results to Valovich's study (mean score on the identical 16 symptom checklist was 9.78±2.07), the subjects in this study scored significantly higher scores at each assessment point; pre (p<0.001, t=15.13), post (p<0.001, t=11.08), and follow up (p<0.001, t=5.26).[18] When compared to Van Lunen's study (mean score on the identical 16 symptom checklist was 6.40±1.20 pre and 6.55±0.76 for the post), the subjects in this study scored significantly higher at each assessment point; pre (p<0.001, t=36.05), post (p<0.001, t=29.72), and follow up (p<0.001, t=16.70) (Figure 6).[15]

True/ false misconception

There was a significant main effect found between the three testing periods for "once you sustain a concussion you are at a higher risk to get another one" (F_1=3.6; P=0.046). Post-hoc analysis revealed the difference was found between pre and follow up (P=0.040) testing with the follow up scoring higher. There were no significant differences between any of the testing sessions for the remaining six true and false questions (Table 5). More than 73% of the subjects got the seven true and false statements correct on all three assessments. The most common misconception, for all three assessments, was an athlete who recovered from a head injury is less able to withstand a second blow to the head. Finally, over 97% of the coaches correctly identified that concussions may affect both memory and learning.

CHAPTER 4
DISCUSSION

The purpose of this study was to identify if the Heads-Up: Concussion in High School Sports DVD alone could be an effective tool for educating coaches about sports-related concussions. Surprisingly, the subjects' knowledge of concussions did not increase significantly after watching the DVD or four weeks later when the follow up was given. Except for those subjects who completed only the pre and post; their sign and symptom checklist decreased significantly following the DVD. This finding raises questions regarding the effectiveness of the Heads-Up DVD by itself and if it alone is an appropriate educational tool for educating coaches about concussions.

By using only the DVD, the subjects' knowledge did not increase immediately after watching or four weeks later when the follow up was given. Conversely, Van Lunen found when using the Heads-Up pamphlet and informational clipboard there was a significant increase in the coaches' knowledge.[15] Suggesting that one potential explanation for the discrepancies in findings between studies is that Van Lunen's coaches had surprisingly low scores on the sign and symptom checklist.[15] It is surprising that our lowest sign and symptom score is higher than Van Lunen's average score, as those who are in a coaching education program have shown to score higher on concussion knowledge assessments.[15, 18] Further, an additional potential explanation could be due to the coaches in Van Lunen's study had a mean age of 41 years, while we had an average of 22 years.[15] Ours coaches have essentially grown up with concussion in the news since Troy Aikman and Steve Young retired most likely due to their number of concussions. The number of published materials on concussion in sport has increased greatly from only 5 being published from 1960-1969, to 172 published from 2000-2004.[23] Concussions have become a

nationally recognized injury and the difference in age could a reason why the coaching education students did not have a significant increase in overall score. The *New York Times* has published 15 articles on concussion in the last year alone.[24] One study found that a passive dissemination of guidelines or educational materials is a relatively weak method for helping to improve overall knowledge and use of the educational materials.[25]

Surprisingly, we did not find a difference in those who had a history of concussion as compared to those who did not have a history of concussion. A previous investigation by O'Donoghue showed coaches who had previously sustained a concussion scored significantly better on the concussion knowledge assessment than those coaches who did not have a previous concussion.[14] Perhaps this happened because the coaches were able to recognize the signs and symptoms that they had experienced themselves.[14] However, Van Lunen showed that the coaches in her study did not have a significant difference in either the overall score or the sign and symptom checklist.[15] There are a few potential explanations of this finding, either the coaching students who did not have a history of concussion scored really well on the assessments for other unknown reasons or the subjects who did have a previous concussion may have had a "mild" concussion and did not have many signs and symptoms therefore they did not recognize the other signs and symptoms. Our findings show that coaches with coaching education are more likely to correctly recognize the signs and symptoms of a concussion, than the subjects in previous studies.[15, 18] It is surprising there was no difference because it is thought that once a coach has sustained a concussion and experienced those symptoms, they would be better able to identify a concussion based upon this signs they observed during their experience. This was not the case in the present study.

The results of our investigation indicated there were no significant differences between genders with the overall score or symptom recognition. Previous investigations have presented mixed results on this topic with O'Donoghue reporting male coaches scored significantly higher than the female coaches, while Kaut indicated no differences.[14, 26] It is possible that males, who typically coach higher risk sports, tend to be exposed to more concussions that lower risk sports. While females typically have a higher rate of concussion in similar sports (e.g., soccer and basketball), football predominately a male sport, is responsible for the largest number of concussions.[27] One limitation in interpreting these results is that 76.9% of the subjects were male.

We also found no significant differences between the two types of delivery methods, face-to-face or web based. Web based learning is often called online learning or e-learning because it includes online course content.[28] In order to make online programs more effective it is important to identify the individuals' educational needs to create an appropriate educational tool.[28] This is a potential limitation of this study, as the subjects' were not given the correct answers to the test or any other concussion information by the research team. An additional consideration is how the age difference influences the comfort level with online educational tools specifically with using the internet.[28] Chumley-Jones suggested that web based learning was comparable to, but not superior to, other educational methods.[29] It has been suggested that web based learning may stimulate learning differently depending on the subjects' educational level (undergraduate or graduate).[29] Video-based learning is used as an "anchor" or situation for creating a realistic context to make learning motivating, meaningful, and useful.[30] To help bridge the gap between the classroom and the real-world conditions computer technology has potential for offering interactive, authentic instructional experiences.[30] While having a video-based

educational tool, it may also benefit more coaches to also have printed material to read, as some coaches may not have the knowledge or capabilities to view the video or web based material. Whether the instructional method was online or face-to-face the DVD addresses both a visual and auditory learning style. As students have different attitudes about learning a student may prefer either a visual or auditory learning method.[31] is unlikely that a one size fit all approach can meet the needs of every student it is important to be aware of all learning styles when making a new educational tool.[31]

Our findings showed there was no significant difference in undergraduate education and graduate education. While we do not know what type of higher degree Van Lunen's subjects' had, she did find a significant difference between those who had a high school diploma or a GED versus who had a higher education.[15] However, O'Donoghue did not find a statistical difference with a higher education degree.[14] Valovich did find that those who participated in a coaching education program more easily recognized the symptoms of a concussion.[18] Since there were a limited number of graduate students as compared to undergraduate it is difficult to assess whether having a higher degree is an indicator of being able to recognize a concussion.

In order to identify that a concussion has occurred, the first step in proper management, is the recognition of common symptoms. Specifically, we found that coaches were more likely to identify blurred vision, confusion, dizziness, headache, loss of consciousness, and nausea and were less likely to identify amnesia and sleep disturbances. In the Valovich study, over 60% of the coaches correctly identified amnesia, confusion, dizziness, headache, and loss of consciousness, while they were less likely to identify blurred vision, nausea, and sleep disturbance.[18] This shows that the subjects in this study understood that vision problems and nausea are concussion symptoms as compared to Valovich, but coaches in general do not realize

that sleep disturbances are a symptom of concussion and needs to be recognized. However, sleep disturbances are not seen the moment a concussion happens, the athlete will typically report it the next day. It is encouraging that coaching education students are able to identify most of the concussion signs and symptoms, but they still have room for improvement as over 25% of symptoms were not correctly identified. We found a significant difference in our mean signs and symptoms as compared to Valovich and Van Lunen.[15, 18] Van Lunen reported mean signs and symptoms numbers for both pre and post, however, her numbers were not significant when compared with each other.[15] These differences could be because the coaching education students have more of a concussion knowledge base as opposed to Valovich and Van Lunen due to being more enrolled in a coaching education program.

There are several misconceptions that occur with concussions, but those in a coaching education program tend to realize these misconceptions. Over 87% of the subjects correctly identified that a second blow to the head would not help one remember things they forgot the after the first blow; however, unfortunately, 13% subscribed to this misconception. Conversely, all 60 of the New England coaches in a previous study, correctly identified this misconception. However, our subjects, did better than the Rhode Island general public in which only 58.2% got it correct.[32] While there is still room for improvement, our subjects in a coaching education program were more likely to recognize this misconception as opposed to the general public.

There are several other misconceptions and ideas that coaches tend to not recognize. The other true and false questions were not found to be significant. Many of these questions have previously been tested in other literature. “An athlete who displays any signs or symptoms of a concussion should not be allowed to return to play” 61.5% of youth coaches correctly identified this to be true, while 92.3% of the coaching education students answered this question

correctly.[18] This shows that if one were in a coaching education program they are more likely to recognize the signs and symptoms and not allow an athlete to return to play before they are ready. "There are NO long term effects after suffering a concussion" 100% of the New England coaches and 71% of the general public identified that this was a misconception, while 95.9% of the current subjects correctly identified this was a misconception.[12, 32] "An athlete who as recovered from a head injury is less able to withstand a second blow to the head" 87.1% of the New England coaches and 61.2% of the general public answered this misconception correctly, while only 73.4% of the coaching education students correctly identified the misconception.[12, 32] This suggests that the coaching education students are less well informed about some misconceptions as opposed to others as compared to New England coaches, however the subjects still recognized more misconceptions than the general public. It could also be how some of the statements are worded; it is possible the subjects do not understand completely what is being asked.

This study had certain limitations that may have affected the results. There is a possible ceiling effect for the signs and symptoms and the true and false questions; however the mean symptom score was 11.94, so there is room for improvement as the highest score is 16 indicating over 25% of the answers were incorrect. Similarly, for the true and false questions 73% correctly answered which still leaves the subjects room to improve their score. Finally, a variety of educational techniques (e.g., online, course work, conference attendee's) should be utilized to further identify the most appropriate techniques for disseminating the "Heads-Up: Concussion in High School Sports" toolkit.

While previous investigations have suggested that coaches found the toolkit to be helpful, our findings suggest the DVD alone was not effective in increasing the coaching education

students' knowledge on recognizing, managing and preventing concussions. The inability of coaching education students to recognize, manage, and prevent sports-related concussions should prompt organizations to make a more effective concussion toolkit. Until it is mandatory that every high school have a certified athletic trainer available at all games and practices, it is important that coaches be able to recognize, manage and prevent concussions.

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APPENDIX A

REVIEW OF LITERATURE

Concussions are a major health concern in sporting events.[1] Centers for Disease Control and Prevention (CDC) report that there are about 1.6 to 3.8 million sports-related concussions reported every year in the United States with nearly 63,000 concussions annually in high school sports alone.[2-3] In a study conducted from 1999-2001, a concussion incidence rate of 0.81 per 1000 athlete exposures was reported in the collegiate setting.[4]However, in a study from 2005-2006 a total of 8.61 per 1000 athlete exposures was found for the collegiate setting.[5] An athlete exposure is defined as one athlete participating in one practice or one game. Powell found during the 1995-1997 academic years a football concussion incidence rate of 2.82 per 1000 game exposures and 0.25 per 1000 practice exposures in the high school setting.[3] While in 2005-2006 Shankar found 2.56 per 1000 practice exposures and 12.04 per 1000 game exposures for the high school setting.[5] Earlier high school football studies reported the concussion incidence rate to be in the range of 10%-20%, significantly higher than the National Athletic Trainers' Association (NATA) reported incidence rate of 2.8%-5.5%.[4, 6] An even more recent survey done with high school football players by Kaut in 2002, suggested that closer to 15% of athletes sustain a concussion each season.[7] As seen in these studies the incident rate of concussion is high and it is important to recognize and manage them.

Concussions are considered a major medical issue as they can lead to more serious brain injuries and potentially death if not treated properly. Cerebral concussions are often known as a mild traumatic brain injury (MTBI) - a term more indicative of the potential severity of the injury.[8] However the panel for the 3rd International Consensus statement disagrees and states there is a separation of concussion and a mild traumatic brain injury, but the authors did not

define a MTBI.[1] High school and younger athletes comprise the majority of at-risk athletes for a concussion due to the sheer number of young athletes participating in organized sports.[9] This creates a greater concern due to the potential number of concussions these athletes may receive due to increased vulnerability in younger athletes.[7] Additionally, the concussion management techniques have been understudied at the youth and high school level.[9]

Mild traumatic brain injuries (MTBI) are categorized as either focal (non concussion injuries) or diffuse (concussion injuries). Focal injuries are uncommon in athletics; however, if an athlete has delayed concussion signs and symptoms, or if the athlete starts to deteriorate, a focal injury should be considered a possibility. Focal injuries are considered more severe than diffuse injuries.[6] To determine if a focal injury has occurred a CT scan can be used to establish if a subdural or epidural bleed exists.[10] If an athlete has sustained this type of injury, as the bleeding continues the signs and symptoms escalate because there is not enough room in the cranium to contain the additional volume of blood.[10] The additional blood volume coupled with the fixed volume of the cranium increases pressure on different portions of the brain resulting in altered signs and symptoms such as blurred vision, headaches, dizziness, confusion, and disorientation.[10] If a focal injury has occurred, it is important that the athlete rest and recover completely before returning to sporting activities.[10] Full recovery is extremely important as it is possible to over-stimulate the brain, with this excessive stimulation it could potentially leading to longer deficits.[10]

Diffuse injuries are more common in athletes due to the fact they typically are caused by acceleration-deceleration motion coupled with rotational forces, linear forces or both.[8] The most severe type of diffuse brain injury includes structural damage due to axonal disruption.[8] This injury results in impaired cognitive functioning typically manifested as disturbed concentration

and memory.[8] Mechanical stretching of axons could result in membrane disruption and possibly depolarization. This syndrome can last for up to six hours post injury and can lead to an influx of calcium and resultant mitochondrial swelling.

Microtubule breakdown can occur from six to twenty-four hours after the injury due to the increase in axonal calcium levels.[10] Diffuse injuries can also negatively affect the sequence of neurochemical and anatomical events that occur during normal development in an adolescent. When the brain receives a concussive blow a release of neurotransmitters and ionic fluxes occur. Further neuronal depolarization occurs with the binding of excitatory transmitters (glutamate) to the N-methyl-D-aspartate (NMDA) which leads to an influx of calcium and efflux of potassium.[10] As the potassium level increases outside of the cell it leads to a release of excitatory amino acid (EAA) which opens the EAA receptor channel, allowing additional potassium to flow out.[10] The neuronal suppression that occurs due to this is called spreading depression. This causes the sodium-potassium (NA^+-K^+) pump to work overtime requiring increased amounts of adenosine triphosphate (ATP). Thus, a jump in glucose metabolism occurs due to a spike in ATP demand. All of this occurs simultaneously with a decrease in cerebral blood flow. Coupled with the difference of glucose supply and demand, a cellular energy crisis is triggered.[10] An increase in calcium would impair the mitochondrial oxidative metabolism and worsen the energy crisis by not providing enough energy to help with the glucose supply. The mitochondrial would not be able to supply enough ATP to keep up with the demand of glucose. The increased levels of calcium can also activate certain pathways that lead to cell death. The intra-axonal calcium flux disrupts the neurofilaments and microtubules, which in turn impair neural connectivity.[10] Lactate will start to accumulate after hyperglycolysis has been started because lactate production is increased by glycolysis, but there is a decrease in lactate metabolism.[10] This lactate accumulation

can result in acidosis, membrane damage, blood barrier permeability alteration, and cerebral edema resulting in neuronal dysfunction. This energy crisis has been suggested to cause postconcussive vulnerability – an inability for the brain to respond appropriately to a second injury causing even more damage and increased duration of symptoms.[10] If an athlete was to sustain a second concussion during the energy crisis, cellular death could result. Following the initial hit, the concussed brain enters into a depressed metabolism. This spreading depression can cause a loss of consciousness, amnesia or other cognitive dysfunctions.[10]

When the brain is not concussed, cerebral blood flow is tied to neuronal activity and cerebral glucose metabolism.[10] However, once the concussion occurs cerebral blood flow can be reduced by up to 50%. The buildup of calcium is typically seen within hours of the brain injury and can last up to four days. The cerebral glucose usage rate has been known to be diminished within twenty-four hours of the injury and can remain low for up to four weeks.[10] Concussive brain injuries tend to lead to early changes in choline acetyltransferase activity which in turn leads to a loss of forebrain cholinergic neurons. This loss of neurons has been shown to cause learning and spatial memory deficits. It has also been found that chronic changes in cholinergic function occurs following a concussion.[11] Gorman reported that immediately following a concussion there were deficits in motor and reference memory performance.[11] These were found to improve by 24 hours after injury.[11] In Schmidt's study using rats a fluid-percussion injury resulted in a significant change in the morphology of cholinergic neurons in the ventrobasal forebrain when the rat was injured 11-15 days prior.[12] It was also shown that cholinergic neuron dropout was significantly greater on the side ipsilateral to the injury and markedly less on the contralateral side.[12] This is important because ventobasal forebrain and septal cholinergic

neurons have been strongly linked with memory and learning behavior and Alzheimer's disease has been associated with a loss of these particular neurons.[12]

As of this writing, there are no physiologic or neuroanatomic measurements that can determine the severity of a concussion or when complete recovery has occurred.[8] However, even an athlete who is "mildly" injured can exhibit an abnormal neuropsychological exam. These deficits can include the athlete's working memory, information processing speed, attention, and executive function which has been found to be controlled by the frontal lobe.[13] Concussions typically result in neuropathological changes, however these do not show up on the typical neuroimaging. The clinical symptoms tend to reflect a functional deficit rather than a structural injury.[1] This concept leads to the idea of using a functional neuroimaging exam to measure the metabolic and/or physiological state of the brain – the neuropathological changes are not detectable by normal imaging such as a CT or MRI. The older types of functional imaging are typically based on resting metabolic measurements such as the positron emission tomography (PET) and the single-photon emission computerized tomography (SPECT).[13] These have been shown to reveal perfusion deficits better than the simple structural damage capable of being shown by the CT or MRI. However, these tests require the use of a radioactive tracer, which is not practical in the clinical setting. To help overcome this issue, a new functional neuroimaging exam is being researched. Functional Magnetic Resonance Imaging (fMRI) does not require a radioactive device and is limited only by brain hemodynamics and spatial resolution when compared to the conventional MRI.[13] There are three major changes that are detectable by the fMRI including 1) slowing of cerebral circulation, 2) an increase in arterial blood pressure, and 3) an overall increase in cerebral blood volume.[13] They are based on an assumption that an increase in neuronal activity leads to a localized increase of cerebral blood flow in that region.[13]

The fMRI uses blood oxygenation as a measure of certain activations of areas in the brain.[13] When an area of the brain is activated there is an increase of oxygen-rich blood in that local area, more than the typical amount of oxygenated blood seen in that region.[13] Using the magnetic properties of the oxygenated blood, an increase in signal can be detected. The fMRI specifies regional abnormalities in metabolism that are associated with certain neuropsychological test measures in the concussed athlete. Because this does not require a radioactive device, it is possible to run multiple scans to chart progress and show the athlete's recovery over a period of time.[14] There are two major questions about using the fMRI: 1) is it sensitive enough to detect the functional abnormalities? and 2) will it be consistent and reliable? Future research needs to be performed with the fMRI and working memory task for evaluating the clinical outcome, especially when postconcussive symptoms continue. This could help determine if there is an objective way to determine concussion recovery.

In a study conducted by Chen, concussed athletes had more activation peaks outside the normal regions of interest, such as the temporal and parietal lobes, than was "normalized" by the control group.[13] This shows that they had a widely distributed activation pattern during memory processing relative to the control group. The excessive activation was not attributed to answering the questions correctly because there was not a "normal" pattern of activation; it was caused by the athletes using different parts of the brain to arrive at an answer. The symptomatic athletes tended to show this trend of increased activation whether they had lost consciousness at the time of injury or not. It has been suggest that by using working memory and fMRI one could identify an underlying pathology after an athlete sustains a concussion.[14]

There are many sideline tools that can help to determine if an athlete has suffered a concussion. These include neuropsychological evaluations with the Standardized Assessment of

Concussion (SAC) test, the Balance Error Scoring System (BESS), and Immediate Post-Concussion Assessment and Cognitive Testing (ImPACT).

The SAC test was developed in response to the recommendation of the AAN Practice Parameter and the Colorado Guidelines.[15] It was also developed to help determine the neurocognitive deficits from brain injury on the sideline during a game or practice. It is intended to be a standardized means of documenting objectively the presence and severity of neurocognitive impairment after sustaining a concussion.[15] It includes measures of orientation, immediate memory, concentration, and delayed recall. It has been proven that it is adequately sensitive to detect mental status abnormalities.[14, 16] However, the SAC should not be a substitute for formal neurologic or neuropsychological evaluation of the injured athlete.[15] The test is practical to perform on the sidelines because it only takes five to seven minutes to administer and there were no learning effects when using high school athletes.[16] The best way to use the SAC form is to determine a baseline before each athlete begins their season, this way when the athlete sustains a concussion the ATC can determine when the athlete recovers. McCrea suggested that baseline data is reliable and can help to detect mental status changes secondary to concussion during game or practice conditions.[17] According to other research, there is a learning effect with this neurocognitive test, and typically athletes perform better than their baseline within 48 hours of injury.[15] As seen earlier with the neurometabolic cascade affect decreased cerebral blood flow can last up to 10 days, so this increase in score could be due to a learning effect rather than the athlete recovering that rapidly. To help offset the learning effect there are three different forms of the SAC available. Some of the orientation questions include: what month is it, what is the date today, what is the day of the week, what year is it, and what time is it.[15] The immediate memory gives a list of five words that the athlete must repeat back to the administrator three times, and

then again at the end of the test in the delayed recall section.[17] Concentration involves saying a certain number of digits in the reverse order of which the administrator reads them. As the athlete gets one string correct, they move on to the next row. The athlete gets two chances to complete each row. Another concentration question involves the athlete repeating the months of the year in reverse order starting with the month that the administrator chooses.[18] The entire SAC test consists of 30 points, typically baseline scores are found to range between 27-30 with a concussed athlete scoring around 23 or 24. On average the concussed athletes dropped 3.5 points from their baseline.[15] However; this could differ for each individual and is why a baseline test is recommended. The SAC is both reliable and valid; however it has a low reliability when it comes to test-retest.[16] The extraneous factors such as fatigue, emotionality, distraction, and certain other conditions during the games do not appear to interfere with the test performance on the SAC.[15]

The BESS is a balance test using three different stances on two different surfaces, for a total of six trials.[19] The required stance for the athlete to be in is placing their hands on their iliac crests and closing their eyes. When the eyes are closed this starts the 20 second trial. They are asked to stand quietly and with minimal movement as certain movements are counted as points. If the athletes lose their balance they are to try and get back to the testing position as soon as possible.[20] The three stances are double leg, single leg on the non-dominant leg, and tandem in which the non-dominant leg is in the back. The two different surfaces are a firm surface such as the athletic training room floor, court or track (not the field the athlete is playing on) and a foam surface of medium-density.[20] During a football game there is typically a piece of concrete that could be used for the firm testing. There are six different errors and movements the administrator is looking for including: lifting hands off iliac crest, opening the eyes, if the athlete steps,

stumbles or falls, moving their hip into greater than 30 degrees abduction, lifting of the forefoot or heel, and remaining out of the testing position for more than 5 seconds.[16, 20] The athlete's score is calculated by adding one error point for each error that occurred during each of the six trials. Each trial can get a maximum score of 10. As with the SAC test, it is best to determine a baseline score with the BESS to make a more accurate comparison. Previous research has shown decreased stability through days three to five, indicating it is sensitive to alterations of postural-stability after a concussion.[16]

In addition to using the SAC, the Graded Symptom Checklist (GSC) can also be used on the sidelines after a concussion is suspected. The GSC should be administered during the preseason in order to establish a baseline, at the time of injury, 2-3 hours post injury, and then every day until the athlete returns to baseline.[20] There are many different checklists available. The one Iverson used consisted of 21 symptoms and graded on a Likert scale of 0 to 6 to determine severity with 0 being not present and 6 being severe.[21] This particular checklist is also used on the neuropsychological test ImPACT.[21] Iverson has shown that if an athlete sustains multiple concussions they report significantly more symptoms after the injury than at baseline.[21] In Macciocchi's study, the number of athletes reporting an increased number of symptoms after 1 or 2 injuries greatly increased.[22] However, by day 10 their symptoms had returned to baseline.[22] The NCAA study showed that there was a steady decrease in the mean reported graded symptom checklist total scores starting three hours after injury, the overall symptom duration was about 3.5 days.[4] Many of the symptoms on the checklists are common and can include: headache, confusion, tinnitus, dizziness, balance disturbance, blurred vision, nausea, and post-traumatic amnesia.[6] McCrea's NCAA study showed the athletes had increased symptoms during the acute phase immediately following a concussion, however most symptoms were

resolved by day 5.[23] Ninety-one percent of athletes with a concussion returned to baseline within 7 days of sustaining a concussion.[23]

ImPACT is a computer based neuropsychological test of cognitive functioning. It consists of seven assessment modules that produce four composite scores for verbal memory, visual memory, visual-motor speed and reaction time.[21] There is also a graded symptoms checklist that consists of 22 different items ranging from 0 to 6 on a Likert-scale. The reliability of ImPACT has been reported to be from 0.54 to 0.76.[18] An advantage to computer testing is the standardization of administration, along with scoring. ImPACT controls for a practice or learning effect by randomizing the items within each section so it is not the same exact test as they have taken before, but it has the same format. Typically the general public does not use ImPACT; however, they can still sustain a concussion.

Since the public does not have the background coaches have when it comes to concussions, it is important to see what they know, so they can become educated. It has been shown that the Rhode Island general public does not know as much as coaches with regard to concussions. 28% of the general public thought that a concussion was harmless while, not one coach made this error.[24] When it was suggested that a second blow to the head can help a person remember things that were forgotten, 42% of the general public believed this was true while the coaches did not believe it.[24] Due to the misconceptions of the general public, many people, including family members of the players, fans and school administrators may consider it extreme to remove an athlete from play because they do not realize the significance of concussions.[24] To help the parents and administration learn more about concussions and the reasoning for removing the athlete, the CDC has produced fact sheets for parents to help with signs and symptoms. They also have a fact sheet available for athletes to help educate them on the signs and symptoms of

concussion. These are called A Fact Sheet for Parents and A Fact Sheet for Athletes respectively and can be found on the CDC Heads-Up website.

31% of the public surveyed as part of Swift's study believed that people who have sustained head injuries look and act retarded.[25] More than half of the people surveyed also believed that people would respond normally after waking from a coma, that amnesia is only an isolated phenomenon and that if you get hit in the head a second time you will automatically remember everything you forgot from the first time you receive a blow. Virtually all of the general public is unaware that after sustaining a head injury the damaged cells of the central nervous system cannot regenerate. Nerve cells do not recover like other parts of the body once they are damaged.[25] This is why managing concussions is vitally important in helping prevent further damage caused by letting athletes return to play or practice before being fully recovered.

The grading of concussion severity is based strictly upon the severity and duration of the symptoms manifested. Some of the least used concussion grading scales include the Jordan, Ommaya, Nelson, Roberts, Torg, McGill and the original Cantu scales. These are published grading scales, but recent research has shown they have fallen into disuse and that the more commonly used scales by ATCs are the Colorado, AAN, and revised Cantu.[14] However, no concussion grading scale is universally accepted or followed by physicians and certified athletic trainers (ATC).[8] Many scales rely on a loss of consciousness (LOC) to determine the severity of the injury. However, LOC does not have to be present for a concussion to have occurred and this is one of the more prominent misconceptions about concussions. More than 90% of all cerebral concussion have not had LOC associated with them.[26]

The Jordan Grading System for Concussion is based on LOC. A grade 1 injury consists of confusion without amnesia or LOC. Grade 2 consists of confusion with amnesia resolving in less than twenty-four hours or no LOC. Grade 3 is indicated by LOC resolving in two to three minutes or posttraumatic amnesia lasting more than twenty-four hours. While grade 4 is indicated by LOC lasting longer than three minutes.[27]

The Ommaya Grading System for Concussion has six different grades and includes the athlete going into a coma. Grade 1 is confusion without amnesia. Grade 2 consists of amnesia present but no coma. Grade 3 is a coma lasting less than six hours. Grade 4 is a coma lasting between six and twenty-four hours. Grade 5 is a coma lasting more than twenty-four hours and grade 6 is a coma, with death within twenty-four hours.[27]

The Nelson Grading System for Concussion includes five different grades. Grade 0 results when the head is moved very rapidly, but the athlete is not immediately stunned or dazed. Instead, there is a delay in the manifestation of post concussion symptoms. Grade 1 is recognized when the athlete is dazed or stunned immediately, but without LOC or amnesia, and sensorium clears in one minute or less. Grade 2 injuries consists of a headache, feeling cloudy longer than one minute, no LOC and possibly additional symptoms such as, tinnitus, amnesia, an irritable disposition, confusion, dizziness or hyper excitability. Grade 3 is indicated by LOC lasting less than one minute, no coma and the exhibition of grade 2 symptoms during recovery. Grade 4 is indicated when LOC occurs with a duration of more than one minute, no coma and demonstration of grade 2 symptoms during recovery.[27]

The Roberts Grading System for Concussion includes a grading of “bell ringer” which consists of no LOC or posttraumatic amnesia and symptoms lasting less than ten minutes. Grade

1 is indicated with no LOC, posttraumatic amnesia lasting less than thirty minutes and symptoms lasting longer than ten minutes. Grade 2 is a LOC for less than five minutes and posttraumatic amnesia lasting longer than thirty minutes. Grade 3 is LOC greater than five minutes and posttraumatic amnesia greater than twenty-four hours.[27]

The Torg Grading System like most of the others is based on LOC and has six grades. Grade 1 is "bell rung" with confusion, balance deficits, a dazed appearance and no amnesia. Grade 2 is posttraumatic amnesia only, no LOC, and vertigo may be present. Grade 3 is posttraumatic retrograde amnesia, with vertigo and no LOC. Grade 4 is LOC for any duration. Grade 5 is coma and cardio respiratory arrest with grade 6 being death.[27]

The McGill Grading System typically is used throughout Canada, it emphasizes the postconcussive symptoms.[14] A grade 1 concussion consists of no LOC and no posttraumatic amnesia. Grade 1a has no postconcussion symptoms with only seconds of confusion, 1b has postconcussion symptoms and/or confusion resolved within fifteen minutes, and 1c consists of postconcussive symptoms and/or confusion that resolves in over fifteen minutes. Grade 2 consists of posttraumatic amnesia resolving in less than thirty minutes and/or LOC resolving in less than five minutes. Grade 3 is indicated by posttraumatic amnesia greater than thirty minutes and/or LOC longer than five minutes.[14]

The original Cantu Grading Scale focuses on the difference between brief and extended LOC as well as drawing attention to the duration of posttraumatic amnesia.[28] This scale lists a grade 1 injury consisting of no LOC or posttraumatic amnesia lasting less than thirty minutes. Grade 2 consists of LOC lasting less than five minutes or posttraumatic amnesia resolving in

longer than thirty minutes, but less than twenty-four hours. Grade 3 is indicated by LOC lasting longer than five min or posttraumatic amnesia lasting longer than twenty-four hours.[14, 27]

The Colorado Concussion Grading Scale is also based on LOC. Grade 1 is no LOC or confusion without amnesia. Grade 2 is no LOC or confusion with amnesia. Grade 3 is indicated whenever there is LOC regardless of the duration.[14, 27]

The American Academy of Neurology Concussion grading scale (AAN) is a common scale used in many recent studies and is based on LOC.[28] Grade 1 or a mild concussion consists of transient confusion, no LOC, with symptoms and mental status abnormalities resolving in less than fifteen minutes. Grade 2 or moderate concussion consists of transient confusion, no LOC, with symptoms and mental status abnormalities lasting longer than fifteen minutes. Grade 3 or severe concussion is indicated whenever there is LOC regardless of the duration.[8, 14, 27]

In 2001 Cantu revised his grading scale and formed an evidence-based concussion grading scale. Unlike the other grading scales, the grade is not determined until all symptoms are resolved. Grade 1 is no LOC, posttraumatic amnesia or postconcussion signs or symptoms resolving within thirty minutes. Grade 2 is LOC lasting no more than one minute or postconcussion signs or symptoms lasting longer than thirty minutes but resolving within twenty-four hours. Grade 3 is LOC lasting more than one minute or posttraumatic amnesia lasting longer than twenty-four hours or postconcussion signs or symptoms lasting longer than seven days.[27] Using this revision of the grading scale there are more grade 2 and grade 3 injuries reported in sports. This could be interpreted as possibly helping to demonstrate to the public, coaches and athletes that concussions are injuries that need to be taken very seriously. However the opposite

could also be true and it could be an over-reacting response, but when it comes to concussions it is better to be cautious.

Studies have shown that there are certain hallmark signs of concussion which include: headache,[4, 6, 22] confusion,[4, 6, 9] amnesia,[4, 6, 9] and LOC,[10] however LOC and amnesia are not required to make the diagnosis. Many coaches, over 60% of the youth coaches surveyed correctly identified headache, confusion, dizziness, and amnesia as being symptoms of concussions.[29] However, there are less common symptoms that the coaches failed to identify in the survey including sleep disturbances, nausea, and vision problems.[29] In the NCAA concussion study it was reported that only 6.3% of the observed concussions resulted in LOC.[4] Chen's results suggested that postconcussive symptoms are the most important indicator of concussive injuries.[13] Dizziness is a common concussion symptom. Collegiate football players suffering from concussion reported the highest incidence of this symptom of any group studied with 35% reporting this symptom.[30] Athletes have also reported headache, dizziness, balance deficits, and feeling "slowed down" as common signs and symptoms after a concussion.[4] Guskiewicz reported only 8.9% of those sustaining a concussion to have LOC.[6] Only 7.7% of all collegiate athletes in Kaut's study reported LOC.[30] Further demonstrating that athletes do not always fully report their symptoms, 61.2% of collegiate football players reported continuing to play with a headache after being hit in the head.[30]

There have only been a few studies on youth coaches and their knowledge of concussions. When comparing the Guilmette study along with the Valovich McLeod study it was found that youth coaches are less well-informed about concussions as compared to high school football coaches.[24] This could be because youth coaches tend to be the parents of the young athletes and volunteer their time to coach their child's team. After reviewing the results of the

youth coaches survey, it was found that youth coaches are unable to recognize the signs and symptoms of concussions suggesting a need for the development of concussion recognition courses and materials. Many youth sports organizations need to implement these courses and mandate that their coaches take them to become well informed about concussions.[29] Unfortunately, this could be costly and deter youth sports organizations from utilizing these courses.

The New England high school football coaches listed confusion and disorientation as the most common indicators of concussion followed by dilated pupils, headache and loss of memory. They also thought that altered mental status was the most important indicator of a concussion. The coaches realize that LOC is not a common or necessary indicator when it comes to concussion and that concussions can happen without LOC occurring.[24]

There is no set program for certifying coaches that is nationally accepted. However, by participating in a coaching program, either as part of an undergraduate or Master's degree, many coaches become more aware of signs and symptoms associated with concussions when compared to those coaches who do not have a background with a coaching program.[28] The most helpful source of information for high school football coaches was found to be the CDC "Heads-Up" concussion kit with 59% finding it 'very helpful' while healthcare professionals and conferences were 55% and 53% respectively.[24] However only 31% of the coaches surveyed received the *Heads Up: Concussion in High School Sports* tool kit.[24] This shows that even though the CDC tried to make *Heads Up* available to all coaches in the United States, they did not succeed.

Sawyer produced a study involving coaches in five different states across the United States. 70% of the participants indicated they were aware of concussions occurring at their

school.[31] An interesting finding was suburban (68.3%), urban (63.8%) and rural (55.9%) were more likely to have access to concussion materials.[31] The size of the school did not make a significant difference.[31] Surprisingly 69.4% of participants stated their school had a written plan to manage and prevent concussions.[31] This could be because the school has an ATC, however, this study did not take that into consideration. Many coaches reported increasing knowledge and awareness about preventing and managing concussions with not only themselves, other staff, athletes and the athletes' parents.[31]

Most states require coaches to have cardiopulmonary resuscitation (CPR) and first aid certifications.[32] In a situation where an athletic trainer is unavailable, the coach has at least a minimal idea of what needs to be done and what should and should not happen, such as calling Emergency Medical Services (EMS). In a study by Ransone, only 36% of the coaches received a passing score on a First-Aid Assessment exam.[30] This shows even if the coaches are first aid certified they need a regular refresher course. In Sefton's abstract 92% of athletes and coaches believed that bell ringers, dingers, and concussions were different injuries.[33]

One of the greatest challenges facing high school and collegiate athletic trainers and team physicians is recognizing concussions among athletes and managing their postconcussive symptoms.[30] It is important for athletes to understand the signs and symptoms of concussions as well as the associated negative consequences related with not reporting their concussion.[8] The objective is not to remove the athlete from play, but so that proper treatment for the injury can be sought and more serious injury avoided. Athletes need to be more forthcoming in the reporting of their injuries as with many grade 1 concussions the athlete's symptoms could resolve by the time they come off the field or the ATCs go out on the field. Because of this non-reporting by the athletes, many concussions are not recognized by athletic trainers or the medical staff.[9, 34] Many

times an athlete who is trying desperately to get back into the game may minimize his symptoms, which makes a return to play decision extremely difficult.[7, 35] The athletic trainer is simply unaware of the number of symptoms the athlete actually has. Guilmette surveyed 62 coaches who did not have athletic trainers present at practices or games. 19 of these coaches reported that there were no concussions sustained during the football season. 41% of these coaches believed that athletes "rarely" reported concussions and 51% believed that athletes "sometimes" reported concussions while 8% thought they "often" reported concussions.[24] Sefton shows that both coaches and ATCs underestimate the number of unreported head injuries by 91% and 82% respectively.[33] These results show that coaches know their athletes are not reporting their concussions then perhaps it will convince the coaches to look for concussion symptoms instead of waiting on the athlete to tell them. The results of the Kaut study emphasizes the need to educate not only coaches, but the athletes regarding signs and symptoms, specifically the potential danger of failing to report symptoms or playing with symptoms still present.[30] McCrea reported that the most common reason for a concussion to not be reported was the athlete did not think it was serious enough to require medical attention.[7] In Sefton's study 73% of the athletes stated they did not report their injury because they did not feel it was important or serious enough to do so.[33] This reinforces the fact that athletes need to be educated on the symptoms and consequences of not fully reporting their injuries. It appears that improving the education of athletes and coaches regarding concussions can increase the percentage of concussion reporting to medical personnel.[31]

It is suggested that the more education coaches receive about concussions and subsequently communicate to their athletes, will help increase the reporting rate and thus decrease the amount of recurrent injuries.[29] It was suggested in Guskiewicz's epidemiological

study that football players who received one concussion were three times more likely to receive a second concussion in the same season as opposed to those who did not have a previous concussion.[6] In a study conducted by Collins, if an athlete has three or more concussions they are 6.7 times more likely to experience LOC and 9.3 times more likely to show three or four abnormal markers of concussion severity as opposed to those who have no history of concussion.[9]

A decision to return to play (RTP) should be agreed upon with the entire sports medicine team; however the team physician should make the final decision.[8] Guskiewicz has reported 71% of the time the RTP decision is made by both the team physician and the athletic trainer at the collegiate level. However, in most typical high school settings there is less physician involvement and more responsibility in the decision is placed on the ATC.[6, 36-37] This becomes even more challenging if the high school does not have an ATC available. The RTP decision should not be made until the athlete is asymptomatic for a week and then can complete exertional moves while remaining free from symptoms for grade 1 concussions, they need to be asymptomatic for even longer if it is a grade 2 or grade 3.[9, 34] Additionally, a normal neurologic, neuropsychological and postural-stability, such as the BESS, examination must be completed. These exams must show that the athlete is back to baseline, or if no baseline was established, is back to the normative value, before being allowed to return to play. The NATA position statement suggests that younger athletes should be held out longer than older athletes.[8] This is due to the fact that the pediatric brain is still developing and they could possibly suffer permanent brain damage.[38] If an ATC is not present, a physician should make the RTP decision and not the coaching staff. It would be better for the athlete to see a physician who is up to date on concussions rather than a general medical physician who may not know the most current

research. Some of the continuing education hours for physicians could require them to learn about concussions. In the Guilmette study, when the coaches were given different scenarios with symptoms of concussions 70-95% of them said they would definitely consult a healthcare professional before allowing an athlete to RTP.[24] However, there could be a Hawthorne Effect with this study. The coaches need to feel comfortable enough to refer the athlete so that the athlete can get the proper medical care required. In Guilmette's study the majority of coaches reported that they would use a conservative approach to returning athletes to play, however there are a few coaches who would return athletes that were still symptomatic.[6, 24] These are the coaches that need to be educated more fully on the consequences of early return, so that poor RTP decisions are not made or repeated. It has been suggested that no athlete should be RTP until they have been evaluated medically, even if their symptoms lasted less than fifteen minutes.[34] When the Vienna Consensus Statement was produced it added something else to the RTP guidelines. The athlete should not only be symptom free, but should not be taking any pharmacological drugs that could modify the symptoms.[38] These could include pain relievers, anti-depressants, anxiety, or sleep disturbance medications. Even though this may seem like common sense once it is written out, many athletic trainers do not think about this potential complication. The athlete's are constantly asked if they take any medication, but to put this stipulation in writing may make more athletic trainers and physicians take a closer look at any medications the athlete is taking. Neurocognitive testing may be warranted because the athlete could be playing symptom free, but still have some cognitive deficits.[22] According the newest consensus statement on concussions it is advised to use neuropsychological testing to assist in return to play decisions and should not be conducted until the athlete is symptom free.[1] In the absence of neurocognitive testing a more conservative return to play approach is appropriate.[1]

The Canadian Academy of Sport Medicine (CASM) recommends the following guidelines to return an athlete to play. After an athlete sustains a concussion, there needs to be no activity only complete rest. Once asymptomatic they can proceed to light exercise, including walking or stationary cycling. As long as the athlete stays asymptomatic they can move on to the next level. If the athlete becomes symptomatic at any point in this time period, return to the previous step and try to progress again. The next step is sport specific activity, such as skating in ice hockey, followed by on field practice without body contact. If the athlete remains asymptomatic they can move to on field practice with body contact. However they do need to be cleared by a medical doctor for this step to take place. If the athlete handles this well, they can progress on to game play.[1, 14]

The AAN return-to-play guidelines are based on the grade of concussion and the concussion number of that season. A grade 1: 1st concussion return to play when asymptomatic for greater than fifteen minutes; 2nd concussion return to play when asymptomatic for greater than one week; 3rd concussion return to play when asymptomatic for greater than one week. Grade 2: 1st concussion return to play when asymptomatic for greater than one week; 2nd concussion return to play after two weeks if asymptomatic; 3rd concussion return to play after two weeks if asymptomatic. Grade 3: 1st concussion return to play when asymptomatic for greater than one or two weeks; 2nd concussion return to play when asymptomatic for greater than one month; 3rd concussion return to play when asymptomatic for greater than one month.[28]

The Cantu return-to-play guidelines are also based on the original Cantu grading scale and the number of concussions that season. Grade 1: 1st concussion return to play when asymptomatic; 2nd concussion return to play in two weeks when asymptomatic for one week, can consider for season terminating; 3rd concussion terminate season, may return next season. Grade

2: 1st concussion return to play when asymptomatic for greater than one week; 2nd concussion return to play after one month if asymptomatic for one week, consider season terminating; 3rd concussion terminate season, may return next season. Grade 3: 1st concussion return to play one month after injury if asymptomatic for two weeks; 2nd concussion terminate season.[28]

To demonstrate that there are active coaches that would put a symptomatic athlete back in the game, the youth coaches survey reported that 26% would let a symptomatic athlete return to the game, which further reinforces the point that there needs to be educational material available for the coaches to help them become more well informed so that appropriate decisions will be made and the athletes protected.[29] The coaches that passed the first-aid assessment test in Ransone's study tended to return the starters to the game, whereas the coaches that did not pass kept their starters out of the game, a more conservative measure.[30] This could be because of their low confidence levels or because they are not sure of what to do due to a lack of knowledge or training. However, the game situation and a belief that the player is needed can also negatively affect the return of starters to the game.[32]

It is important for an athlete to be fully cleared of signs and symptoms before returning to play to help prevent what is known as second-impact syndrome (SIS). SIS occurs because of rapid swelling and herniation of the brain when an athlete receives a head injury and then sustains a second one before the first symptoms have fully resolved.[7, 38] This second impact does not have to be a "big" hit, it can consist of a tackle and the whiplash that occurs with the hit could cause SIS.[38] Even something simple, such as a coach patting you on the helmet as a way of saying "good job out there" could potentially induce SIS. With SIS the athlete does not initially lose consciousness and often completes the play.[38] However they collapse within two to five minutes with rapidly dilating pupils, respiratory failure and loss of eye movement.[38] These

symptoms occur because of the brain's blood autoregulatory system leads to increased swelling, which in turn increases intracranial pressure and leads to herniation.[38] The athlete tends to slip into a coma and the pupils become fixed and dilated and even after an emergency craniotomy the athlete may not reawaken.[38] In a prospective cohort study done by Guskiewicz it was found that 75% of the athletes that received a second concussion in the same season got their second one within seven days of the first injury.[4] This is in the time period of decreased cerebral blood flow and could be one of the main causes of SIS. This underscores the criticality of proper and thorough training in concussions for the coaching staff.

The main treatment for SIS is to start medical treatment within five minutes which includes intubation and hyperventilation followed by the osmotic diuretic mannitol. However, even in cases where this is done, death may still occur.[35] There are times when the athlete is put on a ventilator and given corticosteroids, but this does not reverse the damage caused by SIS and death typically occurs within a short period of time.[38] SIS has a mortality rate of 50%.[34]

According to a news report on www.highschoolot.com a high school junior from Greenville, NC died from second impact syndrome according to the autopsy.[39] The athlete took a hit in a Friday night game and collapsed on the sideline; two days earlier he had taken a hit during practice and was told that he had a mild concussion. If the school had an ATC or a coach who was knowledgeable about concussions the athlete may not have been playing because he had not been asymptomatic for a week, if appropriate guidelines were followed. There have been other deaths due to second impact syndrome including a sophomore from Winston-Salem, who seemed to have the same issue as the junior. The junior from Greenville was evaluated by an "injury management specialist" and was told it was a mild concussion. He was reevaluated on Thursday and allowed to participate in a light practice that afternoon.[39] The school district has

since removed the title of injury management specialist and are trying to hire an ATC for every high school. An injury management specialist is someone, usually a teacher, who has first aid and CPR certification, they also take courses in injury management according to a news report on www.wnct.com.[40] Currently only one high school in Pitt County has an ATC.[39] If typical return to play guidelines had been exercised, the athlete would not have been allowed to participate until he was asymptotic for a week, regardless of the concussion grading scale used. A third SIS story involves a football player, Ryan Dougherty, who was cleared by his family physician and a neurologist to play, even though he told a teammate that he still had concussion symptoms, specifically a headache.[41] This means that the doctor did not follow the typical protocol or the athlete lied about his symptoms to the doctor so that he would be allowed to return to participation. He sustained his first concussion three weeks before he returned to play. Montclair High School does us the ImPACT test, however not all of the football players had established a baseline, including Ryan. As is found with SIS, his brain had started to hemorrhage and an operation was performed to relieve pressure. Typically hemorrhage is not present with SIS according to Dr. Cantu, but the buildup of pressure is common.[41] This athlete's life could have been prolonged if he had reported his symptoms were still persisting, even after the doctors had cleared him to return to play.

There have been many professional football players who have had to retire because of the number of concussions they have sustained. For example in 1992 Al Toon announced his retirement because has sustained five concussions over six seasons.[42] He had postconcussive symptoms lasting for more than three weeks after his fifth concussion. Some of these symptoms include nausea, vertigo, and headaches.[42] Teammates were stating they could not keep Toon focused in a conversation. Toon himself felt better not having to move around, do things around

the house, or even take a shower, he felt tired all of the time. These are some of the symptoms of postconcussion syndrome; if Toon had not decided to retire he would have had to wait until he was asymptomatic for a week, just like the typical guidelines state. The major concern with multiple concussions, even if they are all grade 1 or "mild", the more concussions a person sustains the longer it takes for their brain to recover, and as stated before if they return before they are fully recovered then they run the risk of SIS. Many other types of factors come into play once a person has multiple concussions, such as an increase in risk of depression and such diseases as Alzheimer's and mild cognitive impairment.[4, 43]

According to Guilmette many high schools do not have an ATC present for practices or games meaning the coaches need to make decisions about athletes and their various injuries including concussions. Guilmette suggests that high school football coaches who do not have access to an ATC need to be especially well informed about the detection, assessment, and management of concussion.[24]

Having ATCs present at practice and games is important to help protect the athletes with not only "typical" injuries, i.e. ankle sprains, but also concussions. It is important to realize that this does not always happen and that coaches then play a pivotal role in concussion treatment and must be well educated in recognizing and managing concussions. To help educate high school football coaches, educational opportunities need to be made readily available. These opportunities can be during coaches' conferences, associations meetings, or through the use of publications. Once the coaches have been educated they need to implement what they learned in their daily practices and games.

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APPENDIX B

Purpose

The purpose of this study is to assess the effectiveness of the CDC's "Heads Up" DVD on future coaches' knowledge of sports-related concussions.

Limitations

- Not a random sample it is a directed and convenient sample
- Accuracy of disseminating knowledge and thoughts in the presentation due to the fact it will be an 11 minute and 38 second DVD in between the two assessments
- Possible ceiling effect with concussion knowledge questions
- Did the subjects actually watch the video

Delimitations

- Future coaches that are currently enrolled in a coaching class and/or program
- A computerized concussion knowledge assessment

Assumptions

- Future coaches will answer the questions truthfully and complete both assessments
- Assessments will accurately measure the future coaches' concussion knowledge
- The future coaches pay attention during the seminar and stay motivated to do well on the assessments
- The subject is actually the student who is suppose to take the assessments

Research hypothesis

H_O: There will be no difference in the pre-assessment scores and the post-assessment scores.

H_A: The post-assessment scores will be significantly higher than the pre-assessment scores.

H_O: There will be no difference in the pre-assessment between the coaches that have had a concussion and the coaches that never had a concussion.

H_A: The coaches who have previously sustained a concussion will score significantly high on the pre-assessment than those who have not had a concussion.

H_O: There will be no difference of concussion knowledge with coaches having different years of experience in the pre-assessment.

H_A: The coaches who have more coaching experience will score significantly higher on concussion knowledge than those coaches who just started coaching.

H_O: There will be no difference in the concussion knowledge of those in online courses and those face to face on the post-assessment.

H_A: The face to face courses will score significantly higher on concussion knowledge than the online courses on the post-assessment.

H_O: There will be no difference in the undergraduate and graduate concussion knowledge.

H_A: The four week follow up will score significantly higher on concussion knowledge than the pre-assessment.

H_O: There will be no difference in the four week follow up and the pre-assessment.

H_A: The graduate subjects will score significantly higher on concussion knowledge in the post-assessment.

Definitions

- Concussion: an injury that changes how the cells in the brain normally work. It is caused from a blow to the head that causes the brain to be shaken or move rapidly inside the skull. Although not correct terminology a “ding” or “bell-ringer” are considered concussions (CDC Heads Up in Youth Sports a fact sheet for coaches).
- Concussion knowledge: the percent correct on the concussion knowledge questions within the assessment.

APPENDIX C

Pre-Assessment

Page 1

1. Please list your middle initial and date of birth in the following format, where M=Middle initial, xx=Month, yy=Day, zz=Year. Mxxyyzz
2. What is your age?
3. What is your gender?
    a. Male
    b. Female
4. How would you describe your race?
    a. Black or African American
    b. American Indian or Alaskan Native
    c. Caucasian
    d. Hispanic
    e. Asian
    f. Native Hawaiian or Pacific Islander
    g. Other
    h. I prefer not to answer
5. What degree program are you enrolled in?
    a. Associates
    b. Bachelors
    c. Masters
    d. Doctorate

Page 2

1. What year are you in the Associates program?
    a. 1st year
    b. 2nd year
    c. 3rd year
    d. 4th year

Page 3

1. What year are you in the Bachelors program?
    a. 1st year
    b. 2nd year
    c. 3rd year
    d. 4th year
    e. 5th year

Page 4

1. What year are you in the Masters program?
    a. 1st year
    b. 2nd year
    c. 3rd year

Page 5

1. What year are you in the Doctorate program?
    a. 1st year
    b. 2nd year
    c. 3rd year
    d. 4th year
    e. 5th year

Page 6

1. What is your major?
    a. Coaching
    b. Exercise science
    c. Athletic training
    d. Physical education
    e. Education
    f. Other
2. How many years have you been coaching?
3. What level do you coach?
    a. Youth sports
    b. High school
    c. College
    d. Professional
    e. Other
4. What is your primary sport to coach?
5. What is your title for this sport? (for example Head Coach, Assistant Coach, Graduate Assistant, Intern)
    a. Head coach
    b. Assistant coach
    c. Associate coach
    d. Graduate assistant
    e. Intern
    f. Student coach
    g. Other
6. Do you coach any other sports?

Page 7

1. What other sport do you coach?
2. What is your title for that sport? (for example, Head coach, assistant coach, graduate assistant, intern)

Page 8

1. Have you ever sustained a concussion?
    a. Yes
    b. No

2. What other creditionals do you have? Please check all that apply.
    a. EMT Basic
    b. Paramedic
    c. ATC
    d. First aid
    e. CPR
    f. AED
    g. Teacher Certified
    h. Other
3. Does your school or team that you coach have a certified athletic trainer (ATC)?
    a. Yes
    b. No
    c. I don't know

Page 9

1. Have you had a discussion with your ATC about concussions?
    a. Yes
    b. No

Page 10

1. How in depth was your discussion with the ATC?
    a. 1=it was mentioned
    b. 2
    c. 3=there was a conversation
    d. 4
    e. 5=talked at length multiple times

Page 11

1. How many athletes were on your team last year in your primary sport?
2. How many concussions were sustained during the previous season?

Page 12

1. Have you heard about the CDC's Heads-Up video on concussions?
    a. Yes
    b. No
2. Which of the following is the most severe injury?
    a. Having your bell rung
    b. Sustaining a ding
    c. Sustaining a concussion
    d. Sustaining a mild traumatic brain injury
    e. They are all the same thing
3. Once you sustain a concussion you are at a higher risk to get another one.
    a. True
    b. False

4. Concussions can affect your memory and learning ability.
    a. True
    b. False

Page 13

1. In your own words, explain how concussions affect memory and learning ability.

Page 14

1. In your own words, what is a concussion.
2. In your own words, what is Second Impact Syndrome (SIS). If you don't know just put "I don't know".

Page 15

1. Which of the following are signs and symptoms of a concussion? (check all that apply)
    a. Chest pain
    b. Black eye
    c. Weakness of neck range of motion
    d. Blurred vision
    e. Nosebleed
    f. Abnormal sense of taste
    g. Dizziness
    h. Sharp burning pain in the neck
    i. Numbness/tingling in upper extremity
    j. Loss of consciousness
    k. Confusion
    l. Nausea
    m. Amnesia
    n. Abnormal sense of smell
    o. Headache
    p. Sleep disturbance
2. Following a concussion, an athlete can go back to playing as soon as they feel they are ok.
    a. True
    b. False
3. An athlete who displays any signs or symptoms of a concussion should not be allowed to return to play.
    a. True
    b. False
4. Sometimes a second blow to the head can help a person remember things that were forgotten after suffering a concussion.
    a. True
    b. False
5. There are NO long term effects after suffering a concussion.
    a. True

b. False

Page 16

1. What are the long term effects of a concussion? (check all that apply)
    a. Slurred words
    b. Chronic headaches
    c. Decreased self-esteem
    d. Blurred vision
    e. Depression
    f. Nerve damage
    g. Amnesia
    h. Sleepiness
    i. Increased risk of concussion
    j. Brain damage
    k. Coordination is worse
    l. More prone to sickness
    m. Forgetfulness
    n. Memory loss
    o. Increased healing time for other injuries
    p. Alzheimer's
    q. Lazy eye
    r. Paranoia
    s. Disorientation
    t. Slow reaction time
    u. Confusion
    v. Decrease balance
    w. ADHD
    x. Mental disability

Page 17

1. Is there a difference between an "official" concussion and a "mini" concussion?
    a. Yes
    b. No

Page 18

1. In your own words, what is a "mini" concussion.

Page 19

1. In your own words, what is an "official" concussion.

Page 20

1. Are there different return to play criteria for suffering a ding and suffering a grade I concussion?
    a. Yes
    b. No

Page 21

1. In your own words, what is the return to play criteria for a ding.

Page 22

1. In your own words, what is the return to play criteria for a concussion.

Page 23

1. In your own words, what is the return to play guidelines for a “bell ringer”?

Page 24

1. Does a loss of consciousness need to occur for a head injury to be considered a concussion?
    a. Yes
    b. No
2. An athlete who has recovered from a head injury is less able to withstand a second blow to the head.
    a. True
    b. False
3. Does memory loss need to occur for a head injury to be considered a concussion?
    a. Yes
    b. No
4. What activities should an athlete NOT participate in if they are still symptomatic from a concussion?
    a. Warm Up
    b. Practice
    c. Strength and conditioning
    d. Game
    e. All activities
5. If a player forgets his position assignment following a collision involving the player’s head would you consult a healthcare professional before allowing the player to return to play?
    a. Yes
    b. No
    c. I don’t know
6. Does a grade I concussion require immediate removal from a game or practice?
    a. Yes
    b. No
    c. I don’t know
7. Does your coaching staff use symptom checklists?
    a. Yes
    b. No
    c. I don’t know
8. If a player was to exhibit disorientation and dizziness but his symptoms clear up within 15 minutes, would you allow them to return before you consulted a healthcare professional?
    a. Yes
    b. No

c. I don't know

9. Would you use a graded symptom checklist if it was made available to you?
    a. Yes
    b. No
    c. I don't know
10. Can you prevent a concussion?
    a. Yes
    b. No

Page 25

1. How can you prevent a concussion? (check all that apply)
    a. Play non-contact sports
    b. Play an individual sport
    c. Wear headgear
    d. Take continuous concussion tests
    e. Avoid sports
    f. Wear sturdy shoes
    g. Avoid bad weather
    h. Equipment
    i. Education
    j. Proper technique
    k. Don't play fatigued

Page 26

1. Where have you learned the most about concussions?
    a. Coaches Association
    b. Conferences
    c. Magazines/newspaper/TV
    d. Healthcare professional
    e. Other coaches
    f. High school personnel
    g. Internet
    h. Heads Up Concussion Kit
    i. Other

APPENDIX D

Post-Assessment and Follow Up-Assessment

Page 1

1. Please list your middle initial and date of birth in the following format, where M=Middle initial, xx=Month, yy=Day, zz=Year. Mxxyyzz

Page 2

1. How much do you feel Heads-Up has helped you understand concussion?
    a. 1=Not at all
    b. 2
    c. 3=A little
    d. 4
    e. 5=A lot
2. Which of the following is the most severe injury?
    a. Having your bell rung
    b. Sustaining a ding
    c. Sustaining a concussion
    d. Sustaining a mild traumatic brain injury
    e. They are all the same thing
3. Once you sustain a concussion you are at a higher risk to get another one.
    a. True
    b. False
4. Concussions can affect your memory and learning ability.
    a. True
    b. False

Page 3

1. In your own words, explain how concussions affect memory and learning ability.

Page 4

1. In your own words, what is a concussion.
2. In your own words, what is Second Impact Syndrome (SIS). If you don't know just put "I don't know".

Page 5

1. Which of the following are signs and symptoms of a concussion? (check all that apply)
    a. Chest pain
    b. Black eye
    c. Weakness of neck range of motion
    d. Blurred vision
    e. Nosebleed
    f. Abnormal sense of taste
    g. Dizziness
    h. Sharp burning pain in the neck

   i. Numbness/tingling in upper extremity
   j. Loss of consciousness
   k. Confusion
   l. Nausea
   m. Amnesia
   n. Abnormal sense of smell
   o. Headache
   p. Sleep disturbance
2. Following a concussion, an athlete can go back to playing as soon as they feel they are ok.
   a. True
   b. False
3. An athlete who displays any signs or symptoms of a concussion should not be allowed to return to play.
   a. True
   b. False
4. Sometimes a second blow to the head can help a person remember things that were forgotten after suffering a concussion.
   a. True
   b. False
5. There are NO long term effects after suffering a concussion.
   a. True
   b. False

Page 6

1. What are the long term effects of a concussion? (check all that apply)
   a. Slurred words
   b. Chronic headaches
   c. Decreased self-esteem
   d. Blurred vision
   e. Depression
   f. Nerve damage
   g. Amnesia
   h. Sleepiness
   i. Increased risk of concussion
   j. Brain damage
   k. Coordination is worse
   l. More prone to sickness
   m. Forgetfullness
   n. Memory loss
   o. Increased healing time for other injuries
   p. Alzheimer’s
   q. Lazy eye
   r. Paranoia
   s. Disorientation
   t. Slow reaction time

u. Confusion
v. Decrease balance
w. ADHD
x. Mental disability

Page 7

1. Is there a difference between an “official” concussion and a “mini” concussion?
    a. Yes
    b. No

Page 8

1. In your own words, what is a “mini” concussion.

Page 9

1. In your own words, what is an “official” concussion.

Page 10

1. Are there different return to play criteria for suffering a ding and suffering a grade I concussion?
    a. Yes
    b. No

Page 11

1. In your own words, what is the return to play criteria for a ding.

Page 12

1. In your own words, what is the return to play criteria for a concussion.

Page 13

1. In your own words, what is the return to play guidelines for a “bell ringer”?

Page 14

1. Does a loss of consciousness need to occur for a head injury to be considered a concussion?
    a. Yes
    b. No
2. An athlete who has recovered from a head injury is less able to withstand a second blow to the head.
    a. True
    b. False
3. Does memory loss need to occur for a head injury to be considered a concussion?
    a. Yes
    b. No

4. What activities should an athlete NOT participate in if they are still symptomatic from a concussion?
    a. Warm Up
    b. Practice
    c. Strength and conditioning
    d. Game
    e. All activities
5. If a player forgets his position assignment following a collision involving the player's head would you consult a healthcare professional before allowing the player to return to play?
    a. Yes
    b. No
    c. I don't know
6. Does a grade I concussion require immediate removal from a game or practice?
    a. Yes
    b. No
    c. I don't know
7. Does your coaching staff use symptom checklists?
    a. Yes
    b. No
    c. I don't know
8. If a player was to exhibit disorientation and dizziness but his symptoms clear up within 15 minutes, would you allow them to return before you consulted a healthcare professional?
    a. Yes
    b. No
    c. I don't know
9. Would you use a graded symptom checklist if it was made available to you?
    a. Yes
    b. No
    c. I don't know
10. Can you prevent a concussion?
    a. Yes
    b. No

Page 15

1. How can you prevent a concussion? (check all that apply)
    a. Play non-contact sports
    b. Play an individual sport
    c. Wear headgear
    d. Take continuous concussion tests
    e. Avoid sports
    f. Wear sturdy shoes
    g. Avoid bad weather
    h. Equipment
    i. Education
    j. Proper technique
    k. Don’t play fatigued

Page 16

1. Where have you learned the most about concussions?
    a. Coaches Association
    b. Conferences
    c. Magazines/newspaper/TV
    d. Healthcare professional
    e. Other coaches
    f. High school personnel
    g. Internet
    h. Heads Up Concussion Kit
    i. Other

APPENDIX E

Correct Answers

Page 12

1. Have you heard about the CDC's Heads-Up video on concussions?
    a. Yes
    b. No
2. Which of the following is the most severe injury?
    a. Having your bell rung
    b. Sustaining a ding
    c. Sustaining a concussion
    d. Sustaining a mild traumatic brain injury
    e. They are all the same thing
3. Once you sustain a concussion you are at a higher risk to get another one.
    a. True
    b. False
4. Concussions can affect your memory and learning ability.
    a. True
    b. False

Page 15

1. Which of the following are signs and symptoms of a concussion? (check all that apply)
    a. Chest pain
    b. Black eye
    c. Weakness of neck range of motion
    d. Blurred vision
    e. Nosebleed
    f. Abnormal sense of taste
    g. Dizziness
    h. Sharp burning pain in the neck
    i. Numbness/tingling in upper extremity
    j. Loss of consciousness
    k. Confusion
    l. Nausea
    m. Amnesia
    n. Abnormal sense of smell
    o. Headache
    p. Sleep disturbance
2. Following a concussion, an athlete can go back to playing as soon as they feel they are ok.
    a. True
    b. False

3. An athlete who displays any signs or symptoms of a concussion should not be allowed to return to play.

a. True
b. False

4. Sometimes a second blow to the head can help a person remember things that were forgotten after suffering a concussion.
    a. True
    b. False
5. There are NO long term effects after suffering a concussion.
    a. True
    b. False

Page 17

1. Is there a difference between an “official” concussion and a “mini” concussion?
    a. Yes
    b. No

Page 20

1. Are there different return to play criteria for suffering a ding and suffering a grade I concussion?
    a. Yes
    b. No

Page 24

1. Does a loss of consciousness need to occur for a head injury to be considered a concussion?
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    b. No
2. An athlete who has recovered from a head injury is less able to withstand a second blow to the head.
    a. True
    b. False
3. Does memory loss need to occur for a head injury to be considered a concussion?
    c. Yes
    d. No
4. What activities should an athlete NOT participate in if they are still symptomatic from a concussion?
    e. Warm Up
    f. Practice
    g. Strength and conditioning
    h. Game
    i. All activities

5. If a player forgets his position assignment following a collision involving the player’s head would you consult a healthcare professional before allowing the player to return to play?
    a. Yes

b. No
c. I don’t know

6. Does a grade I concussion require immediate removal from a game or practice?
a. Yes
b. No
c. I don’t know

7. If a player was to exhibit disorientation and dizziness but his symptoms clear up within 15 minutes, would you allow them to return before you consulted a healthcare professional?
a. Yes
b. No
c. I don’t know

8. Can you prevent a concussion?
a. Yes
b. No

APPENDIX F

Demographic	1.2 What is your age?
	1.3 What is your gender?
	1.4 How would you describe your race?
	1.5 What degree program are you enrolled in?
	6.1 What is your major?
	6.2 How many years have you been coaching?
	6.3 What level do you coach?
	6.4 What is your primary sport to coach
	6.5 What is your title for this sport?
	6.6 Do you coach any other sports?
	8.1 Have you ever sustained a concussion?
	8.2 What other creditionals do you have?
	8.3 Does your school or team that you coach have a certified athletic trainer (ATC)?
	11.1 How many athletes were on your team last year in your primary sport?
	11.2 How many concussions were sustained during the previous season?

	12.1 Have you heard about the CDC's Heads-Up video on concussions?
	24.8 Does your coaching staff use symptom checklists?
	24.9 Would you use a graded symptom checklist if it was made available to you?
Concussion Knowledge	12.2 Which of the following is the most severe injury?
	12.3 Once you sustain a concussion you are at a higher risk to get another one.
	12.4 Concussions can affect your memory and learning ability.
	15.1 Which of the following are signs and symptoms of a concussion?
	15.2 Following a concussion, an athlete can go back to playing as soon as they feel they are ok.
	15.3 An athlete who displays any signs or symptoms of a concussion should not be allowed to return to play.
	15.4 Sometimes a second blow to the head can help a person remember things that were forgotten after suffering a concussion.
	15.5 There are NO long term effects after suffering a concussion.
	17.1 Is there a difference between an "official" concussion and a "mini" concussion?

20.1 Are there different return to play criteria for suffering a ding and suffering a grade I concussion?

24.1 Does a loss of consciousness need to occur for a head injury to be considered a concussion?

24.2 An athlete who has recovered from a head injury is less able to withstand a second blow to the head.

24.3 Does memory loss need to occur for a head injury to be considered a concussion?

24.4 What activities should an athlete NOT participate in if they are still symptomatic from a concussion?

24.5 If a player forgets his position assignment following a collision involving the player's head would you consult a healthcare professional before allowing the player to return to play?

24.6 If a player was to exhibit disorientation and dizziness but his symptoms clear up within 15 minutes, would you allow them to return before you consulted a healthcare professional?

24.7 Does a grade I concussion require immediate removal from a game or practice?

24.8 Can you prevent a concussion?

Qualitative	13.1 In your own words, explain how concussions affect memory and learning ability.
	14.1 In your own words, what is a concussion.
	14.2 In your own words, what is Second Impact Syndrome (SIS).
	18.1 In your own words, what is a “mini” concussion.
	19.1 In your own words, what is an “official” concussion.
	21.1 In your own words, what is the return to play criteria for a ding.
	22.1 In your own words, what is the return to play criteria for a concussion.

APPENDIX G

Tables and Figures

	N	Gender	Age	Delivery Method	History of Concussion	Student Degree Level	Coaching Experience
Pre	169	76.9% male	22.4±4.4	76.3% in class	63.3% no	87.6% UG	2.2±2.9
Post	161	77.0% male	22.4±4.4	77.0% in class	63.4% no	87.6% UG	2.1±2.8
Follow Up	69	72.5% male	21.7±3.2	85.5% in class	65.2% no	100% UG	1.8±2.2

Table 1. Demographics for All Assessments. There were no differences (P>0.05) for all subject demographics.

	Yes
First Aid	51.5 % (87)
CPR	50.9% (86)
AED	21.9% (37)
Heard of Heads Up	17.8% (30)
Coach uses Sign and Symptom Checklist	29.0% (49)
Sustained a Concussion	36.1% (61)
Have an ATC where they coach	43.8% (74)
Discussed concussions with their ATC	12.4% (21)

Table 2. Frequency and Percentages of Subjects' Responses to the Demographic Questions of the Assessment. Only about half of the coaching education students are first aid and CPR certified and less than a fifth of the subjects had heard of Heads-Up before the DVD was watched.

Sport	Frequency
Football	59 (34.9%)
Baseball	26 (15.4%)
Basketball	26 (15.4%)
Softball	12 (7.1%)
Track and Field	6 (3.5%)
Soccer	6 (3.5%)
Cheer	5 (3.0%)
Dance	2 (1.2%)
Wrestling	2 (1.2%)
Swimming	1 (0.6%)
Tennis	1 (0.6%)
Lacrosse	1 (0.6%)

Table 3. Frequency of Sports Coached.

Symptom	Pre	Post	Follow Up
Abnormal Sense of Smell	128 (75.7%)	111 (69.4%)	37 (53.6%)
Abnormal Sense of Taste	127 (75.1%)	116 (72.5%)	41 (59.4%)
Amnesia	**109 (64.5%)**	**105 (65.6%)**	**51 (73.9%)**
Blurred Vision	**157 (92.9%)**	**149 (93.1%)**	**63 (91.3%)**
Black Eye	148 (87.6%)	139 (86.9%)	50 (72.5%)
Chest Pain	152 (89.9%)	132 (82.5%)	52 (75.4%)
Confusion	**156 (92.3%)**	**150 (93.8%)**	**65 (94.2%)**
Dizziness	**158 (93.5%)**	**151 (94.4%)**	**64 (92.8%)**
Headache	**161 (95.3%)**	**153 (95.6%)**	**66 (95.7%)**
Loss of Consciousness	**150 (88.8%)**	**153 (95.6%)**	**64 (92.8%)**
Nausea	**120 (71.0%)**	**108 (67.5%)**	**56 (81.2%)**
Nosebleed	118 (69.8%)	117 (73.1%)	35 (50.7%)
Numbness/Tingling in Upper Extremity	82 (48.5%)	81 (50.6%)	27 (39.1%)
Sharp Burning Pain in the Neck	111 (65.7%)	98 (61.3%)	35 (50.7%)
Sleep Disturbances	**91 (53.8%)**	**82 (51.3%)**	**51 (73.9%)**
Weakness of Neck Range of Motion	98 (58.0%)	73 (45.6%)	25 (36.2%)

Table 4. Frequencies and Percentages of Subjects Correctly Identifying the Symptoms Present in the Assessment (concussion symptoms are in bold). The least recognized concussion symptoms are amnesia, nausea, and sleep disturbances.

	Pre	Post	Follow Up
Once you sustain a concussion you are at a higher risk to get another one. (True)*	152 (89.9%)	154 (96.3%)	69 (100%)
Concussions can affect your memory and learning ability. (True)	167 (98.8%)	155 (96.9%)	69 (100%)
Following a concussion, an athlete can go back to playing as soon as they feel they are ok. (False)	160 (94.7%)	152 (95.0%)	68 (98.6%)
An athlete who displays any signs or symptoms of a concussion should not be allowed to return to play. (True)	156 (92.3%)	148 (92.5%)	66 (95.7%)
Sometimes a second blow to the head can help a person remember things that were forgotten after suffering a concussion. (False)	151 (89.3%)	147 (91.9%)	62 (89.9%)
There are NO long term effects after suffering a concussion. (False)	162 (95.9%)	156 (97.5%)	68 (98.6%)
An athlete who has recovered from a head injury is less able to withstand a second blow to the head. (True)	124 (73.4%)	124 (77.5%)	58 (84.1%)

Table 5. True and False Questions and Correct Answers. About 11% of the subjects believed the misconception of a second blow to the head, and about a quarter of the coaches do not realize an athlete is less able to withstand a second blow to the head.

*P<0.05 between pre and follow up

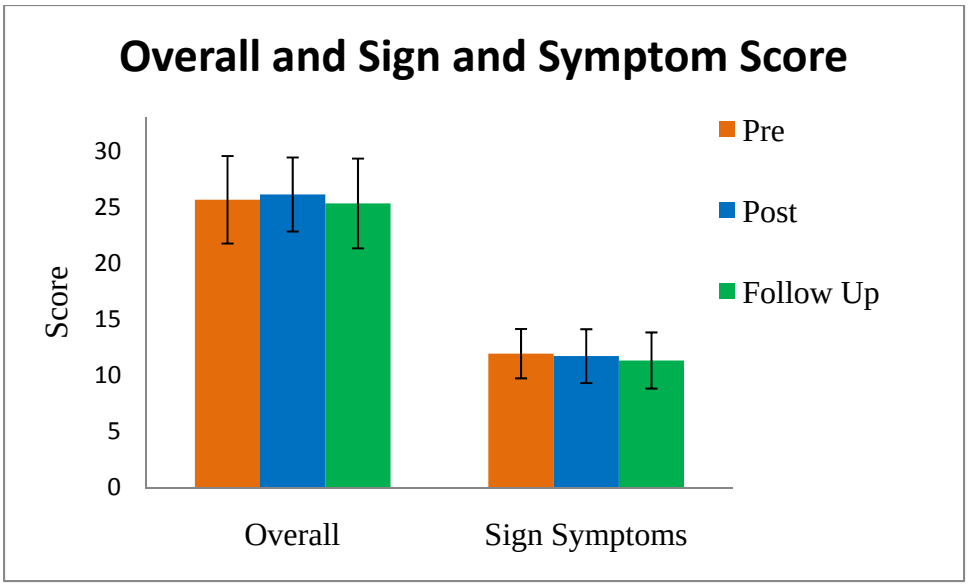


Figure 1. Overall and Sign and Symptom Score. There was no significant difference found in the overall score and the sign and symptom score between pre, post, and follow up (P>0.05). The maximum score for overall is 33 and sign and symptom is 16.

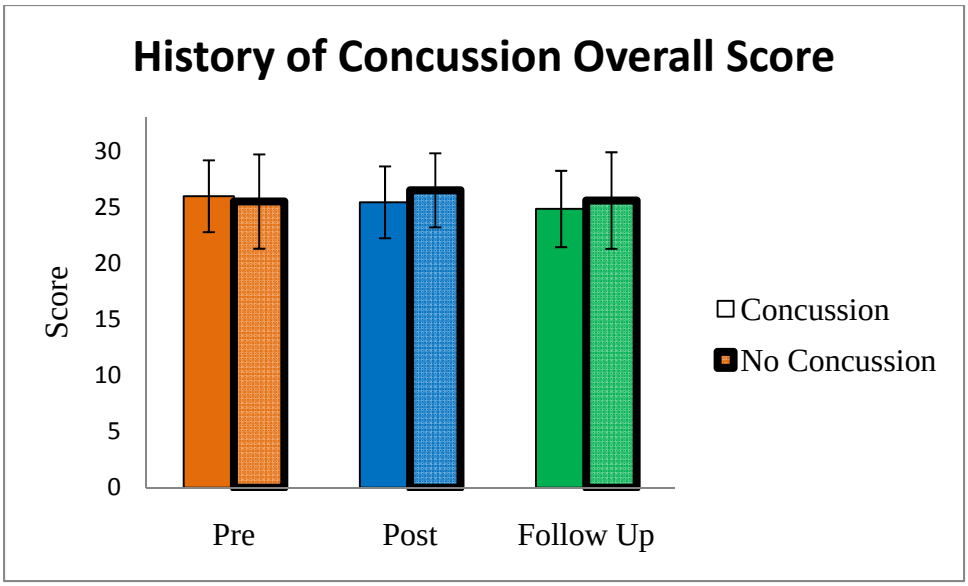


Figure 2. History of Concussion Overall Score. There is no significant difference in the coaches who sustained a concussion and those who have not and between pre, post and follow up. The maximum score is 33.

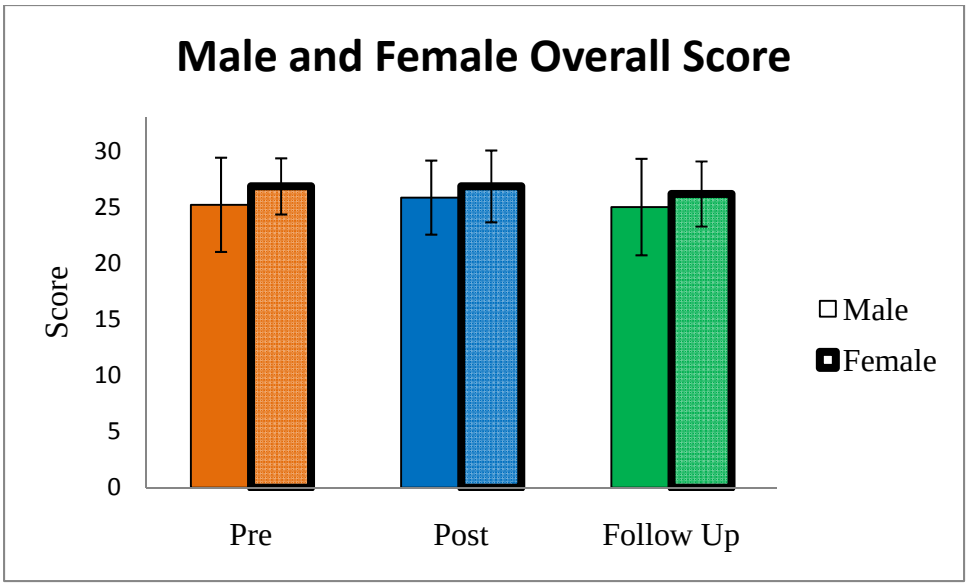


Figure 3. Gender Overall Score. There is no significant difference between males and females and between pre, post and follow up (P>0.05). The maximum score is 33.

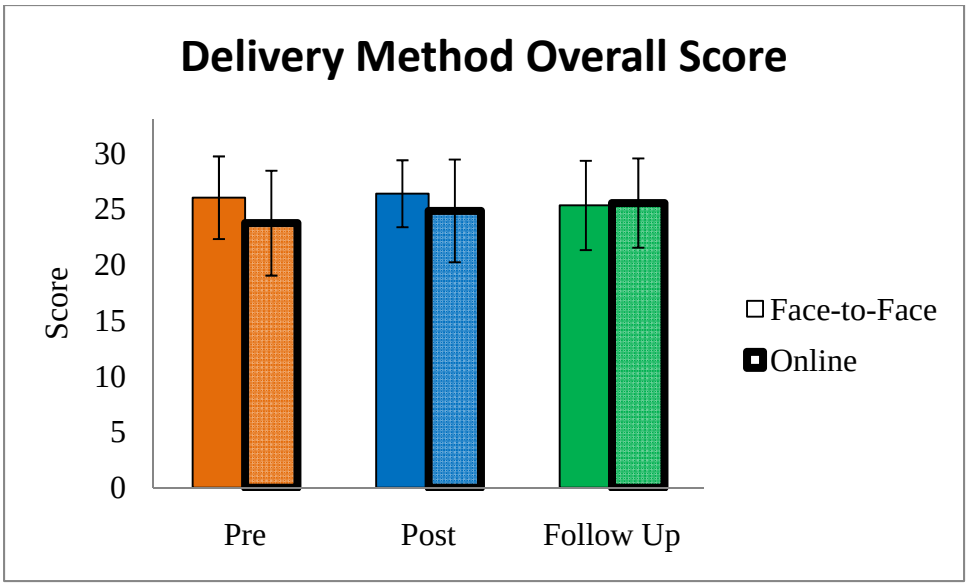


Figure 4. Delivery Method Overall Score. There is no significant difference between face-to-face and online and between pre, post and follow up (P>0.05). The maximum score is 33.

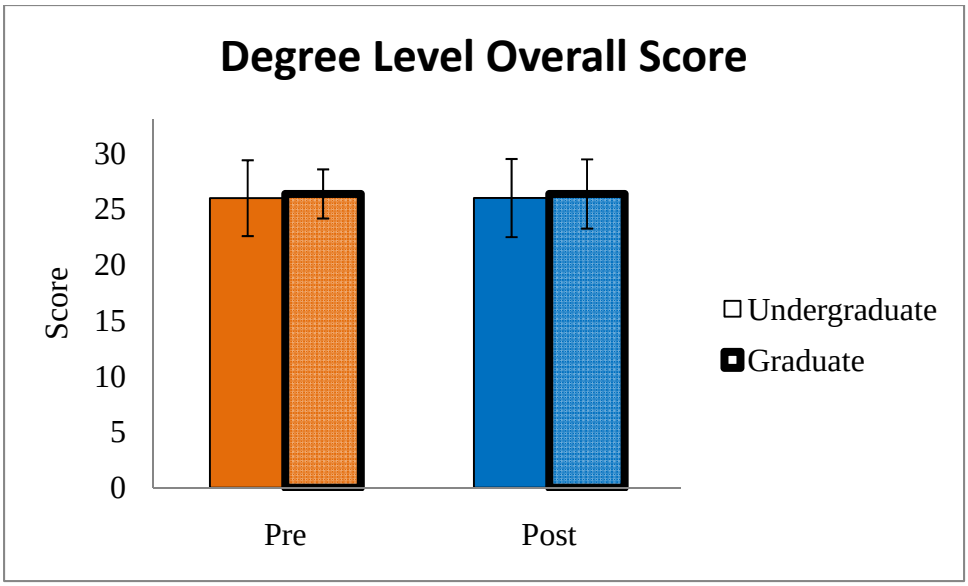


Figure 5. Student Degree Level Overall Score. There was no significant differences in the degree level for the pre and post assessment (P>0.05). The maximum score is 33.

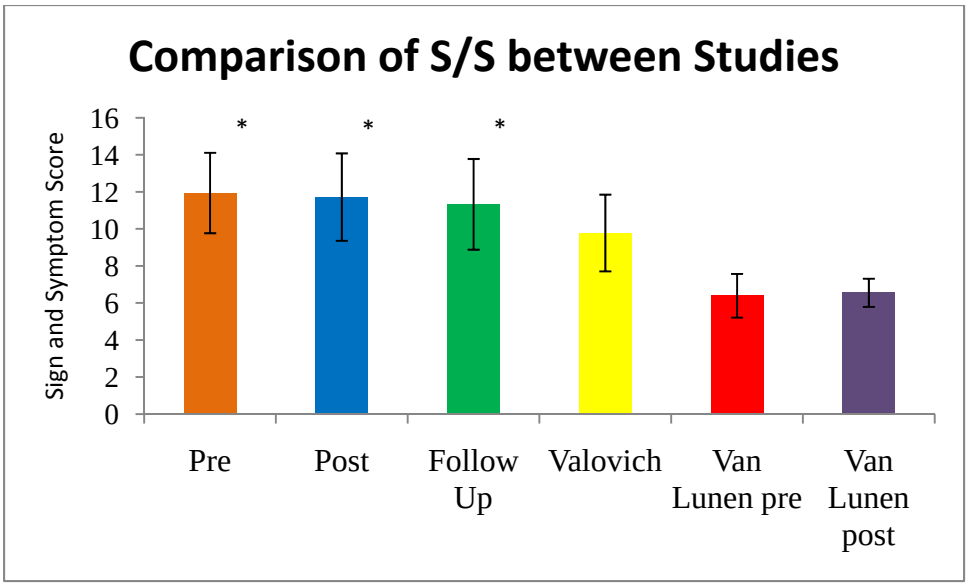


Figure 6. Comparison of signs and symptoms between studies. There is a significant difference when comparing the pre assessment sign and symptom scores to both Valovich and Van Lunen ($p<0.001$), the post assessment sign and symptom scores to both Valovich and Van Lunen ($p<0.001$), and the follow up assessment sign and symptom scores to both Valovich and Van Lunen ($p<0.001$).

APPENDIX H

Heads-Up Toolkit

IMPORTANT PHONE NUMBERS

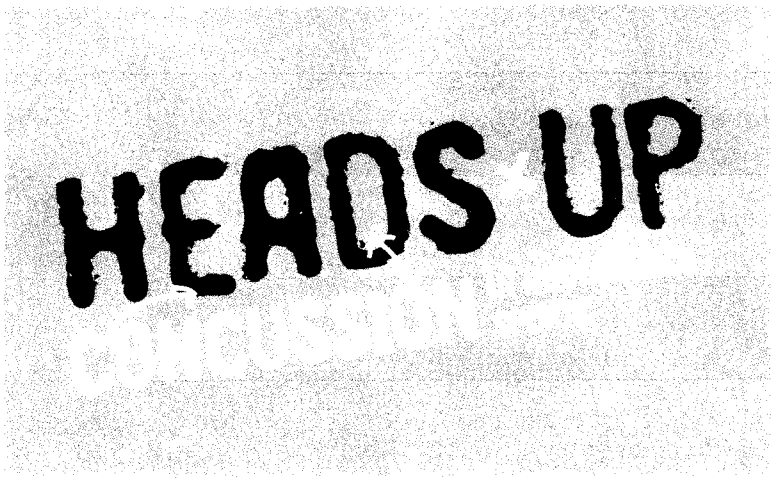
Emergency Medical Services
Name:
Phone:

Health Care Professional
Name:
Phone:

School Staff Available During Practice
Name:
Phone:

School Staff Available During Games
Name:
Phone:

DEPARTMENT OF HEALTH AND HUMAN SERVICES
CENTERS FOR DISEASE CONTROL AND PREVENTION



SIGNS AND SYMPTOMS*

These signs and symptoms may indicate that a concussion has occurred.

Signs Observed by Coaching Staff	Symptoms Reported by Athlete
Appears dazed or stunned	Headache
Is confused about assignment	Nausea
Forgets plays	Balance problems or dizziness
Is unsure of game, score, or opponent	Double or fuzzy vision
Moves clumsily	Sensitivity to light or noise
Answers questions slowly	Feeling sluggish
Loses consciousness	Feeling foggy or groggy
Shows behavior or personality changes	Concentration or memory problems
Can't recall events prior to hit	Confusion
Can't recall events after hit	

*Adapted from: Lovell MR, Collins MW, Iverson GL, Johnston KM, Bradley JP. Grade 1 or "ding" concussions in high school athletes. The American Journal of Sports Medicine 2004;32(1):47-54.

ACTION PLAN

If you suspect that a player has a concussion, you should take the following steps:

1. Remove athlete from play.
2. Ensure athlete is evaluated by an appropriate health care professional. Do not try to judge the seriousness of the injury yourself.
3. Inform athlete's parents or guardians about the known or possible concussion and give them the fact sheet on concussion.
4. Allow athlete to return to play only with permission from an appropriate health care professional.

HEADS UP CONCUSSION

DEPARTMENT OF HEALTH AND HUMAN SERVICES
CENTERS FOR DISEASE CONTROL AND PREVENTION

CDC

SIGNS AND SYMPTOMS*

These signs and symptoms may indicate that a concussion has occurred.

Signs Observed by Coaching Staff	Symptoms Reported by Athlete
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Is confused about assignment	Nausea
Forgets plays	Balance problems or dizziness
Is unsure of game, score, or opponent	Double or fuzzy vision
Moves clumsily	Sensitivity to light or noise
Answers questions slowly	Feeling sluggish
Loses consciousness	Feeling foggy or groggy
Shows behavior or personality changes	Concentration or memory problems
Can't recall events prior to hit	Confusion
Can't recall events after hit	

*Adapted from: Lovell MR, Collins MW, Iverson GL, Johnston KM, Bradley JP. Grade 1 or "ding" concussions in high school athletes. The American Journal of Sports Medicine 2004;32(1):47-54.

ACTION PLAN

If you suspect that a player has a concussion, you should take the following steps:

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3. Inform athlete's parents or guardians about the known or possible concussion and give them the fact sheet on concussion.
4. Allow athlete to return to play only with permission from an appropriate health care professional.

IMPORTANT PHONE NUMBERS

Emergency Medical Services
Name:
Phone:

Health Care Professional
Name:
Phone:

School Staff Available During Practice
Name:
Phone:

School Staff Available During Games
Name:
Phone:

February 2005

HEADS UP

CONCUSSION IN HIGH SCHOOL SPORTS

A FACT SHEET FOR ATHLETES

What is a concussion?

A concussion is a brain injury that:

- Is caused by a bump, blow, or jolt to the head.
- Can change the way your brain normally works.
- Can range from mild to severe.
- Can occur during practices or games in any sport.
- Can happen even if you haven't been knocked out.
- Can be serious even if you've just been "dinged" or had your "bell rung."

How can I prevent a concussion?

It's different for every sport. But there are steps you can take to protect yourself from concussion.

- Follow your coach's rules for safety and the rules of the sport.
- Practice good sportsmanship at all times.
- Use the proper sports equipment, including personal protective equipment (such as helmets). In order for equipment to protect you, it must be:
  - Appropriate for the game, position, and activity
  - Well maintained
  - Properly fitted
  - Used every time you play

How do I know if I've had a concussion?

You can't see a concussion, but you might notice some of the symptoms right away. Other symptoms can show up days or weeks after the injury. It's best to see a health care professional if you think you might have a concussion. An undiagnosed concussion can affect your ability to do schoolwork and other everyday activities. It also raises your risk for additional, serious injury.

What are the symptoms of a concussion?

- Nausea (feeling that you might vomit)
- Balance problems or dizziness
- Double or fuzzy vision
- Sensitivity to light or noise
- Headache
- Feeling sluggish
- Feeling foggy or groggy
- Concentration or memory problems (forgetting game plays)
- Confusion

What should I do if I think I have a concussion?

- **Tell your coaches and your parents.** Never ignore a bump, blow, or jolt to the head. Also, tell your coach if one of your teammates might have a concussion.
- **Get a medical check up.** A health care professional can tell you if you have had a concussion and when you are OK to return to play.
- **Give yourself time to recover.** If you have had a concussion, your brain needs time to heal. While your brain is still healing, you are much more likely to have a second concussion. Second or later concussions can cause permanent brain damage, and even death in rare cases. Severe brain injury can change your whole life.

It's better to miss one game than the whole season.

DEPARTMENT OF HEALTH AND HUMAN SERVICES
CENTERS FOR DISEASE CONTROL AND PREVENTION

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HEADS·UP CONCUSSION IN HIGH SCHOOL SPORTS

A FACT SHEET FOR **PARENTS**

What is a concussion?

A concussion is a brain injury. Concussions are caused by a bump, blow, or jolt to the head. They can range from mild to severe and can disrupt the way the brain normally works. Even a "ding" or a bump on the head can be serious.

What are the signs and symptoms?

You can't see a concussion. Signs and symptoms of concussion can show up right after the injury or can take days or weeks to appear. If your teen reports any symptoms of concussion, or if you notice the symptoms yourself, seek medical attention right away.

Signs Observed by Parents or Guardians	Symptoms Reported by Athlete
• Appears dazed or stunned • Is confused about assignment • Forgets plays • Is unsure of game, score, or opponent • Moves clumsily • Answers questions slowly • Loses consciousness • Shows behavior or personality changes • Can't recall events prior to hit • Can't recall events after hit	• Headache • Nausea • Balance problems or dizziness • Double or fuzzy vision • Sensitivity to light or noise • Feeling sluggish • Feeling foggy or groggy • Concentration or memory problems • Confusion

What should you do if you think your teenage athlete has a concussion?

1. **Seek medical attention right away.** A health care professional will be able to decide how serious the concussion is and when it is safe for your teen to return to sports.

2. **Keep your teen out of play.** Concussions take time to heal. Don't let your teen return to play until a health care professional says it's OK. Athletes who return to play too soon—while the brain is still healing—risk a greater chance of having a second concussion. Second or later concussions can be very serious. They can cause permanent brain damage, affecting your teen for a lifetime.

3. **Tell all of your teen's coaches about any recent concussion.** Coaches should know if your teen had a recent concussion in ANY sport. Your teen's coaches may not know about a concussion your teen received in another sport or activity unless you tell them. Knowing about the concussion will allow the coach to keep your teen from activities that could result in another concussion.

4. **Remind your teen:** It's better to miss one game than the whole season.

It's better to miss one game than the whole season.

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