Comparison of Concussion Incident Rates between NCAA Division I and NCAA Division III Male and Female Soccer Athletes

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Abstract

Researchers have found that soccer has increasing concussion incident rates occurring; yet, studies have demonstrated varied results in the investigation of concussion injuries (Levy et al., 2012). Some studies show that females sustain more concussions than males, but varied results necessitate further research to see if females are requiring more intensive care (Colvin et al., 2009). The purpose of this study was to compare the concussion incident rates between NCAA Division I and NCAA Division III male and female soccer athletes. Twenty head athletic trainers completed an online survey that addressed their soccer team's concussion incident rate and other descriptive statistics. Results from the survey showed no significant differences between divisions or between genders; however, there was approaching significance between divisions. Division III sustained more concussions than Division I, and Division III males sustained more concussions than Division III females. Additional studies are needed to investigate potential division or gender concussion rate differences. This information could be crucial in deciding if the rules in certain sports, such as soccer, should be reevaluated in order to protect the athletes that participate in them.

Review of Literature

In the United States, it is estimated that 3.8 million concussions occur during competitive sports and recreational activities each year; however, there is reason to believe that 50% of concussions sustained go unreported (Harmon et al., 2013). Some reasoning behind this theory is that many coaches, athletic trainers, and other sports medicine professionals do not efficiently utilize established resources in order properly assess and diagnose concussion injuries of student athletes (Daneshvar, Nowinski, McKee, & Cantu, 2011). Another point can be made that 90% of all concussions occur without loss of consciousness, which has been shown to inhibit immediate detection of concussion (Moser et al., 2007). In other words, since most concussions lack the dramatic nature of those with loss of consciousness, they can be much more difficult to detect and can be underdiagnosed (Moser et al., 2007).

The National Collegiate Athletic Association (NCAA) is a national organization in the United States that regulates gameplay of colleges and universities within several sports that comprise Divisions I, II and III. In 2010, the NCAA installed a mandate for all U.S. colleges and universities to have a concussion management plan on file (Klossner, 2011). This mandate was needed in order to counter the prevalence of concussion, and it showed how serious this injury was within the NCAA, especially within the sport of soccer. Soccer is the most popular sport in the world, and it is not traditionally identified as high risk for concussion, but several studies have discovered soccer's concussion incident rate to have met or exceeded that of other sports (Levy et al., 2012). Additionally, another important aspect of concussion incidence within collegiate athletics is gender. Many researchers have collected data to support that female college athletes have a longer recovery period than their male counterparts (Bloom, Loughead,

Shapcott, Johnston, & Delaney, 2008). However, the research varies on whether females sustain more concussions than males and more research is needed.

The researcher has organized the review in such a way that it provides insight into the definition of concussion, concussion incidence within the sport of soccer, methods of diagnosing and assessing concussion, how the NCAA handles the issue of concussion within collegiate athletics, significance of gender in regards to concussion incidence, and the prevalence of concussion between divisions within the NCAA. The intention of analyzing these subjects is to bring awareness about concussion within the NCAA divisions, and advocate the continuing research of how to lower the prevalence of concussion injury.

Definition of Concussion

The 2012-2013 NCAA Sports Medicine Handbook defines a concussion or mild traumatic brain injury (mTBI) as "a complex pathophysiological process affecting the brain, induced by traumatic biomechanical forces" (Klossner, 2011). Concussions usually occur from a blow to the head, but it can also occur after a blow elsewhere on the body causing energy transfer to the head (Klossner, 2011). The rapid onset of cognitive impairment that prohibits function and then the spontaneous recovery from symptoms can characterize a concussion (Klossner, 2011, p. 54). Other researchers define concussion and mild traumatic brain injury as having separate constructs, thus preventing these terms from being used interchangeably. According to McCrory and colleagues (2012) from a consensus statement on the 4th International Conference on Concussion in Sport, concussion is referred to as a subset of traumatic brain injury with its effects more mild and caused from brain "shaking" resulting in clinical symptoms.

Traumatic brain injury is related to the individual's brain having pathological changes occur over time because of a severe blow to the head, face, neck or elsewhere which is not necessarily related to concussion (McCrory et al., 2012). There is clearly a mixture of definition when discussing concussion, and athletic trainers and other medical personnel are the main individuals who pay attention to these definitions when working with student athletes.

Health professionals' responsibility to athletes. Team or primary care physicians have the final decision as to whether an athlete is fit to return-to-play; however athletic trainers and neuropsychologists are an integral part of the multidisciplinary team that helps to care for an athlete in his or her recovery (Broglio, Ferrara, Macciocchi, Baumgartner, Elliot, 2007). An athletic trainer is predominantly the primary source of information about concussion recovery within the school setting, and several points should be remembered in caring for an athlete sustaining a concussion: concussions may go undetected as a result of lack of awareness of symptoms and risks, enough time needs to be given in order for the athlete to recover, and symptoms can be indicators of a concussion (McGrath, 2010).

Underreporting of concussion injury is very dangerous, in that, there could be a higher prevalence of concussion injury than already estimated. Concussions account for less than 10% of total injuries athletic trainers treat, but coaches should expect concussion incident rates accounting for 5% to 10% of athletes (McGrath, 2010). The underreporting of symptoms can be due to the athlete not wanting to leave the game, the athlete being afraid that their position on the team will be taken, the athlete being unaware of the symptoms to look for, or the athlete possibly feeling uncomfortable seeking medical help. It has been reported that 58% of athletes do not have adequate knowledge of sports-related concussion which prevents them from understanding how serious sustaining a concussion is (Miller, Wendt, & Potter, 2011). This situation is

disturbing because this could lead to athletes not recognizing or ignoring symptoms; thus, possibly resulting in more troubling symptoms than they would've had from the beginning.

Allowing time for athletes to recover from a concussion injury is important because many sports medicine physicians have found that concussed athletes are more vulnerable to reinjure themselves if they return to play too soon (Lovell, Collins & Bradley, 2004). Educators should be aware that the student athlete may not be able to meet the same classroom expectations as other students because of this injury, and work should be halted until all symptoms have dissipated and neurocognitive function is back to normal (McGrath, 2010). Symptoms that are exhibited typically are represented in a combination of physical, cognitive, sleep dysregulation, and emotional characteristics (McGrath, 2010). Much research has concluded that headache is the most commonly experienced symptom, followed by dizziness, and feeling "slowed down" (Guskiewicz et al., 2003).

Risk factors of concussion. There are several risk factors that come with concussion incidence, such as history of previous concussion, the number, severity and duration of symptoms, sex, age, sport position, and style of play (Harmon et al., 2013). The history of concussion can indicate a 2 to 5.8 times greater chance that the athlete will sustain another concussion; these athletes may report more symptoms at baseline than those without a history of concussion (Harmon et al., 2013). The number, severity and duration of symptoms are great indicators for prolonged recovery time, and this could mean not only longer physical pain, but more emotional pain because the player cannot go back to participating in sport (Harmon et al., 2013).

Gender is a significant topic with many researchers agreeing that female athletes typically have longer recovery periods compared to male athletes (Harmon et al., 2013). There are mixed responses as to whether females sustain more concussions than males due to decreased head-neck segment mass, but one study found that females have a greater angular acceleration of the head after impact than males indicating higher degree of injury (Harmon et al., 2013). Age can play a role because younger athletes still have additional brain development to occur compared to adults, and a catastrophic hit to the head can cause longer recovery time and higher chance of severe brain injury (Harmon et al., 2013). High school athletes have demonstrated a slower cognitive recovery than collegiate athletes who sustained concussions (Majerske et al., 2008). Sport, position and style of play can be risk factors of concussion because some sports have more contact than others, different positions within different sports have a need for tougher players which can mean that athletes who are not as strong get hurt, and each individual's style of play can either protect them from injury or ensue it (Harmon et al., 2013). Finally, level of play can be a risk factor. According to a study comparing high school athletes with collegiate athletes, the rate of concussion overall was higher in collegiate athletes who were supposed to be at a higher level of play compared to high school athletes (Gessel, Fields, Collins, Dick, & Comstock, 2007). This result could potentially mean that a higher level of play can provide an increased rate of concussion for the collegiate athletes compared to the high school athletes.

Diagnosis of and assessments used for concussion. For assessing a variety of symptoms related to concussions, the assessment style that is predominantly used is a graded symptom checklist that provides an objective tool for examining the severity of symptoms over a series of evaluations (Harmon, et al., 2013). The purpose of these graded symptom checklists, or concussion rating scales, is to determine when the affected athlete can return back to playing

their designated sport(s); and with more than a dozen concussion scales competing, "they are all in agreement that athletes should be symptom free before returning to play" (Randolph, McCrea, & Barr, 2005, p.139). Standardized assessment tools, which are tests that evaluate a concussed individual, use these graded symptom checklists to provide a beneficial structure for evaluating concussions, but there is little evidence supporting that these tests have significant validity (Harmon et al, 2013). The types of assessments that this review will be examining are sideline assessment methods, baseline assessment methods and neurocognitive test batteries most commonly used.

Sideline assessment methods. When an athlete gets hurt during gameplay or practice, typically athletic trainers or other medical personnel immediately respond by assessing and treating the athlete. First, medical personnel or clinicians look for any loss of consciousness which can be an indicator for severe concussion (Lovell, Collins, & Bradley, 2004). After an athlete is seen to be conscious and appears to have received a concussion, the medical personnel use a brief measurement tool for the purpose of measuring the severity of impairment and determining whether the athlete should return to play (Randolph, McCrea, & Barr, 2005). Symptoms that follow concussion, besides loss of consciousness, that are of great consequence are confusion and amnesia (Lovell et al., 2004). A sideline measurement tool usually consists of a short series of questions assessing the athlete's knowledge of what happened before the blow to test for amnesia, assessing the athlete's knowledge of basic information like where the playing facility was located when the athlete received the concussion to test for orientation, and assessing if the athlete can concentrate by asking the athlete to repeat a series of words and/or numbers (Lovell et al., 2004). Some examples of sideline assessments include but are not limited to the

Standardized Assessment of Concussion (SAC) and the Sports Concussion Assessment Tool (SCAT) which take minutes to administer (McGrath, 2010).

Baseline and neurocognitive testing. Neurocognitive testing is used to establish an athlete's baseline before injury, and it explores the cognitive areas of attention, memory, reaction time, concentration, processing speed, and response accuracy (McGrath, 2010). These are areas that would likely be affected by concussion, and these responses are necessary during gameplay. Neurocognitive tests are typical found in paper-and-pencil formats or as computerized programs. On the contrary, neurocognitive testing with computerized programs is not a completely reliable practice according to one study completed by researchers. Broglio and colleagues (2007) concluded that neurocognitive assessments have been able to detect consequences of concussions and computerized testing is practical to use within sports settings, but further investigation on the subject is needed. In a different study, it was found that there are limitations to computerized cognitive assessment, such as the hardware required to administer the tests can be expensive, the hardware can be importable making it less easy to use, and their test-retest reliability and normative data can be insufficient (Collie, Darby, & Maruff, 2001).

A computerized testing program that is used quite frequently within the sports medicine field is Immediate Post-Concussion Assessment and Cognitive Testing or the ImPACT test battery. According to Covassin and colleagues (2009), ImPACT could have been more advantageous if the athletic trainers had validated their baseline tests before making return-to-play decisions, but instead athletic trainers relied more on symptoms than ImPACT. Other commonly used tests are the Stroop task which assesses cognitive automaticity and speed of information processing, and the Postconcussion Syndrome Checklist which helps determine if the individual suffers from any symptoms associated with postconcussion syndrome which are

usually similar to concussion symptoms (Killam, Cautin, & Santucci, 2005). Postconcussion syndrome is what can occur over time after a concussive blow to the head (Leddy et al., 2013.) According to Leddy and his fellow researchers (2013), postconcussion syndrome symptoms may be related to cerebral blood flow regulation being abnormal. With this issue along with computerized testing being deemed unreliable, paper-and-pencil tests may be a more reliable way to check a person's cognitive abilities. These facts give support to self-reporting by the athlete as being a key method for diagnosing and treating concussion which still does not occur on a regular basis (Randolph et al., 2009).

NCAA Procedure Related to Concussion

The NCAA has enforced a policy where each school within the NCAA divisions has to have a concussion management plan. The specifications of this policy that each school constructs and enforces are as follows: an annual process educating the signs and symptoms of concussions and informing the student-athletes that it is their responsibility to tell a medical staff member if they are experiencing these symptoms, the process including the rule that any player sustaining a concussion be removed from competition immediately where medical staff can assess for concussion and then keep the player off the playing grid for the remainder of the calendar day if diagnosed, and the process requiring medical clearance before a student-athlete can return to play (NCAA, 2013).

The NCAA conducted a 2003 concussion study with collegiate football players which may have revealed enough evidence to institute the policy. The study included 2,905 football players from 25 U.S. colleges that were tested at preseason baseline in 1999, 2000, and 2001 with a variety of test measures and followed up with when concussion occurred (Guskiewicz et

al., 2003). The data collected included history of concussion, the incidence of concussion, type of symptoms, duration of symptoms, and the course of recovery among players who were injured during season. The results of the study concluded that players with a history of concussion were more likely to have future concussion injuries than those with no history, and previous concussions may be associated with slower recovery of neurological function. However, Division III ended up having the highest concussion incident rate during games compared to Division I and Division II.

A second study conducted through the NCAA had data collected over a span of 16 years (Dick, Agel, & Marshall, 2007). The study consisted of several sports instead of just football with 16 altogether, and they used the NCAA's Injury Surveillance System (ISS). ISS has been in place since 1982, and its goals are to collect injury and exposure data from a representative sample of NCAA schools, and to provide individual institutions with injury information that will help in their risk management decision making (Dick et al., 2007). The study showed that the ISS had evolved to become a 16-sport surveillance system, and it expanded in 2005 with covering all NCAA championship and emerging sports as well as 50 or more intermural activities (Dick et al., 2007). This study also showed soccer with high prevalence of concussion behind football, ice hockey, and lacrosse.

Concussions in Soccer

Approximately 430,000 men and 322,000 women play soccer at the collegiate level (Daneshvar et al., 2011). Concussions account for 22% of soccer-related injuries (Levy, Kasasbeh, Baird, Amene, Skeen, & Marshall, 2011). This is a relatively high percentage compared to other sports. According to Levy and colleagues (2011), several studies have shown

that a smaller percentage of soccer players knew that they were suffering from a concussion, and of concussed participants, 75% may have had multiple concussions. Head to head contact results for most concussions in soccer, but they also can receive them from head to elbow, head to knee, head to ground, head to goal post, head to ball, and head to other surfaces (Levy et al., 2011). This evidence of high level exposure to concussion injury has led to researching ways of preventing this high incidence, such as wearing protective headgear during play (Levy et al., 2011).

Reduction of concussion in soccer. There are some elements that can be changed in order to help slow the increasing rate of concussion injuries in soccer (Levy et al., 2011). According to Levy and colleagues (2011), one of these elements is making sure the size of the soccer ball is age appropriate. The bigger and denser a ball is for younger players will increase the risk of the younger athletes getting hurt. Another element is for the player to understand proper technique for heading the ball because heading the ball takes practice (Levy et al., 2011). Also, strict adherence to the rules is a very important factor to prevent concussions from happening on the soccer field because players being too rough can cause increased prevalence (Levy et al., 2011). If a player does receive a blow to the head, then the procedure on the field performed by the medical staff are as follows: the ABC's of resuscitation and stabilization of the spine (Levy et al., 2011). Since soccer is played by males and females, there have been studies to see if gender plays a role in increased concussion incident rates for soccer.

The gender relation. Gender can play a part in concussion incident rates and recovery period from concussion injury. There are sex differences between concussed collegiate athletes according to a study conducted by Covassin and colleagues. Soccer was said to be one of the only sports gender difference has been examined (Covassin, Swanik, & Sachs, 2003). The study

described the NCAA Injury Surveillance System as defining concussion in three grades: grade 1 detailing no loss of consciousness with short duration of amnesia, grade 2 detailing loss of consciousness for less than 5 minutes with amnesia up to 30 minutes, and grade 3 detailing loss of consciousness for more than 5 minutes with extended amnesia (Covassin et al., 2003). In soccer, females were found to have sustained significantly more concussions than males (Covassin et al., 2003). In another study, female soccer players were found to have higher percentage of concussion from their head hitting a surface or a ball compared to males who had a higher percentage of concussion from their head hitting another player's head (Dick, 2009). Overall, this study supported the fact that females may be at a greater risk for concussion than males, but there is a chance that females may be reporting more than males; thus, there needs to be further study into gender difference in regards to concussion incidence (Dick, 2009).

Clinically being able to manage concussed male and female athletes is an important aspect when studying gender difference, and one would do this by conducting a detailed clinical interview (identifying mechanism of injury, relevant history, and symptoms), neurocognitive assessment, and a vestibular/balance screening (Covassin, Elbin, Crutcher, & Burkhart, 2013). Other than clinical management, limitations occur when studying gender difference in soccer and in any other sport. Some limitations are that men may "play through pain" more so than women, thus underreporting and possibly sustaining more concussions than women, but the data shows that females are reporting more and seem to sustain more concussions (Covassin, Schatz, & Swanik, 2007). When specifically referring to soccer players, a study conducted by Zuckerman and colleagues showed that there were no significant gender differences between soccer players, but when comparing multiple sports, they uncovered different results (Zuckerman, Solomon,

Forbes, Haase, Sills, & Lovell, 2012). This study still supported the fact that gender could be a modifying factor, but more research would be needed.

Conclusion

The understanding of how to recognize and treat an athlete's concussion symptoms is crucial for an athlete's recovery. The athlete not only needs to be able to return to sports play, but also needs to be able to restore their ability to learn in the classroom. According to the NCAA in regard to treatment of concussion injuries, it is important to remember that not all individuals are the same, so evaluating on an individual basis is necessary (Klossner, 2012). The NCAA has put in place a way for colleges and universities to stay accountable with educating student-athletes about concussion. Many concussions can be prevented with proper safety precautions, implementation of safer rules, proper conditioning, and standardized coaching techniques, but there still is not enough evidence to suggest that concussion will ever be completely eliminated from sport (Daneshvar et al., 2011).

Soccer and gender differences in concussion incident rates need to be studied further to determine whether females actually do sustain more concussions than males or if they are just reporting more, and also if females have a longer recovery period from concussion injury than males (Bloom, Loughead, Shapcott, Johnston, & Delaney, 2008). The study of concussion can bring awareness to student-athletes, medical personnel and the general public in order to slow down concussion incident rates in the future and research is progressing in this direction.

Methods

Approach to the Problem

It is estimated in the United States that between 1 and 4 million sports-related concussions occur each year (Colvin et al., 2009). According to Colvin and colleagues (2009), concussion prevalence has varied over time based upon age, gender, and sport of participation. However, recent studies suggest that the total number of individuals enduring symptoms after sustaining a concussion has been underestimated because these individuals are not seeking proper medical advice (Daneshvar et al, 2011). Reasoning behind why these individuals are not seeking medical advice is because a concussion can cause impairments of neurologic function to rapidly arise and then depart just as quickly, which could explain how athletes, coaches, athletic trainers, and other sports medicine professionals are not recognizing concussions when they occur (Daneshvar, et al, 2011). The purpose of this research was to compare the concussion incident rates between NCAA Division I and NCAA Division III male and female soccer athletes in an effort to assess how concussion injuries are currently being recognized and to enhance awareness in order to address underreporting of concussion injuries. Specifically, the study sought to address the following questions:

1) Are NCAA Division III soccer athletes sustaining more concussions than NCAA Division I soccer athletes?
2) Are female soccer athletes sustaining more concussions than male soccer athletes in either Division I or Division III?

Subjects

The participants chosen were the head athletic trainers from different NCAA Division I and Division III colleges/universities in the Mid-Atlantic Athletic Trainers' Association, which encompasses the states of North Carolina, South Carolina, Virginia, West Virginia, Maryland, and the District of Columbia. The study was approved by the Institutional Review Board, and each athletic trainer participating was told in a letter of invitation linked with their survey that completing the survey was considered to be their informed consent. There were 86 head athletic trainers asked to participate in the study with 53 from NCAA Division I and 33 from NCAA Division III. The subjects were contacted by only the investigator. A survey was emailed to each athletic trainer in order for him or her to report their data. The data that they were asked to report consisted of some opinionated questions as well as investigative questions with both sets pertaining to concussion incident rates for male and female soccer athletes. The athletic trainers are not asked to report any personal information that could potentially identify any soccer athletes being assessed, thus keeping the information reported confidential.

Measures

The only method of collecting data for this study was done through emailing a survey to each of the head athletic trainers. The survey was pilot tested by three students reviewing the questions and the head athletic trainer for Meredith College taking the survey in order to check for clarity. A copy of this survey can be found in Appendix B. Once the head athletic trainer completed the survey, this counted as their informed consent to be reported within the investigator's study. The survey did not allow any personal information about the soccer athletes or the head athletic trainers to be reported in order to ensure confidentiality. The survey began

with the definition of a concussion according to the National Collegiate Athletic Association (NCAA). "It's a brain injury that changes a person's behavior, thinking or physical functioning. They are typically caused by forceful blows to the head or body that result in rapid movement of the head" (NCAA, 2013, Frequently Asked Questions section). This gave the head athletic trainers a focus for completing the survey. Next, the survey asked two identical sets of questions, but the first set was pertaining to only female soccer athletes and the second set pertaining to only male soccer athletes. Participants were asked to only seek information reported within the last three years for the questions pertaining to the athletes.

Procedures

Before sending the survey out to the head athletic trainers, email addresses were accessed. The investigator found the Division I and Division III schools and their respective head athletic trainers' email addresses individually by researching their colleges/universities. The survey consisted of a letter of invitation which explained to the head athletic trainer what to expect for the survey, and how to give their informed consent by completing the survey. The letter of invitation can be viewed in Appendix A. It was explained in the letter that no confidential information would be given for this study. This study was solely to investigate concussion incident rates in NCAA Division I and Division III soccer athletes and to compare between the divisions and genders. The survey was open for athletic trainers to complete over a period of ten days. After that period, the surveys completed were assessed, and the data collected was composed showing results for the research questions. The measurements recorded were the responses from the survey. The responses were recorded by the participant following a link to the survey on their email, and selecting answers based off the directions given by the

survey. The program kept up with how many head athletic trainers responded to the survey while SPSS Statistical Analysis Software was used to analyze the data.

Design and Analysis

Descriptive statistics and a two way ANOVA through SPSS were used to analyze the data collected in this study. Primarily, descriptive statistics were accumulated from the survey program. The descriptive statistics were described in the form of percentages and other values. The design of the survey consisted of: multiple-choice questions asking to check all that apply or to select one answer; and questions using the likert scale of agree, tend to agree, neutral, tend to disagree, and disagree, which described opinionated questions that were answered based off of the head athletic trainer's experience working with soccer athletes. Some questions asked for an average for data analysis because some data might have varied within the past three years. Specifically, questions included identification of division, rate of concussion by the average number of concussions occurring per year divided by the average number of soccer players on a team per year, and other descriptive statistics like common symptoms, length of time before return to play, and when a soccer athlete would most likely receive a concussion. The rate of concussion was the most studied piece of the data recorded because it was being measured for the research questions. The analyses used on each research question are reported below.

Research question 1. The first research question examined the concussion incident rates between NCAA Division I soccer athletes and NCAA Division III soccer athletes. A two way ANOVA was conducted to evaluate the statistical significance of the difference between the responses from head athletic trainers who marked that they were from a NCAA Division I or NCAA Division III school. The alpha level to establish statistical significance was set at $p<.05$.

Research question 2. The second research question examined the concussion incident rates between female and male soccer athletes from Division I or Division III. A two way ANOVA was conducted to evaluate the statistical significance of the difference between the responses from head athletic trainers in the two sections of the survey pertaining to only female soccer athletes and then to only male soccer athletes. The alpha level to establish statistical significance was set at $p<.05$.

Results

In this study, the data was collected using a survey to measure concussion incident rates between NCAA Division I and NCAA Division III male and female soccer athletes. The survey asked participants to recall the past three years when answering questions and it consisted of the same set of questions for each gender: Likert scale responses, multiple choice responses, responses with more than one answer, and short answer requiring a numerical response. The Likert scale consisted of the following choices: agree, tend to agree, neutral, tend to disagree, and disagree. Overall, there were 20 schools that completed questions for male soccer athletes, female soccer athletes, or both. The number of Division III schools that participated calculated to be twelve and Division I came to a total of eight. The research questions for this study were as follows: 1) Do NCAA Division III soccer athletes have a higher concussion incident rate than NCAA Division I soccer athletes?, and 2) Do female soccer athletes have a higher concussion incident rate than male soccer athletes in either division?

Division I Versus Division III

The first research question asked if Division III soccer athletes had a higher concussion incident rate than Division I soccer athletes. This data was analyzed using SPSS to conduct a two way ANOVA with a significance level of <0.05. The responses that were used to calculate a concussion incident rate were the average number of concussions per year for either male or female soccer athletes divided by the average roster size of each male or female soccer team. SPSS analyzed the data by measuring the two dependent variables of concussion incident rate and number of concussions with the independent variables of gender and division. When comparing the dependent variables of concussion incident rate and number of concussions with

division, SPSS found no statistical significance. However, the data for concussion incident rate between divisions was approaching significance with a count of .069 which is shown in Table 1.

The descriptive statistics concluded that the concussion incident rate the past three years for Division III overall has been 0.12, and then 0.08 for Division I. For the survey's Likert scale questions, all responses were neutral when referring to whether Division III soccer athletes sustained more concussions than Division I soccer athletes.

Male Versus Female

The second research question asked if female soccer athletes had a higher concussion incident rate than male soccer athletes in either division. This data was analyzed using SPSS to conduct a two way ANOVA with a significance level of <0.05. After collecting data from the survey, eleven of the twelve Division III schools responded to the male questions, and all twelve responded to the female questions. For Division I, five out of the eight schools responded to the male questions, and six out of eight responded to the female questions. Concussion incident rate was calculated the same as for division, and SPSS analyzed the two dependent variables of concussion incident rate and number of concussions with the independent variable of gender. There was no statistical significance found for concussion incident rate being measured with gender or number of concussions being measured with gender.

For descriptive statistics, females in Division III had a higher concussion incident rate with 0.12 compared to Division I females who had a concussion incident rate of 0.10, but Division III females did not have a higher concussion incident rate than the males in their division who measured to a rate of 0.13. Also, the Division I females had a higher concussion incident rate than the Division I males with the males measuring to 0.06.

For other data, Division III had a total of 31 concussions over the past three years for male and female soccer athletes which averaged to be 10.3 concussions per year for each gender. Division I had a total of 8.25 concussions over the past three years for males and 18 for females which for males averaged to be 2.75 concussions per year and for females averaged to be 6 concussions per year. For the survey's Likert scale questions, responders were neutral when stating female soccer athletes sustained more concussions than male soccer athletes, but responders tended to disagree that male soccer athletes sustained more concussions than female soccer athletes. Other responses from the survey concluded that a male soccer athlete's top three symptoms were headache, feeling like "in a fog", and difficulty concentrating while the top three symptoms for a female soccer athlete were headache, a tie between difficulty concentrating and dizziness, and then a tie between feeling like "in a fog" and sensitivity to light. Also, responses from the survey showed that more concussions occurred during competition for both male and female soccer athletes than during practice.

Discussion

The purpose of this study was to compare the concussion incident rates between NCAA Division I and NCAA Division III male and female soccer athletes. Previous research has found conflicting results showing that females can have more issues with concussion than males, such as females having different symptoms, different recovery periods, and differences in head-neck dynamic stabilization than their male counterparts (Colvin, Mullen, Lovell, West, Collins, & Groh, 2009). Also, there is limited research comparing NCAA Division I and NCAA Division III to each other, and their studies have been found focusing on all three divisions instead of comparing the highest division to the lowest division, such as with the NCAA's concussion study between Division I, II, and III football players (Guskiewicz, et al., 2003). Therefore, the investigator's study was done to explore more information about Division I and Division III with whether one division had a higher concussion incident rate than the other, and whether female soccer athletes sustained more concussions than male soccer athletes.

Division

When viewing this study's results from the comparison of concussion incident rates between Division I and Division III, Division III had the higher concussion incident rate with 0.12 while Division I fell behind at 0.08. Approaching statistical significance was found for this data, but this is not enough to support that Division III has been sustaining more concussions than Division I. For other data, the total number of concussions that occurred over the past three years within Division III counted to be 62 while Division I gathered a total of 26.25 concussions. In other words, the data showed that Division III had over twice as many concussions occurring than Division I during the past three years. More studies need to occur that compare the NCAA

divisions in order to see if Division III is indeed sustaining more concussions than Division I, and, if so, having the public be aware in order to try and prevent the high incidence.

Gender

When viewing the results from the comparison of concussion incident rates between male and female soccer athletes, females in Division III had a higher concussion incident rate with 0.12 compared to Division I females, but Division III females did not have a higher concussion incident rate than the males in their division. This goes against what some researchers have found conducting gender studies comparing concussion incident rates because according to one study by Covassin and colleagues (2003), females were found to have sustained a higher percentage of concussions during games than male athletes. Consistent with Covassin and colleagues' study, Division I female athletes were found to have a higher concussion incident rate than Division I male athletes. Subsequently, the investigator's study results showed that the concussion incident rates varied between male and female soccer athletes in either division. Study results did not show any statistical significance with these totals, thus it cannot be verified that female soccer athletes are sustaining more concussions than male soccer athletes in either division. More studies need to occur in order to see if females actually do sustain more concussions than males, and this may lead to conclusive evidence for the public to be aware on of this issue.

Limitations

In this study, there were some limitations that could have affected the results. One limitation was the uneven number of Division I schools compared to Division III schools asked to participate in the study. If all schools had completed the survey, Division I would have had

more data to add to the collection than Division III. However, only 8 Division I and 12 Division III schools responded to the survey, but this still ended up being an uneven number that most certainly could have supported Division III having more concussions and higher concussion incident rates than Division I. The second limitation was the survey questions. The questions should have been written in such a way to see exact totals for responses over the past three years, and not the average number for responses over the past three years. The survey had no way of statistically showing an increase in concussion incident rates over the past three years which inhibited the demonstration of trends in concussion incidence. A third limitation which occurred from the survey was that a participant answered a numerical response question with a range instead of an exact number, so the reviewer had to average the range in order to put down a single number for the data. The fourth limitation was that a participant filled out the questions, but did not mark which division their school was from. In this case, the data had to be voided and not added in with the total. This data could have affected the results and may have changed the findings between the divisions since the concussion incident rates were so close.

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Appendix A

Dear Certified Head Athletic Trainers,

I am an undergraduate student majoring in Exercise and Sports Science at Meredith College in Raleigh, NC, and I am requesting your help to complete part of my bachelor's degree requirements. Please follow the link at the end of this letter to an online survey titled: Comparison of Concussion Incident Rates between NCAA Division I and NCAA Division III Male and Female Soccer Athletes Survey.

The purpose of this study is to compare the concussion incident rates of NCAA Division I and NCAA Division III male and female soccer athletes. Investigating the incident rates of concussion injury will determine how prevalent these athletes sustain concussions and potentially uncover information that can bring awareness and improved techniques of treatment and prevention for these male and female soccer athletes.

You are being asked to please complete a survey that should take approximately 5 to 10 minutes. The survey consists of demographic questions and 4 Likert scale (1- Agree to 5- Disagree) questions pertaining to female and male soccer athletes. You will not be allowed to indicate any personal information about the male and female soccer players or yourself in order to assure confidentiality. Meredith College Institutional Review Board has approved this study for the protection of human subjects.

Your participation in this study is completely voluntary. If you choose to participate you may choose to discontinue participation at any time, and you do not have to answer survey questions that you do not wish to. Your completion of the survey implies your consent to participate in this study. If you choose to withdraw your consent to participate at a later time, you can notify the investigator by emailing to williawh@email.meredith.edu.

Please click on the survey link provided or copy and paste the URL into your internet browser. Last day for submission of this survey will be next Friday, November 22nd, 2013:

http://www.surveytool.com/s/concussionsurvey

Thank you for your time and contribution!

Sincerely,

Whitney Williams

Appendix B

Comparison of Concussion Incident Rates between NCAA Division I and NCAA Division III Male and Female Soccer Athletes Survey

According to the National Collegiate Athletic Association's website, a concussion is defined as "a brain injury that changes a person's behavior, thinking or physical functioning. They are typically caused by forceful blows to the head or body that result in rapid movement of the head" (NCAA, 2013, Frequently Asked Questions section). This definition will be a guide for answering the following questions.

Select which category applies to your school:

a) Division I

b) Division III

The next following questions pertain to **FEMALE** soccer athletes only. Please consider the last three years when reporting.

What has been the AVERAGE roster size for the female soccer team at your college/university for the past three years? (Please indicate a number): _____

On AVERAGE, how many cases of concussions have occurred in female soccer athletes PER YEAR? (Please indicate a number): _____

What were the MOST commonly reported signs of a concussion that female soccer athletes exhibited at your college/university? (Choose all that apply.)

a) Headache

b) “Pressure in head”

c) Neck Pain

d) Nausea or vomiting

e) Dizziness

f) Blurred vision

g) Balance problems

h) Sensitivity to light

i) Sensitivity to noise

j) Feeling like “in a fog”

k) Difficulty concentrating

l) Difficulty remembering

m) Fatigue or low energy

n) Confusion

o) Drowsiness

p) Trouble falling asleep

q) More emotional

r) Irritability

s) Sadness

t) Nervous or Anxious

Do females sustain more concussions due to practice or competition?

a) Practice

b) Competition

What is the AVERAGE length of time a female soccer athlete is restricted from organized practice/competition due to a concussion?

a) Same day

b) 1-2 days

c) 3-6 days

d) 1-2 weeks

e) 3-6 weeks

f) 6+ weeks

Female soccer athletes are more at risk of sustaining a concussion than male soccer athletes.

Agree Tend to Agree Neutral Tend to Disagree Disagree

NCAA Division III female soccer athletes are more at risk of sustaining a concussion than NCAA Division I female soccer athletes.

Agree Tend to Agree Neutral Tend to Disagree Disagree

The incident rate of concussion injury in female athletes at your college/university has steadily risen within the last three years.

Agree Tend to Agree Neutral Tend to Disagree Disagree

Female soccer athletes suffering long-term effects from concussion injury is common.

Agree Tend to Agree Neutral Tend to Disagree Disagree

The next following questions pertain to **MALE** soccer athletes only. Please consider the last three years when reporting.

What has been the AVERAGE roster size for the male soccer team at your college/university for the past three years? (Please indicate a number): _____

On AVERAGE, how many cases of concussions have occurred in male soccer athletes PER YEAR? (Please indicate a number): _____

What were the MOST commonly reported signs of a concussion that female soccer athletes exhibited at your college/university? (Choose all that apply.)

a) Headache
b) "Pressure in head"
c) Neck Pain
d) Nausea or vomiting
e) Dizziness
f) Blurred vision
g) Balance problems
h) Sensitivity to light
i) Sensitivity to noise
j) Feeling like "in a fog"
k) Difficulty concentrating
l) Difficulty remembering
m) Fatigue or low energy
n) Confusion
o) Drowsiness
p) Trouble falling asleep
q) More emotional
r) Irritability
s) Sadness
t) Nervous or Anxious

Do females sustain more concussions due to practice or competition?

g) Practice
h) Competition

What is the AVERAGE length of time a male soccer athlete is restricted from organized practice/competition due to a concussion?

a) Same day
b) 1-2 days
c) 3-6 days
d) 1-2 weeks
e) 3-6 weeks
f) 6+ weeks

Male soccer athletes are more at risk of sustaining a concussion than female soccer athletes?

Agree Tend to Agree Neutral Tend to Disagree Disagree

NCAA Division III male soccer athletes are more at risk of sustaining a concussion than NCAA Division I male soccer athletes.

Agree Tend to Agree Neutral Tend to Disagree Disagree

The incident rate of concussion injury in male athletes at your college/university has steadily risen within the last three years.

Agree Tend to Agree Neutral Tend to Disagree Disagree

Male soccer athletes suffering long-term effects from concussion injury is common.

Agree Tend to Agree Neutral Tend to Disagree Disagree

Thank you for your participation!

Table 1

Significance for Concussion Incident Rate and Independent Variables

Source	*df*	Mean Square	*F*	Sig.
Sex	1	.002	.593	.447
Division*	1	.013	3.564	.069
Sex and Division	1	.005	1.346	.255

Note: Significance (Sig.) is measured at the $p<0.05$ level.

*The concussion incident rate between divisions showed approaching significance, but this value does not support the result from the study that Division III had a higher concussion incident rate than Division I.