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THE RELATIONSHIP BETWEEN THE ATHLETE AND THE ATHLETIC TRAINER AND HOW IT EFFECTS CONCUSSION REPORTING

by

JADA PHILLIPS, ATC

(Under the direction of Thomas Buckley)

ABSTRACT

Currently there are an estimated 1.6–3.8 million concussions annually in the United States; therefore, it is imperative that healthcare professionals recognize these injuries to reduce future injury risks such as Second Impact Syndrome (SIS), depression, and Mild Cognitive Impairment. In order to reduce these risks, healthcare professionals need to find ways to increase the athletes' willingness to report their concussions. McCrea suggests that healthcare professionals need to promote open lines of communication for injury reporting. In searching for different means by which to promote lines of communication to increase the athletes' willingness to report concussions, two possible means were identified. The first would be to explore the relationship between the athletic trainer (AT) and the athlete (i.e. perceived closeness), and the second would be to explore the amount of autonomy support given by the healthcare provider. **Objective:** To investigate if closeness and autonomy support predict athletes' willingness to report their concussion symptoms. **Design:** Multiple Linear Regression using two independent variables (Health Care Climate Questionnaire – HCCQ, and Need for Relatedness Scale – NRS) and one dependent variable (Willingness to Report Scale – WRS). **Participants:** 108 high school and collegiate athletes (\bar{x} age=17.9 \pm 2.3 years). The participants completed a demographic sheet and three questionnaires. **Main Outcome Measures:** Autonomy support, perceived closeness, and willingness to report were the outcomes and were measured using three questionnaires. The Health Care Climate Questionnaire measured autonomy support. The Need for Relatedness scale

measured perceived closeness. The Willingness to Report Scale measured the willingness of athletes to report concussion symptoms to their AT. **Results:** Interestingly, findings indicated that perceived closeness predicted WR for only HS subjects. Specifically, perceived closeness significantly predicted 15.8% of the variance of WR for HS subjects ($F=8.436$, $p=0.006$).

Conclusions: Because perceived closeness predicted willingness to report for high school subjects, it is suggested that high school athletic trainers develop closer relationships with their athletes to increase reporting of concussions. By developing a closer relationship there is a potential to increase concussion reporting, thus also potentially decreasing the risk of SIS and other long term effects of concussions.

Index Words: Athletic trainer, Athletic training, Athlete, High school, College, Autonomy support, Need for relatedness, Perceived closeness, Willingness to report, Concussion, Interpersonal relationship

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B.S. Erskine College, 2008

A Thesis Submitted to the Graduate Faculty of Georgia Southern University in

Partial Fulfillment of the Requirements for the Degree

MASTER OF SCIENCE

STATESBORO, GEORGIA

2010

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Electronic Version Approved:
May 2010

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Chapter 1: Introduction and Methods

INTRODUCTION

Currently there are an estimated 1.6 – 3.8 million concussions occurring annually in the United States.¹ A concussion is a complex pathophysiological process affecting the brain, induced by traumatic biomechanical forces and, for adolescents to young adults (ages 15-24), sports are second only to car accidents for the leading cause of concussions.^{2,3} With only 47.3% of athletes reporting their concussions, it is evident that under-reporting of concussions is of concern. Therefore, it is imperative that ATs recognize these injuries in order to keep athletes safe from potential further injury.⁴ One of the most common responses given by athletes for why they do not report their concussions is that they do not feel that the injury is severe enough to report it to their coach, AT or other medical personnel.^{4,5} Removal from play, lack of knowledge of the signs and symptoms of concussions, and not wanting to let down their teammates were also found to be deterrents for reporting concussions to a healthcare professional.⁶

In order to appropriately manage a concussion, the healthcare professional must first know that one has occurred. Although it is reported that 5 - 8% of football athletes have sustained a concussion,⁷⁻¹² current research suggests that these numbers may be low and there are likely more concussions occurring.^{4,13} Indeed, some have suggested concussion rates may be as high as 15 - 55% for sport and recreation athletes in a calendar year.^{4,14} Further, under-reporting of concussions is prevalent, with rates ranging from 18.7% to 70%.^{4,6,13} Concussions are unique in that, with mild concussions, they are an injury that is relatively easy to hide, as many of the symptoms require self-reporting by the athlete. If obvious physical signs and symptoms are not present, such as balance abnormalities, loss of consciousness (LOC), or disorientation, it is difficult for the healthcare professional on site to know that a concussion has occurred. Therefore, many athletes may be continuing to participate despite having sustained a concussion

and increasing their risk for long-term effects of concussions such as Second Impact Syndrome (acute onset), depression, mild cognitive impairment, and chronic traumatic encephalopathy (CTE) (late-life onset).¹⁵⁻²⁰

Second Impact Syndrome (SIS) occurs when an athlete incurs a second, potentially minor, blow to the head while still symptomatic from a prior concussion.^{15,21} This second hit results in a rapid increase in intracranial pressure, causing brain herniation leading to a loss of autoregulation resulting in both respiratory and brain failure to occur within 2-5 minutes of the second impact.^{16,22,23} SIS often occurs because the initial concussion either went un-reported or it was poorly managed and the athlete was allowed to return to play before being asymptomatic.⁴ To further support the idea that athletes need to be asymptomatic before being allowed to return to play, Boden reported that 60% of athletes who sustained catastrophic head injuries received them while playing symptomatic from a previous head injury.²⁴ In this same study, Boden reported that 8.9% of catastrophic head injuries were fatal.²⁴

In addition to SIS, there are other long-term effects of concussions that are also a concern. Athletes with a history of a concussion are 3-6 times more likely to receive a second concussion, are at a higher risk of prolonged signs and symptoms, and may suffer potential long term complications including mild cognitive impairments (MCI), earlier onset of Alzheimer's disease, depression, and CTE.^{9,17-20,25,26} Indeed, Guskiewicz reports that athletes with a history of 3 or more concussions are 3 times more likely to be diagnosed with MCI and depression later in life.^{17,19} Recent evidence, while still inconclusive, suggests the possibility of CTE as being a long term effect of concussion as well.²⁰ CTE is characterized by atrophy of the cerebral hemispheres, medial temporal lobe, thalamus, mammillary bodies, and brainstem.²⁰ Essentially, CTE is atrophy of the brain, which research involving boxers suggests occurs in at least 17% of

individuals with a history of repetitive concussions.²⁷ Possible outcomes of CTE are memory disturbances, behavioral and personality changes, parkinsonism, and speech and gait abnormalities.²⁰

Although current rates of reported concussions are between 5-8%,⁸⁻¹² studies have shown that this number is low and that concussions have been found to be anywhere from 15-55% of all injuries reported.^{4,14} One of the most common responses given by athletes and patients for why they do not disclose information to their AT or physician is that they do not feel that the injury (concussion) or problem (illness) is important enough to report.^{4,5,28} In addition to not feeling the concussion was important enough to report, other reasons why athletes do not report their concussions are they do not want to be removed from play, they do not know they've sustained a concussion, and they do not want to let down their teammates.⁴ It was also indicated that patients did not disclose information because they did not understand why the questions they were being asked were relevant.²⁸ In order to reduce the long term effects of concussion and to reduce the incidences of SIS, healthcare professionals need to investigate strategies to increase the athletes' willingness to report their concussions.^{4,5} One suggestion by McCrea was to educate the athletes on the signs and symptoms of concussions as well as the possible effects concussions can have.⁴ McCrea also suggests that healthcare professionals need to promote open lines of communication for injury reporting.⁴ In searching for different means by which to promote lines of communication to increase the athletes' willingness to report concussions, two possible means were identified. The first would be to explore the interpersonal relationship between the AT and the athlete, and the second would be to explore the amount of autonomy support given by the AT.^{29,30}

A closer relationship between the AT and the athlete is a potential mechanism to increase the athletes' willingness to report a concussion.²⁹ Current research on this relationship is limited, but it suggests is that athletes who perceive their AT as willing to listen to them and are interested in their concerns may demonstrate higher levels of satisfaction with care provided by their AT.³¹ In continuing this idea, athletes who are more satisfied with their healthcare tend to have an increase in trust with their AT.³² Due to the limited amount of research on this relationship, the coach-athlete relationship will be used as a model when examining the AT-athlete relationship due to its close comparison as perceived by the investigator. Within the coach-athlete relationship literature, a closer relationship has been found to have an increase in an athlete's ability and willingness to trust his/her coach as well as to promote the exchange of information and disclosure.^{29,33} This concept of increased trust and disclosure between coaches and athletes due to a closer relationship can potentially be transferred to the AT-athlete relationship.

In addition to creating a closer and more personal relationship, the amount of autonomy support given by the AT can also play a role in a patient's behavior in regards to his or her health and well being.³⁰ Autonomy support is the idea of giving athletes freedom or independence and allowing them to make choices and involving them in their health care.³⁴ In a glucose control study conducted by Williams, it was found that patients of healthcare providers who provided more autonomy support were able to maintain a healthy diet and exercise more regularly, resulting in lower glucose levels.³⁵ Providers who gave more autonomy support tended to promote more positive health outcomes in their patients, which enabled the patients to feel more motivated and competent.³⁵ The more autonomy support an individual receives, the more likely they are to integrate autonomous behavior (a full sense of choice about a decision within their

healthcare, rather than having a decision forced upon them in regards to their healthcare).³⁶ An individual exhibiting autonomous behavior may be more likely to care about their health and well-being.^{30,36} These findings suggest that in giving autonomy support, and therefore helping the athlete to integrate autonomous behavior, the athlete will be more likely to have and maintain health related behavior changes.³⁶ Therefore, the literature suggests the more autonomy support given, the more likely the athlete will care about their health and thus potentially be more willing to report their concussions to their AT.³⁰

The purpose of this study is to investigate if closeness and autonomy support predict athletes' willingness to report their concussion signs and symptoms to their AT. Although several predicting variables could have been used in the model to predict athletes' willingness to report concussion symptoms, only perceived closeness and autonomy support were chosen for this study. These two specific variables were used in the model because this study investigated variables that the AT can control. For example, the AT can control the amount of autonomy support provided to the athlete, however, the AT cannot control for the athlete's gender. In the development of this study, three hypotheses were made: 1) Closeness and autonomy support will predict the athletes' willingness to report a concussion; 2) Closeness will predict the athletes' willingness to report a concussion; and 3) Autonomy support will predict the athletes' willingness to report a concussion. It is hypothesized that an increase in closeness will predict the athletes' willingness to report and we also hypothesize that an increase in autonomy support will predict the athletes' willingness to report. Optimally, through the outcomes of this study, another tool may be available for health care professionals to utilize in the prevention of Second Impact Syndrome and other long term effects associated with concussions.

PARTICIPANTS

One hundred and nineteen subjects were recruited to participate in the study; however, 11 were later removed after they were determined to be outliers, skewing the distribution of the data. Therefore, there was a total of 108 subjects (\bar{x} age = 18.0 ± 2.3 years, ages ranged 14-23 years), including subjects from both a local private high school (\bar{x} age = 16.0 ± 1.3 years) and a large public university (\bar{x} age = 19.7 ± 1.3 years). For all subjects, there was a total of 56 males (52.3%) and 51 females (46.8%). Within the high school subjects, females represented a slightly larger proportion of the sample (51.1%) than did female subjects in the college sample (45.0%) (Table 1). Inclusion criteria required that the subjects be student-athletes who were actively participating in athletics at their respective schools. The athletes represented a diverse set of sports (Table 2). There were no exclusion criteria for participation in the study. Prior to participation, subjects 18 and older and parents of minors signed an informed consent form and minors (17 and younger) signed an assent form as approved by the university's IRB.

INSTRUMENTATION

In this investigation, three questionnaires were utilized to assess the athletes' perception of the level of autonomy support their AT gives them, the athletes' interpersonal relationship with their AT (e.g. perceived closeness), and the athlete's willingness to report injury signs and symptoms to their respective AT (Appendix A).

- The Health Care Climate Questionnaire (HCCQ)³⁶

The HCCQ measures perceptions of the degree to which a healthcare provider provides autonomy support. Sample question: "I feel that my athletic trainer has provided me with options and choices". This instrument consists of 15 questions scored on a Likert scale ranging from 1-7.

A higher score represents higher perceived autonomy support given by the health care provider. This instrument has shown to be both valid and reliable (Cronbach's alpha = 0.95) within the healthcare profession (e.g. physicians).³⁶

- The Need for Relatedness scale (NRS-10)³⁷

The NRS-10 measures the relationship between two individuals (e.g. athlete and AT). Sample question: "In my relationship with my athletic trainer I feel supported". The instrument consists of 10 questions scored on a Likert scale ranging from 1-7. A higher score indicates more perceived acceptance and closeness within the relationship. This test has shown to be both valid and reliable (Cronbach's alpha = 0.91) for relationships in the work place, but it is possible to be used interchangeably in different life domains (ex. school, sport, etc).^{37,38}

- Willingness to Report Scale (WRS)

This newly created scale rates athletes' willingness to report injury signs and symptoms to their AT. Sample question: "If I were experiencing swelling, following an injury, I would tell my athletic trainer". The scale consists of 20 items that represent injury signs and symptoms, which are scored on a Likert scale ranging from 1-7. Ten of these signs and symptoms are directly related to a concussion and the remaining 10 are orthopedic related signs and symptoms that are not typically associated with a concussion. The concussion signs and symptoms were adopted from the Graded Symptom Checklist, which is used to assess the prevalence and severity of the signs and symptoms of concussion.³⁹

A higher score on the Willingness to Report scale indicates a higher likelihood that the athlete would report their signs and symptoms. Our pilot testing (n=49 undergraduate Health and

Kinesiology students) of this instrument revealed that it is reliable (Cronbach's alpha = 0.92) within the sport setting.

PROCEDURES

For the high school sample, an email was sent to the parents/guardians of all high school student-athletes from the athletic secretary. The email contained both the informational letter and parental consent forms for minors. The parents/guardians were asked to print, sign, and return the parental consent forms to the athletic secretary of the high school if they were allowing their child to participate in the study. The parents/guardians were given two weeks to return the consent forms. At one week, a reminder email was sent to the parents/guardians to return the forms. After obtaining the parental consent forms, an athletic meeting was called by the athletic director at the high school. Student-athletes who were minors and whose parents/guardians had returned the consent forms were asked to report to the meeting. Additionally, student-athletes who were 18 years or older were also asked to report to the meeting. The study was then explained and an informational letter was given to every athlete. Informed consent was obtained from each athlete who was over the age of 18 years and agreed to participate, and informed assent was obtained from each athlete who was under the age of 18 years and agreed to participate. Because the primary investigator was the athletic trainer at the high school, she left the room after explaining the process, answering any questions, and dispersing the demographic sheet (Appendix A) and the three experimental questionnaires. Only the athletic secretary, who was not a coach of any sport, remained in the room with the student-athletes and collected the questionnaires as the athletes completed them. The response rate was 50% (52/104) for the high school population.

For the college, the student-athletes were approached individually by the primary investigator at a study hall session. The coaches were not present when the athletes were approached, and the coaches were not informed of who did or did not participate in the study. An informational letter about the study was provided and the study was explained at the time the student-athletes were asked to participate. The student-athletes were then given a demographic sheet (Appendix A) to complete, followed by three experimental questionnaires. The response rate was 100% for the collegiate student-athletes.

For both the high school and collegiate data collection, the questionnaires were placed in a randomized order prior to data collection. It took approximately 5-10 minutes to complete the demographic sheet and the three questionnaires.

DATA ANALYSIS

Each of the questions on the three instruments is scored on a likert scale from 1 (Strongly Do Not Agree) to 7 (Strongly Agree). The total number of questions for each instrument ranges from 10 to 20. To calculate a final score for each instrument, the total of the items selected for each question was summed. This generated an independent total score for each of the three instruments. For all the instruments used in this study, a lower score indicated lower perceptions or willingness to report and higher scores indicated higher perceptions or willingness to report. The HCCQ can range in scores from 15 – 105 (low to high). The NRS-10 can range in scores from 10 – 70 (low to high). And lastly, the Willingness to Report Scale can range in scores from 10 – 70 (low to high) for the ten signs and symptoms pertaining specifically to concussions and 20 – 140 (low to high) for the entire questionnaire.

STATISTICAL ANALYSIS

A forward stepwise multiple regression analysis was performed between the dependent variable (WR) and the independent variables of autonomy support (HCCQ) and perceived closeness (NRS). A forward stepwise regression analysis was chosen in order to exclude variables that did not significantly contribute to the model. This analysis allowed us to predict the athletes' WR from the two variables of autonomy support and closeness. Stepwise regression analyses were also run, utilizing split file, on the different subgroups (group, gender, AT gender, and previous concussion history). Alpha was set at 0.05.

RESEARCH HYPOTHESIS

Hypothesis #1 – Null hypothesis ($R^2 = 0$): The variables chosen (closeness and autonomy support) will not predict the athletes' willingness to report a concussion to their ATC.

Alternative hypothesis ($R^2 > 0$): The variables chosen (closeness and autonomy support) will predict the athletes' willingness to report a concussion to their ATC.

Hypothesis #2 – Null hypothesis ($\beta_1 = 0$): Perceived closeness will not predict the athletes' willingness to report a concussion to their ATC. Alternative hypothesis ($\beta_1 > 0$): Perceived closeness will predict the athletes' willingness to report a concussion to their ATC. We hypothesize that higher perceived closeness will predict an increase in the athletes' willingness to report a concussion to their ATC.

Hypothesis #3 – Null hypothesis ($\beta_2 = 0$): Autonomy support will not predict the athletes' willingness to report a concussion to their ATC. Alternative hypothesis ($\beta_2 > 0$): Autonomy support will predict the athletes' willingness to report a concussion to their ATC. We

hypothesize that higher autonomy support will predict an increase in the athletes' willingness to report a concussion to their ATC.

LIMITATIONS

- There is no randomization in subject recruitment.
- The primary investigator was the athletic trainer at the local high school.
- Duration of AT-athlete relationship for the college student-athletes was 0.5 years.

DELIMITATIONS

- Only student-athletes ranging in ages from 13-23 were surveyed.
- A single private high school was used.
- A single public university was used.
- Participants were interscholastic/intercollegiate athletes at their respective schools.

ASSUMPTIONS

When administering the questionnaires, it was assumed that the athletes did not report what it is that they felt they were 'supposed' to answer. It was assumed that the athletes were honest in all of their responses. Finally, it was also assumed that when taking the surveys the student-athletes did not converse or assist each other in answering the questions.

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Chapter 2: Literature Review

CONCUSSIONS

The answers to the questions ‘What are concussions?’ and ‘Why do we care?’ are imperative to understand for individuals involved within the athletic field. Regardless if these individuals be an athlete, a parent, a coach, or a medical professional, it is pertinent for there to be some level of minimal understanding of these questions and their answers. These questions will not only be thoroughly investigated, but also answered by examining the following topics: what is a concussion; what are the signs and symptoms of concussions; what the causes of concussions are; how concussions are diagnosed; how to prevent concussions, and current issues associated with concussions. In addition to looking at concussions the topics of autonomy support and interpersonal relationships will also be reviewed.

What Is a Concussion?

Although concussions have been researched for the past two-three hundred years, and more heavily in recent years, surprisingly there is no universally accepted definition of concussion. Although there are many similar definitions that have been used in attempts to accurately describe a concussion, one that has been recently reviewed and revised in early 2009 is provided by the Third International Consensus on concussions. This definition states that “concussion is a complex pathophysiological process affecting the brain, induced by traumatic biomechanical forces”.¹ There are several common features that can be used to define the nature of a concussions such as: 1) concussions can be caused by a direct blow to the head, face, neck, or elsewhere on the body with an ‘impulsive’ force transmitted to the head; 2) concussions typically result in a rapid onset of short-lived impairment of neurologic function that resolves spontaneously; 3) concussions may result in neuropathological changes, but the signs and

symptoms largely reflect a functional disturbance rather than a structural injury; 4) concussions result in a graded set of symptoms that may or may not involve loss of consciousness; and 5) no abnormality on standard structural neuroimaging studies is seen in concussion.¹

The following are examples of other accepted definitions of concussions:

- A concussion is an acute alteration in mental status that may or may not involve the loss of consciousness after the traumatic event.²
- A concussion is any trauma induced alteration in mental status that may or may not include a loss of consciousness.³
- A concussion can be caused by a direct blow to the head or elsewhere on the body with an ‘impulsive’ force transmitted to the head.⁴
- Concussions are “conditions of temporarily altered mental status as a result of head trauma”.⁵
- ‘Any transient neurologic dysfunction resulting from a biomechanical force’.⁶

Definitions that state that concussions can occur with or without loss of consciousness such as the American Academy of Neurology (AAN) definition above, confront common misconceptions that concussions are only present if there is a loss of consciousness. Valovich found that 42.3% of coaches endorse this misconception.⁷

What are signs and symptoms of a concussion?

As shown in the previous definitions, it is difficult to define a concussion without also listing the signs and symptoms associated with them. Some of the most common signs and symptoms reported are headache, blurred vision and dizziness.^{8,9} Maddocks reports that 93% of athletes with a concussion were found to report a headache and 75% reported blurred vision.⁹

Kaut found that 30% of athletes sustaining a concussion reported dizziness and 28.9% reported visual effects.¹⁰

Although these are the most commonly reported, they are far from being the only signs and symptoms existing for concussion. Other signs and symptoms indicative of a concussion are loss of consciousness, retrograde/anterograde amnesia, confusion, trouble concentrating, ringing in the ears, feeling in a 'fog', nausea, vomiting, sensitivity to light or sounds, balance disturbance, etc.^{8, 11, 12}

A common belief about concussions is that loss of consciousness must be present in order for a concussion to be sustained by the athlete. Recent literature has reinforced that this belief is false and that concussions can exist without loss of consciousness.¹³ Post Concussion Symptoms (PCS; i.e. headache, confusion, dizziness, etc.) have been found to be more important indicators of the presence or severity of a concussion rather than loss of consciousness.^{4, 14, 15} Specifically, Post Traumatic Amnesia (PTA) is thought to be a better indicator of severity of concussion than loss of consciousness.^{16, 17} In further support that loss of consciousness plays less of a role in the diagnosis of concussion, research has revealed that LOC is present in less than 15% of all reported concussions.^{7, 11, 13, 18}

Athletes with a concussion, on average, tend to be asymptomatic within seven days of the initial injury.¹⁸ Cognitive impairments resolve within five to seven days and balance related problems tend to take about three to five days to resolve.¹⁸ Another factor effecting the duration of symptoms is the athlete's previous history of concussion. Guskiewicz found that 30% of athletes who have a previous history of three or more concussions will have symptoms that last longer than seven days as opposed to the 7% of athletes who have no history of previous concussion and symptoms lasted longer than seven days.¹⁹

What Causes a Concussion?

When an athlete is struck in the head, there is a physiological process that takes place within the brain. In this neurometabolic cascade of events, neurotransmitters (Glutamate) and ions (Potassium and Calcium) are released upon impact when the head receives a substantial hit. The Sodium and Potassium pumps in the brain have to work overtime in order to get the Potassium and Calcium back to their pre-concussed homeostatic levels. When these pumps begin working at such magnitudes they increase their demand for energy (ATP). To make ATP for these pumps to use, glucose is needed from the blood. This increased demand for glucose occurs when there is a decrease in cerebral blood flow. The reason for about a 50% deficit in cerebral blood flow is not fully understood. These increased demands of ATP made by the brain cause an energy crisis. While the brain is in such a state, it has an increased vulnerability and is therefore potentially less able to react to a second injury. Hits sustained while the brain is in this state of vulnerability lead to longer lasting deficits and possibly to Second Impact Syndrome (SIS). At about ten days, post-injury, cerebral blood flow returns to homeostatic levels and the brain is theoretically no longer be in this vulnerable state. ⁶

By understanding the physiological process of concussions, it is feasible to predict what biomechanical forces cause them and, thus, medical professionals can then implement strategies by which to prevent them.²⁰ A couple of biomechanical causes of concussions that have been recognized are poor technique and the location of the hit.^{21, 22} Poor technique such as spearing puts the athlete at a higher risk of concussion because the athlete is leading with the top of their head. Athletes are 6.5 times more likely to receive a concussion if they receive or give the blow with the top of the head as opposed to those athletes who use proper techniques within their sport.²¹ Another location that appears to result in higher rates of concussions is a blow to the

back of the head. Pellman (2003) found that less force is needed to cause a concussion through a hit to the back of the head as it does elsewhere on the head.²² Even though it is nearly impossible to prevent an athlete hitting the ground with the back of their head when tackled, it is still important for the medical professional to know this information so that they can be aware that a seemingly non-concussive blow, either given or received, can cause a concussion. It is more feasible, however, to prevent athletes sustaining concussions received from hits to the top of the head. This can be done through proper education of the technique of tackling, reiterating the importance of not dropping the head during tackles, and reinforcement of current rules.

How are concussions diagnosed?

Diagnosis and management of mild concussions has proven to be challenging for medical professionals. Some of the methods used in the diagnosis of concussions are both functional testing tools and imaging techniques. Functional tests such as the Standardized Assessment of Concussion (SAC) test and the Balance Error Scoring System (BESS) test are used for both baseline and post-injury measurements. A series of questions by which to assess the athlete's neurocognitive integrity can also be asked on the sideline to assist in the diagnosis of concussion.⁹ Despite their inability to accurately diagnose a concussion imaging techniques such as Computed Tomography (CT) scans and Magnetic Resonance Imaging (MRI) tests are used to assess post-injury trauma to the brain to rule out more severe trauma to the brain such as subdural hematomas.⁴

Due to the fact that athletes experiencing mild concussions tend to have difficulties with cognitive deficits a test was needed by which to measure these deficits. The SAC test is designed to objectively measure neurocognitive impairment in areas such as orientation, immediate memory, concentration, and delayed recall.²³ The SAC test consists of four domains; orientation,

immediate memory, concentration, and delayed recall. The athlete's score is out of a possible thirty points.²³ Concussed athletes have shown to score an average of 3.5 points lower on the SAC test as compared to their pre-season baseline score.²³ However, in a more recent study conducted by McCrea, he found that the SAC test was only useful for the first two days post-injury.¹³ The basis for this statement is due to the fact that after the first two days from the initial concussion, the athletes are scoring higher on the test when compared to their pre-season baseline scores. This trend indicates a 'practice effect'. This is when the athletes are learning the test and thus it is no longer accurate in identifying the severity or duration of the concussion.¹³ A survey found that athletic trainers feel the SAC test is a simple test to learn to administer and it is useful in the diagnosis of concussion as well as helpful in making return to play decisions.²³

Another often used tool on the sideline is the Balance Error Scoring System (BESS) test. The BESS test is an alternative to expensive equipment used in testing the postural stability of an athlete who has sustained a concussion. The BESS test assesses postural stability by requiring the athlete to complete a series of balance tasks standing on both a firm surface and a foam surface. The athlete is scored based upon the number of errors the athlete commits during the tasks. The tasks consist of standing in a double-leg stance, single-leg stance, and tandem stance on, first, a firm surface for twenty seconds each, and then followed by performing these tasks on a foam surface for twenty seconds each. The athlete is to complete all six of these tasks with their eyes closed and their hands on their hips. A point is added for errors such as lifting hands off the hips, opening the eyes, moving into more than thirty degrees of flexion or abduction, stepping or stumbling, and remaining out of the testing position for more than five seconds. A lower error score is optimal and represents a greater postural stability. The BESS test has been shown to be an adequate test in the assessment of postural stability when more expensive balance

testing equipment is not available.²⁴ Both the SAC and BESS tests are endorsed by the National Athletic Trainers Association (NATA) and the Third International Consensus Statement.^{1,40}

Post-traumatic amnesia (PTA) and Post-concussion symptoms (PCS) have been shown to be important indicators of concussion and therefore questions by which to assess these symptoms are beneficial in the diagnosis of concussion.^{4,17} When assessing PTA, questions checking the athlete's memory are used to assess the athlete's orientation. Athletes with a concussion scored significantly lower in memory and delayed recall, thus indicating the need to assess this cognitive function following trauma to the head.²³ The Maddock's questions have proven to be more sensitive than the standard orientation questions such as the date, year, date of birth, name, age, etc. The Maddock's questions refer to recently acquired events such as what quarter is it, how far into the quarter are we, who scored last, who did we play last week, did we win last week, etc.⁹ When assessing PCS, not only are signs and symptoms acquired from the athlete, but testing and/or questions assessing possible cognitive impairments are asked. It is suggested that math problems be asked of the athlete due to the fact that math processing was found to be significantly difficult for athletes who had sustained substantial impacts to the head.²⁵ Nearly 30% of athletes experienced visual effects and visual tasks were also found to be difficult for athletes sustaining a concussion.¹⁰ Chen suggests that when testing the athletes, we challenge the athletes visually in addition to the traditional verbal questions.⁴

Imaging techniques that are used to assess concussions include CT scans and MRI's. These techniques generally assess the structure of the brain and tend to rule out more severe brain injuries. These imaging techniques tend to present normal readings indicating no brain damage has occurred with a concussion.¹⁴ This is because MRI's and CT scans pick up structural damage and when dealing with most concussions the damage done is metabolic rather than

structural.²⁶ MRI's and CT scans, therefore, have proven to be ineffective when used to assess concussions seeing as these tests reported positive results of concussion in only 9% of subjects who were diagnosed with concussions.¹⁴ In efforts to find an imaging technique that would detect injury to the brain caused by concussions, a study was conducted using functional MRI (fMRI). This study required the subjects to perform visual and verbal tasks while the MRI was conducted. This study found that fMRI is a promising imaging technique for evaluating clinical outcomes especially when post concussion symptoms persist and other imaging results are normal.⁴ So, while current imaging techniques appear to miss concussive brain injuries, there is potential for fMRI to be used in this assessment in the future.

Prevention:

With 1.6-3.8 million concussions occurring annually it is imperative that we try and find methods by which to prevent these mild traumatic brain injuries.²⁷ Although not all concussions can be prevented, adequately assessing and managing the ones that happen to occur can reduce the chance of further injury to the athlete both immediately and long term.²⁸ Gessel states that by understanding the biomechanical causes of concussions, it is possible for medical professionals to implement strategies by which to prevent them.²⁰

Methods that can possibly decrease the occurrence of concussions, both initial and repeat concussions, would be to have the athletes implement correct techniques, getting the athletes to report their concussions to their athletic trainer or medical professional on site, and to educate coaches. Other methods by which to intervene would be through educational programs, better equipment, and also through enforcing game rules as well as possible policy changes.²⁰

Due to the fact that poor tackling technique, such as spearing, leads to increased risk of concussion,^{21,22} it is important that the athletes are using correct and legal techniques. One of the

possible reasons responsible for this lack of good technique is because the athletes' are not being given instruction on how to tackle properly.²⁸ Altering teaching techniques has been suggested as a means by which to reduce concussions, thus educating coaches on the consequences of improper tackling would potentially assist in reducing concussions due to poor technique.²⁸ This statement is supported by literature which theorizes that by getting coaches to cooperate and work with medical professionals, the number of concussions can potentially be reduced.²⁸

In attempts to obtain the goal of reducing concussion rates (second concussions which result from unreported initial concussions), getting the athletes to report their concussions when they occur is essential.²⁰ Current research shows that 5-8% of all reported injuries being reported are concussions.^{9, 11, 18, 20, 28} Due to the fact that a mild concussion is an injury that can potentially go undetected by medical professionals; the reporting of these brain injuries relies heavily upon the athletes to self-report them. Studies have found that athletes do not appear to recognize the signs and symptoms of concussion and this lack of knowledge directly effects the reporting of these injuries.^{12, 30} In a study conducted by Kaut, it was found that it is important to increase the athletes' awareness of the signs and symptoms of head injuries in order to prevent repeat concussions and further damage.¹⁰ This is because if an athlete does not realize what they are experiencing is a concussion, they obviously cannot report a concussion that they do not know they have.

Educating coaches has also shown to be an area in which increasing their knowledge about concussions could possibly increase the correct management and prevention of further injury.^{7, 30} Recent surveys have shown that 42% of coaches believe that a loss of consciousness is necessary in order for an athlete to sustain a concussion and 32% state that they did not believe a mild concussion required immediate removal from the game.⁷ Furthermore, 26% said that they

would allow an athlete to return to play while they are still reporting signs and symptoms of a concussion.⁷ Another study reports that 92% of coaches agree that a ‘bell ringer’ and a concussion are two different injuries, when in fact these are one and the same.³⁰ An additional key piece of information found is that coaches’ attitudes towards head injuries significantly affect the reporting of these head injuries.³⁰ Coaches who have had a previous coaching education course were more likely to recognize the signs and symptoms of a concussion. This information leads into the idea that educating coaches would increase the number of concussions reported to the athletic trainer or medical professional on site.^{7, 30} This also supports the notion that by educating coaches or other individuals involved in athletics, there will be fewer athletes participating in sports while still symptomatic and thus decreasing the chances of a second and potentially worse injury.⁷

Under-Reporting of Concussions:

Current issues in regards to concussions are the under-reporting of concussions and the unfortunate event of Second Impact Syndrome. Under-reporting refers to the number of concussions that are occurring and yet are not brought to the attention of the athletic trainer or other medical personnel available. Although current rates of reported concussions are between 5-8%, other studies have shown that this number is low and that concussions have been found to be anywhere from 15-55% of all injuries reported.^{8, 31} Of the athletes who sustained a concussion only 24% of them even realized that the symptoms they are experiencing are the result of a concussion.³¹ One study found that 80% of participants did not report their concussions to a medical professional.³⁰ However more often reported numbers of unreported concussions range from 18% - 50%.^{8, 10, 31, 32}

McCrea conducted a study in 2004 which investigated the frequency of unreported concussions of high school football players (n=1,532) and also reasons athletes did not report their concussions.³¹ This study investigated these areas in order to more accurately understand the prevalence of concussions in high school football players and to make recommendations for injury prevention strategies.³¹ The subjects completed a questionnaire pertaining to history and frequency of previous history of concussion prior to the football season. At the conclusion of the season the subjects completed a questionnaire which reported the number of concussions before the season and the subjects were asked if they had sustained a concussion during participation in the current football season. McCrea's findings from this study presented fairly alarming data. Of the 1,532 subjects who participated in the study, 229 (15.3%) reported sustaining a concussion, as defined by the post season questionnaire, during the current season.³¹ What is alarming is that of the 15.3% who sustained a concussion, only 47.3% reported this injury.³¹ Therefore, this study reports that 52.7% of concussions went unreported. This is of concern not only because over 50% of concussions were unreported, but because these athletes continued to play while still exhibiting signs and symptoms of concussion.³¹ The main reason athletes gave for not reporting their concussion was that they did not think it was serious enough (66.4%).³¹ Other reasons given for not reporting were that the athletes did not want to leave the game (41%), did not know they had a concussion (36.1%), and they didn't want to let teammates down (22.1%).³¹ McCrea states that it is important to increase the reporting of concussion symptoms because athletes who do not report them and continue to participate in sports are at an increased risk for catastrophic events associated with a second concussion such as Second Impact Syndrome (SIS). Because most cases of SIS occur from the initial concussion being unreported or poorly managed, McCrea

concludes from this study that for health care professionals to diagnose a concussion, and thus potentially prevent SIS, it is vital that athletes be willing to report symptoms of concussions.³¹

A retrospective study conducted by Kaut in 2003 aimed to identify the prevalence of concussions in collegiate athletes, evaluate athletes' willingness to report symptoms, assess athletes' general knowledge of concussions, and lastly to review potential differences between gender and the reported incidence of concussions. The study reviewed 461 athletes during a 6 year period. Athletes were given a questionnaire during a medical screening program prior to participation in sports. The results found that over 30% of athletes surveyed reported feeling dizzy following a blow to the head. Of this 30%, 28.2% reported that they continued to play despite experiencing this symptom. Also, of all athletes surveyed, 18.7% did not report this symptom to their coach or athletic trainer. However, the unreported symptom of dizziness was higher (25.2%) for football athletes. Headache was another symptom that followed a blow to the head that went unreported (30.4 % of all athletes surveyed and 61.2% being football athletes). Also, nearly 20% of athletes reported having a previous history of concussion and 8% reported loss of consciousness.¹⁰ This study suggests that athletes may not be reporting symptoms of a concussion because of not wanting to be removed from play and also because they may not know they've sustained a concussion. Kaut concludes from this study that athletes need to be educated on concussion symptoms so that they can be aware of them and therefore know to report them.¹⁰

In efforts to increase the athletes' educational awareness, it is imperative to impress upon them the importance of communicating their signs and symptoms to a medical professional or at least to a coach.¹⁰ Increased awareness about concussions, their symptoms, and effects has been brought about through the use of educational tools such as the 'Heads up' packet.²⁰ In educating

the coaches, parents, and athletes it is important to urge them to report any signs and symptoms of concussion to the athletic trainer or to a medical professional who is available.²⁸

Contrary to the stereotypical reason of not wanting to be withheld from competition, it was found that athletes are not reporting their concussions more so because they do not think the injury is serious enough to warrant medical attention.^{30,31} Sefton found that this particular reason was voiced by 73% of athletes.³⁰ Kaut reports that over half of the athletes surveyed did not understand the potential problems that could be associated with concussions.¹⁰ These startling numbers indicate the need to educate athletes on the potential consequences of concussion both immediate and long term.^{30,31} Some examples of long-term deficits that athletes need to be aware of are depression, Mild Cognitive Impairment (MCI) and memory problems. Athletes who have a history of three or more concussions are three times more likely to be diagnosed with depression and they are also at the highest risk of being diagnosed with MCI and memory deficits later in life.^{33,34} A more immediate concern with unreported concussions is the occurrence of Second Impact Syndrome (SIS).

Jaquan Waller, a 16 year old, high school football player was at practice and suffered a hit that was reported as being severe enough to get him sent home from practice. When his mother arrived to pick him up from practice, Jaquan needed assistance getting into the car. Later that evening, Jaquan reported a headache and feeling 'woozy'. The high school did not have a Certified Athletic Trainer and he was checked by an 'injury management specialist' who was an assistant teacher certified in CPR and first aid. Two days later, Jaquan was permitted to play in a game, and shortly after being tackled, he collapsed on the field. By the next morning, September 20, 2008, Jaquan Waller was declared brain-dead and removed from life support.³⁵

The fatal accident responsible for the life of Jaquan Waller is known as SIS. SIS occurs when an athlete who is still exhibiting signs and symptoms from a previous concussion sustains a second, seemingly minor, hit shortly after the first.^{5, 26, 31, 36} This second hit results in a rapid increase in intracranial pressure, causing brain herniation leading to a loss of autoregulation resulting in both respiratory and brain failure to occur within 2-5 minutes of the second impact.^{16,22,23,26,36} Proctor gives a thorough description of the sequence of events following the second impact:

The athlete with SIS typically appears stunned but remains conscious for a few seconds or minutes and is sometimes able to walk to the sideline before collapsing. The athlete then becomes semiconscious with rapidly dilating pupils, fixed eye movements, and experiences respiratory and brainstem failure, usually within two to five minutes of the second impact.³⁷

This sequence of events is also present in five of the six case studies of Second Impact Syndrome presented by Cantu.³⁶

During 1984 – 1991, seven years, four cases of SIS were documented. During 1992-1995, 4 years, there were seventeen cases of SIS documented.⁵ In a three year study involving only four states; it was found that 2.6 people in a 100,000 population who had sustained a sport related brain injury resulted in either hospitalization or fatality.⁵ The proportion attributed to SIS is unknown.⁵ Although the highest rates of SIS are most prevalent in males who participate in football, boxing, ice hockey and snowboarding, logic tells us that SIS can occur in any sport in which there is a chance that the head will be hit.^{5, 36}

Education is vital in the effort of preventing the occurrence of Second Impact Syndrome.³⁶ Educating coaches, parents, and athletes about the signs and symptoms of a concussion and the importance of reporting the initial concussion is the best chance for the prevention of SIS. McCrea states that most of the instances of diagnosed SIS were the resultant

of the unreported initial concussion, thus again emphasizing the need for increasing the athletes' willingness to report their initial concussion.³¹

Currently there are Certified Athletic Trainers at only 42% of high schools in the United States.³⁸ A study conducted by McCrea presented data that suggests that 75% of those athletes who reported their concussion, reported it to their Certified Athletic Trainer (ATC).³¹ This information indicates that another important factor of preventing SIS is having an ATC employed at all high schools. ATC's are educated in the signs and symptoms of concussions and qualified to assess and manage them. Jaquan Waller's signs and symptoms of his initial concussion were apparent, especially in the fact that he had to be sent home from practice and needed assistance getting into the vehicle. Had an athletic trainer been employed at his high school, and his concussion was appropriately treated, he would potentially still be alive and playing football today.

Conclusion:

A concussion is a complex pathophysiological process affecting the brain, induced by traumatic biomechanical forces.² Signs and symptoms commonly associated and reported with concussions are headache, blurred vision, dizziness, nausea, balance problems, LOC, difficulty remembering, or difficulty concentrating.^{8, 9, 40}

Currently, 1.6 - 3.8 million concussions occur annually in the United States.²⁷ With this number of concussions occurring it is imperative that we try and find methods by which to prevent these mild traumatic brain injuries.²¹ Results of damage done to the brain from repeated concussions could include long-term cognitive impairments affecting an individual's intellectual capacity and memory. This damage could unfortunately also be death or severe disability. The most common numbers of reported concussions are around 5 - 8% of all reported injuries.^{9, 11, 18,}

^{20, 28, 29} Although these numbers are the most commonly reported, current research has shows that concussions could be anywhere from 15-70% of all reported injuries in a given season.^{12, 31}

Under reporting of concussions is a problem that is being found to be more and more prevalent with rates from of 18.7% to 52.7%.^{10, 31} Because concussions are difficult to detect without the apparent symptoms of balance abnormalities, loss of consciousness (LOC), and disorientation it is difficult for the medical professional on site to know that a concussion has occurred unless reported by the athlete. This indicates the need for increasing athletes' willingness to report their concussions. Many athletes are continuing to play in sports while having sustained a concussion and thus increasing their risk for Second Impact Syndrome (SIS).

SIS occurs when an athlete incurs a second concussion while still symptomatic from an earlier concussion.^{41, 42} This often times takes place because the initial concussion went unreported or the initial concussion was poorly managed.³¹ One of the most common responses given by athletes for why they do not report their concussions is that they do not feel that the injury is severe enough to report it to their coach, athletic trainer or other medical personnel.^{30, 31} In order to reduce long term effects of concussion and to reduce chances of SIS, medical professionals need to find ways to increase the athletes' likelihood to report their concussions.^{30,}

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Concussions are serious brain injuries with the potential of being fatal if not properly assessed and managed. A comprehensive education program is an important tool for individuals who are involved in athletics. Perhaps then we can prevent millions of athletes from becoming potential Second Impact Syndrome victims like Jaquan Waller.

INTERPERSONAL RELATIONSHIPS

Relationships are not only prevalent but they are also essential in every aspect of life. The saying ‘no man is an island’ attests to the social character of the human nature to need and have relationships with groups and individuals.⁴³ Some examples of where these relationships exist in life are in school (teacher/student), work (boss/employee), healthcare (doctor/patient), home (parent/child) and in sports (coach/athlete). General relationship research has been thoroughly covered in the past 20 years and research within the context of sport is increasing as well.⁴³ Having a positive, working relationship is important not only for the psychological well being of the individuals involved (i.e. doctor/patient, coach/athlete, etc.) but also for success in the setting that the relationship is within (i.e. healthcare, sports, etc).⁴³

When addressing the aforementioned issue of the under reporting of concussions in sport, it has been suggested to educate the athletes on the recognition and potential severity of concussions, to educate the coaches on the importance of teaching proper technique, and also to implement adequate fitting and updated equipment.^{20,31} McCrea also states that in addition to educating the athletes, there is also a need to promote open lines of communication for injury reporting.³¹ In addressing McCrea’s suggestion regarding promoting open lines of communication, the relationship between the athletic trainer (AT) and the athlete is examined. The Self Determination Theory (SDT) states that humans have three innate needs; the need for competence, autonomy support and relatedness.⁴⁴ Relatedness is defined as the extent to which the individual feels that they are connected to others in a warm, positive, interpersonal manner (i.e. being ‘close’ to others).⁴⁴ Therefore, the potential idea is presented that the ‘closeness’ of the relationship between the AT and the athlete may have an effect on the athletes’ willingness to report a concussion due to ‘closeness’ being an innate need.⁴⁴

Current research on the relationship between the AT and the athlete is limited, but what research does exist suggests a few things. The Role Delineation Study conducted by the NATA found that injury prevention, evaluation, and rehabilitation in addition to administrative duties, and professional development were fundamental responsibilities of the AT.⁴⁶ While these responsibilities are indeed essential, the AT must also maintain a quality relationship with the athlete in order to facilitate the process of these responsibilities.⁴⁷ The importance of this relationship has been found to be fundamentally important when providing care to athletes and furthermore, most ATs agree that developing a strong rapport with their athletes is important.⁴⁷

One study conducted by Unruh in 1998 examined the AT-athlete relationship in regards to the athlete's perception of satisfaction of care.⁴⁷ His study found that athletes who perceive their AT as willing to listen to them and are interested in their concerns may demonstrate higher levels of satisfaction.⁴⁷ In continuing this idea, athletes who are more satisfied with their healthcare tend to have an increased trust with their AT.⁴⁸ It has been suggested that in efforts to increase athletes' satisfaction of care provided by their AT, the AT should improve their own listening and communication skills.⁴⁸ In a second study in 2005 Unruh found that higher profile athletes in Division I and II schools had higher satisfaction rates with their AT. Vice versa, lower profile athletes in Division I and II schools had lower satisfaction rates with their AT.⁴⁸ These findings suggest that athletes generally perceive ATs to give more attention to higher profile athletes thus leaving the lower profile athletes less satisfied with their AT. Due to the limited research on this relationship, both the doctor-patient and the coach-athlete relationship were explored to determine a relationship by which to use as a comparison when examining the AT-athlete relationship.

When looking closer at the doctor-patient relationship it is stated that effective treatment relies on the disclosure of relevant information from the patient (as similar in the AT/athlete relationship as well).⁴⁹ It was found that disclosure of information was dependent upon compassion, trust, respect, and directed questioning from the physician (i.e. questions with psychological focus or clarifying patient responses about psychological aspects).^{49,50,51} In research conducted by Sankar, it was found that patients were not disclosing information because they did not feel that the problem was worth telling the physician.⁴⁹ These findings are the same as in other health care professions (athletic training) as suggested by McCrea.³¹ It was also found that patients did not disclose information because they did not understand why the questions they were being asked were relevant and thus, because they did not see the relevance of the questions, they did not feel the need to disclose the information.⁴⁹ Sankar suggests that physicians explain the importance of the questions and why they're relevant to the patient's healthcare in order to increase disclosure.⁴⁹ Trust and disclosure can be disrupted by communication problems (i.e. interrupting the patient), and therefore, it is suggested that physicians undergo communication training to better these skills and to incorporate them into their patient care.^{52,53}

Dr. Wissow conducted a study looking at how longitudinal care (care over time) affects patients disclosing psychosocial information to their physicians.⁵³ Prior to this study, longitudinal care was believed to promote trust and Dr. Wissow had similar findings and also added that longitudinal care, along with patient-centered care, improves communication.^{53,54} Patient-centeredness consists of three major components: interpersonal sensitivity, partnership, and medical information giving. The components of 'interpersonal sensitivity' and 'partnership' were highly correlated ($r=0.64$, 0.66 respectively) with psychosocial information giving (injury/symptom reporting) from the patient. Dr. Wissow's conclusion that longitudinal care and

patient-centeredness are important for disclosure, leads us to review the coach-athlete relationship as it is more longitudinal in nature.

Examining the coach-athlete relationship, Jowett states that closeness is reflected in mutual feelings of trust and respect and that closeness has been found to characterize the effectiveness of the coach-athlete relationship.⁴³ This information is evident in the findings that a closer relationship between the coach and athlete has been found to have better and more effective results such as an increase in the athlete's ability and willingness to trust their coaches. In addition to increased trust, athletes who have closer relationships with their coaches have also been found to have an increase in exchanging and disclosing information to their coaches.^{43, 45}

After reviewing both the doctor-patient and the coach-athlete relationship, the investigator determined that the coach-athlete relationship will be used rather than doctor-patient relationship because the investigator perceives the coach-athlete relationship to be more appropriate when comparing to the AT-athlete relationship. Although both relationships suggest that closeness and increased levels of trust will increase the patient's/athlete's willingness to disclose information,^{43,45,49-51} the coach-athlete relationship is developed through daily interactions over a season or several seasons just as the AT-athlete relationship, whereas a doctor or nurse may know his/her patient for a much shorter period of time. Due primarily to this observation, the coach-athlete relationship is chosen as a closer comparison to the AT-athlete relationship for this study as opposed to the doctor-patient.

In efforts to find a way by which to increase the athlete's willingness to report signs and symptoms of a concussion to their AT, the idea was presented that we look at the closeness of the relationship between the AT and the athlete. In using the coach-athlete relationship as a comparison to the AT-athlete relationship we begin to see potential connections to assist with

increasing willingness to report. Information presented throughout research in regards to the AT-athlete relationship suggests that increasing the athlete's satisfaction may increase their trust in their AT.⁴⁸ Information presented in regards to the coach-athlete relationship suggests that a closer relationship (increased levels of trust) may increase the athlete's willingness to disclose information.^{43, 45} If we combine this information we can potentially make the theoretical leap that in creating a closer relationship between the AT and the athlete, we may be able to increase the athlete's willingness to report their signs and symptoms of concussion to their AT.

AUTONOMY SUPPORT

Autonomy support is described as support given by the health care provider which allows the individual to feel volitional and responsible for the initiation of their behavior.⁴⁵ The amount of autonomy support given by the healthcare provider has been found to play a role in the patient's behavior in regards to their health and well being.⁴⁵ Therefore, in addition to creating a closer and more personal relationship, the amount of autonomy support given by the healthcare provider was also examined to see how it could contribute to potentially increasing the athlete's willingness to report a concussion. Before we delve into autonomy support, we need to first understand its foundation and thus need to explore the Self Determination Theory.

The Self Determination Theory (SDT) proposes that humans have three innate psychological needs: autonomy, competence, and relatedness to others.⁴⁵ Autonomy is described as the degree to which the individual feels volitional and responsible for the initiation of their behavior. Competence is the degree to which they feel that they are able to achieve their goals and desired outcomes. Relatedness is defined as the extent to which they feel that they are connected to others in a warm, positive, interpersonal manner.⁴⁵ The theory holds that support for these needs by the social environment will enhance the individuals mental and physical

health.⁴⁵ When an individual is more autonomous, they have a full sense of free will and choice because the activity is interesting or personally important as opposed to being controlled where they feel pressured or coerced into the act.⁴⁵ For example, someone who stops smoking and perceives this act as being freely chosen as opposed to being pressured by some force is experiencing being autonomous rather than being controlled.

Often times, when discussing autonomy in patients, autonomy is confused with independence. Even though they may seem similar, patient autonomy is not patient independence. Being autonomous is described as feeling volitional or willing to engage in a behavior, whereas being independent is described as acting without reference to or support from another person.^{55,56} Patients seldom want to make decisions to change their behavior without the advice or support from their physicians.⁴⁵ Patients therefore do not want to act independently, but rather they want to experience a full sense of volition when making a decision about a certain behavior or treatment.⁴⁵ From the providers point of view, giving autonomy support to a patient does not mean that you are leaving the patient to decide things on their own. Rather, you are supplying them with advice and support as needed to allow them to make an informed choice or decision.⁴⁵

The SDT states that people become autonomous through the process of internalization. Internalization is when the individual converts external regulatory processes into internal regulatory processes.⁵⁷ In this process of internalization, the patient takes the external regulations that initially are the urgings of the provider and integrates them as their own (internal regulations). Because the urgings of the provider have been integrated into the patient's sense of self, they will be autonomous in carrying out their behavior and thus will feel volition in their

behavior and more positive outcomes, such as maintaining this behavior, can be expected (i.e. such as potentially reporting signs and symptoms of a concussion to their AT).⁴⁵

It has been found that interpersonal environments that support the patient's needs for autonomy, competence, and relatedness are predicted to facilitate greater internalization, resulting in more behavior change and its maintenance, which in turn will lead to improved health outcomes.⁴⁵ When administering autonomy support the provider needs to take into account the perspectives of the patients and provide the following care: relevant information and opportunities for choice, encourage the patients to accept more responsibility for their health behaviors, interact more meaningfully with the patients by asking what the patient wants to achieve, listening and encouraging questions, providing understandable and satisfying replies to their questions, and lastly, not judging the patient when they are giving their opinions and histories of past behaviors.⁴⁵ A provider who is giving autonomy support should focus on minimizing the use of pressure and control.⁴⁵ A study by Deci found that there were three main elements in facilitating autonomous behavior. 1) provided a meaningful rationale for why a behavior is being recommended so that individuals will understand the importance of the activity for themselves, 2) acknowledging patients feelings and perspectives so they will feel understood, and 3) using an interpersonal style that emphasizes choice and minimizes control so the patients won't feel pressured to behave.⁵⁸

Autonomy support has been used in healthcare in several areas such as in weight loss, glucose control, and in smoking cessation programs.⁵⁹⁻⁶¹ In the glucose control study conducted by Williams, it was found that patients of healthcare providers who provided more autonomy support were able to maintain a healthy diet and exercise more regularly resulting in lower glucose levels.⁶⁰ Providers who were autonomy supportive in this study tended to promote more

positive health outcomes in their patients which enabled the patients to become more autonomously motivated and to feel more competent.⁶⁰ In reviewing these studies, The SDT handbook states that because being autonomy supportive involves taking the patient's perspective, it will also allow for understanding the reasons why patients engage in unhealthy behaviors as well as why they don't engage in healthy ones.⁴⁵

In conclusion, the more autonomy support an individual receives, the more likely they are to integrate autonomous behavior; a full sense of choice about a decision within their healthcare rather than having a decision forced upon them in regards to their healthcare.⁵⁹ An individual exhibiting autonomous behavior is more likely to care about their health and well-being and therefore adhere to behavior changes (e.g., reporting signs and symptoms).^{45,59} When transferring this research to the AT-athlete relationship, we see that there is substantial research to back the idea that autonomy support is a relevant area to explore when searching for ways to potentially increase the athletes willingness to report. The findings suggest that in giving autonomy support, and therefore helping the athlete to integrate autonomous behavior, the athlete will be more likely to have and maintain health related behavior changes.⁵⁹ In short, the more autonomy support provided by the AT, the more likely the athlete will care about their health and make behavior changes and thus potentially be more willing to report their concussions to their AT.⁴⁵

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Chapter 3: Results:

DESCRIPTIVE STATISTICS

Of the original 119 subjects, 11 were removed as outliers. Outliers were determined as being individuals whose scores fell two standard deviations outside of the mean. Of the remaining 108 subjects, 25 subjects (23.4%) self-reported a previous history of concussion; 6 high school subjects (13.0%) and 19 college subjects (31.1%). (Table 1) All subjects successfully complete all three questionnaires; The Health Care Climate Questionnaire, the Need for Relatedness Scale, and the Willingness to Report Scale ($HCCQ_{total} \bar{x}=83.4 \pm 13.4$; $NRS-10_{total} \bar{x}=50.3 \pm 12.0$; and $WRS_{total} \bar{x}=98.6 \pm 19.3$). (Table 3). The mean HCCQ score for the present study was slightly elevated than a previous study (n=103) conducted by Williams who reported an HCCQ mean score of 66.5 ± 12.0 .¹ Normative data for the remaining two questionnaires was not available. The two subscales of the WRS had mean scores of $WRS_{conc} \bar{x}=50.8 \pm 10.8$ (concussion symptoms) and $WRS_{non-conc} \bar{x}=47.8 \pm 9.6$ (non-concussion symptoms).

CORRELATIONS

A Pearson's correlation test was performed to identify any significant relationships between athletes' willingness to report (WR) concussion symptoms and perceived closeness and autonomy support. This correlation analysis was run to determine if the variables chosen were related to WR before conducting a regression analysis to determine if the variables predicted WR. The correlation analysis was first reviewed for all subjects and then individually by group (high school and college). (Table 4).

All Subjects:

Overall (n=108), there was a small, but significant, positive correlation between NRS and WR ($r=0.24$, $p=0.007$) when all subjects were considered. There was a small, but significant, positive correlation between NRS and WR ($r=0.28$, $p=0.019$) for male athletes. Finally, there were small, but significant positive correlations between NRS and WR ($r=0.27$, $p=0.011$) for athletes with female AT's and between NRS and WR ($r=0.23$, $p=0.020$) for athletes with no previous history of concussion. Although not significant, there was a trend towards a positive correlation between NRS and WR ($r=0.23$, $p=0.055$) for female athletes.

High School:

Overall (n = 47), there was a significant, moderate positive correlation between NRS and WR ($r=0.40$, $p=0.003$) of high school athletes surveyed. There were moderate, significant positive correlations between NRS and WR ($r=0.34$, $p=0.020$ and $r =0.44$, $p=0.016$ respectively) for both males and females and also between NRS and WR ($r=0.45$, $p=0.002$) for athletes with no history of previous concussion.

College:

Overall (n=61), there was a small, but significant positive correlation between HCCQ (autonomy support) and WR ($r=0.24$, $p=0.034$) of the collegiate athletes surveyed. There were no other significant correlations between measures within the college subjects.

PREDICTIONS FOR WILLINGNESS TO REPORT

All subjects:

Overall ($n = 108$), the regression analysis revealed that the model significantly predicted WR ($F_{(1,106)}=6.358$, $p=0.013$) with an R^2 of 0.057 (5.7% of the variance of WR explained). However, the only independent variable that was included in the model and significantly predicted WR was NRS ($t=2.521$, $p=0.013$, $\beta=0.238$).

The regression analysis also revealed that the model significantly predicted WR for subjects who had a female athletic trainer ($F_{(1,70)}=5.458$, $p=0.022$) with an R^2 of 0.072 (7.2% of the variance of WR explained). Again, the only independent variable that was included in the model and significantly predicted WR for subjects with female AT's was NRS ($t=2.336$, $p=0.022$, $\beta=0.269$). No other analysis demonstrated significant predictions for demographic variables.

High School:

When considering data from the high school athletes, ($n=47$), the regression analysis revealed that the model significantly predicted WR ($F_{(1,45)}=8.436$, $p=0.006$) with an R^2 of 0.158 (15.8% of the variance of WR explained). The only independent variable that was included in the model and significantly predicted WR was NRS ($t=2.905$, $p=0.006$, $\beta=0.397$).

When analyzing data from subjects who had no previous history of concussion, the regression analysis revealed that the model significantly predicted WR ($F_{(1,38)}=9.375$, $p=0.004$) with an R^2 of 0.198 (explaining 19.8% of the variance of WR). The only independent variable

that was included in the model and significantly predicted WR for subjects with no previous history of concussion was NRS ($t=3.062$, $p=0.004$, $\beta=0.445$).

College:

The regression analysis with data from the collegiate athletes ($n=61$) revealed, that the model did not significantly predict WR in the college sample that was surveyed. In addition to not predicting overall WR in college subjects, the regression analysis revealed that the model also did not significantly predict WR when the sub-sample was split according to athlete gender, AT gender, and previous concussion history.

ANALYSIS OF WILLINGNESS TO REPORT SCALE (WRS) SCORES BETWEEN HIGH SCHOOL AND COLLEGE ATHLETES

A one-way ANOVA was performed to identify any significant differences in responses on the WRS between groups (i.e., high school and college).

$WRS_{\text{non-conc}}$ and WRS_{total} were not found to have significant between group differences. However, WRS_{conc} was found to have significant differences in responses between groups ($F_{(1,106)}=4.042$, $p=0.047$), with collegiate athletes reporting significantly more concussions symptoms ($\bar{x}=52.6 \pm 10.2$) than high school athletes ($\bar{x}=48.4 \pm 11.3$).

Chapter 4: Discussion

The purpose of this study was to investigate the role of perceived closeness and autonomy support in predicting athletes' willingness to report concussion signs and symptoms to their athletic trainer. The present study found that perceived closeness was the only variable that significantly predicted athletes' willingness to report (5.7% of the variability explained). While 5.7% may appear relatively small, when considering that it is one variable within a complex multivariate problem, we suggest it to be a meaningful contribution to explaining WR. When further analyses were conducted, it was discovered that perceived closeness was found to significantly predict WR only for high school athletes.

The primary finding of our study was that, of the two predictors chosen for the model, the level of the athletes' perceived closeness to their AT was the only variable that significantly predicted WR for high school athletes, and not for their collegiate counterparts. We look to John Bowlby's Attachment Theory² and Erik Erikson's Stages of Psychosocial Development³ to explain this need for closeness that was found in high school athletes. Attachment, a concept related to closeness, is defined as an affectionate bond between an individual and an attachment figure who is often times a caregiver.² The Attachment Theory proposes that prior to adolescence children are primarily attached to their parental figures and, upon adolescence, although children continue to be attached to their parents, individuals also tend to attach to their peers and other significant figures to help them define their identity.² Because ATs are both care givers and potentially viewed as peers by adolescent children, ATs qualify as being a potential attachment figures for high school aged children, especially for the sample of the present study who had a graduate student serving as their AT. Erikson indicates in his stages of psychosocial development that adolescents (ages 13-19) are attempting to establish their identity and discover their roles in

society.³ Additionally, Erikson suggests that although young adults (ages 20-34) are also looking to form relationships, the relationships being formed in this stage are more intimate in nature (i.e. love). Young adults are afraid of rejection and they isolate themselves to avoid the pain associated with rejection, especially if they are unsuccessful with developing the close bonds or a sense of identity in the previous stage (adolescents).³ Inferring from both Bowlby and Erikson, it appears as though adolescents require attachments with their peers (i.e., ATs) while they explore the outside world and form a sense of identity, whereas young adults almost avoid attachment in order to protect themselves from the pain associated with rejection.^{2,3} This information suggests that high school athletes (adolescents, ages 13-19) have a higher need for attachment to peers, such as ATs, (i.e. closeness) than collegiate athletes (young adults, ages 20-34) based on their natural developmental stage in life. Research from Bowlby and Erikson provide a potential explanation as to why the present study found that perceived closeness predicts WR for high school athletes and why perceived closeness had no predicting power for college athletes.

Aside from age differences, another potential explanation as to why perceived closeness was more prevalent in high school athletes as opposed to collegiate athletes is possibly due to the length of the AT-athlete relationship. The length of the AT-athlete relationship in the high school athletes studied was 1.5 years, whereas the length of the AT-athlete relationship in 41% of the collegiate athletes studied was 0.5 years (Table 1). Longer relationships have been found to promote trust and increases in communication and disclosure.⁴ Jowett states that, within the coach-athlete relationship, closeness is reflected in trust and that closer relationships increase the disclosure of information.^{5,6} Research thus suggests that perceived closeness was a more salient factor in the lives of high school athletes, serving as a significant predictor of WR whereas perceived closeness possibly did not predict WR for college athletes because it is not a salient

factor for these athletes who had a shorter term relationship with their ATs. Therefore, one explanation for the findings of greater perceived closeness in one group (high school athletes) as opposed to another (college athletes) is potentially based, in part, on the length of the relationship between the AT and the athlete. A limitation should be noted, however, that a one year difference was present in only 41% of AT relationships with college athletes.

In reference specifically to youth athletes, Timson and Jowett report communication that involves spontaneous conversation in regards to daily activities (school, practice, etc.) has shown to be the foundation for trust in the coach-athlete relationship.⁷ This finding is important to understand because research also states that closeness within a relationship is reflected in mutual feelings of trust.⁵ Athletes who have closer relationships with their coaches have been found to have an increase in exchanging and disclosing information to their coaches.^{5,6} Therefore, with trusting relationships developing (particularly in youth athletes) due to spontaneous conversation, closer relationships are formed and thus an increase in disclosure of information may be seen. Because the coach-athlete relationship is being used as a comparison to the AT-athlete relationship, this information may suggest that perceived closeness is related to higher disclosure (which may include willingness to report concussions) in high school athletes due to increased trust in their AT. This is supported by research which suggests that coaches, and likely ATs, who create opportunities for such conversations are more likely to develop trusting relationships with those athletes.⁷ Clinically, ATs can develop this trust with athletes by taking advantage of opportunities to hold spontaneous conversations about daily activities (i.e. school, sports, extra-curricular activities, etc.) and thus increasing the possibilities for disclosure, such as WR concussion symptoms.

Another central finding of the present study was that perceived closeness predicted WR for high school subjects who had no previous history of concussion. The current study also found that, in the high school setting, 87% of subjects had no history of previous concussion as compared to 69% of college subjects who had no history of previous concussion. Because research is not available to specifically address why perceived closeness predicted WR for those athletes with no previous history of concussion, we return to an earlier explanation. When previously addressing why perceived closeness predicted WR for high school subjects (adolescents, ages 13-19) and why it did not predict for college subjects (young adults, ages 20-34) it was suggested that high school subjects had an increased need for closeness.^{2,3} Because high school subjects have an increased need for closeness and also have a higher rate of no previous history of concussion, it is therefore suggested that age (the adolescent stage) could possibly explain why perceived closeness predicts WR for high school subjects with no previous history of concussion.

The results also revealed that perceived closeness significantly predicted WR for athletes who had female ATs. This finding that athletes were significantly reporting concussion symptoms to female ATs is supported by the findings of Wissow⁴ and Patrick.⁸ Wissow reports that patients who have female physicians communicate more overall, discuss more psychosocial information, and show more partnership building than patients who have male physicians.⁴ Additionally, Patrick reports that female physicians had more participatory visits with their patients than male physicians.⁸ Participatory visits with female physicians implied that that the patients engaged in partnership-building, question-asking, and information giving.⁸ Regardless of the patient/athlete's gender, research from Wissow and Patrick reinforce the findings of the current study that perceived closeness predicts disclosure (WR) to female ATs. Clinically, this

finding suggests that female athletic trainers should be aware that athletes are more willing to report concussion symptoms to them. It should be noted that the athletic trainer at the high school used in this study was also the primary investigator.

When the WRS was broken down and analyzed by willingness to report non-concussion symptoms ($WRS_{\text{non-conc}}$) and concussion symptoms (WRS_{conc}) there was a significant difference between groups for WRS_{conc} . Specifically, college subjects reported significantly more concussion symptoms than high school subjects. Although there is some debate as to which group (high school or college) is sustaining more concussions, a study by Guskiewicz reported that high school athletes have a higher rate of concussion.⁹ The findings reported by Guskiewicz is interesting in relation to the current study because he identified higher rates of concussion amongst high school athletes than college athletes, yet in the current study, collegiate subjects reported more concussion symptoms overall.⁹ In knowing that concussions are more prevalent in high school subjects, the findings of our study reinforce the need to increase reporting in high school athletes.⁹ Clinically, high school ATs should be aware that the rate of concussions is higher in high school athletes, yet they are reporting fewer concussion symptoms.

A surprising finding from our study was that autonomy support did not predict the athletes' willingness to report concussion symptoms. Autonomy support, in terms of the AT-athlete relationship, is the concept of allowing an athlete to be involved in the choices and decisions made in regards to his/her healthcare and, thus, encouraging the athlete to feel responsible for the initiation of their health care related behavior.¹⁰ Specifically, autonomy support has been shown to increase patients' feelings of responsibility for healthcare related behaviors in patients who already have a condition/illness (i.e., obesity or diabetes).^{1,11} Autonomy support was initially hypothesized to predict the athletes' WR because of the idea that

the athlete, if provided with autonomy support prior to the injury, would feel responsible for their well being and decide to report their concussion symptoms to their AT. Because autonomy support in healthcare populations deals more directly with the patients involvement in healthcare decision making,¹⁰ specifically after a condition/illness is present,^{1,11} it is suggested that future research not use autonomy support in predicting the willingness to report an injury/illness due to the condition (i.e., concussion) not yet existing. Rather, we suggest future research examine the influence of autonomy support in athletes' adhering to return to play decisions made by the AT following a concussion. It is suggested to ATs that although autonomy support did not predict WR concussion symptoms, it should still be considered for its potential ability to increase the athletes' compliance of return to play decisions.

This study was limited by a lack of randomization by both the primary investigator being the athletic trainer at the high school where the data was collected and there were a limited number of high school student-athletes available. Additionally, the subjects (specifically, 41% of college subjects) in this study were limited by the duration of the relationship between themselves (the athletes) and their AT (i.e. 0.5 years). Future investigations should further explore the AT-athlete relationships with longer durations in both high school and college environments. Finally, like all survey based research, we assumed the subjects answered questions honestly and not how they were 'supposed' to answer them. To overcome this limitation, although the consent/assent forms addressed confidentiality of the surveys, future research should also verbally remind the participants that their responses are completely confidential, coded, and will be reviewed only by the investigator. Other suggestions for future research might be to exclude sports that are at a lower risk of sustaining a concussion (i.e., golf, tennis, swimming, etc.) and to use different methods for data collection for high school athletes

(athletic meetings where all sports are present) vs college athletes (team meetings where all members of individual teams present).

Also, in previous research, NRS has been used successfully in the athletic setting whereas the HCCQ has been primarily used in the healthcare setting. Although the HCCQ is both an established and validated instrument in the healthcare setting, it is suggested that future researchers either find a better measure of autonomy support already in existence that is used in the athletic setting, or a better measure within the athletic setting needs to be developed. Lastly, future research should also consider exploring other means by which to increase reporting within college athletes such as personality (introverted/extroverted), parenting type (controlling/autonomy supportive), and athlete knowledge of concussion symptoms and effects of concussions. This area of future research is suggested because results from this study found that neither perceived closeness or autonomy support predicted WR for college athletes.

CONCLUSION

The results of this study indicate that perceived closeness significantly predicted high school athletes' willingness to report concussion symptoms to their AT. The clinical applications of this study would be to suggest that high school ATs attempt to develop closer relationships with their athletes in order to potentially increase their willingness to report concussion symptoms. Increasing the reporting of concussion symptoms may allow health care providers, specifically ATs, to potentially prevent athletes from participating in sports while still being symptomatic from a previous concussion. In doing so, athletic trainers may be able to potentially reduce life threatening injuries such as the unfortunate event of Second Impact Syndrome from occurring along with potentially preventing other long term effects associated with concussions.

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Appendix A

13. I don't feel very good about the way my athletic trainer talks to me.

1	2	3	4	5	6	7
strongly disagree			neutral			strongly agree

14. My athletic trainer tries to understand how I see things before suggesting a new way to do things.

1	2	3	4	5	6	7
strongly disagree			neutral			strongly agree

15. I feel able to share my feelings with my athletic trainer.

1	2	3	4	5	6	7
strongly disagree			neutral			strongly agree

Willingness to Report Scale

Please rate how likely you would be to report the following signs and symptoms as a result of an injury to your athletic trainer using the following scale:

EXAMPLE:

If I were experiencing _____, following an injury, I would tell my athletic trainer.

1 2 3 4 5 6 7
Strongly disagree *Neutral* *Strongly agree*

1. Swelling

1 2 3 4 5 6 7

2. Point Tenderness (an area that is tender to touch)

1 2 3 4 5 6 7

3. A headache

1 2 3 4 5 6 7

4. Numbness or tingling

1 2 3 4 5 6 7

5. Blurred Vision

1 2 3 4 5 6 7

6. Dizziness

1 2 3 4 5 6 7

7. Joint Pain

1 2 3 4 5 6 7

8. Loss of Consciousness/blacking out (had experienced)

1 2 3 4 5 6 7

9. Poor balance or coordination

1 2 3 4 5 6 7

10. Abdominal Pain

1 2 3 4 5 6 7

11. Mild aching/throbbing pain in my arms or legs

1 2 3 4 5 6 7

12. Memory Problems

1 2 3 4 5 6 7

13. Nausea (feeling sick to your stomach)

1 2 3 4 5 6 7

14. Fever

1 2 3 4 5 6 7

15. An obvious deformity (a body part doesn't look 'right' or isn't 'like it's supposed to be')

1 2 3 4 5 6 7

16. Ringing in my ears

1 2 3 4 5 6 7

17. A bruise

1 2 3 4 5 6 7

18. Seeing stars

1 2 3 4 5 6 7

19. Sensitivity to light (lights seem to be too bright or light 'hurts' your eyes)

1 2 3 4 5 6 7

20. Sharp severe pain in my arms or legs

1 2 3 4 5 6 7

The Need for Relatedness Scale (NRS-10)

Sylvie Richer & Robert J. Vallerand (1996).

Here is a list of statements about what you may feel towards your athletic trainer. Please indicate to what extent you agree with each of the following items.

Do not agree at all	Very Slightly agree	Slightly agree	Moderately agree	Agree	Strongly agree	Very Strongly agree
1	2	3	4	5	6	7

In my relationship with my athletic trainer, I feel ...

- | | | | | | | | |
|--------------------------|---|---|---|---|---|---|---|
| 1. ... supported. | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
| 2. ... close to them. | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
| 3. ... understood. | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
| 4. ... attached to them. | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
| 5. ... listened to. | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
| 6. ... bonded to them. | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
| 7. ... valued. | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
| 8. ... close-knit. | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
| 9. ... safe. | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
| 10. ... as a friend. | 1 | 2 | 3 | 4 | 5 | 6 | 7 |

Demographic Information

Circle your gender:

Male or Female

Age:

Circle your current year in school:

FR SO JR SR

Have you ever had a concussion before?

Yes No

Circle the following sports you play at your high school or university:

- Football
- Baseball
- Softball
- Cross Country
- Basketball
- Track and Field
- Wrestling
- Soccer
- Tennis
- Golf
- Cheerleading
- Volleyball
- Swimming

Appendix B

Table 1. Subject Information

	Number of subjects	Mean Age
Total	108 (100%)	18.0 ± 2.3
High School	47 (43.5%)	16.0 ± 1.2
College	61 (56.5%)	19.7 ± 1.3

	Athlete Gender		Missing Data
	Male	Female	
Total	56 (52.3%)	51 (47.7%)	1
High School	23 (48.9%)	24 (51.1%)	0
College	33 (55.0%)	27 (45.0%)	1

	AT Gender		Missing Data
	Male	Female	
Total	35 (32.7%)	72 (67.3%)	1
High School	0 (0%)	47 (100%)	0
College	35 (58.3%)	25 (41.7%)	1

	Previous History		Missing Data
	Yes	No	
Total	25 (23.4%)	82 (76.6%)	1
High School	6 (13.0%)	40 (87.0%)	1
College	19 (31.1%)	42 (68.9%)	0

	Length of AT-Athlete Relationship (in years)
High School	1.5 (100%)
College	
W. Basketball	4 (23.0%)
Football	1 (36.1%)
All other sports	0.5 (41.0%)

Table 1. All high school athletes used in this study had a female AT. Also, 23.4% of all subjects had a previous history of concussion.

Table 2. Subject information by Sport and Group

SPORT	Number of Subjects			HS		Coll		HS - Prev. Hx		Coll - Prev. Hx	
	Total	HS	Coll	M	F	M	F	Yes	No	Yes	No
Football	38	16	22	16	0	22	0	2	14	7	15
Baseball	16	11	5	11	0	5	0	2	9	1	4
Softball	13	11	2	0	11	0	2	1	9	2	0
Cross Country	8	8	0	5	3	0	0	0	8	0	0
Basketball	34	20	14	9	11	0	14	2	18	6	8
Track and Field	28	22	6	12	10	0	6	2	20	0	6
Wrestling	3	3	0	3	0	0	0	0	3	0	0
Soccer	24	17	7	9	8	3	3	3	13	3	4
Tennis	8	5	3	1	4	3	0	1	4	0	3
Golf	2	2	0	2	0	0	0	0	2	0	0
Cheerleading	9	9	0	0	9	0	0	1	8	0	0
Swimming	2	0	2	0	0	0	2	0	0	0	2
Totals	185	124	61	68	56	33	27	14	108	19	42
Percentages	100.0	43.5	56.5	48.9	51.1	54.1	44.3	12.8	85.1	31.1	68.9

Table 2. Note: M = male, F = female, HS = high school athletes, Coll = college athletes, and Prev. Hx = previous history of concussion. High school athletes participated in more than one sport thus explaining why their totals do not reflect demographic data in Table 1. There is one missing piece of data for college gender and there are two missing pieces of data for high school previous history of concussion.

Table 3. Instrument Scores (Means and Standard Deviations)

	HCCQ (15-105)	NRS (10-70)	WRS total (20-140)	WRS conc (10-70)	WRS non-conc (10-70)
Total	83.4 ± 13.4	50.3 ± 12.0	98.6 ± 19.3	50.8 ± 10.8	47.8 ± 9.6
High School	87.6 ± 9.5	51.0 ± 10.7	94.7 ± 19.4	48.4 ± 11.3	46.3 ± 9.4
College	80.2 ± 15.0	49.8 ± 49.8	101.6 ± 18.8	52.6 ± 10.2	49.1 ± 9.6

Table 3. Note: The range for possible scores is in parentheses following the respective instrument. There was a significant difference in WRS scores for the concussion symptom total. Specifically, college athletes significantly reported more concussion symptoms than high school athletes. NRS significantly predicted WR for all subjects and, more specifically, high school athletes.

Table 4. Correlations between WR and predicting variables

All Subjects					
		HCCQ		NRS	
		r	p	r	p
Regression Model		0.14	0.082	0.24	0.007**
Gender	Male	0.13	0.171	0.28	0.019*
	Female	0.15	0.141	0.23	0.055
ATC gender	Male	0.18	0.144	0.19	0.134
	Female	0.13	0.144	0.27	0.011*
Previous Hx	Yes	0.23	0.137	0.30	0.075
	No	0.12	0.147	0.23	0.020*

High School					
		HCCQ		NRS	
		r	p	r	p
Regression Model		0.15	0.154	0.4	0.003**
Gender	Male	0.15	0.247	0.34	0.020*
	Female	0.18	0.203	0.44	0.016*
ATC gender	Male	NA	NA	NA	NA
	Female	NA	NA	NA	NA
Previous Hx	Yes	0.15	0.390	0.27	0.304
	No	0.20	0.114	0.45	0.002**

College					
		HCCQ		NRS	
		r	p	r	p
Regression Model		0.24	0.034*	0.16	0.117
Gender	Male	0.23	0.103	0.22	0.108
	Female	0.29	0.075	0.12	0.273
ATC gender	Male	0.18	0.144	0.19	0.134
	Female	0.31	0.065	0.13	0.273
Previous Hx	Yes	0.29	0.118	0.29	0.112
	No	0.22	0.080	0.09	0.283

Table 4. For the overall regression model, NRS (perceived closeness) had weak but significant positive correlations with WR for all subjects and for high school subjects. HCCQ (autonomy support) had a weak but significant positive correlation with WR for college athletes.