

2011

Athletes' Knowledge and Perceptions of Sport Related Concussions and the Decision to Seek Treatment

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**ATHLETES' KNOWLEDGE AND PERCEPTIONS OF SPORT RELATED
CONCUSSIONS AND THE DECISION TO SEEK TREATMENT**

**A Masters Thesis presented to the Faculty of the
Graduate Program in Exercise and Sport Sciences
Ithaca College**

**In partial fulfillment of the requirements for the degree
Master of Science**

by

Olivia Jarem

August 2011

**Ithaca College
Graduate Program in Exercise & Sport Sciences
Ithaca, New York**



CERTIFICATE OF APPROVAL

MASTER OF SCIENCE THESIS

This is to certify that the thesis of

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**submitted in partial fulfillment of the requirements for the degree of Master of
Science in the School of Exercise and Sport Sciences at Ithaca College has been
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Date:	<u>July 18, 2011</u>	

ABSTRACT

The purpose of the study was to examine specific factors (namely knowledge, perceptions, and demographic characteristics including gender differences) that may influence an athlete's decision to report a sport related concussion (SRC). Participants were Division I and III soccer and lacrosse athletes ($n = 618$) who participated in an online assessment intended to evaluate knowledge of concussive symptoms and previous reporting behavior. Descriptive statistics were calculated to determine rates of reported (57.7%, 176/305) and unreported (42.3%, 129/305) concussions, as well as reasons why athletes failed to report SRCs. Athletes identified not wanting to be withheld from competition or practice (43.2%) and not thinking the injury was serious enough (40.6%) as the primary reasons for failing to report a prior SRC. Average scores on the concussion knowledge quiz were consistently high for athletes both with (90.2%) and without (87.4%) previous concussion history. Logistic regression analysis examined the main effects of the independent variables (knowledge, perceptions, and the demographic characteristics of gender, age, sport played, and division level of competition) on reporting behavior; specifically, which variables increased the prediction that an athlete would fail to report a SRC ($p < .05$). Significant variables that contributed to the model and the corresponding odds ratios (OR) that predicted failure to report SRC included: perceiving an expectation to play through or minimize injury in sport ('culture of risk') (OR = 2.12), an increase in age by one year (OR = 1.39), playing lacrosse (OR = 2.40), and competing at the Division III level (OR = 2.91). Chi-square tests revealed no significant overall association between the genders on failure to report a SRC, but post-hoc analysis revealed that significantly more Division III male athletes failed to report concussions than females ($\chi^2(1) = 8.04, p < .01$). Results from this study helps identify

additional factors besides knowledge of SRC symptoms that may influence an athlete's decision to report SRC, specifically the previously uninvestigated influence of culture of risk and the potential influence of athletic identity. Results also expand the literature that currently debates whether male or female athletes sustain more SRC's (Dick, 2009). This information may help sports medicine professionals and sport psychology consultants target areas of intervention and education that can improve SRC management.

ACKNOWLEDGEMENTS

I would like to thank Dr. Justine Vosloo for her guidance, statistical proficiency, and continued support throughout this project. I would also like to acknowledge Dr. Kent Scriber for his expertise and suggestions with regard to literature review and methodology. Finally, I would like to thank Dr. Miranda Kaye for her assistance in preparing and offering feedback for this project.

DEDICATION

I would like to dedicate this thesis to all the NCAA athletes and coaches who made study possible. I would also like to thank Chad, whose support throughout the past year made everything possible.

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Chapter 1

INTRODUCTION

Sport-related concussion (SRC) has recently become a popular topic of discussion in both the medical and athletic communities. According to the Centers for Disease Control and Prevention (CDC), approximately 1.5 million Americans suffer a traumatic brain injury (TBI) each year, and of those injured, approximately 25% fail to receive medical attention (Setnik & Bazarian, 2007). Following motor vehicle accidents, sports are the second leading cause of concussions in the 15-24 years old age bracket (Sosin, Sniezek, & Thurman, 1996), and they are currently on the rise in all sports, including those traditionally referred to as 'non-contact' (Bloom, Loughead, Shapcott, Johnston, & Delaney, 2008). The most recent incidence estimate of SRC has increased from 300,000 in 1998 to between 1.6 and 3.8 million per year in 2006 (Langlois, Rutland-Brown, & Wald, 2006). The wide range present in this statistic calls to attention the discrepancy that exists between the number of SRCs occurring in athletics each year versus the number that are actually reported. Additionally, there is a shared consensus among researchers and sports medicine professionals that this statistic is an underestimate and that a significant proportion of SRCs go unreported and undiagnosed (Broglio, Vagnozzi, Sabin, Signoretti, Tavazzi, & Lazzarion, 2010; Langlois et al., 2006; McCrea, Hammeke, Olsen, Leo, & Guskiewicz, 2004).

The discrepancy between the occurrence of concussions in athletics and the actual reporting of such is not unfathomable considering the current lack of a universal means for measuring the severity of concussions (Guskiewicz, 2001; Lovell, 2009). As attention regarding the identification and management of SRC has grown over the past two

decades, so has the controversy over how to properly define and treat this type of injury. Currently, there is no unanimously accepted definition of a concussion or of a universal management system for treating SRC (Lovell, 2009). The most recent definition proposed by the CDC (2010) defines a concussion as a bump, blow, or jolt to the head that alters the normal functioning of the brain. These alterations to the brain can be physiological, biomechanical, and/or psychological in nature. Diagnosing a SRC is additionally complicated by the fact that both physical and cognitive symptoms may not appear immediately after injury (Putukian & Echemendia, 2003). Symptoms can occur two to three days after the initial blow to the head and may last upward of several weeks or months (Kontos, Collins, & Russo, 2004; Lovell, 2009).

SRCs are known as the ‘invisible injury’ because there are no completely objective, external markers (such as a crutch or a sling) that mark an athlete as concussed (Johnston et al., 2004). Unlike an anterior cruciate ligament (ACL) injury or broken bone, SRCs require more subjective means for determining whether or not an athlete has sustained this injury or is ready to return to play (RTP). Because relying on an athlete’s honest self-report of SRC symptoms is an inherent part of the diagnosis and perceived progress of this particular injury, understanding what factors influence reporting behaviors is an essential component for improving diagnosis and treatment.

Continuing to play while experiencing concussive symptoms places an athlete at an increased risk for sustaining more severe short and long term neurologic, physiologic, and psychological consequences. RTP before an athlete’s SRC symptoms are fully resolved increases the risk of second impact syndrome (SIS), a devastating and potentially fatal swelling of the brain that can lead to seizures, subdural hematomas, a

coma, and death (Cantu, 2003; Logan, Bell, & Leonard, 2001). Post-concussion syndrome (PCS) is another concern with athletes who have previously sustained a SRC. PCS increases one's risk for sustaining future concussions, increases an individual's likelihood for developing damaging neurological consequences (such as Alzheimer's disease and Parkinson's syndrome) (Kontos et al., 2004), and results in the athlete experiencing negative cognitive, physical, and emotional consequences that alter mood and ability to physically and cognitively function optimally (Logan, 2010; Mittenberg, Canyock, Condit, & Patton, 2001).

A majority of current research on SRCs has been to identify populations and characteristics of athletes who are at risk for sustaining this type of injury. Gender is a demographic of current interest with regard to SRCs. While numerous studies have indicated female athletes to be at the greater risk for receiving a SRC (Dick, 2009), other research has suggested that the genders may not differ as much in the incidence of SRC as they do in reporting behaviors with regard to this injury (Bloom et al, 2008). According to the author Dick (2009), although research demonstrates a difference in SRCs between the genders, few authors have provided explanations for this discrepancy.

To date, minimal research has been done to examine specific factors that influence athletes' self-reporting of their concussions. Of the few studies that have examined these factors, a lack of comprehensive knowledge regarding concussions as well as fear of being suspended from competitive play are the two most commonly recorded reasons why athletes fail to report their SRCs (Broglio et al., 2010; Cusimano, Chipman, Volpe, & Donnelly, 2009; Delaney, Lacroix, Leclerc, & Johnston, 2002; Kaut, DePompei, Kerr, & Cogneni, 2003; McCrea et al., 2004). Research has demonstrated that

between 20% (Delaney et al., 2002) to 36% (McCrea et al., 2004) of athletes who experience a concussion fail to report their injury because they were unaware that the symptoms they were experiencing were caused by a SRC. Kaut and colleagues' (2003) investigation acknowledged a need for research to better identify the areas of knowledge athletes lack and for a better understanding of athletes' behaviors upon experiencing any symptoms of a SRC. Previous literature has failed to investigate other factors, such as gender role conflict, athletic identity, and culture of risk that may also influence athletes reporting behaviors with regard to SRCs. The present study will examine the previously mentioned factors (lacking knowledge and fear of being withheld from competition) in conjunction with questions that may reveal new explanations as to why athletes minimize or fail to report SRC symptoms.

Examining athletes' perceptions and attitudes regarding concussions in sport is a factor currently lacking in the literature. A 2004 study with high school football athletes revealed that approximately 66% of the players who had sustained a SRC over the course of a season admitted failing to report the injury because they did not believe a concussion was a 'serious enough injury' worth reporting (McCrea et al., 2004). This finding, although revealing, has failed to be investigated further in studies with collegiate athletes. Stigma associated with the culture of risk and misconceptions regarding the severity of the concussion injury itself has been proposed by numerous authors (Bloom et al., 2008; Broglio et al., 2010; Cusimano et al., 2009; Gessel, Fields, Collins, Dick, & Comstock, 2007; McCrea et al., 2004), but empirical research examining reporting behaviors with this regard is so far limited and predominantly speculative.

The current study examined the potential factors that influenced or prevent an athlete from deciding to seek proper medical attention after sustaining a SRC. In addition to lack of knowledge and fear of being suspended from play, the author suspected that other factors, including gender differences, perceptions regarding concussions, previous experience with concussions, individual sport differences, and level of sport may also have influence on the decision to report the injury. Additionally, the author intended to examine attitudes and perceptions held by athletes regarding concussions in their sport, which may lead to a better understanding of what influences their knowledge and reporting of SRCs and any related symptoms. Understanding the reasons why athletes may or may not seek medical attention after sustaining a head injury and identifying who is most at risk for underreporting symptoms are imperative for health care professionals and coaches to recognize.

Statement of Purpose

The purpose of this study was to examine potential factors (specifically knowledge, perceptions, and gender differences) that may influence the college athlete's decision to seek treatment after sustaining a SRC. An additional purpose was to expand the literature regarding reasons why athletes may fail to report a SRC beyond the current literature that supports lacking knowledge as the main deterrent.

Hypotheses

The author hypothesized: 1) An increased level of SRC knowledge will result in an increased likelihood that the athlete will report sustaining this type of injury. 2) Participants' perceptions of SRC will influence reporting behaviors by: a) Perceiving SRC to be an important injury worthy of reporting will decrease the likelihood that an

athlete will have failed to report a prior SRC. b) Perceiving SRC to be an injury with a moderate to high likelihood of occurring in one's sport will increase the likelihood that an athlete will report a SRC. c) Perceiving a culture of risk in sport and positively affirming athletic identity (d) as an influential factor contributing to reporting behavior will increase the likelihood that an athlete will fail to report a prior SRC. Based on previous literature (Bloom et al., 2008; Dick, 2009), the author expected a gender difference in the reporting of SRC, with females reporting SRC more often than males. 3) Male athletes will have failed to report SRC more often than female athletes.

Scope of the Problem

Although rates of SRC have doubled across all participating NCAA sports since the 1988-1989 season, it remains unclear whether heightened awareness, improved management, or an actual increase in the incidence of this injury has influenced the statistical augmentation (Hootman, Dick, & Agel, 2007). Additionally, there is a consensus that the current injury statistic of 1.6 to 3.8 million SRCs per year is an underestimate due to a significant number of athletes failing to report and/or minimizing symptoms of a concussion (Broglia et al., 2010; Langlois et al., 2006; McCrea et al., 2004). While the reasons for failing to report SRCs remain unclear, previous research has demonstrated that insufficient knowledge of symptoms, fear of being suspended from play, and misguided perceptions of SRCs as a serious injury are the top explanations (Cusimano et al., 2009; Delaney et al., 2002; Kaut et al., 2003; McCrea et al., 2004). Research with regard to these explanations has so far been limited and has failed to account for differences in reporting behavior with respect to genders, division levels, and the sports of soccer and lacrosse, specifically. Also, research has failed to empirically

examine stigma associated with the culture of risk in the sports of soccer and lacrosse that may influence reporting behaviors of SRC in this population of college athletes.

Assumptions of The Study

For the purpose of this study, the following assumptions were made:

1. The subjects are representative of typical collegiate Division I and Division III soccer and lacrosse athletes.
2. The participants' experiences with regard to concussions represent a typical college athlete's experience.
3. The participants will respond honestly on the Concussion in Soccer and Lacrosse Survey.
4. The modified Concussion in Soccer and Lacrosse Survey is an accurate, reliable, and valid measure for ascertaining participants' knowledge and perceptions regarding SRCs and reporting behaviors.

Definition of Terms

1. To date, there is no one universally accepted definition of the *concussion* injury (Lovell, 2010). Authors Guskiewicz and colleagues (2003) define a concussion as “an injury resulting from a blow to the head that [causes] an alteration in mental status and one or more of the following symptoms: headache, nausea, vomiting, dizziness/balance problems, fatigue, difficulty sleeping, drowsiness, sensitivity to light or noise, blurred vision, memory difficult, and difficult concentrating” (p.2550). The CDC (2010) defines a concussion as a “type of traumatic brain injury, or TBI, caused by a bump, blow, or jolt to the head that can change the way [the] brain normally works.” For the purposes of the present study, the term *sports related concussion* (SRC) is used synonymously with

concussion to emphasize the fact that this study will be investigating this particular head trauma as they occur in the sports of soccer and lacrosse.

2. *Second Impact Syndrome* (SIS) is an injury sustained while an individual is still symptomatic from a previous concussion that can result in swelling of the brain, increased intracranial pressure, brain herniation, a coma, and death (Cantu, 2003).

3. *Post-Concussion Syndrome* (PCS) is defined as three or more concussive symptoms that endure for upwards of three weeks to three or more months after the initial head injury (Logan, 2010).

4. *Gender role conflict* is the male psychological state that is negatively influenced by societal standards and expectations (O'Neil, 2008). Gender role conflict theory is related to the gender role strain and masculine ideology that is highly intertwined with the formation of athletic identity in male athletes (Steinfeldt & Steinfeldt, 2010).

5. *Athletic identity* is the extent to which an athlete characterizes or identifies with their role as an athlete (Brewer, Van Raalte, & Linder, 1993).

6. *Culture of risk* is defined by Nixon (1993) as the internalized acceptance of risk taking and of sustaining and playing with injuries in sport.

7. *Return-to-play (RTP) Guidelines* are the philosophy and standardized methods athletic trainers use to manage SRCs and to assess progress that will lead to the eventual decision of when the athlete is allowed to return to sport (Guskiewicz et al., 2004).

Delimitations

The delimitations of this study were as follows:

1. Only Division I and Division III, male and female, soccer and lacrosse student-athletes who were 18 years of age or older served as participants.

2. Only knowledge, perceptions, history of SRC, reporting behavior, and demographic information (age, gender, ethnicity, year in school, number of years playing sport, level of sport, type of sport) were studied.

3. The modified Concussion in Soccer and Lacrosse Survey will be used as a measurement tool.

Limitations

The limitations of this study were as follows:

1. The results may only be generalized to Division I and Division III soccer and lacrosse athletes.

2. Subject participation was voluntary and participant recruitment will not be random. This may have contributed to self-selection bias.

3. Completion of the survey questions required that participants retrospectively accounted for prior experiences with SRCs, both professionally and self-diagnosed. Therefore, failure to account for all prior instances of SRC or overestimating the number of previous SRCs was possible.

4. The survey itself was subject to social desirability bias, as participants may not have wanted to reveal that they had previously sustained a SRC and failed to report the injury.

5. When accounting for number of times the athlete had failed to report a concussion, the present survey did not specify whether this failure to report the injury occurred while participating in sport or outside of competition. Therefore, the present analysis cannot delineate between the concussions that went undocumented specifically while engaging in sport versus during outside activities. Regardless, this information is justified, as it is possible that an athlete who sustained a concussion outside of sport (i.e. on the weekend

while socializing) failed to report this concussion and returned to practice (i.e. the Monday after) while symptomatic.

6. The regression analysis used in examining the data is subject to shrinkage, or population specificity. Therefore, the regression equation that was developed may lose accuracy when applied to a different sample or population.

7. The current study was non-experimental, and therefore causation cannot be determined, only speculated.

Chapter 2

REVIEW OF LITERATURE

Introduction

The following chapter is a review of literature that focuses on the occurrence of sport related concussion (SRC) in athletic populations. Specifically, the review will focus on SRC as they occur between the genders and within the sports of soccer and lacrosse.

SRC – The Controversy

There is currently no universally accepted definition of SRC, nor is there unanimous consensus regarding the proper management and return to play (RTP) guidelines for this type of injury (Lovell, 2009). Such controversy over the definition and management of SRC could exist because of the inherent characteristics associated with this type of injury. Symptoms of SRC are variable and dependent upon a number of individualized factors, thus making it difficult to generalize the experience of SRC for every athlete. SRC are not as observable, quantifiable, or objective as a broken bone or torn ligament, and therefore the management of this type of injury requires some subjectivity in the interpretation of symptoms (Guskiewicz, 2001). The honest reporting and accurate knowledge of symptoms by the concussed athlete may also complicate the issue. Each of the potential factors contributing to the controversy over definition and management of SRC are discussed individually below.

SRC – The Symptoms

The nature of competitive sport places all athletes at risk for sustaining SRC. However, some athletes will be prone to this specific injury more than others (Kutcher & Eckner, 2010). The sequelae of potential effects due to SRC vary from athlete to athlete.

To date, no single pathophysiologic discovery has revealed the reason for individual differences in SRC symptoms and experiences (Kutcher & Eckner, 2010). The fact that there is no one universal experience of SRC significantly complicates the issue of diagnosis and management.

Several physical symptoms are associated with SRC. The most easily recognizable symptoms include loss of consciousness (LOC) and amnesia (Guskiewicz, 2001). LOC, although once thought to be the telltale sign of SRC, occurs in less than 10% of concussive head injuries (Lovell, 2009). The rates of amnesia in SRC are also relatively low, occurring in approximately 27% of all cases (Guskiewicz, Weaver, Padua, & Garret, 2000). Less visible physical symptoms are shown to be more common to athletes' general experiences with SRC. Headache is one of the most frequently reported symptoms of SRC (Guskiewicz et al., 2003; Martineau, Kingma, Bank, & Valovich McLeod, 2007). Other commonly reported symptoms include nausea, problems with balance, dizziness, impaired vision, photosensitivity (sensitivity to light), hyperacusis (sensitivity to noise), feeling foggy or sluggish, fatigue, and sleep disturbances (Lovell, 2009).

In addition to the physical symptoms, there are a variety of potential neurological and cognitive impacts of SRC. Neurological deficits in reaction time, visual motor speed, memory, and mental processing are demonstrated in athletes suffering from SRC (Lovell, 2009). Athletes may report concentration and memory problems that can last anywhere from a few days to a few months (Lovell, 2009; Martineau et al., 2007). Complicating SRC diagnosis is the fact that both physical and cognitive symptoms may have a delayed onset that does not appear immediately after sustaining the initial concussive blow to the

head (Martineau et al., 2007). This could result in an athlete continuing to play despite having realized he or she had received a SRC.

The fact that SRCs are a physical trauma to the brain augments the potential for psychological disturbances. SRCs can have a significant impact on an athlete's psychosocial daily functioning, particularly with regard to social relationships, schoolwork, and overall motivation and compliance with treatment programs (Guskiewicz et al., 2007; Kuehl, Snyder, Erickson, & Valovich McLeod, 2010). Mainwaring and colleagues (2004) noted differences in Profile of Mood States (POMS) between concussed and non-concussed college athletes that could not be accounted for by pre-injury mood disturbance and functioning. Specifically, higher levels of depression, anxiety, confusion, fatigue and overall negative mood disturbance were found in athletes suffering SRC compared to control groups (Kutcher & Eckner, 2010; Mainwaring et al., 2004). Hutchison, Mainwaring, Comper, Richards, and Bisschop (2009) conducted a study with university athletes to compare emotional responses between musculoskeletal injuries and SRC. The authors found distinct differences in POMS assessment between the groups. Concussed athletes displayed higher levels of fatigue and decreased vigor than the musculoskeletal injury group. The authors speculated that a combination of altered brain chemistry and inability to exercise resulted in the distinctive differences displayed in the SRC group (Hutchison et al., 2009). Although emotional disturbance is a significant component of SRC symptoms, it is an area of study that is currently lacking in SRC research (Hutchison et al., 2009; Mainwaring et al., 2004). This impedes a thorough understanding of the emotional and psychosocial impacts of SRC (Hutchison et al., 2009; Johnston et al., 2004).

Certain neurological deficits as well as psychosocial effects may be influenced by previous instances of SRC (Covassin, Elbin, Kontos, & Larson, 2010; Guskiewicz et al., 2007; Kuehl et al., 2010). Specifically, a dose-response gradient has been suggested with regard to the number of SRCs and cognitive functioning (Covassin et al., 2010). As the number of SRCs increases, there is the potential for a decrease in verbal and visual memory and an increased likelihood of depression (Covassin et al., 2010; Guskiewicz et al., 2007). Although no studies to date have demonstrated that a prior history of mood disorders exacerbates the psychological symptoms associated with a SRC, this consideration warrants further investigation as athletes with higher baseline levels of depression, fatigue, and anxiety may experience the mood altering influence of the SRC more severely (Kutcher & Eckner, 2010). The lack of investigation with regard to pre-existing mood levels as a potential influencing factor makes generalizing the neurocognitive symptoms of a SRC difficult to affirm. Because certain effects may or may not become exacerbated based upon an individual's prior history with head trauma or mood disturbance, a universal statement regarding the symptoms of SRC is complicated by numerous personal and environmental factors unique to the individual athlete. This adds to the difficulty of constructing an absolute, all-encompassing definition of SRC.

SRC – The Guidelines

The seventeen grading systems and return-to-play (RTP) guidelines that evolved over the past 30 years have created more confusion, rather than clarity, over the proper management of SRC (Guskiewicz, 2001; Kontos, et al., 2004; Lovell, 2009). RTP guidelines are the philosophy and standardized methods athletic trainers use to manage

SRCs and to assess progress that will lead to the eventual decision of when the athlete is allowed to return to sport (Guskiewicz et al., 2004). Most grading systems were developed with little empirical foundation and rely heavily on the two symptoms (LOC and amnesia) that were previously mentioned as being rare among the list of potential symptoms (Guskiewicz, 2001; Kontos et al., 2004). Because of this, no one grading system has been established in the field as the standard of SRC management (Guskiewicz, 2001).

Currently, there is a push for a more individualized approach to SRC management that would take into account mechanism and severity of injury, severity of symptoms, prior history with SRC, and developmental level of the athlete (Guskiewicz, 2001; Kutcher & Eckner, 2010; Lovell, 2009). Increasing consensus among sports medicine professionals dictate the use of neurocognitive testing (such as the ImPACT test), screening tools (such as the Balance Error Scoring System [BESS]), and tests of mental status (such as the Standardized Assessment of Concussion [SAC]) in conjunction with an athlete self-report of symptoms as the most comprehensive approach to the diagnosis and management of SRC (Guskiewicz et al., 2004; Lovell, 2009; Martineau et al., 2007). Authors have proposed that neuropsychological data testing be required of all athletes at baseline in order to improve future diagnosis (Kontos et al., 2004; Lovell, 2009; Moser et al., 2007).

According to authors Guskiewicz and colleagues (2004), the ImPACT is one of a number of computerized neuropsychological tests that allows for neurocognitive baseline tests of athletes prior to participation in the sport. If a suspected SRC occurs, the individual can be re-tested and recovery can be compared to the athlete's original test

scores. The ImPACT test examines the cognitive domains of information processing speed, reaction time, impulse control, and verbal and visual memory (Guskiewicz et al., 2004). The BESS is a postural-stability test that examines the sensory effects of a SRC, as it requires an individual to perform three stances (double-leg, single-leg, and both legs together) with eyes closed on a firm and foam surface and record the number of errors (e.g. stumbles, falls, opening eyes, etc.) (Guskiewicz, 2001). The SAC assesses neurocognitive deficits in the domains of orientation, immediate memory, concentration, and delayed recall while also testing strength, sensation, and coordination (Guskiewicz, 2001; Guskiewicz et al., 2004). While no clear grading system or method of assessing the SRC has unanimous approval among researchers and sports medicine professionals (Guskiewicz, 2001), the widespread use of neurocognitive testing has become a popular incorporation into most athletic programs' assessment of SRC (Lovell, 2009).

Due to the subjective nature of the injury itself, sports medicine professionals must rely on the athlete's self-report of SRC symptoms and symptom resolution in conjunction with the standardized forms of assessment (Guskiewicz, 2001). Regardless of which RTP guideline or assessment tool a sports medicine professional uses to manage the SRC, he or she must, by default, take into account athletes' own statements of which SRC symptoms they are experiencing and to what severity those symptoms are affecting their ability to function. A grey area exists when the neurocognitive tests and screening tools no longer show a deviation from the athlete's baseline performance. This is no guarantee the athlete has fully recovered, yet this is the point where the sports medicine professional must rely on the athlete's honest report of symptoms to determine if they are ready to return to sport. The varying signs, symptoms, and consequences of SRC add to

the difficulty of establishing universal management and RTP guidelines. The push toward making SRC guidelines more objective is an essential step in addressing the complicated issues related to SRC diagnosis and treatment (Guskiewicz et al., 2004).

SRC – The Current Trends in Reporting

Continuing to rely on athletes' self-report of symptoms proves to be problematic for a number of reasons. Before an athlete can report sustaining a potential SRC, he or she must possess accurate knowledge regarding SRC symptoms. The athlete must also be aware of the potential consequences of continuing to play before SRC symptoms have fully resolved. This basic understanding of SRC is lacking across a variety of sports at multiple competitive levels.

A recent study of high school varsity football athletes revealed that almost 36% of players who sustained a SRC failed to report their injury because they were unaware that the symptoms they were experiencing were caused by a concussion (McCrea et al., 2004). Sixty six percent of the players who had sustained a SRC continued to play because they did not think a SRC was a serious enough injury worthy of reporting (McCrea et al., 2004). Ultimately, of the 229 players who had sustained a SRC, less than half (47.3%) actually reported their injury to another person (McCrea et al., 2004). These findings are consistent across all levels of the sport. An earlier study revealed that of the 44.8% of professional football athletes who had likely sustained a SRC, only 18.8% of the players realized they had experienced one (Delaney, Lacroix, Leclerc, & Johnston, 2000). Although these studies only considered the experiences of high school and professional football players throughout the course of one season, they raised concern over the substantial prevalence of athletes who were failing to report their SRC and

continuing to play while experiencing symptoms. The authors suggested that the prevalence rates of SRCs are significantly underestimated due to the number of athletes shown to hide their true incidence (McCrea et al., 2004).

Other studies have reiterated the fact that a significant proportion of athletes are ignorant to SRC symptoms and the consequences of continuing to play. A retrospective study revealed that over three quarters of the university soccer and football athletes (80.1% and 76.6%, respectively) surveyed who sustained a SRC did not realize they had suffered one, indicating they continued to play while experiencing symptoms (Delaney et al., 2002). Another study that examined 461 male and female college athletes revealed that nearly 20% had failed to report dizziness to an athletic trainer or coach, and over 30% continued to play while experiencing a headache after being hit in the head (Kaut et al., 2003). Fifty six percent of these athletes admitted having no knowledge of the possible consequences of SRC (Kaut et al., 2003). Responses to potential problems associated with SRC were varied and overall indicated a limited and deficient amount of knowledge regarding the potential physical, cognitive, somatic-sensory, and fatal consequences of SRCs (Kaut et al., 2003). Sixty two percent of the 342 professional Italian soccer athletes who reported sustaining a SRC over the course of a year did not report this injury, primarily because the athletes did not think the injury was 'serious enough' to report (Broglia et al., 2010). While it has been demonstrated in research that athletes lack knowledge that is essential for reporting instances of SRC, no studies have investigated the relationship between accurate knowledge of SRC symptoms and the influence on reporting behaviors. The present study examined this relationship with aims to improve awareness over which athletes' may be more likely to underreport or

minimize their SRC because they simply lack appropriate knowledge of SRC symptoms and consequences.

A 2009 study of Canadian minor league ice hockey players revealed that over 30% of the athletes felt that an athlete could continue to play while experiencing concussive symptoms as long as he was feeling '90% better' (Cusimano et al., 2009). Twenty percent of the players thought it were acceptable for an athlete to play in important games as long as he was 'careful' (Cusimano et al., 2009). Studies with high school and collegiate athletes have reflected similar misconceptions and lack of understanding related to the consequences of continuing to play with concussive symptoms (Kaut et al., 2003; McCrea et al., 2004). In conjunction with holding accurate knowledge of SRC symptoms and consequences, the perceptions and attitudes an athlete may hold with regard to the significance of this injury may influence the decision to report the SRC.

Although results from the aforementioned studies are limited to youth and university athletes that primarily participate in the sports of soccer, football, and hockey, the disconcerting trends in knowledge are the same. The discrepancy between the unavoidable occurrence of SRCs in athletics and the deficient knowledge of symptoms is evident in all levels and types of sport. Although a few studies have examined the lack of knowledge and failure to report symptoms in soccer (Broglia et al., 2010; Delaney et al., 2002; Kaut et al., 2003), none of these explored the predictive influence of perceptions on reporting of SRCs. To date, no studies have examined these issues in the sport of lacrosse.

The Potential Consequences of SRC

After sustaining an injury, most athletes feel significant pressure to RTP as quickly as possible (Roderick, Waddington, & Parker, 2000). This situation could lead athletes to RTP before their concussive symptoms are fully resolved. The consequences of these actions can be devastating and potentially fatal. Current discussion has focused on the increased susceptibility of athletes who have sustained a previous SRC and the devastating effects multiple SRCs may have on the individual (Kontos et al., 2004; Lovell, 2009). Increasing awareness has been devoted to the possibility that as the number of SRCs increase, the athlete's threshold for sustaining a future SRC decreases along with an increased likelihood of experiencing long-term cognitive and neurologic consequences (Cantu, 2003; Kontos et al., 2004; Martineau et al., 2007). The study of recurrent concussions has been primarily limited to high school and collegiate football players (Guskiewicz et al., 2003), professional and collegiate soccer players (Broglia & Guskiewicz, 2001), and professional boxers (Jordan, Master, Zimmerman, & Zazula, 1996).

Continuing to play with a SRC places an athlete at an increased susceptibility for sustaining other injuries (Guskiewicz, 2001). The altered sensory functions and loss of fine motor control inherent with SRC can inevitably impact athletic performance (Guskiewicz, 2001). Typical symptoms of SRC, such as dizziness, difficulty concentrating, impaired balance and vision, can increase the likelihood for an athlete to make a grievous error that would result in an additional physical injury. Numerous authors suggest that sustaining a previous SRC places an athlete at an increased risk for receiving a future concussion, as the impact of the blow may lower the individual's

threshold for subsequent SRCs (Guskiewicz et al., 2004; Guskiewicz et al., 2003; Kutcher & Eckner, 2010).

A more severe consequence of continuing to play with concussive symptoms is the increased likelihood of second impact syndrome (SIS) (Cantu, 2003). SIS occurs when an athlete experiences a second concussive injury while still recovering from a prior SRC (Martineau et al., 2007; McCrea et al., 2004). This second impact can be relatively minor and still result in devastating consequences that occur seconds to minutes after the second hit (Cantu, 2003). SIS causes massive swelling of the brain that can result in seizures, subdural hematomas, and ultimately, a coma and potential death (Cantu, 2003; Logan et al., 2001). Although relatively rare and typically displayed in adolescents aged 14-16 (Cantu, 2003), the possibility of SIS augments the potential for even a mild SRC to have severely damaging effects (Logan et al., 2001). This holds true if an athlete fails to report an initial incidence of SRC or misrepresents symptoms in order to RTP sooner than necessary.

Post-concussion syndrome (PCS) is another concern with SRCs that can have significant cognitive, physical, and emotional consequences. More likely to occur with SRC than SIS (Guskiewicz et al., 2004), PCS is defined as three or more concussive symptoms that endure for upwards of three weeks to three or more months after the initial head injury (Logan, 2010). PCS most often accompanies instances of SRC that included a LOC after the initial injury (Mittenberg et al., 2001). Athletes with PCS are at an increased risk for experiencing more negative mood and cognitive disturbances that can significantly alter daily functioning. The cognitive impact of PCS may result in decreased concentration, memory, and overall performance in school-related activities (Logan,

2010; Mittenberg et al., 2001). Physically, athletes may experience a persistent headache, dizziness, fatigue, hyperacusis, and an overall feeling of malaise (Mittenberg et al., 2001). Emotionally, PCS may result in depression, irritability, and anxiety that can significantly affect social interactions and scholastic performance (Logan, 2010; Mittenberg et al., 2001). Individuals with PCS are at an increased risk for sustaining future concussions and have an increased likelihood for developing damaging neurological consequences, such as Alzheimer's disease and Parkinson's syndrome (Kontos et al., 2004).

With proper management and appropriate RTP, the long-term effects of a single instance of SRC are generally minimal (Kontos et al., 2004). However, the consequences associated with multiple SRCs can have a significant impact on an individual's physical and cognitive functioning (Guskiewicz et al., 2004; Guskiewicz et al., 2003; Kontos et al., 2004). Kuehl and colleagues (2010) examined the impact of multiple SRCs on an athlete's health-related quality of life. Athletes across ten sports at the Division I, II, and junior college level completed questionnaires that assessed physical functioning, bodily pain (BP), mental health, social functioning (SF), role limitations, vitality (VT), general health, and headaches. A dose-response relationship was found between the number of SRCs and measures of BP, SF, VT, and headache on health-related quality of life. Specifically, the athletes with a history of three or more SRCs demonstrated the lowest scores for BP, SF, and VT, and displayed the highest scores for negative impact of headaches. This study demonstrated the possible damaging effects of multiple SRCs on an athlete's long-term functioning, particularly with regard to social relationships, motivation, energy, and pain tolerance (Kuehl et al., 2010).

A landmark study by Guskiewicz and colleagues (2007) surveyed 2,552 retired professional football players with a history of recurrent SRCs. The authors found that sustaining multiple SRCs placed these individuals at greater risk for being diagnosed with clinical depression more so than the average lifetime prevalence rate of depression found in the U.S. population. Specifically, having sustained three or more SRCs placed these athletes at a three times greater risk for depression. Even having sustained only one or two previous SRCs placed the athletes at a 1.5 times greater risk for developing depression. When asked whether or not they thought prior concussive injuries had any impact on cognitions in later life, 31.1% of the previously concussed athletes responded yes. 11.5% of the retired football players 50 years of age or older reported feeling “unusually sad, nervous, or under a lot of stress ‘a lot of the time’ or ‘always’” (Guskiewicz et al., 2007, p. 906). Questionnaires given to the spouses and close relatives of the retired athletes substantiated these results (Guskiewicz et al., 2007).

Although findings from the Guskiewicz and colleagues (2007) study are limited to the retrospective, self-reported responses of retired professional football athletes, the study gave merit to the potential psychological long-term impacts of multiple SRCs and continuing to play while experiencing symptoms. Football has been the sport of choice in examining these potential consequences due to the contact nature of the sport and the number of successive blows experienced throughout the course of a single game. While effects of recurrent concussions have been examined in soccer athletes (Broglia & Guskiewicz, 2001; Kontos et al., 2004), the studies are limited in comparison to the number of studies examining high school, collegiate, and professional football players’ experiences with SRC. In general, professional football, hockey, and boxing are the most

frequently observed athletes with regard to the effects of multiple SRCs (Cantu, 2003; Kontos et al., 2004). More studies are needed, particularly in the sports of soccer and lacrosse, to examine potential long-term consequences of sustaining multiple SRCs and continuing to play with concussive-symptoms.

Gender Differences

Are male or female athletes more likely to sustain a SRC? The findings are mixed. Gessel and colleagues (2007) conducted a descriptive epidemiologic study that followed groups of high school and collegiate athletes across nine sports. The authors tracked 396 high school athletes and 482 collegiate athletes throughout the 2005-2006 school year and compared rates of concussions in these groups. Two sports (soccer and basketball) played by both genders were examined in this study. In both sports, females sustained more concussions than their male counterparts at both the high school and collegiate level. Additionally, the ratio of concussions to total number of injuries sustained by soccer and basketball players was higher in girls than it was in boys (Gessel et al., 2007). In a three year cohort study of Division I, II, and III athletic teams, Covassin, Swanik, and Sachs (2003) also reported that female collegiate athletes sustained more SRC's than their male counterparts in soccer and basketball.

This is not necessarily the trend displayed in all sports competed by both sexes. A study by Bloom and colleagues (2008) examined gender differences between college varsity ice hockey, football, lacrosse, soccer, rugby, and basketball players. The authors found that in general, males sustained more concussions in a 12-month period than did women. However, a majority of the concussions sustained by male athletes went unrecognized at the time. The study also found that both sexes suffered more undiagnosed concussions than they did diagnosed ones (Bloom et al., 2008). The reason

for the pervasiveness of undiagnosed SRCs went unexamined in the former study. The present author predicts knowledge and perceptions related to gender role conflict, athletic identity, and culture of risk may influence this prevalence demonstrated in both genders. A discussion on gender role conflict, athletic identity, and culture of risk is addressed in the subsequent section.

Multiple underlying factors may account for the gender differences in incidence statistics presented in the aforementioned studies. Bloom and colleagues (2008) suggested that females may recognize and acknowledge the symptoms of concussions more often than their male counterparts. Whether female athletes possess more accurate knowledge of SRC symptoms and RTP guidelines remains to be examined in the literature and was an aim of the present study. It has also been suggested that female athletes may be more diligent in reporting SRCs than male athletes, which could account for the varying conclusions from study to study (Dick, 2009). The culture of sport that encourages coaches, ATCs, parents, and players to be more diligent and protective of female injuries and downplay or minimize the injury experience in male athletics may support this hypothesis (Gessel et al., 2007; Nixon, 1993).

Findings are inconsistent as to which gender recovers faster from an SRC. It appears that the amount of recovery time varies from sport to sport. Bloom and colleagues (2008) found that rugby and soccer players, whether male or female, took the same amount of time to recover. Males took longer to recover than females in basketball, while female hockey players took longer to recover than male hockey players (Bloom et al., 2008). These last results are particularly intriguing, because hockey is one sport where the protective equipment for both genders is the same, yet the rules dictate the

male version as ‘full contact’ (body checking is allowed), while the female game is considered ‘non-contact’ (intentional body contact is prohibited) (Dick, 2009). It seems counterintuitive that female hockey players would sustain more concussions and take longer to recover than their male counterparts. This may indicate a physiological component that accounts for the gender differences seen in SRCs (Bloom et al., 2008). Differences in head size, neck strength, torso strength, and angular acceleration of the head and neck on impact between men and women are noted as having potential influence on the occurrence of SRCs (Bloom et al., 2008; Delaney et al., 2002; Dick, 2009; Gessel et al., 2007).

There is currently a lack of consensus among sports medicine professionals as to whether male or female athletes are more susceptible to SRCs. Although a majority of current literature indicates females may be at a greater risk for receiving SRCs than males (Dick, 2009), the topic calls into consideration the implications of reported versus unreported incidence statistics. Bloom and colleagues (2008) found that while both genders of athletes had failed to report instances of concussions, male athletes tended to underreport symptoms of SRC more often than their female counterparts. Therefore, it may be possible that the differences in SRC rates between the genders may not be due to actual disparities in SRC occurrences; rather, the difference may be accounted for by female athletes’ tendencies to report SRCs more often than their male counterparts (Bloom et al., 2008). Previous authors have suggested that current trends in reporting behaviors that may mask the true gender differences of SRCs in athletic populations (Bloom et al., 2008; Dick, 2009). The present investigation addressed gender differences

with regard to reporting behavior, with the intention of revealing trends that may expose a bias in the way current SRC prevalence statistics are accounted for.

Gender Role Conflict, Athletic Identity, and Culture of Risk

To help explain the incongruity in SRC reporting statistics, a discussion of gender role conflict, athletic identity, and culture of risk in sport is obligatory. In modern society, sport has increasingly become a vehicle through which values, norms, and the perception of risk is defined (Frey, 1991; Nixon, 1993). Sport and risk-taking behavior have become part of society's designation of what it means to be masculine, committed, hard-working, and successful (Frey, 1991; Roderick et al., 2000). Athletes across all ages and genders are learning to internalize the risks inherent in sport as positive, familiar, and acceptable (Frey, 1991), and ultimately, are being taught to minimize and discredit any discussion of injury and pain out of fear of being viewed as weak and undedicated to the sport (Nixon, 1993).

Gender role conflict is the male psychological state that is negatively influenced by societal standards and expectations (O'Neil, 2008). Gender role conflict theory is related to the gender role strain and masculine ideology (O'Neil, 2008) that is highly intertwined with the formation of athletic identity in male athletes (Steinfeldt & Steinfeldt, 2010). In a survey study of 179 high school football players, the participants who reported higher levels of athletic identity also reported higher levels of gender role conflict, specifically within the subscale of conflict between work, family, and school and the need for success and achievement (Steinfeldt & Steinfeldt, 2010). The authors suggested the added pressure of athletics in high school males conflicts with the expectations placed upon them in other areas of their lives (Steinfeldt & Steinfeldt,

2010). The desire to achieve coupled with pressures from work, family, and school could influence an athlete's desire to hide injury or weakness as he tries to adhere to traditional masculine norms. The Steinfeldt and Steinfeldt (2010) study also revealed an inverse relationship between higher levels of gender role conflict and more negative help-seeking attitudes. The implications of this study are significant when coupled with the tendency for college-aged men to report significantly higher levels of gender role conflict related to sex, power, and competition issues than adult males (O'Neil, 2008). The suggestion that male athletes may minimize or fail to report instances of SRC more often than female counterparts (Bloom et al., 2008) could potentially be influenced by the paradigm of 'masculine ideology' that makes men internalize cultural expectations of machismo and shun those who fail to uphold the expected norms (O'Neil, 2008).

A majority of the literature with regard to gender role conflict has been examined in the college-aged population not specific to athletes. While Steinfeldt and Steinfeldt's (2010) investigation is relevant to a discussion of gender role conflict in athletes, the research is limited to a population of high school football players. With regard to SRCs and reporting behaviors, previous literature upon which the present survey is based addressed gender role conflict only peripherally. By presenting options of such as, 'Didn't think [the SRC] was serious enough,' and, 'Didn't want to let down teammates,' McCrea and colleagues (2004) offered options possibly related to gender role conflict and culture of risk. However, no investigation was made with regard to these concepts. The authors attributed such responses to the competitive personalities that participate in football and to inaccurate knowledge held by the athletes who participated in the survey (McCrea et al., 2004). The present study addressed the same responses more thoroughly

by placing them in context with additional questions. The supplementary questions intended to offer additional explanations (such as gender role conflict and/or culture of risk) as to why an athlete may perceive the need to minimize or not report a SRC specifically in the sport of soccer or lacrosse.

Athletic identity is the extent to which an athlete characterizes or identifies with their role as an athlete (Brewer et al., 1993). Identification as a performing athlete has been shown to influence self-esteem, self-confidence, and positive self-image (Roderick et al., 2000). This identity is most often developed between the ages of 10 and 20, and has shown to be the strongest in intercollegiate athletes throughout their competitive college years (Houle, Brewer, & Kluck, 2002). Related to gender role conflict theory, it has been suggested that identifying as an athlete promotes a need for success and achievement in male high school athletes (Steinfeldt & Steinfeldt, 2010). If success and achievement were to be undermined by an injury, particularly an 'invisible injury' such as a SRC, an athlete may be less likely to interpret that injury as significant enough to voluntarily report the symptoms that would take the athlete out of competitive play (Safai, 2003).

Because athletic identity is sustained by performing athletic activity, a variety of negative emotions, including depression, frustration, anxiety, and guilt may result when playing time is threatened by injury (Roderick et al., 2000). Many athletes will continue playing though an injury to avoid those negative feelings and to sustain their sense of self-worth associated with playing status (Roderick et al., 2000). Athletes who express strong associations with their sport or team may convince themselves that playing through pain and sustaining injury are a worthy and necessary sacrifice (Nixon, 1993).

Although no research to date has explicitly examined athletic identity with regard to the SRC injury, previous research has shown that athletes with higher athletic identity may engage in more negative health behaviors, including participating in sport despite injury (Brewer et al., 1993). Therefore, it is likely that a strong athletic identity may influence an athlete's decision to hide a SRC from others, particularly when the culture of risk associated with that sport is favorable for playing through injury.

Culture of risk is defined by Nixon (1993) as the internalized acceptance of risk taking and of sustaining and playing with injuries in sport. While gender role conflict is, by definition, contained to the study of male athletes' expectations of themselves and of other males, research has demonstrated that female athletes are just as likely to adhere to a culture of risk that promotes risk-taking and playing through pain as their male counterparts (Safai, 2003). Sport is a domain through which athletes are expected to view their bodies as indestructible machines rather than vulnerable flesh and bone (Roderick et al., 2000). Additionally, an athlete is expected to risk health and personal safety for the betterment of the team and for the ultimate goal, success (Frey, 1991). This culture of risk results in "lived contradictions" for athletes who are supposed to embody health yet continue to play while injured (Safai, 2003, p. 128).

There are multiple reasons why athletes will continue to play through injury. A prominent cause examined in professional European soccer athletes was the fear of losing one's place on the team (Roderick et al., 2000). Particularly in collegiate and professional athletics, a player's worth is determined by his or her contribution to the team and organization. If the player is unable to play and contribute to the success of the team, that injured player may be devalued and stigmatized as uncommitted and weak (Nixon 1993;

Roderick et al., 2000). These issues of status have not been examined in the literature on collegiate soccer and lacrosse athletes with regard to SRCs. To date, the focus of status and pressure to perform has been primarily examined in professional sporting arenas and with little specificity to concussion injuries (Flint, 1999; Guskiewicz et al., 2007; Nixon, 1993; Roderick et al., 2000).

Not wanting to be withheld from competition because of a SRC is a concern evident in youth and high school sporting arenas (Cusimano et al., 2010; McCrea et al., 2004), but no studies to date have examined this theme specifically in college-athlete populations. Being withheld from competition opposes the strength, pride, and invincibility valued in the culture of risk surrounding athletics (Nixon, 1993), which could influence an athlete's desire to play while experiencing concussive symptoms. A consideration of the present study was to examine if the fear of being withheld from competition was a factor in athletes' decisions to report sustaining a SRC.

The media is highly influential in establishing the culture of risk associated with particular sports. Media attention surrounding elite level performers often idolize the athletes who play through injury and criticize or even mock those athletes who sit the bench to heal (Cusimano et al., 2009; Flint, 1999). Nixon (1993) explored the messages displayed in American sports media print and found six major themes and nineteen subcategories related to the acceptance of risk, pain, and injury in sport. The pressure to perform, stigma associated with disability, incentives to play, masculinity, athletic identity, and acceptance of pain were common threads throughout the media's attention to athletic injury (Nixon, 1993). When society glorifies an athlete who plays while

injured, younger athletes internalize this behavior and the expectation of minimizing an injury to be considered a great athlete (Cusimano et al., 2009; Flint, 1999).

Overall, it is likely that gender role conflict, athletic identity, and culture of sport have some influence on the underreporting of SRCs in athletics. While a few studies have cited the fear of being withheld from competition as a reason to ignore concussive symptoms (Broglia et al., 2010; Cusimano et al., 2010; McCrea et al., 2004), further investigation is needed in the realm of collegiate athletics. Understanding the individual expectations and societal influences on playing through SRC symptoms may prove useful in addressing the current condition of athletes underreporting their occurrence.

Division Differences

Each year, the National Collegiate Athletic Association (NCAA) collects injury data from a sample of NCAA member institutions using the Injury Surveillance System (ISS) (NCAA, 2010). The ISS is a web-based program available to all participating NCAA institutions where athletic trainers may enter and record injury data (Gessel et al., 2007). The NCAA compiles the data and accumulates reliable and up to date trends in types and mechanisms of injuries across a representative sample of all NCAA sports (NCAA, 2010). The purpose of the ISS is to obtain evidence necessary to make the decisions that influence changes in health and safety regulations in collegiate athletics (Gessel et al., 2007).

In 2007, Hootman and colleagues conducted a summary of the past sixteen years of ISS data across 15 NCAA sports. The data summary revealed that Division I athletics overall had the highest number of injuries throughout the pre-, post-, and regular seasons while Division III athletics had the lowest rates of injury. Both game and practice injury rates were highest in Division I sports and were the lowest in Division III athletics.

Between all sports and division levels from the 1988-1989 and 2003-2004 seasons combined, rates of concussions doubled from 0.17 per 1,000 athletes to 0.34 per 1,000 athletes, respectfully (Hootman et al., 2007). Although rates of concussions specific to division level were not reported, the present study aimed to shed light on whether differences with regard to this specific injury exist between Division I and Division III soccer and lacrosse athletes.

Differences in the rates of injury between division levels may be accounted for by the number of hours dedicated to participation in sport in Division I versus Division III athletics. For Division I athletes, sport is a year-round commitment with no distinct off-season. Even “spring” sports such as lacrosse require six weeks of 20 hour per week commitment followed by an additional 8 hours per week for the remainder of a fall semester. In contrast, a Division III spring sport such as lacrosse only allow for 16 formal practices (with coaches present) during an off-season. Additionally, a Division I sport may begin practicing up to two weeks earlier than the same sport will at a Division III school. However, less access to certified athletic trainers may be available to Division III athletes, due to size of staff and differential attention for various sports during the off-season. Therefore, the added hours participating in sport combined with a greater pressure to perform for scholarship and other incentives at the Division I level compared with the differential access to medical staff provided at the Division III level may reveal interesting differences with regard to the failure to report symptoms between division levels.

Soccer

Although soccer is considered a moderate-impact sport, there is a growing concern among sports medicine professionals and players about the prevalence of head

injury in this sport (Delaney et al., 2002). SRCs in soccer are typically either the result of a player's head making contact with another object while trying to redirect a ball, or they are due to a series of sub-concussive blows that occur through years of playing (Broglia & Guskiewicz, 2001). Compounding these concerns is the fact that many soccer athletes begin playing the sport at a young age, thus they tend to engage in the activity longer than in other sports where concussions are a significant concern (Delaney et al., 2002). Soccer players are three times more likely to sustain a SRC in a one-year period if they have sustained one in the past (Delaney et al., 2002). That, along with the fact that soccer can be played year-round, only increases the likelihood that players will sustain a SRC at some point during their soccer career.

Covassin et al. (2003) found that SRCs accounted for 7.0% of all male soccer players' game injuries and 1.7% of their practice injuries. In female soccer athletes, SRCs accounted for 11.4% of game injuries and 2.4% of all practice injuries. Both genders were more than 16 times as likely to sustain a SRC during a game as in practice. Additionally, female soccer players had the highest rate of SRCs across all women's sports surveyed. Across 10 sports, men's and women's soccer was listed as one of the three sports with the highest risk of SRC, along with men's and women's lacrosse and basketball (Covassin et al., 2003).

Current controversy exists over whether or not heading the ball in soccer has any significant effect on players' susceptibility to SRCs. Although one study found heading the ball to be the most frequent mechanism for SRCs in high school soccer athletes (Gessel et al., 2007), other studies display no correlation between heading the ball and number of SRCs (Delaney et al., 2002). Studies are mixed in determining whether or not

there are any acute or chronic long term neurocognitive deficits in soccer players as a result of heading the ball (Broglia & Guskiewicz, 2001).

Goaltending is a particularly dangerous position in soccer that is highly susceptible to SRCs. Gessel et al. (2007) found that 21% of high school goalkeepers' injuries were due to SRCs, while SRCs comprised only 11.1% of injuries in other field positions. Similarly, Delaney and colleagues (2002) also found that goalies were more likely to suffer SRCs in a one-year period than field players were. Although the susceptibility of the goaltender position with regard to injury or SRC has not been explicitly examined in the literature, studies have found that the expectation for soccer athletes to be mentally tough is prevalent in professional soccer athletes (Roderick et al., 2000; Thelwell, Weston, & Greenlees, 2005). In order to perform at an elite level, soccer athletes stated the necessity of having a resilient character, and undeterred self-belief, a mentality that never lets one quit, and an ability to cope with whatever demands or expectations are presented at any given moment (Thelwell et al., 2005). Although this relentless pursuit of mental toughness was stated in professional soccer athletes (Roderick et al., 2000; Thelwell et al., 2005), it is possible that the same expectations are placed on collegiate soccer athletes. This determined desire to play regardless of the circumstance may influence the underreporting of SRC and the continuance of playing through symptoms in soccer.

The dangers of unreported concussions are significant in soccer players, even at the collegiate level. In a survey study of 201 university soccer players, Delaney et al. (2002) found that of the 62.7% of players who had sustained a SRC in a one-year period, only 19.8% of those athletes realized that the symptoms they were experiencing at the

time were the result of a SRC. In five of the cases, players experienced a LOC and were still unaware that they had sustained a SRC. Because these athletes were unaware of the diagnosis, this indicates that almost 40% of the soccer players sampled did not seek treatment and continued to play while experiencing concussive symptoms (Delaney et al., 2002). As demonstrated in Delaney and colleagues' (2002) study, the influence of accurate knowledge of SRC symptoms is critical to the reporting of this injury. The existing knowledge held by college soccer players coupled with positive perceptions of SRCs as a serious injury worthy of reporting could explain this margin of error demonstrated in the previous literature.

Lacrosse

Lacrosse is one of the most rapidly growing sports in the NCAA (Dick, Lincoln, Agel, Carter, Marshall, & Hinton, 2007a; Dick, Romani, Angel, Case, & Marshall, 2007b). Women's lacrosse, in particular, has seen a 119% increase in the number of collegiate varsity teams between the 1988-1989 and the 2002-2003 seasons (Dick et al., 2007b). There are major differences between the men's and women's lacrosse game. The most significant differences lie in the amount of body contact and in the level of protective equipment. As in ice hockey, the men's game allows for body checking and aggressive hits, while the women's game is considered non-contact. But as opposed to hockey, which requires both men and women wear the same protective gear, female lacrosse players do not wear any protective equipment other than mouth guards and eyewear (goggles). Goggles only became a mandated requirement as recently as the 2004-2005 season (Matz & Nibbelink, 2004). The men wear shoulder and elbow pads, padded gloves, and a protective helmet.

A component shared by both versions of sport is the high susceptibility of receiving a concussion. Along with men's and women's soccer and basketball, men's and women's lacrosse was cited as the collegiate sport with the highest risk of SRCs over the course of a three year period (Covassin et al., 2003). Of the five men's sports surveyed (soccer, lacrosse, basketball, baseball, and gymnastics), lacrosse had the highest injury rate of SRCs (Covassin et al., 2003). For the men, SRCs were the third most common game injury and had a nine times greater chance of occurring during a game than in practice (Dick et al., 2007a). In women, SRCs were the third most common game injury and were five times more likely to occur during a game than in practice (Dick et al., 2007b). Compared with four other women's sports (soccer, basketball, softball, and gymnastics), female lacrosse players had the highest inherent risk of receiving a SRC in a game (Covassin et al., 2003). Other studies have confirmed that both genders of the sport are at a greater risk for sustaining a SRC during a game than in practice and have mentioned the increase in intensity level during games to be a possible reason for this discrepancy (Bowman, Bradney, & Dompier, 2010; Matz & Nibbelink, 2004).

Mechanisms of sustaining a SRC differ between the genders. Eighty percent of SRCs in men's lacrosse occurred as a result of contact with other players (Dick et al., 2007a), while over half (56%) of head injuries in women were due to contact from a stick (Dick et al., 2007b). The difference in mechanisms of sustaining a SRC can be attributed to the differences in the style of play (contact versus non-contact) and level of protective equipment. Conceivably, climate of risk differences between the men's and women's game may impact the mechanism of SRC, but the research has yet to address this discrepancy in the sport of lacrosse. Additionally, the mechanism of injury may or may

not influence an athlete's recognition or reporting of a SRC. If an athlete assumes that contact with another player or a stick is a routine part of the game, that athlete may assume such mechanisms of injury are to be expected and therefore trivial. This line of thinking may decrease the likelihood that an SRC is recognized and/or reported.

Studies show that there has been an increase in the number of SRC's in the men's game since 1996, when the helmet design was changed (Dick et al., 2007a). Alterations to make the helmets more lightweight and less cumbersome resulted in helmets that were less effective in sustaining anterior-impact forces and less effective in protecting the head over multiple impacts (Dick et al., 2007a). Although easier to move in, this study calls into question the potential need for modification to the type of helmets currently worn by male lacrosse athletes (Dick et al., 2007a). Additionally, another study demonstrated discrepancies between brands of helmets that were worse at protecting athletes from SRCs and indicated the athletic trainers noticed differences in the effectiveness of certain brands of helmets worn by their lacrosse athletes (Bowman et al., 2010).

The climate of risk associated with the sport of lacrosse may account for such high instances of SRCs compared to other sports. Lacrosse is proclaimed to be the 'fastest sport on two feet' and is revered because of its combination of skill, aggressiveness, and fast-paced style of play (Logue & Allen, 2001). Schroth (1995) found that male lacrosse players, along with male rugby players, displayed significantly higher sensation seeking needs than noncontact sport athletes (crew and soccer). The desire for thrill and experience seeking shown in male lacrosse athletes could increase susceptibility to injury, although no current studies have documented this relationship with regard to SRC. No study to date has assessed the climate of risk for the women's

game, but due to the current controversy over changing equipment and rules, it justifies the investigation in the present study.

Currently, significant controversy exists as to whether or not more protective gear is needed in the women's game. One school of thought is that mandated head gear will encourage more dangerous and aggressive play similar to the men's game and will take away from the finesse and beauty inherent in the women's style of play (Covassin et al., 2003; Dick et al., 2007b; Matz & Nibbelink, 2004). Another side argues that the statistics of head injury in the women's game already exists despite the current lack of gear. In that case, it is best to be proactive in preventing potential head trauma and mandate headgear be worn in the women's game (Matz & Nibbelink, 2004). In December 2010, New York State lacrosse officials voted 'no' to a motion that would have mandated headgear in female high school lacrosse players by a margin of 7-2 (Shannon, 2010). The event has sparked debates across the country over whether or not rules should be amended to the women's game. The climate of risk in women's lacrosse is indisputably changing regardless of the outcome of the vote.

Applied Sport Psychology Implications

As the field of applied sport psychology continues to grow, so does interest in examining the psychological impacts of athletic injuries. Athletes are known to have increased mood disturbances after sustaining an injury, particularly with responses related to depression, anxiety, anger, fatigue, self-esteem, and stress (Putukian & Echemendia, 2003). While such adverse reactions are commonly demonstrated in concussed athletes, Bloom, Horton, McCrory, and Johnston (2004) proposed additional considerations unique to the SRC injury that warrant specialized attention. These

distinctive considerations are ones to which a sport psychology consultant (SPC) could play an indispensable role in addressing.

First, because SRCs are an 'invisible injury,' identification of a concussed athlete is made difficult for teammates, coaches, and the athlete's support system to distinguish (Bloom et al., 2004). Research has shown that the absence of visible injury markers may make teammates and coaches less likely to offer support to an injured athlete throughout his or her recovery (Evans & Hardy, 2002). Such behavior demonstrated from those surrounding the athlete could have a negative impact on an athlete's feelings of isolation and perceived social support. The SPC could provide emotional support to the concussed athlete while simultaneously educating coaches and teammates about providing appropriate support to the athlete throughout the rehabilitation process.

The overlap of post-concussive symptoms with symptoms associated with psychological responses to injury and clinical diagnoses of depression, anxiety, and trauma make SRC injuries unique (Bloom et al., 2004). Behavioral disturbances, feelings of isolation, disorientation, feeling foggy or sluggish, fatigue, emotional instability, altered mood, inability to focus or concentrate, decreased speed of information processing, impaired cognition, sleep disturbances, and impaired memory (Bloom et al., 2004; Lovell, 2009; Mainwaring et al., 2004; Putukian & Echemendia, 2003) are symptoms witnessed in both various psychological disturbances and in the athlete dealing with a SRC. Therefore, it becomes difficult to distinguish between an emotional disturbance that occurs from being injured or because of the metabolic dysfunction occurring within the brain as a result of the SRC (Mainwaring et al., 2004; Putukian & Echemendia, 2003). Rather than feeling depressed because of forced time in

rehabilitation and out of sport (as is the case with most other injuries), concussed athletes may feel depressed because of the actual injury and resulting metabolic changes occurring in the brain itself. The SPC could play an integral role in evaluating an athlete's emotional response to the SRC injury and determining if such response were evidence of a more pervasive clinical disturbance.

A third consideration unique to SRCs is the loss of physical fitness that may occur as the athlete is forced to rest throughout recovery from this injury (Bloom et al., 2004). Most athletic injuries require rehabilitation exercises, which provide an athlete with both physical activity and a sense of purpose and control. However, there is no standard intervention technique for a concussion, only rest and waiting for symptoms to resolve (Bloom et al., 2004). The RTP from a SRC is a gradual process that involves being asymptomatic before allowing increased intensities, amounts, and duration of physical exertion (Johnston et al., 2004). Lack of physical exertion is known to be a source of stress, frustration, and depression in injured athletes (Evans & Hardy, 2002), and is likely to occur in athletes suffering from SRC (Hutchison et al., 2009). Because rehabilitation and subsequent goal setting can positively impact an athlete's sense of self-efficacy and control (Evans & Hardy, 2002), the absence of such outlets could have grave consequences on an athlete's motivation, self-confidence, and perceived locus of control. Therefore, it is imperative that the system surrounding the concussed athlete (including the SPC) show continued support and understanding throughout the resting period to enhance the athlete's feelings of social support and sense of involvement with the team. This support system can also encourage and esteem the athlete as he or she gradually recovers from the SRC and returns to sport.

Because no two SRCs are alike, there exists a wide range in recovery time from one instance of SRC to the next. A lack of understanding as well as inappropriate perceptions regarding how long rehabilitation for this specific injury should take may result in anxiety and frustration for both the athlete and the coach (Bloom et al., 2004). The SPC could be part of the team that helps educate the athlete and coach on the unique and individualized time frame of SRC recovery. Additionally, it would be advantageous for the sports medicine professional working with the athlete to inform him or her about the RTP guidelines that will be utilized and the gradual progression the athlete will be expected to perform before experiencing a complete recovery. Providing this information upfront can serve as feedback, which research demonstrates to be a valuable component of successful rehab (Evans & Hardy, 2002). Emphasizing the value of rest, withdrawal from stimulating environments, and practicing balanced health habits are important interventions that may be provided by the SPC as the athlete recovers from the SRC (Johnston et al., 2004).

In addition to the roles played by coaches, teammates, and sports medicine personnel, the sport psychology consultant (SPC) can offer unique services that may help identify, communicate, provide support, and educate athletes who have sustained a SRC or who are at an increased risk for minimizing and underreporting symptoms of this particular injury (Kontos et al., 2004). Previous research has demonstrated that particular groups of athletes (namely, male football, hockey, and soccer players) are subject to a culture of risk that negatively influences reporting SRCs and help-seeking behaviors (Cusimano et al., 2009; Guskiewicz et al., 2007; Kontos et al., 2004; Roderick et al., 2000; Steinfeldt & Steinfeldt, 2010; Thelwell et al., 2005). The previous literature,

coupled with the present study's aim to expand understanding of male and female soccer and lacrosse athletes' perceptions of these issues, could benefit the SPC and intervention strategies used to address these misconceptions and concerns to a wider spectrum of athletes. Knowledge regarding how best to target SRC education and intervention strategies to groups of athletes at all ages, genders, division levels, and types of sport should be an objective of future injury rehabilitation research. The present study seeks to expand the current literature with regard to such applied sport psychology considerations.

Summary

The complex nature of the SRC injury combined with the lack of universally accepted definitions, RTP guidelines, and consensus regarding long-term consequences make management of this injury “currently one of the most hotly debated issues in sports medicine” (Lovell, 2009, p.95). SRCs are a highly individualized injury with the potential for symptoms and side effects to vary from athlete to athlete. Adding to the difficulty in diagnosing a SRC is the fact that both physical and cognitive symptoms may not appear immediately after sustaining the injury and may take up to three days to fully emerge (Kontos et al., 2004). Additionally, SRCs are complicated by the ‘invisible’ nature of the injury, meaning there are no visually distinguishable features that clearly identify an athlete as concussed (Bloom et al., 2004). These factors combined make it possible for an athlete to fail to realize he or she had sustained a SRC and to potentially hide the occurrence of the injury from others.

Previous research has shown that a significant proportion of athletes both intentionally and unintentionally continue to play while experiencing concussive symptoms, placing them at an increased risk for receiving a second concussion and

sustaining potentially devastating short- and long-term effects (Bloom et al., 2008; Delaney et al., 2002; Kaut et al., 2003; McCrea et al., 2004). The literature has also shown that athletes of all ages are guilty of lacking the appropriate knowledge necessary to identify a SRC, thus increasing the likelihood that they will continue to play while experiencing symptoms (Bloom et al., 2008; Cusimano et al., 2009; Delaney et al., 2000; Kaut et al., 2003; McCrea et al., 2004). Bloom and colleagues (2008) highlight the need for research to explore and to educate athletes with regard to the lacking knowledge, inaccurate perceptions, and gender considerations that exist with the SRC injury. With that in mind, the present study examined areas of knowledge, perceptions, and gender differences as these factors influence reporting behavior of SRCs.

Chapter 3

METHODS

This chapter describes the methodology of the study in detail. The methods section is organized as follows: (a) subjects, (b) design, (c) measurement and procedures, and (d) data analysis.

Participants

Participants for the present study were sampled from ten different Division I and ten different Division III colleges and universities throughout the East Coast of the United States. Participants were male and female student-athletes currently participating as members of their respective Division I or Division III varsity soccer or lacrosse team. A total of 618 participants responded to the survey, but fewer than this number completed the necessary demographic portion of the survey. All participants were between 18 and 25 years of age ($M = 19.77$; $SD = 1.33$; $n = 601$) and had competed in their respective sport for an average of 10.97 years ($SD = 3.94$; $n = 588$). Females accounted for a larger percentage of the survey responses (59.5%, 357/600), compared to males (40.5%, 243/600). A total of 267 NCAA soccer (males $n = 110$; females $n = 157$), and 332 NCAA lacrosse (males $n = 132$; females $n = 200$) athletes from the Division I (males $n = 117$; females $n = 161$) and Division III (males $n = 123$; females $n = 193$) programs were represented. One hundred and seventeen ($n = 117$, 19.6%) of the Division I and 148 (24.8%) of the Division III participants competed in soccer, accompanied by 163 (27.3%) Division I and 168 (28.2%) Division III lacrosse athletes (see Figure 1). Of the 588 participants who reported their ethnicity, a majority of participants ($n = 548$, 88.5%) identified themselves as Caucasian. Other ethnic groups included African American

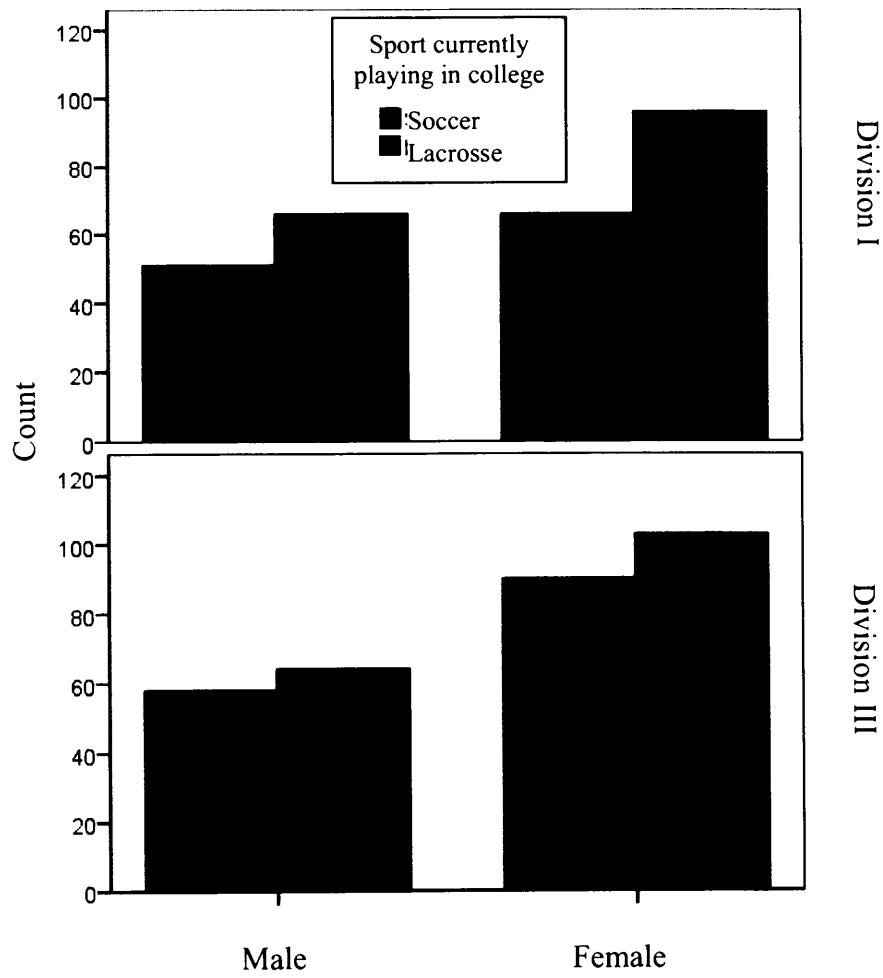


Figure 1. Description of Participants

($n = 10$, 1.6%), Hispanic or Latino ($n = 20$, 3.2%), Hawaiian or Other Pacific Islander ($n = 1$, 0.2%), or other/did not respond ($n = 31$, 5.0%). A majority of the participants were freshman, sophomores, or juniors in college (32.5%, 26.5%, and 22.0%, respectively), and a smaller proportion of respondents were seniors (14.1%) or fifth year redshirts (1.8%).

Design

The following was a descriptive survey study that compared knowledge and perceptions of SRC in multiple demographic groups. Groups included Division I and Division III athletes, soccer and lacrosse players, and male and female athletes. The study examined the influence of concussion-specific knowledge and concussion-related perceptions on the decision to report and seek treatment after sustaining a SRC. The study also examined the influence of gender on the likelihood of reporting SRC. Participants responded to certain survey questions based retrospective experiences with concussions, but a majority of the questions, (those assessing knowledge and perceptions), were based on the athletes' current opinions and understanding of SRC.

Measurements

The survey instrument utilized for the present investigation was adapted from two previously published studies that examined concussions in athletics. The purpose of the questionnaire was to establish a baseline comparison of SRC knowledge and perceptions between participants. Questions regarding SRC symptoms, situational mechanisms of injury, and methods of treatment were asked before a formal definition of a concussion was provided. This allowed the athlete an unbiased opportunity to answer what they thought symptoms of a concussion were. The remaining questions were answered after

the participant read the provided definition of a concussion. Those questions recorded the number of previous reported and unreported SRCs, reasons for not reporting SRCs, and the potential likelihood that one may sustain a SRC in their particular sport. Climate of risk was assessed by asking participants if they perceived SRC to be an injury with a moderate to high likelihood of occurring and if they perceived an expectation to minimize or downplay injury in their sport (refer to Appendix A).

The first part of the survey was a knowledge quiz adapted from a study examining Canadian youth hockey players', parents', coaches', and athletic trainers' knowledge of concussions in hockey (Cusimano et al., 2009). The second part of the questionnaire was modified from a study that examined the prevalence of reported and unreported concussions in male high school football players along with reasons why the athletes failed to report their SRCs (McCrea et al., 2004). Although a number of studies regarding concussions have been published in recent years, there are very few that included the precise quantitative and qualitative questions this study seeks to ask. In fact, only McCrea and colleagues' (2004) and Broglio and colleagues' (2010) studies utilized a questionnaire that included questions regarding athletes' reasons for failing to report SRCs. Cusimano and colleagues' (2009) study was one of the only studies to include a test of concussion knowledge. One other study (Setnik & Bazarian, 2007) examined potential factors in reporting concussions, but the focus of the study was more about the individual's experiences with concussions. Although important, questions such as "If you were knocked out, how long were you knocked out," and "What were you doing while this head injury occurred," were not useful in assessing the knowledge and perceptions aspect of concussions that the authors of this study wished to examine (Setnik &

Bazarian, 2007). For this reason, the present author combined qualities of the two appropriate surveys and modified the questions to suit the needs of this research.

Cusimano and colleagues' (2009) knowledge quiz was modified to exclude terms related specifically to hockey and was made more inclusive to other sports, including soccer and lacrosse. Questions were also rewritten to address both male and female participants (the original study only directed questions to male hockey players). Specific changes to the original survey include Question 2, which formerly stated, "A hockey player can get a concussion by..." (Cusimano et al., 2009, p. 319). The researcher changed choice 'c', "Hitting his head on the boards or ice," to "Hitting one's head on the ground, turf, grass, or gym floor." This modification was made the statement more pertinent to soccer and lacrosse athletes. Additionally, the author added a fifth option for this question that was not included in the original survey (choice 'd', "A hit to one's body" choice 'e' previously existed and was moved down to accommodate choice 'd'). While this option was not included in Cusimano et al.'s (2009) study, it is not always a direct hit to the head that results in a concussion. This type of head injury can occur from any mechanical force that may have an affect on the brain, including a hard hit to the neck, back, or trunk of one's body (Kaut et al., 2003). Choice 'c' of Question 5 in the original study was modified to include the term 'immediately,' ("Stop playing *immediately* and tell the coach or trainer"). The author felt as though the original phrasing of the statement, "Stop playing and tell the coach or trainer," was too vague because it did not give a time frame for when the athlete should stop playing (Cusimano et al., 2009). Question 12 in the original study ("When a player has a concussion, what may he feel like?") was modified from short answer format into a multiple-choice version of the

question addressing knowledge of symptoms (Cusimano et al., 2009). The author felt that a more quantitative means for assessing participants' knowledge would be easier, less time consuming, and more comprehensive than if participants were expected to type in sentences on their own volition. Participants' had the option of choosing "always," "sometimes," "never," or "I don't know," when provided with a list of potential symptoms. Quizzes were scored out of a total value of 19 points: one point was assigned to every correct response for Questions 1-6, a full point was assigned for a response of "sometimes" for question 7 a-m, and a half point was given for the response "always" for question 7 a-m (see Appendix A).

Modifications to the McCrea et al. (2004) questionnaire included deletion of the word "football" as well as a modification to the definition of a concussion. The definition was changed to fit the qualifications of a concussion as defined by the U.S. Department of Health and Human Services and the Centers for Disease Control and Prevention (CDC, 2010). The CDC's definition was included as opposed to McCrea et al.'s (2004) original definition because the researchers appreciated the more comprehensive description that included "bump, blow, or jolt" as opposed to the less encompassing definition of a concussion as "a blow" to one's head. Other modifications included the addition of a third choice after the question "Did you report your concussion to anyone?" (McCrea et al., 2004, p.17). The author of the present study included an option for "Not every time," to assess those athletes who may have a mixed history of reporting SRCs. The author also included an additional option to the question regarding why the athlete did not report the concussion. "Didn't want to appear 'weak'" was a choice that was added to consider potential climate of risk that may be associated within the sports of soccer and lacrosse.

The author added six additional questions that were not included in any previously published article to address perceptions of SRC. To date, no study has explicitly examined perceptions as they relate to the reporting of SRCs. Therefore, the author of the present study included three questions (numbers 12, 13, and 16) to assess the importance and reasons for reporting SRCs. Additionally, questions 14 and 15 were added to assess culture of risk and athletic identity that may influence athletes' injury reporting behaviors. Question 10 ("Hypothetically, if you did sustain a concussion during practice or competition, do you think you would report it?") was also added to include participants who may not have received a previous SRC, but whose opinion regarding the reporting of SRC was still of interest to the present researcher.

The demographic questions at the end of the survey categorized gender, age, ethnicity, year in college, sport played (to differentiate soccer players vs. lacrosse players), number of years playing sport (to quantify experience in sport), and current level of competition (to compare differences across Divisions I and III).

Procedures

After receiving institutional review board approval, the main author contacted the head coaches of the twenty women's and men's soccer teams (ten Division I, ten Division III) and twenty women's and men's lacrosse teams (ten Division I, ten Division III) via email to explain the purposes and procedure of the study (Appendix B). The coach was not required to provide contact information (email) of their players. The author simply asked that the coaches forward the email with the survey link to their athletes. The coaches and participants were reminded in the emails that their participation was voluntary and their responses would remain confidential.

Upon the coaches' approval and subsequent forwarding of the email to their players, the participants had six weeks to take the survey. The author sent reminder emails to all coaches at weeks two, four, and six requesting that they encourage their athletes to complete the survey. Kittleson (1997) reported that follow up emails in web-based surveys approximately double the response rate.

Consent was obtained when the participant accessed the online survey and was provided with a formal statement of informed consent (Appendix C). Participants indicated their understanding of the informed consent by hitting the 'continue' button to proceed with the survey. Participants were provided with the contact information of the principal researcher and her advisor before and after the survey were complete, as well as in the initial and follow up email to the coaches thanking them for their support and participation in the study. Coaches were also given the authors contact information and continued communication was encouraged should any questions or concerns arise before, during, or after the study was complete.

Data Analysis

The purpose of this study was to examine potential factors (knowledge, perceptions, and gender differences) that may influence the athlete's decision to seek treatment after sustaining a SRC. Additionally, the study sought to expand the literature regarding reasons why athletes may fail to report a SRC beyond the current literature (Broglia et al., 2010; McCrea et al., 2004) that supports lacking knowledge as the main deterrent. The hypotheses for the study were:

1. An increased level of SRC knowledge will result in an increased likelihood that the athlete will report sustaining this type of injury.

2. Participants' perceptions of SRC will influence reporting behaviors by:
 - a) Perceiving SRC to be an important injury worthy of reporting (Question 12) will decrease the likelihood that an athlete will have failed to report a prior SRC.
 - b) Perceiving SRC to be an injury with a moderate to high likelihood of occurring in one's sport (Question 13) will increase the likelihood that an athlete will report a SRC.
 - c) Perceiving a culture of risk in sport (Questions 14) and d) positively affirming athletic identity as an influential factor contributing to reporting behavior (Question 15) will increase the likelihood that an athlete will fail to report a prior SRC.
3. Males will have failed to report SRC more often than females.

All statistics were calculated using PASW Version 18.0 software (SPSS, Inc, 2009, Chicago, IL). Descriptive statistics were recorded for all participants and utilized for purposes of determining the participant's gender, sport played, and level of competition. Means and standard deviations of participants' age and number of years playing their sport were recorded. Logistic regression analysis examined the main effects of the predictor variables (knowledge and perceptions) on the criterion variable (failure to report SRC) (Hypothesis 1 and 2). With logistic regression, percentages and odds ratios were reported. Alpha level was set at .05.

Chi-square analysis compared groups of athletes (Division I to Division III, soccer to lacrosse, male to female [Hypothesis 3]) on their likelihood of reporting SRCs. An "enter" method of regression was utilized to compare these demographic variables to

the outcome variable of interest (failure to report) in model 2. An independent t-test was also used to compare groups of athletes who reported having prior experience with SRC and their scores on the knowledge quiz to groups of athletes with no previous history of concussions.

Summary

The following study examined factors (knowledge, perceptions, and gender differences, specifically) that may influence Division I and Division III soccer and lacrosse athletes' decision to seek treatment for a SRC. The hypotheses were 1) That increased level of knowledge regarding SRC would have a direct, positive impact on an athlete's decision to seek medical attention after sustaining this type of injury; 2) That participants would be more likely to report a SRC if they perceive concussions to be a serious injury worthy of immediate attention. Based on previous literature (Bloom et al., 2008; Dick, 2009), the author expected to find gender differences in the reporting of SRC, with the hypothesis 3) Female athletes will report SRCs more often than male athletes. To assess such factors, a modified Concussion in Soccer and Lacrosse Survey was utilized adapted from previous surveys given to amateur hockey and football athletes (Cusimano et al., 2009; McCrea et al., 2004). Chi-square analysis was used to compare groups of athletes (Division I to Division III, soccer to lacrosse, male to female) on their likelihood of reporting SRCs, and logistic regression analysis was run to examine the main effects of the predictor variables (knowledge and perceptions) on the criterion variable (reporting of SRC).

Chapter 4

RESULTS

Knowledge Quiz and Perceptions

All participants, regardless of previous concussion history, were included in a descriptive analysis of concussion knowledge and an examination of perceptions related to reporting behavior. Five hundred and seventy five (575) out of the original 618 participants completed all parts of the knowledge quiz, which were subsequently included in the analysis of SRC knowledge quiz scores. An independent t-test revealed significant differences in average quiz scores between male ($M = 16.59$, $SD = 2.25$, $n = 234$) and female ($M = 17.05$, $SD = 1.97$, $n = 343$) participants ($t(575) = -2.60$, $p < .05$). Significant differences ($t(572) = -2.92$, $p < .01$) were also demonstrated in the scores of participants who had previously sustained a concussion ($M = 17.13$, $SD = 2.04$, $n = 287$) compared to those with no prior history of the injury ($M = 16.61$, $SD = 2.13$, $n = 287$).

Almost all participants (99.3%, $n = 591$) responded that they thought it was important to tell someone if they had sustained a concussion, but over two thirds (68.2%, $n = 410$) reported that they felt an expectation for athletes in their sport to play through or “hide” symptoms of an injury. An even larger percentage (86.4%, $n = 520$) perceived that an athlete’s status on the team (i.e., starter versus non-starter, senior versus freshman) could influence an athlete’s decision to hide or minimize symptoms of a SRC. Almost 60% (57.5%, 347/604) of all participants felt that an athlete in their sport was at least moderately likely to sustain a SRC, and 33.4% (202/604) felt that there was a very high likelihood of an SRC occurring in their respective sport.

Prevalence of SRC and Reporting Behavior

Six hundred and three (603) out of the original 618 (97.6%) who initially responded to the survey completed the necessary concussion history section. Approximately half (50.6%, 305/603) reported sustaining at least one concussion in their lifetime. Because participants with no prior history of a concussion could not contribute to a predictive model examining reporting behavior, those participants ($n = 300$) were excluded from the subsequent analysis.

Significantly more SRCs occurred in soccer athletes than lacrosse athletes ($\chi^2 (1) = 6.96, p < .05$), although the percentage of athletes' in both sports who had previously sustained a SRC was high (54.7% in soccer, 45.8% in lacrosse). Of the concussions that had been experienced by this subset of participants, 83.6% (255/305) had occurred while participating in sport (SRC) compared to 39.3% (120/305) that had occurred outside of sport. Approximately 16% (48/305) within the previously concussed group admitted failing to report this injury every time it had occurred. A larger proportion of these participants (26.6%, 81/305) responded that they had reported this injury inconsistently (i.e., Not 'every' time). In total, 42.3 % (129/305) of the participants who had sustained at least one concussion had failed to report this injury once, compared to the 57.7% (176/305) who reported this injury diligently.

In response to the survey question assessing reasons why participants had previously failed to report a SRC, the most frequently cited response was that the athlete, "Didn't want to be pulled out of the game or practice" (43.2%, $n = 163$). This finding was followed closely by the second most common response, "Didn't think it was serious enough" (40.6%, $n = 153$). Approximately one third of the previously concussed

participants cited they, “Didn’t know it was a concussion” (32.6%, $n = 123$), followed by approximately a quarter who “Didn’t want to appear weak,” (23.9%, $n = 90$) and “Didn’t want to let down teammates/coach” (22.3%, $n = 84$) (See Table 1).

Hypotheses 1 & 2

In an attempt to address hypothesis one (*an increased level of SRC knowledge will result in an increased likelihood that the athlete will report the injury*) and two (*perceptions of SRC will influence reporting behavior*), logistic regression analyses were used to examine the main effects of the independent variables on the criterion variable (failure to report SRC). Independent variables in the regression model included score on the SRC knowledge quiz (a score value out of 19 points), perception of SRC as an important injury worthy of reporting (Y/N), perception of SRC an injury with a high likelihood of occurring in the participants’ sport (3 levels), perceived ‘culture of risk’ (expectation to play through or minimize injury in sport, Y/N), and perceived influence of playing status on reporting behavior (Y/N).

Alpha level was set at $p < .05$. Overall, 66.3% of cases in model 1 were correctly classified. The Hosmer and Lemeshow (1989) test was non-significant ($\chi^2(8) = 6.21, p = .62$) indicating adequate model fit. Model 1 accounted for 2.4 – 3.3 % of the variance, as indicated by the “Cox and Snell” and “Nagelkerke” approximate R-square values respectively. The independent variables of knowledge quiz score and perception of SRC relative to importance, likelihood, and the influence of playing status on reporting behavior did not contribute significantly to the model (see Table 2). Although the aforementioned variables had little predictive value, it is worthy to note that approximately 90% (257/284) of the previously concussed athletes reported that

Table 1.

Reasons Why Athletes' Failed to Report SRC. Responses are not mutually exclusive, as participants were asked to check all that apply

Reason why SRC was not reported	Percentage of Participants
Did not want to be pulled out of the game or practice	43.2
Did not think it was serious enough	40.6
Did not know it was a concussion	32.6
Did not want to appear 'weak'	23.9
Did not want to let down teammates/coach	22.3

Table 2.

Binary Logistic Regressions for Reporting Behavior – Model 1¹

	Odds	Likelihood ² (95% CI)	<i>p</i>	Wald χ^2
Knowledge ³	1.007	(0.915 – 1.107)	.894	0.018
Importance ⁴	0.000	(0.000)	.999	0.000
Likelihood (1) ⁵			.752	0.571
Likelihood (2) ⁶	1.318	(0.635 – 2.738)	.459	0.549
Likelihood (3) ⁷	1.210	(0.602 – 2.431)	.593	0.286
Expectation ⁸	1.782	(1.146 – 2.771)	.010*	6.579
Status ⁹	0.894	(0.486 – 1.644)	.718	0.130

* = $p < .05$

Note:

1. Model 1 includes only those participants who reported experiencing a concussion in the past and only the predictor variables of interest to test hypotheses one and two
2. Likelihood = Likelihood the athlete would fail to report a concussion
3. Knowledge = Knowledge quiz score (out of 19 points)
4. Importance = perception of SRC as an important injury worthy of reporting 0 (Y) or 1 (N)
5. Likelihood (1) = perception of SRC as an injury with a not very likely/no likelihood of occurring
6. Likelihood (2) = perception of SRC as an injury with a moderate likelihood of occurring
7. Likelihood (3) = perception of SRC as an injury with high likelihood of occurring
8. Expectation = ‘Culture of risk’; expectation of athletes in sport to play through injury or “hide” symptoms of an injury (culture of risk) (Y/N)
9. Status = perception that status on a team (e.g. starter versus non-starter, senior versus freshman) influences reporting (Y/N)

they felt a concussion was very likely to moderately likely to occur and about 88% (250/284) responded that they believed 'status' (such as senior versus freshman, starter versus non-starter) influenced an athletes' decision to hide symptoms of a SRC. Additionally, less than 1% (2/284) of athletes responded that they did not believe it was important to report a SRC. However, perceived culture of risk was the only significant component to the model, such that the odds of failing to report a concussion were almost doubled (odds ratio [OR] = 1.78) if the athlete perceived a culture of risk to play through or minimize symptoms of an injury.

Hypothesis 3

Gender differences were found between males and females with regard to previous concussion experience, with male athletes sustaining more SRCs than females ($\chi^2 (1) = 9.89, p < .01$). This trend was found in lacrosse athletes specifically, with males sustaining more SRCs than females ($\chi^2 (1) = 9.45, p < .01$). There were no significant differences in male and female soccer athletes relative to SRC incidence rates ($\chi^2 (1) = 1.81, p < .18$). To address hypothesis three (*male athletes will have failed to report SRC more often than female athletes*), a chi-square analysis revealed no significant association between gender and reporting behavior in participants with previous concussion history, ($\chi^2 (1) = .31, p = .58$). However, significant associations were found between type of sport ($\chi^2 (1) = 6.74, p < .01$) and division level ($\chi^2 (1) = 5.05, p < .05$) on reporting behavior. Therefore, a second round of regression analyses were run to include the demographic variable of interest (gender), type of sport (2 levels), division level (2 levels), and age in addition to the five independent variables previously included in the original models. The inclusion of these additional variables improved the predictive value

of model 1. Odds ratio, significance values, confidence intervals and Wald's χ^2 were reported (see Table 3).

Sixty nine percent (69.4%) of cases in model three were correctly classified with the inclusion of the additional independent variables. The Hosmer and Lemeshow (1989) test for model three was non-significant ($\chi^2 (8) = 5.12, p = .75$) indicating adequate model fit. With the addition of the demographic variables, the amount of explained variance for model three increased to 13.0% - 18.0% as indicated by the Cox and Snell and Nagelkerke approximate R-square values.

When all variables were included in the regression model, perception of a culture of risk, age, sport, and division level became significant predictors influencing reporting behavior. The odds of an athlete who perceived a culture of a culture of risk in sport to minimize or hide symptoms of an injury increased to 2.12 in this model ($\Delta OR = 0.34$). Additionally, an increase in age by one year increased the likelihood of the athlete failing to report a concussion by a factor of 1.39. The odds of an athlete failing to report a concussion was almost two and a half times greater ($OR = 2.40$) if the participant played lacrosse compared to an athlete who played soccer. The odds of failing to report were almost three times greater (2.91) if the athlete played Division III sports over competing at the Division I level. Post-hoc analysis of the demographic variables compared rates of unreported SRCs in lacrosse and Division III athletes stratified by gender. No significant differences were found between the genders in lacrosse athletes' reporting behavior ($\chi^2 (1) = 0.01, p = .91$), but significantly more male than female Division III athletes were guilty of failing to report their SRCs ($\chi^2 (1) = 8.04, p < .01$) (see Figure 2).

Table 3.

Binary Logistic Regressions for Reporting Behavior – Model 2¹

	Odds	Likelihood ² (95% CI)	<i>p</i>	Wald χ^2
Knowledge ³	0.973	(0.878 – 1.078)	.600	0.275
Importance ⁴	0.000	(.000)	.999	0.000
Likelihood ⁵			.630	0.924
Likelihood ⁶	1.460	(0.672 – 3.173)	.339	0.914
Likelihood ⁷	1.317	(0.631 – 2.751)	.463	0.538
Expectation ⁸	2.120	(1.309 – 3.433)	.002**	9.334
Status ⁹	0.862	(0.430 – 1.730)	.677	0.174
Age ¹⁰	1.390	(1.177 – 1.641)	.000**	15.122
Gender ¹¹	0.904	(0.591 – 1.383)	.641	0.218
Sport ¹²	2.403	(1.557 – 3.708)	.000**	15.676
Division ¹³	2.902	(1.870 – 4.504)	.000**	22.582

* = $p < .05$, ** = $p < .01$

Note:

1. Model 2 includes the original predictor variables with the inclusion of the demographic variables of interest
2. Likelihood = Likelihood the athlete would fail to report a concussion
3. Knowledge = Knowledge quiz score (out of 19 points)
4. Importance = perception of SRC as an important injury worthy of reporting 0 (Y) or 1 (N)
5. Likelihood (1) = perception of SRC as an injury with a not very likely/no likelihood of occurring
6. Likelihood (2) = perception of SRC as an injury with a moderate likelihood of occurring
7. Likelihood (3) = perception of SRC as an injury with high likelihood of occurring
8. Expectation = ‘Culture of risk’; expectation of athletes in sport to play through injury or “hide” symptoms of an injury (culture of risk) (Y/N)
9. Status = perception that status on a team (e.g. starter versus non-starter, senior versus freshman) influences reporting (Y/N)
10. Age = range from 18-25
11. Compared males (0) to females (1)
12. Compared soccer (0) to lacrosse (1)
13. Compared Division I (0) to Division III (1) athletes

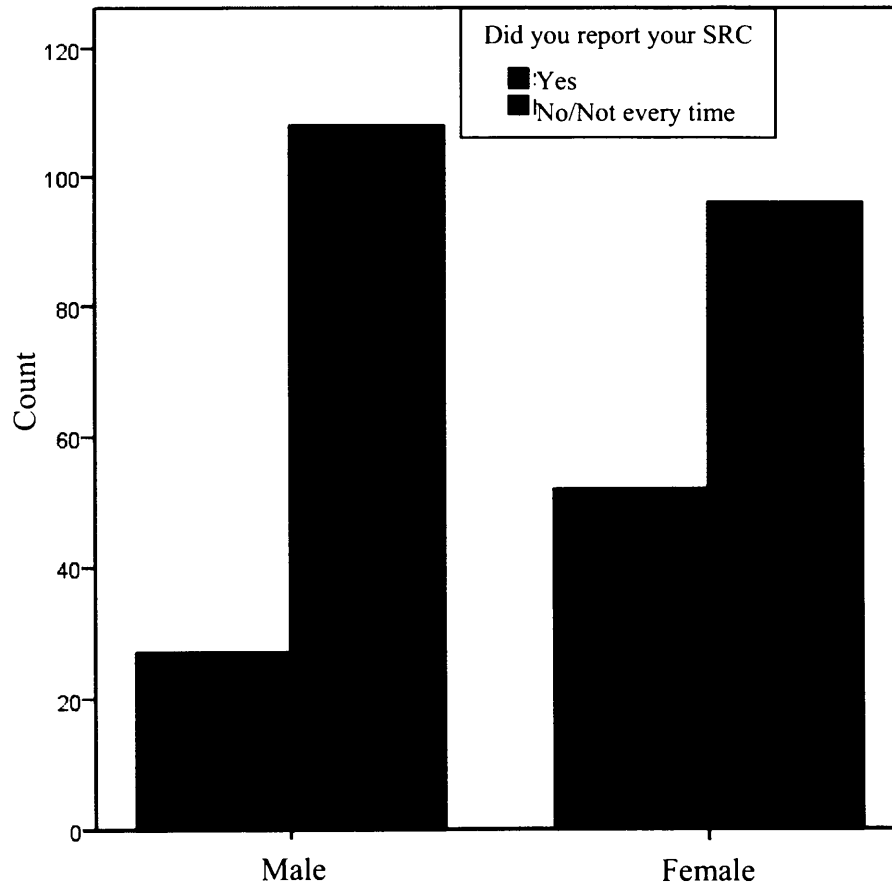


Figure 2. Gender Differences in Division III Reporting Behaviors

Summary

Out of six hundred and three (603) participants who completed all parts of the survey, approximately half (50.6%, 305/603) reported sustaining at least one concussion in their lifetime. Rates of reported (57.7%, 176/305) and unreported (42.3 %, 129/305) concussions were calculated, as well as reasons why athletes failed to report SRCs. Not wanting to be withheld from competition or practice (43.2%) and not thinking the injury was serious enough (40.6%) to report were the most popular justifications. Average scores on the knowledge quiz were consistently high for athletes both with (90.2%) and without (87.4%) previous concussion history. Logistic regression analysis examined the main effects of the predictor variables (knowledge, perceptions) on the criterion variable (failure to report SRC), and also examined the influence of demographic characteristics (gender, age, sport played, division level of competition) on increasing the prediction of reporting behavior ($p < .05$). Perceiving an expectation to play through or minimize injury in sport ('culture of risk') approximately doubled the odds that an athlete would fail to report a SRC. Increasing age increased the likelihood of the athlete failing to report a concussion by a factor of 1.39. Chi-square tests revealed no significant association between the genders on failure to report a SRC, but significant differences between type of sport (lacrosse) and division level (Division III) increased the likelihood of failure to report. Post-hoc analysis revealed no gender differences with regard to failure to report SRC in lacrosse, but significantly more Division III male athletes failed to report concussions than females.

Chapter 5

DISCUSSION

The purpose of the present study was to examine specific factors, namely knowledge, perceptions, and gender differences that may influence athletes' self-report of their sport related concussions (SRCs). In response to Kaut and colleagues' (2003) call for research to place a greater emphasis on understanding concussion injury outcomes, the present study sought to expand the literature by examining the influence of psychological factors, (specifically culture of risk and athletic identity), and demographic characteristics, (namely gender, type of sport, and division level of competition), with regard to potential influence on reporting behavior. Additionally, the study intended to investigate reporting behavior in two relatively unexamined high to moderate collegiate contact sports (soccer and lacrosse), which the previous concussion literature has failed to devote significant attention.

Out of the 50.4% (305/605) participants who reported sustaining a previous concussion, a majority of the participants (83.6%, 255/305) stated that their concussions had occurred while participating in their respective sport of soccer or lacrosse. In comparison, a lesser percentage (39.3%, 120/305) reported receiving a concussion outside sport. However, the concussions received outside of sport were included in the present analysis of reporting behavior for two reasons. One, participants' responses for where their previous concussions had occurred (either within sport or outside of sport) were not mutually exclusive, as participants were asked to reference all prior concussion experiences when responding to the question that served as the outcome variable of interest ("Did you report your concussion to anyone?" [Yes, No/Not every time]).

Second, there is the argument that concussions which occur outside of ones' immediate sport season still places an athlete at risk for continuing to play through symptoms in sport (Delaney et al., 2002). The author felt that even a concussion sustained outside of ones' immediate sport still held the potential for the athlete to 'play through' symptoms and/or fail to report this injury to appropriate medical and/or coaching personnel (e.g. an athlete sustained a concussion on the weekend 'outside' of sport, but then returned to practice on Monday while symptomatic).

The relatively high occurrence of SRCs in the present population (42.3%, 255/605) reflects the recent upward trend in SRC occurrence rates across all sports, regardless of the sports' contact classification category (i.e., collision, contact, or non-contact sport) (Bloom et al., 2008). A general belief maintained by most sports medicine personnel is that the current incidence rates of SRCs inaccurately reflects the true number that occur in athletics each year (Broglia et al., 2010; Langlois et al., 2006; McCrea et al., 2004). This position was supported in the present analysis. Although a minority of previously concussed participants admitted failing to report their injury every time it had occurred (15.7%, 48/305), a larger proportion of these participants (26.6%, 81/305) admitted failing to report this injury consistently (i.e., Not 'every' time). The relatively small-to-moderate contrast between those athletes who reported their concussions diligently (57.7%, 176/305) and those who failed to report a concussion at least once (42.3%, 129/305), is alarming. These findings parallel those of the McCrea and colleagues' (2004) study with high school football athletes, which revealed slightly less than half (47.3%) of the participants reported their SRC (McCrea et al., 2004). Results from the present study coupled with findings from previous research (Delaney et al.,

2000; Delaney et al., 2002; Kaut et al., 2003; McCrea et al., 2004) reiterate the need to address why athletes are either intentionally or unintentionally failing to report SRCs and continuing to play while experiencing concussive symptoms.

A majority of literature to date emphasizes a lack of comprehensive knowledge pertaining to concussion symptoms and the risks associated with continuing to play through injury as the most likely reason why athletes fail to report SRCs (Delaney et al., 2002; Kaut et al., 2003; McCrea et al., 2004). The present study simultaneously did and did not support this claim. The third most cited reason why participants' failed to report their injury was that the athlete did not know it was a concussion at the time the injury occurred (32.6%, 123/305). This number is reflective of previous research that demonstrated between 20% (Delaney et al., 2002) to 36% (McCrea et al., 2004) of athletes who failed to report a SRC did so because they were unable to connect the presence of their symptoms to having a concussion. However, lacking awareness was not the most frequently cited reason why athletes in the present study failed to report a SRC, nor was knowledge a significant factor in predicting subsequent reporting behavior (Wald $\chi^2 = 0.018, p = .894$). Therefore, results from the present analysis suggest that other factors (i.e., perceived culture of risk, falling into certain demographic categories) may play a more influential role than acknowledging symptoms in an athletes' decision to seek treatment.

The mean scores on the concussion knowledge quiz (out of 19 points) were relatively high for both groups with ($M = 17.13, SD = 2.04$) and without ($M = 16.60, SD = 2.16$) prior history of concussions, indicating most college athletes possess adequate knowledge of concussion symptoms. Although these results may call into question how

reflective knowledge quiz scores are relative to participants' knowledge, the legitimacy of utilizing a short questionnaire to measure knowledge of concussion symptoms has been validated in previous research with similar aged-populations (Cusimano et al., 2009; Kaut et al., 2003). Also, the original survey from which the present knowledge quiz had been adapted was developed through extensive literature review, expert review, content blueprinting, and pilot testing (Cusimano et al., 2009). Therefore, a conclusion drawn from the current findings suggest that college-aged athletes, contrary to previous research, understand the symptoms of a SRC to a fairly high degree. The findings also suggest that despite statistically significant differences between results on the knowledge quiz in athletes with and without a prior history of concussions ($t(573) = -3.04, p < .01$), the average level of knowledge in both groups is relatively similar (and accurate). No studies to date that have assessed athletes' concussion knowledge have compared groups with and without previous concussion experience. It is likely that athletes with previous SRCs scored higher on the knowledge quiz because of their personal experience identifying symptoms. Perhaps these athletes were educated more extensively by athletic trainers or other medical professionals as a result of receiving treatment for their prior injury. It is also possible that athletes who have previously experienced SRC symptoms learned more about this injury from talking to fellow teammates, coaches, or friends, which allowed them to identify symptoms and appropriate behavioral responses more readily than athletes with no prior concussion experience.

The discovery that knowledge quiz scores did not significantly predict reporting behavior is contrary to what was hypothesized. What this finding suggests is similar to the implications of the Health Belief Model (HBM) in social learning theory, which is

founded on the idea that behavior change will only occur once an individual believes the perceived severity of a susceptible health condition warrants a change in behavior (Rosenstock, Strecher, & Becker, 1988). This argument coincides with the second most popular response for failing to report a SRC: “Did not think it [the concussion] was serious enough” (40.6%, 153/305). Perhaps simply knowing the symptoms and potential risks are not enough to deter athletes from continuing to play while symptomatic. Additionally, it is possible that participants’ did not realize they had experienced a SRC at the time the injury initially occurred (hence the third most popular response, “Did not know it was a concussion”) but have since become more knowledgeable (as reflected in relatively high scores on the concussion knowledge quiz). Heightened awareness and increased visibility of this particular injury in sport over recent years (Broglia et al., 2010) may account for this shift demonstrated in the present population. The number one reason why athletes failed to report a concussion was due to a competitive factor that compelled the athlete to continue playing in the game, despite knowing she or he had sustained a SRC. The finding that over 40% of previously concussed athletes failed to report their SRC because they “Didn’t want to be pulled out of the game or practice” (43.2%, 163/305) and/or did not think the injury was serious enough (40.6%, 153/305) parallels the results of the Broglia and colleagues’ (2010) study with professional Italian soccer athletes and the McCrea and colleagues’ (2004) study with high school football players. Considering the finding that positively affirming an expectation to play through or hide symptoms of an injury was the only significant factor in the original model predicting failure to report (Wald $\chi^2 = 6.58, p < .05$), there may be an internalized acceptance of risk taking and of sustaining and playing with injuries in sport that adds to

the picture of why athletes are failing to report SRCs. It is also possible that athletes' responses ("Did not think 'it' [the concussion] was 'serious enough' to report") is reflective of this culture of risk mentality. Previous researchers (Broglio et al., 2010; McCrea et al., 2004) have attributed this response as merely a reflection of athletes' lacking knowledge related to the significance of the concussion injury. However, because the present analysis demonstrates an internalized expectation to downplay injury as the only significant non-demographic factor predicting reporting behavior, it may be possible that athletes are interpreting the statement to mean something different. Perhaps choosing this response is more reflective of a culture of risk than it is reflective of lacking adequate knowledge of the concussion injury.

Adding to this argument is the finding that over 99% of all athletes (591/595) responded that they felt it was important to tell someone if they sustained a concussion. This could indicate that athletes know a SRC should be reported, but as demonstrated in the present study, are failing to do so for other reasons. However, this may also mean that athletes lack education with regard to the seriousness of brain injury and the long-term damage SRCs could potentially cause. The present knowledge quiz did not test for extensive understanding of long-term impacts of SRCs, only understanding of the symptoms, potential mechanisms of injury, and what an athlete should do if symptoms were present. Future research should consider examining athletes' reporting behavior and knowledge of potential damaging effects of even 'minor' SRCs that athletes may not typically believe to be 'serious.' Perhaps a study such as this could more explicitly compare lacking awareness of long-term severity and culture of risk as deterrents to reporting SRCs.

When the regression model was expanded to include demographic variables of interest, age was another factor predictive of whether an athlete would fail to report the SRC. Specifically, there was almost a one and a half (OR = 1.39) times greater odds that an athlete would fail to report a concussion with every one year increase in age. This trend to acknowledge age as a predicative factor over time has not been examined in previous literature to date. Although the finding may seem counterintuitive, it potentially supports an increasing internalized acceptance of sustaining injury throughout the college years, which actually places the athlete at a greater risk for minimizing symptoms of a SRC, despite being knowledgeable of the consequences. There may also be an increasing pressure for older athletes to continue to play through injury, since their window of opportunity to play collegiate sport decreases with every successive year.

Although the question attempting to assess the influence of athletic identity (“Do you think ‘status’ such as senior versus freshman, starter versus non-starter influences the decision to hide or minimize symptoms”) resulted in a non-significant contribution to the model predicting reporting behavior, what is interesting to note is that almost 90% (250/284) of previously concussed participants responded ‘yes,’ they believed athletic identity to play a role in such behavior. As with the other predictor variables attempting to assess culture of risk and perceived importance, the responses by athletes with previous concussion experience were overwhelmingly in favor of affirming that they perceived these factors to contribute to reporting behavior. The finding that three out of the four predictors assessing psychological variables influencing reporting behavior were so overwhelmingly stated in the affirmative may have detracted from the predictive power of these variables in the subsequent regression model. While issues related to

status have been demonstrated in professional sporting arenas and with little specificity to concussion injuries (Flint, 1999; Guskiewicz et al., 2007; Nixon, 1993; Roderick et al., 2000), no other study to date has attempted to explicitly assess the influence of culture of risk or athletic identity with regard to SRC reporting behavior. The items used to assess these variables in the present study were created by the author for exploratory analysis. The current investigation highlights a potential need for future research to examine the influence of culture of risk and athletic identity specific to SRC reporting behavior utilizing more reliable and valid measures.

Perceiving an expectation to play through or “hide” symptoms of an injury in one’s respective sport was found to more than double the odds that a previously concussed athlete had failed to report a concussion. While other research has demonstrated a similar propensity for athletes’ to internalize this expectation at varying levels of competition (Nixon, 1993; Roderick et al., 2000; Safai, 2003), this was the first study to explicitly examine the contribution of this belief specifically to predicting reporting behaviors of the concussion injury. Other concussion studies have discussed a potential culture of risk associated with a fear of being withheld from competition as a main deterrent affecting reporting behaviors (Broglia et al., 2010; Cusimano et al., 2009; Delaney et al., 2002; McCrea et al., 2004), but no research to date has compared the predictive influence of this expectation on subsequent reporting behavior and compared it to the predictive influence of knowledge. The present finding implicates the significance of a perceived culture of risk in collegiate athletics as more influential in determining failure to report a SRC than knowledge of concussion symptoms and appropriate behavioral responses.

The present study furthers the debate as to which gender is more likely to fail to report a SRC. Although males in this sample did sustain more SRCs than females ($\chi^2(1) = 9.89, p < .01$), the present study found no significant differences in reporting behavior between the genders across both sports. This contrasts Bloom and colleagues' (2008) study, which found male athletes to both sustain and underreport SRCs more often than females. However, males did score significantly lower than females on the concussion knowledge quiz, supporting the argument that discrepancies in reporting behavior between the genders could be attributed to a differential understanding of the injury (Bloom et al., 2008). A unique finding from the analysis did suggest a significant difference in reporting behavior between male and female Division III athletes (see subsequent paragraph). However, because this was only the fourth study to specifically examine reporting behavior in college athletes and the first to suggest knowledge of symptoms as a non-significant deterrent, further investigation is needed to explore the potential differences in reporting behavior between male and female college athletes.

The present study was the first to examine reporting behavior in the sport of lacrosse. Previous research has focused predominantly on reporting behavior in American football and soccer (Broglia et al., 2010; Delaney et al., 2002; Kaut et al., 2003; McCrea et al., 2004). This was also the first study to compare reporting behavior in college soccer and lacrosse athletes. The odds of a lacrosse athlete failing to report a concussion was almost two and a half times greater than the odds of a soccer athlete failing to report a previous SRC. Although prevalence of SRC incidence was more frequent in soccer players ($\chi^2(1) = 3.96, p < .05$), the finding that more lacrosse than soccer athletes had failed to report a concussion could implicate a culture of risk specific to lacrosse that

encourages these athletes to minimize SRCs more so than soccer athletes. Lacrosse is considered a more physically aggressive sport relative to soccer due to the frequent contact that is encouraged, and in many cases required, by game play. Lacrosse is more analogous to football and hockey, in that athletes are conditioned for strength and speed, compared to soccer, which trains primarily for lower body strength, endurance, and does not promote heavy body contact. The rules of men's lacrosse, in particular, allow for checking and forceful hits to players' bodies which may encourage a culture that promotes playing through pain and downplaying the severity of injuries. Soccer is not exposed to the same high impact collisions on a regular basis as dictated by the rules of play. Additionally, no significant differences were found between male and female lacrosse athletes' reporting behavior, indicating the sport in general demonstrates a higher propensity than soccer to minimize or hide instances of SRC.

The present study was the first to specifically investigate the difference in SRC reporting behavior between Division I and Division III athletes. The findings suggest that the odds of a Division III athlete failing to report a SRC are almost three times greater than the odds that a Division I athlete would fail to report this injury. Despite reports that Division I athletes are more likely to experience a SRC (Hootman et al., 2007), this may simply be due to an increased exposure to injury over the course of one academic year. Although Division I athletes spend more time participating in their sport relative to Division III athletes, the present findings suggest that the increased exposure rate does not automatically result in an increased likelihood that an athlete would fail to report a SRC. On the contrary, Division III athletes, who numerically participate in less hours of organized competition over the course of the academic year, appear to report SRCs less

often than their Division I counterparts. There may be other variables, previously unaccounted for, that would increase the likelihood that a Division III athlete would fail to report a SRC. Lack of accessibility to certified athletic trainers in the off-season and larger staff to athlete ratios at the Division III level may be contributing to the discrepancy, although further examination is needed to help explain these results. It is also interesting to note that significantly more male than female Division III athletes failed to report their SRCs, implying potential gender role expectations specific to the culture of sport in Division III athletics that influences reporting behavior in males at this level of competition.

The current interpretations of results are limited by a number of factors inherent with survey research. Because participant responses regarding prior concussion history were gathered retrospectively and relied on self-report, failure to account for all prior instances of SRC and/or overestimating the number of previous SRCs was possible. Previous research has mentioned the sensitivity of the chosen definition of ‘concussion’ (Kaut et al., 2003; McCrea et al., 2004) in influencing the way athletes’ self-report prior concussion experiences. Although the definition used in the study was the most recent definition presented by the Centers for Disease Control and Prevention (CDC, 2010), it is possible that athletes’ may have interpreted their past potential concussions more or less stringently because of the phrasing. The knowledge quiz utilized in the present investigation was not the most encompassing or highly technical evaluation of concussion knowledge; however, the purpose of this study was not to scrupulously investigate the extent of college athletes’ knowledge of concussion symptoms. This is not to say college athletes are experts at understanding the intricacies of this injury, nor are

they fully aware of the long- and short-term impacts of a SRC. However, the present study demonstrates that Division I and Division III soccer and lacrosse athletes' possess, at least to a fairly high degree, sufficient knowledge that would allow a majority to recognize sustaining a SRC if symptoms were present. Future research should consider examining athletes' reporting behavior in isolation with a knowledge quiz that tests for accurate understanding of the severity and seriousness of this injury. This may help clarify the reason why athletes are responding that they underreport SRCs because they are not 'serious' enough injuries worthy of reporting. Research may also want to consider expanding the present study to include a more diverse sample, as the participants from the present study represented a dominantly Caucasian demographic. It would be appropriate for future research to examine a more diverse ethnic and cultural sample in efforts to make the results more generalizable to the larger athletic population.

Due to the finding that only about 18.0% of the variance in failure to report SRCs could be explained by the examined variables of interest, there may be limits to how reflective the predictive value of the present regression model is to the larger athletic population. However, cell sizes were relatively small in three out of the four questions assessing perceptions in this previously concussed group, which may have detracted from the significance of their predictive effect. Specifically, 90% of the previously concussed athletes (257/284) reported that they felt a concussion was very likely to moderately likely to occur, compared to only 9.5% (27/284) who responded they felt a concussion was not very to not at all likely to occur while participating in soccer or lacrosse. Less than 1% (2/284) of athletes responded that they did not believe it was important to report a SRC, and only 12.0% (34/284) of participants responded that they did not believe

'status' (such as senior versus freshman, starter versus non-starter) influenced athletes' decision to hide symptoms of a SRC. The limited responses refuting the survey questions call into question a) the effectiveness of the questions' abilities to assess athletic identity, culture of risk, and perceptions of SRC, and b) if these beliefs are truly pervasive across a wider range of college athletes. This was the first study to attempt to assess these variables on self-reporting of SRCs specifically within the collegiate population. Future studies should consider exploring other avenues, particularly culture of risk and demographic vulnerabilities that may also influence an athletes' decision to report a SRC. A more valid and reliable measure of athletic identity and culture of risk is suggested for future research to increase the amount of explained variance in a similar model.

The present study does not suggest that college athletes perfectly understand the complexities and dangers associated with concussions. Nor is it refuting previous research that found lacking knowledge to be a significant contributor to the failure to report this injury. The author's intention was to expand what is currently known about predispositions for reporting SRCs and to compare risk factors by examining their predictive value. This study does suggest that other, previously unexamined variables might impact reporting of SRCs. Specifically, perceiving a culture of risk to minimize or downplay symptoms of an injury, participating in lacrosse, and competing at the Division III level were shown to increase the likelihood that an athlete would fail to report a SRC. This was the first study to attempt to quantify an influence of culture of risk, athletic identity, and/or misconceptions of the concussion injury that previous research has mentioned in discussion (Bloom et al., 2008; Broglio et al., 2010; Cusimano et al., 2009; Gessel et al., 2007; McCrea et al., 2004).

Summary

The current research suggests that lacking knowledge, once previously believed to be the hallmark factor influencing SRC reporting behavior, may not be as important as a perceived expectation to minimize or downplay symptoms of an injury. Additionally, demographic vulnerabilities such as increasing age, participating in the sport of lacrosse, and competing at the Division III level may increase the likelihood that an athlete will fail to report a SRC. The predictive significance of the aforementioned demographic vulnerabilities also support the argument that a culture of risk specific to age, sport played, and level of competition is a factor influencing athletes' decision to report, although a complete understanding of what variables increase the likelihood that an athlete will report their SRC has not been accomplished. The current investigation is limited by a number of factors inherent with survey research, including relying on athlete self-report of prior SRCs, a knowledge quiz that did not extensively examine the severity of the concussion injury, and an author-generated attempt to assess culture of risk and athletic identity specific to reporting behavior.

Chapter 6

SUMMARY, CONCLUSIONS, AND RECOMMENDATIONS

Summary

This study examined influences that predict reporting behavior in Division I and Division III soccer and lacrosse athletes. Six hundred and eighteen ($n = 618$) participants responded to an online survey that intended to evaluate knowledge of concussive symptoms, appropriate behavioral responses upon sustaining this injury, previous experience with SRCs, and prior reporting behavior. Independent t-tests revealed significant differences on knowledge quiz between groups with and without prior history of SRC, although average scores were fairly high for both groups. Subsequent data analyses were conducted on the 305 athletes who had previously sustained a concussion.

The most common reason why an athlete failed to self-report a SRC was that they did not want to be removed from the game or practice, followed closely by a perception to disregard the injury as serious. Logistic regression analysis revealed minimal explained variance in reporting behavior when including the predictor variables of knowledge quiz score, perception of SRC as an important injury worthy of reporting, perception of SRC as an injury with a high likelihood of occurring in the participants' sport, perceived expectation to play through or minimize injury in sport, and perceived influence of playing status on reporting behavior. In this model, only perceiving a 'culture of risk' (expectation to play through or minimize injury in sport) significantly predicted that an athlete would fail to report a SRC.

In contrast to previous literature (Bloom et al., 2008), chi-square analysis revealed no significant association between gender and reporting behavior in participants with

previous concussion history. However, significant differences did exist between type of sport and division level of competition on reporting outcomes. A second logistic regression that included the aforementioned predictor variables of knowledge and perceptions in conjunction with gender, sport, division, and age accounted for a larger percentage of the explained variance and correctly classified more cases than the initial model. Specifically, the odds that an athlete would fail to report a concussion more than doubled if that athlete perceived a culture of risk to minimize or hide injury. The odds of failing to report were almost two and a half times greater if the participant played lacrosse over soccer and almost three times greater if the athlete played Division III sports over competing at the Division I level. Interestingly, increasing age also predicted failure to report, such that an increase in age by one year increased the likelihood of the athlete failing to report a concussion by a factor of 1.39.

Although not all of the original hypotheses were supported by the subsequent data analyses, there does appear to be an interesting interaction between knowledge regarding SRCs as serious combined with a perceived culture of risk to downplay the severity of an injury. Division I and Division III soccer and lacrosse athletes appear to be fairly knowledgeable about concussive symptoms and appropriate behavioral responses upon sustaining this injury. However, where athletes may lack specific knowledge is with regards to the potential devastating and harmful effects of even a 'minor' concussion that the athlete may perceive to be non-threatening. This was the first study to examine the predictive value of knowledge in combination with other variables that may potentially influence reporting behavior in college athletes. This was also the first study to attempt to quantify the influence of a culture of risk and athletic identity on reporting behavior.

Conclusions

The results of this study yielded the following conclusions:

1. Athletes' knowledge of concussion symptoms do not significantly predict likelihood of failing to report this injury, although a lack of knowledge pertaining to the significance of this injury may play a role.
2. Perceiving a culture of risk in sport to minimize or hide symptoms of an injury does increase the odds that an athlete will fail to report a SRC.
3. Demographic characteristics including an increase in age, playing lacrosse, and competing at the Division III level appear to increase the likelihood than an athlete will fail to report a SRC.
4. A complete understanding of why athletes are either intentionally or unintentionally failing to report SRCs and continuing to play with symptoms has not been achieved.

Recommendations

The following recommendations for further study were made after the completion of this investigation:

1. Continue to promote SRC education, but specifically target the misconception that there is such a thing as a 'minor' or 'non-serious' SRC. Future prevention initiatives may want to address this misconception as much as programs that simply seek to heighten visibility of the injury.
2. Consider examining athletes' reporting behavior and knowledge of potential damaging effects of even 'minor' SRCs that athletes may not typically believe to be 'serious.' Perhaps a study such as this could more explicitly compare lacking

awareness of long-term severity and culture of risk as deterrents to reporting SRCs.

3. Coaches, athletic trainers, parents, educators, and the media can contribute to reversing the cultural phenomenon that glorifies athletes who play through injury. Discourage athletes to play through concussive symptoms and heighten awareness about the devastating consequences of former athletes who have failed to report SRCs or played with the injury.
4. Continue to investigate the potential influence of athletic identity on reporting behavior, as an overwhelming amount of responses from participants' in the present study affirmed this to be a contributing factor. The finding that three out of the four predictors assessing psychological variables influencing reporting behavior were so overwhelmingly stated in the affirmative may have detracted from the predictive power of these variables in the subsequent regression model, therefore another means for assessing their significance on reporting behavior may be advisable. The current investigation highlights a potential need for future research to develop more reliable and valid athletic identity and culture of risk measures to examine the influence of these variables specific to SRC reporting behavior.
5. Consider examining reporting behavior of SRCs from a Health-Belief Model (HBM) orientation. As the present study indicates, athletes are aware of symptoms and behaviors one should engage in upon sustaining a potential SRC, yet they are continuing to fail to report this injury. The HBM is founded on the idea that behavior change (e.g., reporting behavior) will occur only after an

individual believes they are a) susceptible to sustaining the ailment and b) perceive the severity of that condition warrants a change in behavior (Rosenstock et al., 1988). Although the perceived susceptibility was demonstrated in the present population (as demonstrated by over 90% of the previously concussed athletes who felt a concussion was very likely to moderately likely to occur), it appears the perceived severity of this injury as a dangerous threat is lacking (over 40% believing a SRC was not 'serious enough' to report).

6. Promote further investigation of SRCs in soccer and lacrosse, two sports that are relatively ignored compared to American football. Although high-collision sports such as football, rugby, boxing, and hockey tend to attract concussion researchers' interest, the present analysis reveal that SRCs are common occurrences in soccer (54.7% of all soccer participants) and lacrosse (45.8% of all lacrosse participants) as well. Considering soccer is the most popular sport internationally (Broglia et al., 2010) and lacrosse is one of the fastest growing sports in the United States (Dick et al., 2007a; Dick et al., 2007b), it may be beneficial for future research to target promoting SRC awareness specifically in these sports (i.e., specifically addressing the 'culture of risk' that may or may not permeate these sports differentially).
7. Continue to identify specific demographic variables that may influence failure to report SRCs. Based on the current study, a suggestion for future research would be to examine reporting behavior specifically in Division III male athletes. There appears to be a predisposition for athletes in this category to fail to report SRCs more so than any other demographic examined in the present study. As this was

the first study to compare reporting behavior across division levels, future research may want to highlight the potential influence this variable may have on reporting behavior.

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APPENDIX A

Concussions in Soccer and Lacrosse Survey

Please answer the following questions honestly. Remember, all surveys will remain completely anonymous and confidential.

Part I

1. A concussion is:
 - a. An injury to the spinal cord
 - b. An injury to the brain
 - c. A cut on the skin
 - d. I don't know

2. An athlete can get a concussion by:
 - a. A direct blow to the head
 - b. A hit to the jaw
 - c. Hitting one's head on the ground, turf, grass, or gym floor
 - d. A hit to the body
 - e. All of the above

3. A helmet or headgear prevents a player from getting a concussion
 - a. Yes, it completely protects a player
 - b. No, it does not protect a player
 - c. It helps, but does not completely prevent one
 - d. I don't know

4. If a player hits his head during a game or practice, he or she should:
 - a. Keep playing
 - b. Not tell anyone
 - c. Stop playing immediately and tell the coach or athletic trainer
 - d. Continue playing, then tell a coach or athletic trainer after the game/practice

5. A concussion is treated by:
 - a. Taking medication from a doctor
 - b. Therapy with a trained professional
 - c. Resting completely
 - d. I don't know

6. When a player is feeling the effects of a concussion, is it okay to play?

- a. Yes, as long as the player is careful
- b. Yes, but only for important games
- c. No, the player shouldn't play
- d. I don't know

7. What are some of the possible symptoms of a concussion?

Always Sometimes Never I don't know

- a. Headache
- b. Feeling of "pressure" in the head
- c. Nausea or vomiting
- d. Balance problems
- e. Dizziness
- f. Double or blurry vision
- g. Bothered by light or noise
- h. Feeling sluggish, hazy, foggy, or groggy
- i. Memory problems
- j. Confusion
- k. Mood Changes (ex: increased feelings of depression, anxiety, fatigue)
- l. Loss of consciousness
- m. Death

Part II

USE THE FOLLOWING DEFINITION OF CONCUSSION TO ANSWER THE QUESTIONS BELOW. PLEASE DO NOT GO BACK AND REVISE ANY OF YOUR PREVIOUS ANSWERS UPON READING THE DEFINITION.

- **Definition of Concussion:** *A concussion is a bump, blow, or jolt to the head that can happen even if you haven't been knocked out. You may notice one or more of the symptoms soon after, a few days after, or even weeks after injury: headache or "pressure" in head, nausea or vomiting, balance problems or dizziness, double or blurry vision, bothered by light or noise, feeling sluggish, hazy, foggy, or groggy, difficulty paying attention, memory problems, mood disturbances, and confusion.*
-adapted from the Center for Disease Control and Prevention, 2010

8. Based on the above definition, have you ever experienced a concussion during practice or competition of your sport?

_____ Yes → How many? _____
_____ No

8a. Have you ever experienced a concussion outside of your sport?

_____ Yes → How many? _____
 _____ No

9. Did you report your concussion to anyone?

_____ Yes (go to #9a below)
 _____ No
 _____ Not every time → How many times did you not report it? _____
 (go to #9a below)

9a. To whom did you report your concussion? (check all that apply)

_____ Athletic Trainer _____ Coach _____ Parent _____ Teammate
 _____ Other (who?) _____

10. Hypothetically, if you did sustain a concussion during practice or competition, do you think you would report it?

_____ Yes
 _____ No

11. If you did not report your concussion to anyone, why not? (check all that apply)

_____ Didn't think it was serious enough
 _____ Didn't want to be pulled out of the game or practice
 _____ Didn't know it was a concussion
 _____ Didn't want to let down teammates/coach
 _____ Didn't want to appear "weak"
 _____ Other (why?) _____

_____ Does not apply

12. Do you think that it is important to tell someone if you sustained a concussion?

_____ Yes → Why? _____
 _____ No → Why not? _____

13. How likely do you think it would be for someone in your particular sport to sustain a concussion during play?

_____ Very likely
 _____ Moderately likely
 _____ Not very likely
 _____ Not at all likely

14. Do you think there is an expectation of athletes in your sport to play through injury or "hide" symptoms of an injury?

_____ Yes → Explain _____
_____ No → Explain _____

15. Do you think an athlete’s status on a team (e.g. starter versus non-starter, senior versus freshman) may influence the athlete’s decision to hide or minimize symptoms of a concussion?

_____ Yes → Explain _____
_____ No → Explain _____

16. What do *you* think are possible reasons why athletes do not report concussions in sport? (Your answer can include any type of sport and any level of sport [youth, high school, collegiate, professional] you think this issue may pertain to): _____

Please fill in the following demographic information. Your answers are completely private and anonymous.

Demographics

Age: _____

Gender: _____

Ethnicity: _____

Current Year in College (Freshman, Sophomore, Junior, Senior, 5th year): _____

Sport Currently Playing in College: _____

Number of years you have played this sport: _____

Current level of Competition (Division I, Division III): _____

APPENDIX B

Recruitment Statement

The following is the template email that will be sent to the head coaches of 10 Division I and 10 Division III soccer and lacrosse teams:

Dear Coach (Name),

Hello! My name is Olivia Jarem. I am a former Division I lacrosse athlete and graduate of SUNY Albany in Albany, New York. Currently, I am graduate student studying Sport Psychology at Ithaca College in Ithaca, New York.

For my Master's thesis project here at Ithaca, I am interested in studying athletes' knowledge and attitudes towards concussions in sport. As you are well aware, concussions are a very "hot" topic right now in the world of sport, from the youth to the professional level. I am particularly interested in examining what our collegiate athletes' attitudes towards concussions are – if they think they are serious injuries worthy of immediate attention; if they think the long-term impact of concussions on one's health are significant, etc. Assessing this type of information can help us, as educators, mentors, and health professionals, improve our knowledge of concussions and the ways we can target our education and treatment of this particular injury within collegiate athletics.

What I am asking of you is simply your permission and support in **forwarding the bottom half of this email (that includes the survey link)** to your team of student-athletes. The following surveys will remain completely **anonymous and confidential** – there will be no way for me to access any identifying information of who participated in the survey (including personal email, location, etc.) once the participant submits their response. The participant would be able to take the survey **at any time over the next six-weeks (1/31/2011 – 3/7/2011)**, and **participation takes approximately 5 minutes**.

I truly appreciate your time and consideration and would be more than happy to answer any questions you may have for me regarding this study. I can be contacted via this email address or by phone (518-727-0875), if you prefer. I thank you in advance for your consideration and would be extremely appreciative of your participation in this project. To reiterate, please copy and paste the bottom half of this email (which includes the survey link) into an email for your student-athletes. Additionally, if you would be interested in reading any part of my thesis (including the results and implications after data has been collected), I would be more than happy to make that information available to you.

Best Regards,
Olivia Jarem

Olivia Jarem, Master's of Science Student in Sport Psychology
Ithaca College
Department of Exercise and Sport Sciences

Concussions in Soccer and Lacrosse – A Survey

Please complete the attached brief survey. Your responses will remain completely anonymous and confidential. Participation will only take about 5 minutes. The survey link will remain open from (1/31/2011 – 3/7/2011).

Concussions in athletics are a very “hot” topic right now in the world of sport. The following survey is aimed at assessing athlete’s knowledge and attitudes toward concussion in their respective sports of soccer and lacrosse. The following study is being conducted by a graduate student in the Sport Psychology department at Ithaca College in Ithaca, New York.

Your anonymous responses will provide researchers, sports medicine professionals, educators, and coaches with valuable information to further enhance the current knowledge of concussions in collegiate athletics.

APPENDIX C

Informed Consent

Because the surveys will be administered to participants online through their email, choosing to access the weblink and continuing on with the survey will serve as the participants' consent. Upon accessing the survey, the participant will be prompted by a message that displays the following:

Please complete the attached brief survey. Your responses will remain completely anonymous and confidential. Participation will only take about 5 minutes.

By continuing with the survey, you are giving your consent to participate in the present study.