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Understanding and Identifying The Knowledge and Attitudes of High School Coaches on Sport-Related Concussions

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Identifying and Understanding the Knowledge and Attitudes of High School Coaches on Sport-Related Concussions

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To Grandpa John- my guardian angel. Your words are my strength and your stories of success in life are my inspiration. You are near, even if I don't see you. You are with me, even if you are far away. You are in my heart, in my thoughts, in my life, always…. This one's for you!

"If heaven weren't so far away" – Justin Moore

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Abstract

Identifying and Understanding the Knowledge and Attitudes of High School Coaches on Sport-Related Concussions

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Background and Purpose of the Study: Sport-related concussions are a major public health issue, particularly so in the setting of sports. Sports dominate American culture and with millions of athletes of all ages participating in these sports these athletes predispose themselves to the risks of sport-related concussions. High-school athletes are of particular interest because of the heightened risks of long-term consequences and of particular note second impact syndrome, which is a catastrophic injury primarily reported in the adolescent aged athlete. Appropriate concussion assessment and management is necessary for reducing the possibility of these long-term effects of concussions. Properly trained and educated medical personnel such as Certified Athletic Trainers (ATC) can help reduce these risks, however, there is a lack of these qualified

healthcare professionals throughout high-school sports. With this limited number of high schools employing Certified Athletic Trainers and medical professionals, coaches become the primary decision makers in their absence.

Methods: This study utilized a modified mixed methods methodology with a triangulation design to measure the knowledge and attitudes of high-school coaches. A sample of 183 high school coaches participated in this study.

Results: High-school coaches had adequate knowledge of sport-related concussions (Mean: 18.96) and good attitudes (Mean: 66.67) as measured by the RoCKAS-HSCH instrument. Statistically significant differences were found between high-school coaches' knowledge and coaching experience (p=.008) and gender coached (p=.017). This indicated that those coaches who had higher levels of coaching experience and coached both male and female athlete's had significantly higher mean knowledge scores. Significant differences also existed between high school coaches' attitudes and experience (p=.010) as well as level of sport coached (.001) indicating those coaches with higher levels of coaching experience who coached a combination of freshman, junior varsity and varsity level sports had significantly higher mean attitude scores.

Conclusion: It is vital to understand the knowledge and attitudes that coaches have about concussion and to persist with educational efforts and the assessment of their efficacy in a systemic and organized manner. Through ensuring that coaches are educated about sport-related concussion, athletic trainers and coaches can work together to make sure that the best care is being provided to athletes and develop Initiatives to assist the coaches in helping them establish team cultures that are supportive of concussion safety. Together, coaches and athletic trainers can ensure that athletes and parents are educated about concussion recognition and can work collaboratively to develop and implement concussion safety policies at their schools.

Keywords: Sport-related concussion, Certified Athletic Trainer, knowledge, attitudes, factors, high school coaches.

CHAPTER I

INTRODUCTION

Background of the Problem

Concussions have moved to the forefront of public awareness, particularly in the setting of high-school sports (Giza, et al., 2014). Concussions are a potentially serious injury in sports that if managed inappropriately can result in short- and long-term cumulative impairments and death (Khurana, et al., 2012, Giza, et al., 2014); concussions are also one of the most challenging and controversial topics within sports medicine and healthcare of athletes. Adolescent athletes are of particular interest due to the ongoing neurocognitive development that occurs throughout adolescence and their increased susceptibility to injury and longer recovery following brain injury (Marar, et al., 2012). The incidence of concussion is reaching epidemic proportions as an estimated 1.6 to 3.8 million concussions occur during sport and recreational activity annually, with concussion representing 8.9% to 13.2% of all high school athletic injuries, with rates of repeat concussion as high as 36% (Esquivel, et al., 2013, Marar, et al., 2012, Giza, et al., 2014). It is likely that these numbers are an underestimate, as many concussions go unreported (Giza et al., 2014). As the incidence of concussions continues to rise, the impact of concussion, the importance of recognizing signs and symptoms, receiving proper management/treatment and the value of education becomes even more urgent in order to reduce the possibility of long-term effects of concussions (Provvidenza, et al., 2013). The diagnosis and management of sport-related concussion is a difficult task even under the best of circumstances (Lovell, et al., 2009). As a result, properly diagnosing as well as managing a concussed athlete is a challenging task for not only physicians and sport medicine professionals but for coaches of these athletes as well. It is therefore also important for coaches to be able to recognize and diagnose an athlete with a concussion. This is where coaches come in to play because their knowledge of concussion will be critical in identifying any symptoms in their athletes and their attitude about concussion safety will help in the management of a sport-related concussion.

Although properly trained and educated medical personnel such as Athletic Trainers can help reduce these risks, here is a lack of these qualified health care professionals throughout high school sports with only 37% of high schools employing a full-time athletic trainer (Casa et al., 2015). Most coaches rely on athletes to report concussive symptoms. Unfortunately, an estimated 53% of athletes do not report concussion injuries. Early recognition and appropriate concussion management is vital to reducing or eliminating concussion-related comorbidities, thus it is clear that coaches play a pivotal role in concussion injury recognition and management (Register-Mihalik, et al., 2013, Saunders, et al., 2013.) With these limited numbers of high schools employing athletic trainers, coaches who don't have access to qualified health care professionals need to have knowledge and positive attitudes on prevention, detection, assessment and management of sport-related concussions to help decrease the risk associated (O'Donoghue, et al., 2009, Barr, 2003). Given the prevalence of concussions among adolescent athletes, there has been a push to educate coaches about the dangers associated with concussions as well as the proper way to manage concussions should they occur (Hossler, et al., 2013). Coaches set the tone for safety among their athletes and are uniquely positioned to recognize a potentially concussed athlete and respond in a way that reduces the risk of developing adverse health outcomes (Parker, et al., 2015, Chrisman, et al., 2014). However, the extent to which the coaches undertake this role will depend upon their perceptions about sport-related concussion injury (White, et al., 2013).

Statement of the Problem

Coaches are key to promoting a supportive environment when it comes to concussion safety and prevention, as many coaches are among the most influential individuals in an athletes' life. Their role extends beyond teaching technical and tactical aspects of sport, as they play an integral role in athletes' health, well-being and personal development. Coaches have the responsibility of insuring that the health and welfare of their players at all times. Thus, it is imperative that coaches are knowledgeable about how to recognize concussion, fully aware of concussion protocols, procedures and laws that are in place for concussions at all times as well as be able to recognize the signs and symptoms associated with sport-related concussions.

Previous literature has demonstrated that improved knowledge and attitudes influenced concussion-reporting behaviors (Kurowski et al., 2014). Research studies examining the understanding and knowledge base of sport concussion among coaches found that there is limited, incomplete or a lack of standardized knowledge (McCrory et al., 2017). For example, a study by White et al. (2013) found that coaches, who play a fundamental role in adolescent athletes' initial experiences and safety in sport, were unclear about the common signs and symptoms, management and return-to-play guidelines associated with sport-related concussions.

Other common concussion misconceptions among coaches included: failure to recognize many common signs and symptoms of concussion, such as believing loss of consciousness is required for a concussion to have occurred; allowing an athlete who presents with concussive symptoms to continue participating; and considering "bell ringers" and "dings' as different injuries other than concussions (Saunders, et al., 2013, Valovich McLeod, et al., 2007, Faure, et al., 2011). These misconceptions may occur in part due to a wide variation in the perceptions of sport-related concussion among high-school coaches. Individuals who have a better knowledge and positive attitudes of sport-related concussion management, assessment and treatment may be more likely to report concussion injuries. For example, coaches may understand and believe that concussion is a serious injury and even a medical concern; however, if they also believe that removing a particular athlete from participation may influence the result of a game they may still choose to let the athlete continue to play and risk further injury (Register Mihalik et al., 2013). A 2007 study reported that only 61% of adolescent coaches correctly recognized the signs and symptoms of a concussion (McLeod et al., 2007). Researchers also found inconsistency in how coaches handled concussion management and return-to-play policies relative to published guidelines (Faure et al., 2011). With the limited research on coaches' knowledge and attitudes towards concussion, it is vital for coaches who do not have access to qualified health care professionals to be well educated on proper prevention, detection, assessment, and management as well as understand their seriousness to help decrease the risk associated with concussions. Information on how knowledgeable coaches are in regards to a sport-related concussion is limited in the research. Moreover, the underreporting of concussion by these athletes also implies that many adolescent athletes will be returning to sport participation while experiencing concussion signs and symptoms and this places coaches in an ideal position to identify concussions. Coaches might be the next level of concussion "safety net" since they will be at an ideal position to observe signs and symptoms of concussion, especially when a medical professional, such as an athletic trainer, is not available.

Purpose

The purpose of this study was to use the validated and reliable Rosenbaum Concussion Knowledge and Attitude Survey-Coach Version (RoCKAS-HSCH) tool to help identify and understand the knowledge and attitudes of high school coaches on the topic of sport-related concussions as well as to identify and understand the differences between high school coaches knowledge and attitudes between the 11 independent variables described below.

Variables

The two dependent variables in this study were knowledge and attitudes. The independent variables were age, gender, ethnicity, experience, degree, major, concussion education, professional development, gender coached, coaching position and level of sport coached.

Research Questions

The overarching research interest framing the dissertation study is as follows:

What are the knowledge and attitudes of high school coaches on sport-related concussions?

The corresponding research questions and hypotheses are as follows below.

Research Question 1 address the overall knowledge of the high school coaches:

RQ1: What is the knowledge of sport-related concussion in high school coaches as defined by RoCKAS-HSCH?

H1. High school coaches will have poor knowledge of sport-related concussions as measured by RoCKAS-HSCH.

Research Question 2 address the overall attitude of the high school coaches:

RQ2: What are the attitudes of sport-related concussion in high school coaches as defined by RoCKAS-HSCH?

H2. High school coaches will have unsafe attitudes of sport-related concussions as measured by RoCKAS-HSCH.

Research Questions 3 address the differences between knowledge and the 11 factors:

RQ3a. What is the difference between high school coach's knowledge and gender?

H3a. There will be no difference in high school coaches' knowledge of sport-related concussions and gender as measured by RoCKAS-HSCH.

RQ3b. What is the difference between high school coach's knowledge and age?

H3b. There will be no difference in high school coaches' knowledge of sport-related concussions and age as measured by RoCKAS-HSCH.

RQ3c. What is the difference between high school coach's knowledge and ethnicity?

H3c. There will be no difference in high school coaches' knowledge of sport-related concussions and ethnicity as measured by RoCKAS-HSCH.

RQ3d. What is the difference between high school coach's knowledge and experience?

H3d. There will be no difference in high school coaches' knowledge of sport-related concussions and experience as measured by RoCKAS-HSCH.

RQ3e. What is the difference between high school coach's knowledge and degree?

H3e. There will be no difference in high school coaches' knowledge of sport-related concussions and degree as measured by RoCKAS-HSCH.

RQ3f. What is the difference between high school coach's knowledge and major?

H3f. There will be no difference in high school coaches' knowledge of sport-related concussions and major as measured by RoCKAS-HSCH.

RQ3g. What is the difference between high school coach's knowledge and concussion education?

H3g. There will be no difference in high school coaches' knowledge of sport-related concussions and concussion education as measured by RoCKAS-HSCH.

RQ3h. What is the difference between high school coach's knowledge and professional development?

H3h. There will be no difference in high school coaches' knowledge of sport-related concussions and professional development as measured by RoCKAS-HSCH.

RQ3i. What is the difference between high school coach's knowledge and gender coached?

H3i. There will be no difference in high school coaches' knowledge of sport-related concussions and gender coached as measured by RoCKAS-HSCH.

RQ3j. What is the difference between high school coach's knowledge and coaching position?

H3j. There will be no difference in high school coaches' knowledge of sport-related concussions and coaching position as measured by RoCKAS-HSCH.

RQ3k. What is the difference between high school coach's knowledge and level of sport coached?

H3k. There will be no difference in high school coaches' knowledge of sport-related concussions and level of sport coached as measured by RoCKAS-HSCH.

Research Questions 4 address the differences between attitude and the 11 factors:

RQ4a. What is the difference between high school coaches' attitude and age?

H4a. There will be no difference in high school coaches' attitudes of sport-related concussions and age as measured by RoCKAS-HSCH.

RQ4b. What is the difference between high school coaches' attitude and gender?

H4b. There will be no difference in high school coaches' attitudes of sport-related concussions and gender as measured by RoCKAS-HSCH.

RQ4c. What is the difference between high school coaches' attitude and ethnicity?

H4c. There will be no difference in high school coaches' attitudes of sport-related concussions and ethnicity as measured by RoCKAS-HSCH.

RQ4d. What is the difference between high school coaches' attitude and experience?

H4d. There will be no difference in high school coaches' attitudes of sport-related concussions and experience as measured by RoCKAS-HSCH.

RQ4e. What is the difference between high school coaches' attitude and degree?

H4e. There will be no difference in high school coaches' attitudes of sport-related concussions and degree as measured by RoCKAS-HSCH.

RQ4f. What is the difference between high school coaches' attitude and major?

H4f. There will be no difference in high school coaches' attitudes of sport-related concussions and major as measured by RoCKAS-HSCH.

RQ4g. What is the difference between high school coaches' attitude and concussion education?

H4g. There will be no difference in high school coaches' attitudes of sport-related concussions and concussion education as measured by RoCKAS-HSCH.

RQ4h. What is the difference between high school coaches' attitude and professional development?

H4h. There will be no difference in high school coaches' attitudes of sport-related concussions and professional development as measured by RoCKAS-HSCH.

RQ4i. What is the difference between high school coaches' attitude and gender coached?

H4i. There will be no difference in high school coaches' attitudes of sport-related concussions and gender coached as measured by RoCKAS-HSCH.

RQ4j. What is the difference between high school coaches' attitude and coaching position?

H4j. There will be no difference in high school coaches' attitudes of sport-related concussions and coaching position as measured by RoCKAS-HSCH.

RQ4k. What is the difference between high school coaches' attitude and level of sport coached?

H4k. There will be no difference in high school coaches' attitudes of sport-related concussions and level of sport coached as measured by RoCKAS-HSCH.

Significance of the Study

The question that remains is why so many misconceptions among coaches on sport-related concussions still exists despite recent legislative and educational efforts that have become mandated in every state across the country. If we can understand the knowledge and attitudes of these coaches on concussion injuries, we may be able to better address the misconceptions among coaches on sport-related concussion as well as decrease the number of underreported concussions and ultimately decrease the risk of long-term consequences and catastrophic injuries that are associated with sport-related concussions. With previous literature demonstrating that coaches' knowledge and attitudes influence concussion-reporting behaviors in athletes, researchers still struggle to understand the reasons why coaches and athletes have a lack of knowledge and attitudes. To date there are no studies that rationalize why high school level coaches' have such poor knowledge and attitudes. Despite all the recent legislative mandates, including mandated concussion education, there is very limited research that indicates the general knowledge and attitudes of coaches. So, the first step would be to determine what levels of knowledge and attitudes these coaches truly have and to better understand those levels, then explore variables that may or may not be related to the coaches' knowledge and attitude levels as there has yet to be any study determining if there is any predictive effect.

By researching the knowledge and attitudes that high-school coaches possess on sport-related concussions, researchers and medical professionals can use the data to insightfully develop strategies that will increase recognition and reporting of concussion injury. This, in turn, may lead to decreases in the recurrent concussive injuries in high-school athletes' and help prevent catastrophic injuries such as Second Impact Syndrome (SIS).

Operational Definitions

There are two main constructs used in this survey instrument which are identifiable in the literature to survey instruments that are used to evaluate perspectives on a topic. These two constructs are knowledge and attitudes. Knowledge refers to the facts, information, and skills acquired by a person. Specifically, knowledge is defined as the range of one's information or understanding; the sum of what is known (ASA, 2014). A high school coaches' knowledge comes from previous education, experiences and is also obtained through sources such as medical literature, lectures, and conversations with peers. Attitudes are defined as associations between an act or object and an evaluation; the tendency to evaluate a person, concept, or group negatively (Westen,2003).

In this document Sport-Related Concussions (SRC) are defined according to the 5th International Conference on Concussion in Sport (2016) as a traumatic brain injury induced by biomechanical forces where SRC can be caused by either a direct blow to the head, face, neck or elsewhere on the body with an impulsive force transmitted to the head. SRC typically results in the rapid onset of short-lived impairment of neurological function that resolves spontaneously. However, in some cases, signs and symptoms evolve over a number of minutes to hours. SRC may result in neuropathological changes, but the acute clinical signs and symptoms largely reflect a functional disturbance rather than a structural injury and, as such, no abnormality is seen on standard structural neuroimaging studies. SRC results in a range of clinical signs and symptoms that may or may not involve loss of consciousness. Resolution of the clinical and cognitive features typically follows a sequential course. However, in some cases symptoms may be prolonged. Additional key words will be operationally defined as the text of this document progresses throughout the next few sections.

Conceptual Framework

The conceptual framework is understood through a series of steps. Throughout this review of the literature, it becomes obvious that there is a large amount of disparity in the sport-related concussion research in regard to the knowledge and attitudes that high-school coaches possess. I utilized theory to help me understand my research problem and provide direction as well as to inform and guide my student to organize my ideas and interpret my results. I developed a conceptual framework based on what I learned from the literature and from combining two theories along with the constructs of the RoCKAS-CH tool. The Theory of Planned Behavior (TPB) and Theory of Reasoned Action (TRA) are two theories that demonstrate many of the components of knowledge and attitudes definition that will help us understand the knowledge and attitudes of high-school coaches on sport-related concussions (Figure 1). The Theory of Planned Behavior (TPB) was developed was developed from the Theory of Reasoned Action (TRA) (Hackman, et al., 2014). Although each theory can provide a base of explanation for understanding the knowledge and attitudes of coaches on sport-related concussion, a combination of these theories, proposed as a potential theoretical framework of explanation, works better than any given theory itself. The Theory of Planned Behavior (TPB) and Theory of Reasoned Action (TRA) are one of the most widely applied models of decision making in health and injury prevention and provides one means for understanding the factors associated with the intention to report concussion injuries (Hackman, et al., 2014)

The Theory of Planned Behavior (TPB) is one theory often applied to understanding health behaviors (Register-Mihalik, et al., 2013) Prior research has found that constructs from the Theory of Planned Behavior can help explain between-individual variability in concussion knowledge and attitudes (Chrisman, et al, 2013, Kroshus, et al., 2014, Register-Mihalik, et al., 2013). The major theme of this theory is that knowledge is an important predictor of behavior only to the extent that it "links a behavior of interest to positive or negative outcomes, to the normative expectations of important referent individuals or groups, and to control factors that can facilitate or inhibit performance of the behavior" (Ajzen, et al. 2011). The TPB (Figure 1) places significant value on social referents or people who influence the behavior of these athletes, which is very important in sport especially among high school athletes (i.e. Coaches, teammates, parents) (Register-Mihalik et al., 2013). There has been limited application of a behavior change theory to sports injury prevention, however recent suggestions have been made that the Theory of Planned Behavior may be an appropriate frame for an understanding of concussion reporting behaviors (Kroshus, et al. 2014). Evidence exists that the TPB is a better predictor of self-report behaviors than observed behaviors (Register-Mihalik, et al., 2013).

The Theory of Planned Behavior is a robust expectancy value theory that has been tested in a variety of contexts involving rational decision-making. According to TPB the most important predictor of a behavior is the intention to perform that behavior. Intention is conceptualized as being directly predicted by three factors: attitudes, subjective norms and perceived behavioral control. Intention mediates the association among these factors and the performance of the behavior. Attitude reflects the individual's evaluation of the consequences of performing the behavior. Subjective norms reflect perceived pressure to perform the behavior from people whose opinions and behaviors are considered important to the individual in this case the adolescent athlete. Perceived behavior control reflects an individuals' evaluation of the ability to perform the behavior. Effectively intervening to increase symptom reporting requires first understanding the psychosocial mechanisms though which this reporting is facilitated or constrained (Crocus, et al., 2014). The TPB was developed in effort to explain the relationships between attitude and behavior. Athletes attitude about concussion compared to an athletes' attitude toward reporting of a concussion, which attitude toward concussion reporting theoretically begin a better predictor of athletes likely to report a concussion (Register-Mihalik, et al., 2013). For example, just because someone believes a concussion is a serious injury, does not-mean they are likely to report that injury, as how they feel about the actual reporting would have a stronger relationship with their reporting behavior. According to the TPB, individuals who intend to perform a specific behavior are more likely to actually engage in the behavior (Register-Mihalik et al., 2013). When individuals experience a gap between their behaviors and how they believe a referent group would behave, they can experience an internal pressure to modify their beliefs or behaviors out of a desire for social approval (Cialdini, et al., 2004). However, the extent to which an individual is motivated to make their behavior correlate with norms varies by their extent of identification with the referent group, or the extent to which the referent group represents an aspirations self-concept, for coaches, this likely means parents, administrators and other coaches in their sport.

The Theory of Reasoned Action is used to explain and predict behavior based on attitudes, norms and intentions. The construct of TRA are behavior beliefs, evaluations of behavioral outcomes which leads to attitude, then normative beliefs, motivation to comply which leads to subjective norms. Both the attitude and subjective norm lead to intention to perform the behavior, which results in the behavior. TRA does not account for people's perception of the power they have over their behavior. This is where the Theory of Planned Behavior introduces control beliefs, perceived power which leads to perceived control, then intention to perform the behavior, after which then the behavior occurs (Kruger, 2019) (Figure 1).

Attitude toward the behavior is defined as “a person’s general feeling of favorableness or un-favorableness for that behavior” (Fishbein et al. 1975). Subjective norm is defined as a person’s “perception that most people who are important to them think he /she should or should not perform the behavior in question” (Azjen, et al., 1980). Attitude toward behavior is a function of the product of one’s belief that performing the behavior will lead to a certain outcome, and an evaluation of the outcome. Subjective norm is a function of the product of one’s normative belief which is the “person’s belief that the referent thinks he/she should (or should not) perform the behavior” (Azjen, et al., 1980), and his/her motivation to comply to that referent.

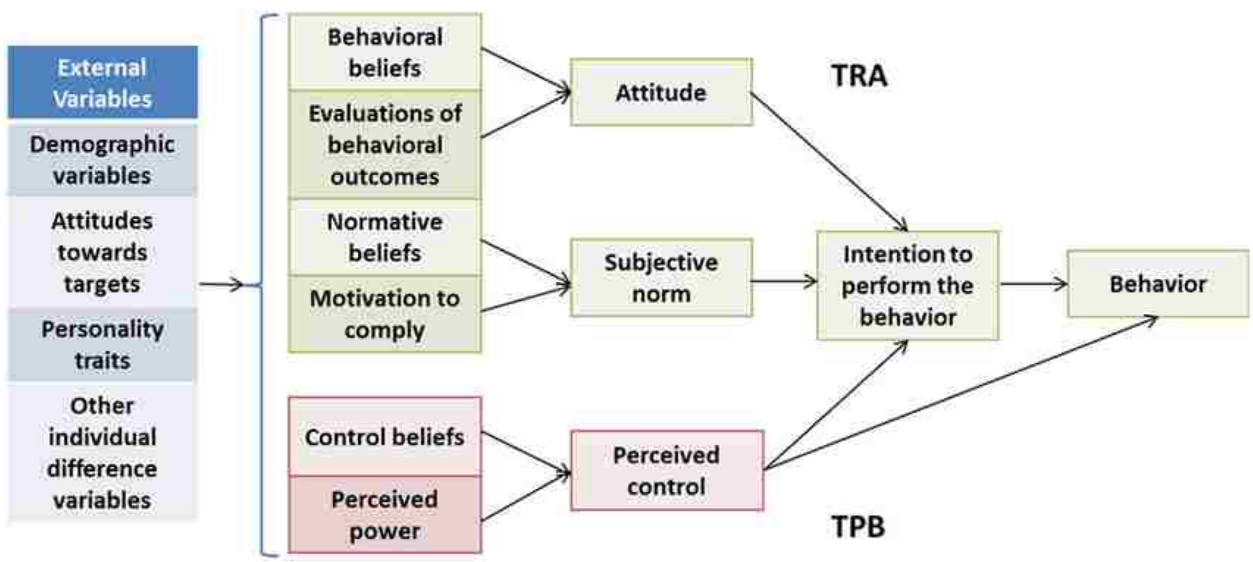

Figure 1. Theory of Planned Behavior (TPB) & Theory of Reasoned Action (TRA) adopted from “Theory of Reasoned Action and Theory of Planned Behavior-Based Dietary Interventions” Hackman, C.I., Knowlden, A.P. (2014), Adolescent Health Medicine and Therapeutic, 5: 101-114.

CHAPTER II

REVIEW OF RELATED LITERATURE

Introduction

The management and treatment of concussions has evolved over the years, unfortunately many coaches still seem to believe that youth and adolescence is a period of indestructibility (Halstead, et al., 2010). Coaches are frequently unaware or ignorant of the dangers of concussions (Moser, et al., 2005). Complicating concussion knowledge is the that a concussion may be "toughed out" and does not require medical attention (Halstead, et al., 2010).

As with many sports injuries, concussed athletes may feel pressure to resume their sport participation. This pressure may be self-imposed by the situation; for example, playoff game versus regular season game, result of organizational and team dynamics such as the coach, other players and the parents (Kongos, et al., 2004). Medical advances cannot keep up with the increasing expectations of athletes to perform at higher levels and the associated pressure and stress associated with these expectations (Bauman, 2005). Athletes are becoming bigger, faster, quicker, stronger and more athletic in order to meet the growing demands of the sport. The intense media exposure of athletes in sports and the ever-increasing social pressure to set personal, school, national, and professional records, encourage athletes to push and find new physical and mental limits. The potential for making a lot of money in professional sport and receiving full collegiate athletic scholarships draws more people into the game, yet the possibility of losing it due to injury, creates additional pressure once the athlete has become accustomed to the lifestyle (Bauman, 2005). These soaring wages, awards and increased media attention generate higher expectations for consistently elevated performances. These accelerated expectations by both the athlete and coaches means athletes must be more prepared, more competitive, and more able to return to play quickly after an injury. For the athletes, these expectations add more stress, which has taken the pressure to perform to limits higher than ever before and potentially continue to participate in athletic activities while injured. The pressure to excel in pursuit of collegiate scholarships and professional contracts has resulted in some athletes going beyond the legal limits to enhance performance, to accelerate recovery and to win at all costs, and for others just to stay in the game (Bauman, 2005). High school athletes and those with scholarship possibilities especially, will try to convince parents and coaches that they feel fine in order to resume play (Bye, et al., 2008). Again, without possible appreciation for the negative consequences attending these actions if they are undertaken when a concussive injury is present, as discussed previously by Halstead, et al., (2010) and Khurana, et.al., (2012) in regard to the short- and long-term health consequences and risk of the catastrophic event of Second Impact Syndrome (Figure 2).

"Be ready to play or someone will take your place", continues to be the bottom line, one that every athlete clearly understands. This pressure for athletes to stay healthy continues to escalate. None of the importance to the success of the team, the small chance of receiving a collegiate scholarship, or even the smaller possibility of playing professionally should be relevant factors in determining whether a concussed athlete should be continuing to play and not report injury. There should be a fundamental change in the attitudes of coaches such that no value attaches to an athlete "playing hurt" (Wilson, et al., 2010). Coaches must learn that they can embody the virtues of a team player; dedication, commitment, and self-sacrifice without compromising their health and safety.

Established Definitions of Concussion

Sport-related concussion has been studied extensively, and many different definitions of concussion have been proposed (Broglie et al., 2014, Giza et al., 2014, Khurana, et al., 2012, Covassin, et al., 2010). Despite a significant increase in research dedicated to identifying and managing sport-related concussion, it remains one of the most complex injuries in sports today (Broglio, et al., 2014). The term concussion originates from the Latin *concutere,* which means "to strike together" or "to shake violently" (Giza et al., 2014). Researchers and practitioners have struggled to operationalize a clear definition of a concussion (Kontos, et al., 2004). Given the vast array of definitions in the literature, there is no one clear definition. Concussion is the historical term representing low-velocity injuries that cause brain "shaking", resulting in clinical symptoms that are not necessarily related to a pathological injury. A concussion is often considered an "invisible" injury as no biological marker exits to detect this injury and diagnosis largely depends on a patient report.

A concussion defined by The American Academy of Neurology is an altered mental state that may or may not include loss of consciousness (Covassin, et al., 2010). The National Athletic Trainers' Association defines a concussion as a mild diffuse injury that is often referred to as a mTBI or Mild Traumatic Brain Injury. It involves an acceleration-deceleration mechanism in which a blow to the head or the head striking an object results in one or more of the following conditions: headache, nausea, vomiting, dizziness, balance problems, feeling "slowed down", fatigue, trouble sleeping, drowsiness, sensitivity to light or noise, loss of consciousness, blurred vision, difficulty remembering or concentrating (Guskiewicz, et al., 2004). Cited in several studies, the definition defined by the Summary and Agreement of Fifth International Symposium of Concussion in Sport is the most widely accepted definition as it has a broad application by medical organizations and widespread use within the literature. The Fourth International Symposium of Concussion in Sport defines a concussion as a “complex pathophysiological process affecting the brain, induced by traumatic biomechanical forces and includes five major features: Concussion may be caused either by a direct blow to the head, face, neck or elsewhere on the body with an impulsive force transmitted to the head. Second, a concussion typically results in rapid onset of short-lived impairment of neurologic function that resolves spontaneously. Third, concussion may result in neuropathological changes, but the acute clinical symptoms largely reflect a functional disturbance rather than a structural injury. Fourth, concussion results in a graded set of clinical symptoms that may or may not involve loss of consciousness. Resolution of the clinical and cognitive symptoms typically follows a sequential course; however, it is important to note that in a small percentage of cases post concussive symptoms may be prolonged. Lastly, concussion may result in neuropathological changes, but the acute clinical symptoms largely reflect a functional disturbance rather than a structural injury (Halstead, et al., 2010, McCrory, et al., 2009, McCrory, et al., 2016).

In the immature brain, concussion leads to deficits in excitatory neuro transmission, an impairment that is associated with a loss of experience-dependent plasticity resulting in long periods of memory deficits. Even when appropriate recovery time is allowed, restoration of memory function is not complete (Marar, et al., 2012, DeBeumont, et al., 2012). With the multiple definitions that exist, one theme consistent throughout all is that concussions involve the direct transfer of kinetic energy to the brain.

Underreporting of Concussion

One of the largest problems facing the topic of concussions is the large amount of underreporting that occurs from the athletes (Figure 2). Athletes have a strong desire to compete and return to play; there is a tendency within the sports community to minimize the seriousness of injuries to facilitate this return to play (Barth, et al., 2011). Thirty to eighty percent of athletes' who sustain a concussion will have residual effects and symptoms afterwards (Manasse-Cohick, et al., 2013). Many athletes continue to participate in practices and games while experiencing concussion-related signs and symptoms, potentially predisposing them to subsequent and more complicated brain injuries that may result in delayed recovery or even catastrophic consequences such as Second Impact Syndrome (Register-Mihalik, et al., 2013).

High school athletes are heavily influenced by their coaches, and they don't want to disappoint them or feel that they are letting the team down. In some instances, the athletes may feel that their ability to play on the team might be jeopardized if they sat out of the game and in these instances, the athlete will refrain from reporting potential concussion symptoms. With the clinical diagnosis of concussion based on the presence of signs and symptoms and self-reporting of these symptoms to medical professionals, or coaches, the initial reporting of the injury is somewhat limited (Kay, et al., 2014). With more than 53% of athletes not reporting concussion injuries it is clear that these individuals have found ways to minimize the seriousness of their injury (Register-Mihalik, et al., 2013). Many athletes' reported reasons such as not wanting to be removed from play, not wanting to disappoint coaches and teammates, feeling pressure from coaches to play injured, fear of suffering negative consequences such as loss of playing time or position as a starter or having their toughness questioned, and social disapproval for not reporting concussions to coaches. Thus, it is clear from the literature that many athletes continue to participate in practices and games while experiencing concussion related signs and symptoms. Coaches continue to have a lack of knowledge of concussion assessment and management, potentially predisposing these athletes to subsequent and more complicated brain injuries. The majority of concussions (80-90%) resolve in a short (7-10 day) period, however recovery may be longer in children and adolescents. Second Impact Syndrome (SIS) is a rare but catastrophic injury that occurs primarily in in athletes 13-18 years of age who are still recovering from a concussion sustains a subsequent brain injury. SIS results in rapid swelling, loss of autoregulation of intracranial and cerebral perfusion pressures and almost always results in death or sever long-term injury, resulting in a 50% mortality and 100% morbidity rate (McCrery, et al., 2014, Cantu, 1998, Halstead, et al., 2010, Karlin, 2011, Fisher, et al., 2004, Bakhos, et al., 2010). Research conducted by Boden (2007) found that 15% of deaths related to catastrophic head injuries in high school and college football players resulted from Second Impact Syndrome. Sixty-one percent of the deaths related to SIS had a prior brain injury of which 91% were the same season and 39% were playing with residual neurological symptoms.

One commonly proposed strategy to reduce concussion underreporting in high-school athletes has been to educate the athletes, the parents and coaches about concussions (Rieger, et al., 2018). Recently, studies have examined knowledge and attitudes concerning concussions in high-school coaches' and have noted a general lack of understanding about concussions (Hossler, et al., 2013). Research shows that improved coach knowledge of the signs, symptoms, assessment and management of concussion positively affected concussion symptom reporting behaviors in high-school athletes. Based upon the limited evidence that exists in the literature regarding high-school coaches' knowledge and attitudes about concussions, further exploration of these measures is imperative.

Pathophysiology of Concussion

Concussions occur from forces applied directly or indirectly to the skull that result in the rapid acceleration and deceleration of the brain (Broglio, et al., 2014). The sudden change in cerebral velocity elicits neuronal shearing, which produces changes in ionic balance and metabolism. When accompanied by clinical signs and symptoms, changes at the cellular level are called concussion. Concussions may be most widely thought of as a clinical syndrome of neurocognitive or behavioral dysfunction resulting from a biomechanically induced alteration of brain physiology (Giza et al., 2014). Numerous factors or considerations need to be accounted for when dealing with sport-related concussions. Those factors include skull shape, size and geometry, density and mass of neural tissue, thickness of scalp and skull, nature and direction of the concussive blow, head-body ratio and the mobility of the head and neck (Shaw, 2002, Cantu., 1992). Irrespective of the diverse methods, which can be used to deliver a concussive injury, all share at least one feature, they all involve the near instant transfer of kinetic energy. This will require either an absorption (acceleration) or release (deceleration) of kinetic energy by the head and brain. Sufficient kinetic energy from the blow must be discretely, finitely and effectively absorbed by the head and brain triggering various intracranial stresses, strains, waves and emotions responsible for the concussive state (Ommaya et al., 1971, McIntosh et al., 1996, Frieda, 1961).

A common misconception surrounding concussions is the idea that you must be hit in the head for a concussion to occur. A significant blow to the neck, face, jaw or elsewhere in the body can result in a concussion as long as the force is transmitted to the head (McRory, et al., 2005). It has been demonstrated that greater force is required to cause similar concussive injury in smaller brains than in larger brains with greater mass. This suggests that children symptomatic after a concussion have sustained greater force than an adult with similar post concussive symptoms (McCrory, et al., 2004). The brain is contained within the cranium surrounded by cerebral spinal fluid. In this position, the brain is free to move about the cranium; however, the cranium has bony protuberances. Hence, high velocity movement of the brain inside the cranium typically results in focal axonal damage that, depending upon the sites of injury, will present in the common signs or symptoms of concussion (Bailes, et al., 2001). Common acute symptoms include headache, dizziness, nausea, confusion, memory impairment, imbalance, and behavioral changes (Giza et al., 2014). These outcomes are the result of the action of one of two types of biomechanical forces on the head, acceleration-deceleration forces or rotational forces. Accelerations-deceleration forces occur when an object such as a baseball, traveling at high velocity strikes the head. These forces also occur when the body and head are in motion and collide with a stationary object such as a basketball player striking the occipital region of the cranium on the hardwood floor. Rotational forces occur when the cranium rotates along its axis in an angular motion, while the brain remains in a relatively fixated position (Bailes, et al., 2001). This type of shearing force is common in a football tackle where the players head rotates from the impact of the tackle. Occasionally, concussions are a result of the combination of both acceleration-deceleration and rotational forces (Kontos, et al., 2004). Regardless of the precise role played by rotation, it is clear that energy imparted by acceleration of the head, sets the brain in motion. The brain floats or is suspended in a protective cocoon of cerebrospinal fluid within the subarachnoid space which allows it some freedom to move. Due to its gelatinous and viscoelastic properties, it is relatively incompressible but readily distortable. The brain therefore responds to a sudden change in velocity of the head by oscillating, gliding, rotating, swirling or spinning within the cranial vault (Holbourn, 1943).

Normally, the brain is shielded from dashing itself against the walls of the skull by the cushioning properties of the cerebrospinal fluid and its external protective coverings or membranes. However, if the momentum becomes more forceful, the brain will come into violent contact with the bone of the skull causing deformation, distortion or compression of neural tissue. More severe jolting or jarring of the head due to the accelerative trauma is likely to result in contusions or lacerations (Shaw, 2002). At least two characteristic types of injuries are recognized as occurring under these conditions: coup and contre-coup. Coup injuries are those, which are maximal, occurring directly beneath the point of impact on the skull. These types of coup injuries tend to be associated with acceleration trauma. By contrast, contre-coup injuries occur elsewhere on the surface of the brain, most conspicuously opposite to the site of cranial impact. They tend to be associated with deceleration trauma (Ommaya et al., 1971). A third type of mechanical brain injury implicated in concussive injury is that of compression of the skull, a traumatic blow that suddenly but temporarily indents or bends the skull at the site of impact without fracturing it. This produces an immediate change in intracranial volume, brain compression and the consequent generation of pressure waves and pulses. These are transmitted diffusely within the cranial vault with a particular destination being the brainstem and the cranio-cervical junction (McIntosh et al., 1996). A fourth possible biomechanical factor in the induction of concussion involves sudden movement of the head about the neck similar to that, which occurs in severe whiplash injury. Under these conditions, hyperextension followed by flexion of the head and neck produce stresses and strains at the craniospinal junction. These assumedly interfere with brainstem function by distorting, displacing and stretching its neural elements (Friede, 1961).

Signs and Symptoms

Research evidence has demonstrated that concussion symptoms can be divided into several broad categories: Physical, cognitive, emotional and sleep. Physical includes headaches, fatigue, dizziness, drowsiness, sensitivity to light and noise, nausea, balance problems, visual disturbance (double or blurry vision), vomiting, and numbness/tingling. Cognitive includes poor concentration, problems with memory, feeling mentally foggy, and feeling slowed down. Emotional includes feeling irritable, grater emotionality, sadness and nervousness and sleep problems which includes sleeping more than usual, trouble falling asleep and sleeping less than usual (Gioia, et al., 2008, Coghlin, et al., 2009, McCrory, et al., 2005, Lovell, et al., 1999, Wiebe et al., 2011). The most commonly reported concussion symptoms according to Marar, et al., (2012) are headache (94.2%), dizziness (75.6%) and concentration difficulty (54.8%). These most commonly self-reported symptoms are backed by the research of Collins et al. (2003), Delaney et al. (2002), Guskiewicz et al. (2003), and McCrory et al. (2000) when they found that the most commonly self-reported symptom was headache (83%), dizziness (65%), confusion (57%), amnesia (17%) and loss of consciousness (10%). Mailer et al. (2008) noted the reliability and sensitivity of the self-reported concussive symptoms. Reliability of the self-reported symptoms ranged from .88-.93 and sensitivity was 89%. Also noted were variety of situations that could affect these scores such as dehydration, strenuous exercise and underreporting (Patel et al., 2007, Williams et al., 1994, McCrea et al., 2004).

The initial symptom presentation of a concussed athlete is dependent upon two key features 1) the biomechanical aspects of the injury, as well as 2) the specifically affected brain structures (Collins, et al., 2002). A blow to the frontal portion of the cranium or frontal lobe may result in subtle changes in personality or mood, difficulty in executing sport assignments and overt confusion, though it will not likely result in loss of consciousness. A blow to either side of the cranium or temporal lobes is more likely to result in confusion and memory disturbance, amnesia, rather than loss of consciousness. A blow to the back of the head or occipital lobe may result in slowed processing, dizziness, sensitivity to light and noise, and visual disturbance. A blow to the occipital lobe is more likely to result in loss of consciousness given the proximity of the deeper structures of the brain such as the brainstem, which is responsible for consciousness (Kontos, et al., 2004). Concern is particularly paid to these two features to emphasize that the brain is a highly complicated organ and an athlete may present with a myriad of symptoms dependent upon a variety of factors, including but not limited to, the location of injury (Kontos, et al., 2004). Broglio, et al. (2007) found that the majority of impacts occur to the frontal lobe (45.3%), followed by the occipital lobe (26.3%), parietal lobe (12.3%) and the temporal lobe at (7.8-8.4%).

A common misconception is that loss of consciousness must occur in order for an athlete to have a concussion; in a study by Guskiewicz, et al. (2000) it was found that only around nine percent of concussions resulted in a loss of consciousness and nearly eighty-four percent resulting in a headache. A second common misconception involves the use of the term “bell ringer”. According to Guskiewicz, et al. (2004), this term should not be used in clinical, athletic, or educational setting because it minimizes the serious nature of a possible concussion. A study by Valovich McLeod et al. (2008) demonstrated that when high school athletes were asked about their concussion history using the terms concussion and bell ringer, a greater number of the participants reporting having sustained a bell ringer than having sustained a concussion, often due to adolescent athletes believing that bell ringers are not concussions. Athletes with a history of prior concussions are also prone to recurrent concussion injuries. Guskiewicz et al. (2003)

found that athletes with a history of one prior concussive injury are at a 1.5 times increased risk of suffering another concussion. Additionally, those athletes with two prior concussive injuries are at 2.8 times greater risk and athletes with three or more injuries are at 3.5 times greater risk than those athletes with no prior history of concussive injury.

Due to the broad spectrum of their presentation, detection of signs and symptoms of concussion is often difficult. Effective diagnosis of a concussion requires an individual to know and understand the different aspects of concussion including clinical signs and symptoms, cognitive impairment and behavioral disturbances. Commonly reported symptoms include visual distortion, dizziness, drowsiness, excess or inability to sleep, easily distracted, headache, inappropriate emotional response, irritability, loss of consciousness, disorientation, nausea/vomiting, nervousness, personality changes, balance and coordination deficits, difficulty concentrating, tinnitus, sensitivity to noise, sensitivity to light, sadness, feeling in a "fog", and glassy eyed. Often, these symptoms may be caused by other factors and so the presence of these symptoms alone are not enough to diagnose an individual with a concussion, however, they do provide the initial indicator that further testing to rule out a concussion is required (Evans et al., 2014).

Diagnosis

Concussion diagnosis in the athletic environment can be difficult given the pressures and time restrictions of competition, however regardless of the time allotted, there should never be pressure to complete a concussion assessment. Any athlete suspected of having a concussion should be removed immediately from participation and a systematic injury evaluation conducted (Broglio, et al., 2014). The clinical presentation of concussion varies considerably both between individuals and between injuries (Broglio, et al., 2014). Diagnosis of concussion is particularly tricky in the adolescent population where the brain is still growing and maturing (McCrory, et al., 2004). The degree of brain dysfunction manifested by concussion often produces signs and symptoms that fall within the range of normal experiences in the athlete population (i.e. dehydration, fatigue, anxiety). For these reasons, a concussion-assessment model that uses a multi-modal approach including objective baseline testing and careful post injury testing is recommended (Broglio, et al., 2014, McCrory, et al., 2004). The intent of baseline testing is to aid the clinician in the post-injury management process by providing data that represents an athletes' brain function in an uninjured state. Objective baseline and post injury information can be highly sensitive to concussive injuries, but the concussion diagnosis is made by clinically evaluating the injured athlete (Broglio, et al., 2014). Currently there is no consensus as to the most accurate test or combination of tests that diagnose concussions or manage their recovery times. While there is no single "go to" test, utilizing a combination of several diagnostic tools can increase the certainty that an accurate diagnosis is made.

Management

Once an athlete has been diagnosed with a concussion, they should be removed from the sport and not allowed to return to physical activity until cleared by a physician or medical professional (Broglio, et al., 2014). The issue of concussion management in sport is complex and has undergone considerable changes over the years. Most concussion management guidelines were based on expert consensus but lacked empirical validation. This led to several international Congress meetings that encouraged empirical research and the development improved guidelines for the identification and management of sport-related concussions using evidence-based strategies to inform education and clinical practices (King et al., 2014, Mrazik et al., 2011).

Inability to recognize and diagnose concussion are primary factors to the mismanagement of concussion in sports. The most common reason of variation in management protocols of concussion is lack of awareness, and confusion about the published guidelines for concussion. When a sport related concussion is diagnosed, the next step is appropriate management to ensure the athlete is not returned to play earlier than they should be, possibly exposing them to situations that increase the risk of further health complications. (Esquival, et al., 2013, King, et al., 2014, Naftel, et al., 2014, Collins, et al., 2014, Guilmette, et al., 2007).

Education on management of concussion is paramount to the successful recovery and return to sport and activities of daily living for any individual that has suffered a concussion. Literature shows that younger individuals require a longer period of recovery, increasing the need for coaches to stay current with concussion knowledge. An individual that has a concussion should follow a staged progression to ensure symptoms do not return or become exacerbated by cognitive stress or physical stress. Both cognitive and physical stresses prolong recovery and cause symptoms to return even if the individual was asymptomatic at the beginning of the task. Concussion guidelines recommend that no return to play on the same day of concussion injury in adolescents should occur. The cornerstone for concussion management is complete physical and cognitive rest until the acute symptoms have resolved and then a graded program of exertion prior to medical clearance and return to play. It is clear that the medical consequences related to sports concussion are complex, and therefore a multidisciplinary approach is optimal for the evaluation and management of these injuries (Giza et al., 2014).

Return to Play

After an athlete is diagnosed with a concussion, the return to play progression should not start until he or she no longer reports concussion-related symptoms, has a normal clinical examination and performs at or above preinjury levels of functioning on all objective concussion assessments (Broglio, et al. ,2014). The exertional progression should follow the pattern outlined below; the typical time frame consists of 24 hours between levels, however if activity at any level results in a return of symptoms or a decline in test performance, then the activity should be immediately discontinued and restarted 24 hours later or when the athlete is symptom free. The return to play exertional progression typically will keep an athlete out of sport for at least 1 week but the athletic trainer can lengthen the sequence if symptoms return during recovery. Regardless, unanimous agreement exists that an athlete should never return to play the same day as the concussion occurred (King et al, 2014). A consensus statement on return to play guidelines was created at the 4th International Conference on Concussion in Sport, laying a framework for graduated exertional return to play:

1. No Activity
    a. Symptom limited physical and cognitive rest
    b. Objective: Recovery
2. Light Aerobic Exercise
    a. Walking, swimming, stationary cycling at <70% of maximum heart rate
    b. Objective: Increased HR
3. Sport Specific Exercise
    a. Training drills normally used in the sport. (Skating for hockey, running for soccer)

    b. Objective: Increase HR and add movement
4. Non-Contact Training Drills
    a. Progression to more complex training drills (route running in football)
    b. Objective: Exercise, coordination and cognitive load
5. Full Contact Practice
    a. Following medical clearance, participation in normal training activities
    b. Objective: Restore confidence and assess functional skills
6. Return to Play

This graduated progression to return to play serve as a guideline, but when managing sport related concussion, individualization of management is important as no two athletes are the same and no two concussions are the same.

Legislation

In an attempt to reduce the morbidity associated with concussion in high school athletes, Washington State passed a law in 2009 regarding concussion safety known as the Lystedt Law, which is now enacted in all 50 states (Chrisman, et al., 2014). Implemented for adolescent level athletes, the law requires that all athletes, parents and coaches annually receive mandatory education about the perils of concussion and signs that a player could be affected. Any athlete suspected of having suffered a concussion must be immediately removed from the game or practice and is barred from returning until receiving written medical clearance licensed health care provider trained in the evaluation and management of concussions. The law also stipulates concussion education for athletes, parents and coaches. However, still unknown is whether individual schools comply with these laws, and what variations in implementation and education delivery exist and the direct effect it has on athletes, parents and coach's knowledge and attitudes of sport-related concussions.

Legislation surrounding concussion is important, not just in the diagnosis and implementation of protocols for management, but also in the development and distribution for educational materials for coaches.

Education

When athletes', parents, coaches, administrators and others discuss concussive injuries, they should use the appropriate terminology: concussion or mild traumatic brain injury. Use of such colloquial terms as "ding", "bell ringer", and "getting your bell rung" has a connotation that mitigates injury severity and thus should be avoided. When we consider all of the different factors involved with recognition, diagnosis, and management of concussion we can see that education is the key factor. Without education that is up to date and current we cannot expect coaches, parents, athletes or medical professionals to adequately address sport related concussions.

There is a variance in the ways that educational materials are provided, and the information contained in those materials. Consequently, the level of understanding following the different forms of concussion education is also variable and not always in line with the current consensus derived from research. One study by Valovich-McLeod, et al (2007). found that over 95% of coaches feel familiar or somewhat familiar with their state guidelines, while only 31% were familiar with the consensus statements. Two different groups exist when discussing types of education received, formal and informal. Formal education includes in person training such as classes or presentations by a trained professional and online classes. Informal educational materials include pamphlets, flyers, videos, social media, online resources, television, etc. The main effect of educational materials is to provide the best information possible to all parties involved in recognition, diagnosis and management of sport related concussion. Research into the effectiveness of different concussion educational materials suggests that while many coaches, athletes and parents do receive education, and there is some positive effect, not all of the educational materials are on the same quality or create the same effect on knowledge and attitudes. A study by Naftel et al. (2014) demonstrated that only 40% of coaches underwent formal concussion training compared to 90% of Certified Athletic Trainers surveyed reporting receiving formal concussion training. Given the inconsistency between athletic trainer and coach education, refocusing of efforts to better educate coaches should be a priority. However, before we can focus our efforts to educating these coaches, we must first understand their levels of knowledge and attitudes on sport related concussions (Figure 2)

Themes	Relevance
Concussion injury an epidemic *Marar et al., 2012, Gessell et al., 2007, Collins et al., 2002*	Issue at Hand Sports are major role in the lives of athletes More athletes=more risk of SRC
SIS major issue in adolescent athletes *Bey et al., 2008, Harmon et al., 1999, Cantu et al., 1995, Halstead et al., 2010, Saunders et al., 1984, McCrea et al., 2004. Cantu et al., 1995, Halstead et al., 2010*	Why To Look At HS Students Athletes expose themselves to SIS Catastrophic injury
Underreporting continues *Ramley et al., 2012, Bey et al., 2008, Barth et al., 2011*	Problem Athletes in a period of indestructability Misconception concussions can be "toughed out"
Improved knowledge and attitudes leads to improved concussion reporting Register-Mihalik et al., 2012, McCrory et al., 2013, Rosenbaum, 2010, Kurowski, 2014.	Improvements Decrease the number of underreporting concussions Improve concussion awareness
Further research is needed to understand high school coaches knowledge and attitudes about sport-related concussions *Kurowski., 2014, Rosenbaum, 2010, McCrea et al., 2004*	Future Research Significance of the study No studies to date look at the Knowledge and Attitudes in HS Coaches

Figure 2. Key themes in the literature and corresponding studies pertaining to high school coaches and sport-related concussions.

Summary

It is clear from the literature that many athletes continue to participate in practices and games while experiencing concussion-related symptoms, potentially predisposing them to subsequent and potentially catastrophic injury (McCrea et al., 2004). One commonly proposed strategy to reduce concussion underreporting and to improve the knowledge and attitudes of coaches has been to educate these individuals on the topic of concussions (Sarmiento et al., 2010). With many sport-related concussions in adolescents continuing to go underreported, undiagnosed, untreated and mismanaged, high school coaches are in a unique position to assess the athletes' concussion symptoms and provide accurate information to athletes' especially when advanced medical professionals are not present. Literature suggests a relationship between knowledge and attitudes about concussion and concussion reporting, but nothing has been studied in the high school coach population. By ensuring that coaches have appropriate knowledge and positive attitudes toward concussions and identifying the factors) that influence knowledge and attitudes, high school coaches will be able to provide an atmosphere and information conducive to concussion reporting. Coaches' will also be able to provide effective measures to reduce the long-term consequences of sport related concussions and of particular note the risk of second impact syndrome in adolescent athletes.

CHATPER III

METHOD

Introduction

This dissertation took place in several steps. First, participants were recruited through several organizations/associations. Subsequently participation by members who fit the inclusion criteria eventually allowed for the conclusion of data collection which yielded the process of data analysis which will be discussed herein (Figure 7).

Study Design

This modified mixed method study will address the knowledge and attitudes of high-school coaches on sport-related concussions. A concurrent triangulation mixed methods design will be used, also known as a convergent parallel design, which is a "type of design in which qualitative and quantitative data are collected in parallel, analyzed separately, and then merged" (Creswell et al., 2007). It is therefore, also a one-phase design where the quantitative and qualitative methods are "implemented during the same time frame and with equal weight" (Creswell et al., 2007). A variation of the convergent design, data-validation is used, and included the "use of both open and closed ended questions and uses the results from the open-ended questions to better understand the result of the closed ended questions" (Creswell et al., 2007). The reason for collecting both quantitative and qualitative data is to converge the two forms of data, to obtain different but complementary data on the same topic, and to validate the quantitative with the qualitative, in order to bring greater insight into the problem than would be obtained by either type of data separately.

The quantitative design is descriptive and cross sectional, exploratory, and experimental. Cross-sectional studies are used when data will be collected at one point in time. Exploratory research designs are used to examine a phenomenon of interest (concussions) and explore its dimensions, including how it related to other factors (Portney & Watkins, 2009, p.22). Therefore, the design will also include a correlational design to explore if a relationship exists between levels of each of the independent variables and the dependent variable and if the dependent variable correlates linearly/predictably with the independent variables. Demographic characteristics of the sample will be organized and summarized through a descriptive design. The decision to use a descriptive and correlational design is supported by Portney & Watkins (2009) who suggest that a descriptive design is appropriate for use in documenting phenomena of individuals or groups of individuals under study, while a correlational design is appropriate for use in describing the nature of existing relationships among variables.

Instrumentation

The Rosenbaum Concussion Knowledge and Attitude Survey- Coach Version (RoCKAS-HSCH) and Rosenbaum Concussion Knowledge and Attitude Survey- Coach Supplement (RoCKAS-HSCH Sup) is a standardized, valid and reliable tool for assessing concussion knowledge and attitudes specifically in high-school coaches. The RoCKAS-HSCH is a 55-item test developed by Rosenbaum (2007) (Figure 3). It is divided into five sections. Sections 1 and 2 of the RoCKAS-HSCH examine knowledge of the causes and sequelae of concussion using 18 true/false items. Each of the items contained a correct response choice. The correct response choices are supported by the existing clinical data and empirical literature. In Section 1, knowledge was examined using 15 basic items and in Section 2, knowledge was assessed by using three applied items. Section 5 contains a checklist of eight commonly reported post concussive symptoms and eight distractor symptoms. The legitimate post concussive symptoms are among the most commonly reported symptoms by concussed athletes. Correctly answered items receive 1 point, and incorrectly answered items receive no points. The Concussion Knowledge Index (CKI) was derived by summing the scores across Sections 1,2 and 5. Possible scores on the CKI ranged from 0-25 with higher scores indicating higher levels of knowledge.

Attitudes are measured in Sections 3 and 4, which contained 15 items, each with a 5-point Likert scale ranging from “strongly agree” to “strongly disagree”. Of the 15 items, 5 were basic opinion items and 10 were applied opinion items. Participants received 1 to 5 points on each item depending on the safety of their response. The scores from Sections 3 and 4 were tabulated and comprised the Concussion Attitudes Index (CAI). Possible scores on the CAI ranged from 15-75 and higher scores represented safer attitudes about concussion.

The RoCKAS-HSCH Supplement (Figure 4) form obtains detailed information about the demographic background of the samples as well as obtaining additional information about concussion knowledge and attitudes. The RoCKAS-HSCH Supplement helped us obtain information on the 11 independent variables (age, gender, ethnicity, experience, major, degree, concussion education, professional development, gender coached, coaching position and level of sport coached) tested in my study. The RoCKAS-HSCH Supplement consists of 16 items and included four sections: 1) Demographic Information 2) Occupational Information 3) School Information and 4) Concussion Questions. The Demographic Information section is comprised of items about age, sex, and race/ethnicity. The Occupational Information section included information about coaches’ experience level, the team(s) that they coach, and information about potential sources of concussion knowledge. The School Information section includes questions about individuals who make return to play decisions at school sporting events. Several items are included in the Concussion Questions section. All participants receive one common item from this section: an item that pertains to their perceptions about their personal concussion knowledge. Additionally, coaches are presented three “concussion ranking lists” that include instructions directing the participants to rate the importance of the items presented in the following areas: type of injury (i.e. Torn knee ligament vs concussion), signs and symptoms of concussion (i.e. Confusion vs loss of consciousness), and return to play decision makers (i.e. Coach vs athletic trainer).

Because of the high face validity of the RoCKAS-HSCH, seven items were included to assess poor/inconsistent effort and/or lack of thoughtfulness while completing the survey and comprised the Validity Scale (VS). The VS items were in true/false format. Correct responses warranted 1 point, and incorrect responses resulted in 0 points.

The test-retest reliability of the RoCKAS-HSCH CAI and CKI indices showed that the CAI displayed adequate reliability and the items on the CKI closely approached an appropriate level of reliability. The CAI is a stable measure of concussion attitudes, and the CKI is an acceptable measure of concussion knowledge. A significant positive correlation between CAI scores at Time 1 and Time 2 (ICC=.79, $p < .001$) was identified suggesting that the test-retest reliability of the CAI was adequate. Although a statistically significant positive correlation between CKI scores was identified (ICC= .67, $p < .001$), the failure of the coefficient to reach at least .70 places the stability of the CKI into question.

Each online survey contained the letter of solicitation, Rosenbaum Concussion Knowledge and Attitude Survey-Coach Version (RoCKAS-HSCH), Rosenbaum Concussion Knowledge and

Attitude Survey- Coach Supplement (RoCKAS-HSCH Sup) and PI developed series of open-ended scenario questions were uploaded into SurveyMonkey® (Figure 5).

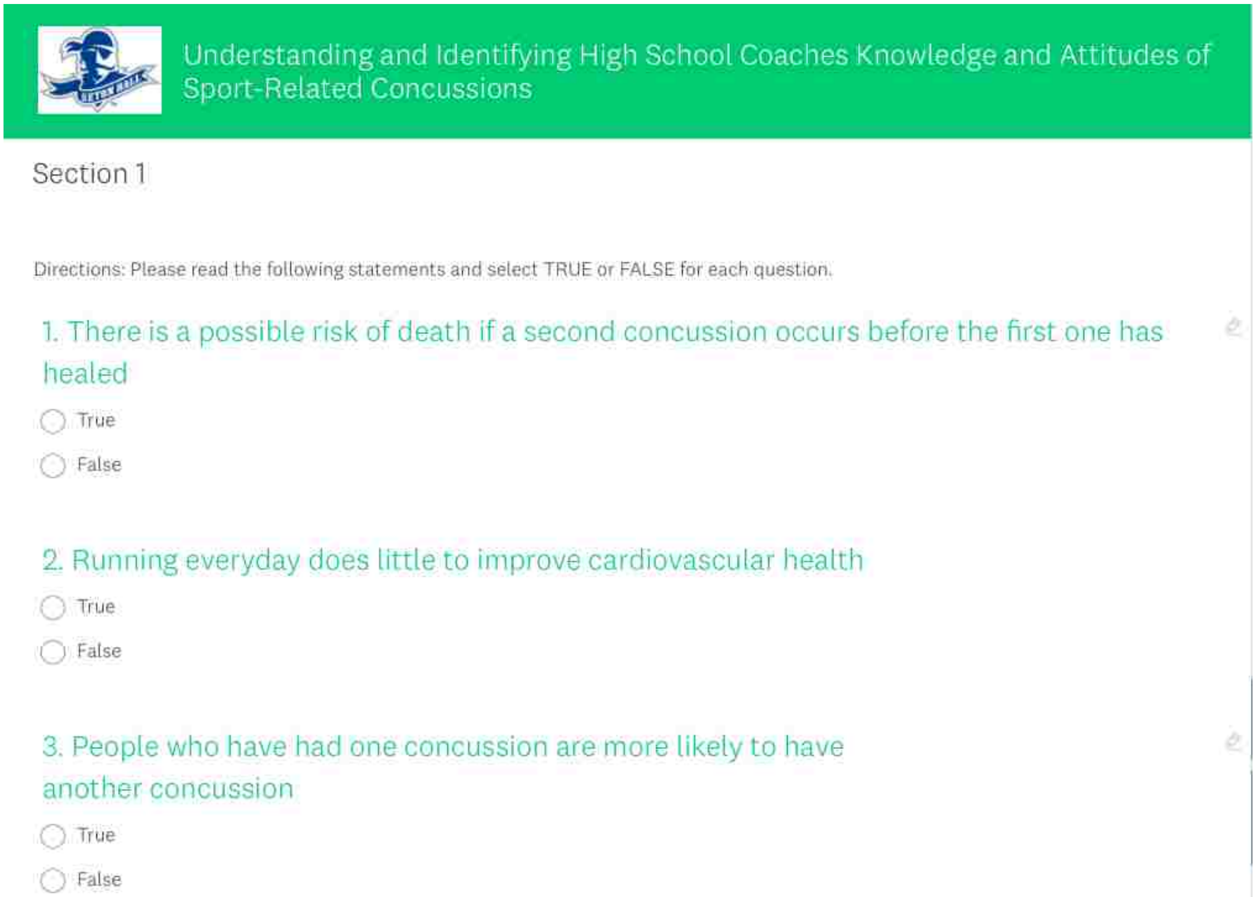

Figure 3. Snapshot of the beginning of the Rosenbaum Concussion Knowledge and Attitude Survey- Coach Version (RoCKAS-HSCH) as found on SurveyMonkey®. This figure illustrates the start of the RoCKAS-HSCH. The main RoCKAS-HSCH questions immediately follow.

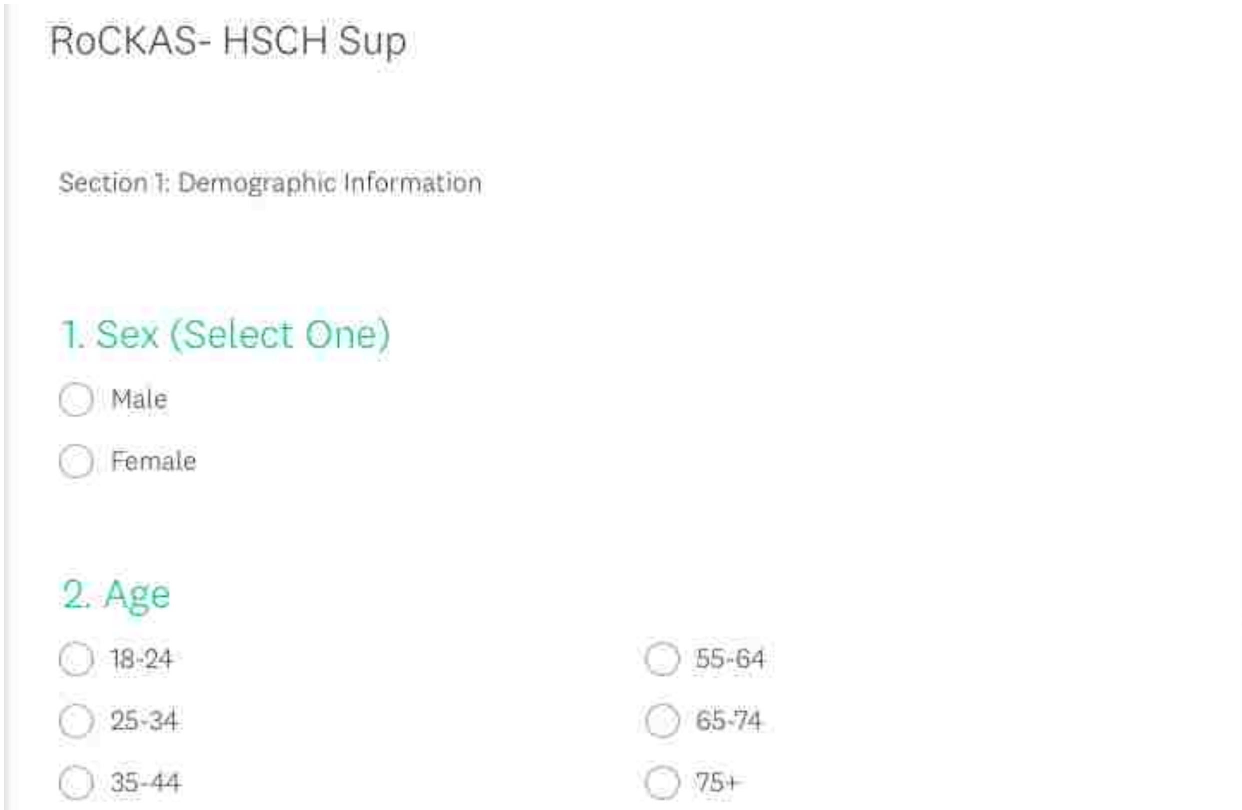

Figure 4. Snapshot of the RoCKAS-HSCH Supplement as found on SurveyMonkey®. This figure illustrates the supplement survey that asks participants to disclose their gender, age, ethnicity, experience, degree, major, concussion education, professional development, gender coached, coaching position and level of sport coached.

Open Ended Scenario Questions

1. Your athlete tells you that he blacked out briefly and was seeing stars during a game after a collision with another player. He sits out of practice for the next couple of days during which he has headaches and can't remember what happened either before or after the collision. Is it ok for him to play in the next game? Why or why not?

Figure 5. Snapshot of the PI developed open-ended scenario questions as found on SurveyMonkey®. This figure illustrates the start of the open-ended questions.

Inclusion/Exclusion Criteria

In order to be included in the research study, participants had to be a high school level coach and had to be willing to participate in the study as well as be adults 18 years of age or older and be an English speaking/reading individual. Participants were excluded if they did not meet the inclusion criteria (Figure 6).

Inclusion	Exclusion
English Speaking	Non-english speaking
Willingness to participate in the study	Non willing to participate in the study
Current high-school level coach	Non coach
18 years of age or older	Not 18 years of age or older

Figure 6. Inclusion and Exclusion Criteria for participants for survey instrument.

Participant Recruitment

The participants were solicited and recruited from a public source e-mail list server compiled by the PI , by going to different high school websites across the east coast (covering Maine to Florida), and accessing the e-mail addresses that were all public information and available on the websites for all high school sport-related coaches identified on the schools' website and utilized for survey distribution. Participation and completing of the surveys, took place online through SurveyMonkey® at the leisure of the participant.

Sample

The target population was the total number of high school coaches currently coaching interscholastic sports at the high school level across the east coast. An a priori power analysis was conducted. Medium effect size was used based on the criteria established by Cohen (1988), when no previous analysis is available to calculate a true effect size. The final sample size of N= 183 with a calculated power of .8 using G power analysis or 80% which Portney and Watkins (2009), suggest is reasonable to protect against type II error, was used.

Protocol

Upon receiving Seton Hall University IRB approval, potential survey participants received an e-mail with the letter of solicitation. If they agreed to participate in the study, they were automatically re-directed to the survey via a hyperlink at the bottom of the email. Informed consent was obtained but a waiver of written documentation of consent was requested as completion of the survey will serve as participants consent to participate. The study explored the knowledge and attitudes of high school coaches on sport-related concussions and to identify any differences in their knowledge and attitudes and the factors (11) Gender, Age, Ethnicity, Degree, Major, Concussion Education, Professional Development, Gender Coached, Coaching Position & Level of Sport Coached.

The study included completing questionnaires on the computer, phone or other internet-enabled device that will last about 15-20 minutes. The questionnaires were the Rosenbaum Concussion Knowledge and Attitude Scale- High School Coach (RoCKAS-HSCH), Rosenbaum Concussion Knowledge and Attitude Scale- High School Coach Supplement (RoCKAS-HSCH Sup) and a PI developed series of open-ended scenario questions. This survey-based study was powered by Survey Monkey®. Weekly e-mail reminders were sent each week following the initial distribution of the survey. Once the study was completed, the data was retrieved by the PI for scoring and analysis through Survey Monkey®. The PI coded and analyzed the qualitative data and then had a second researcher with a qualitative research background code the qualitative data for inter-rater reliability. The PI then analyzed the quantitative data recorded from RoCKAS-HSCH, RoCKAS-HSCH Supplement once all surveys were collected using SPSS.

Figure 7 illustrates a flowchart summary of methodology up to and including post-IRB approval from Seton Hall University.

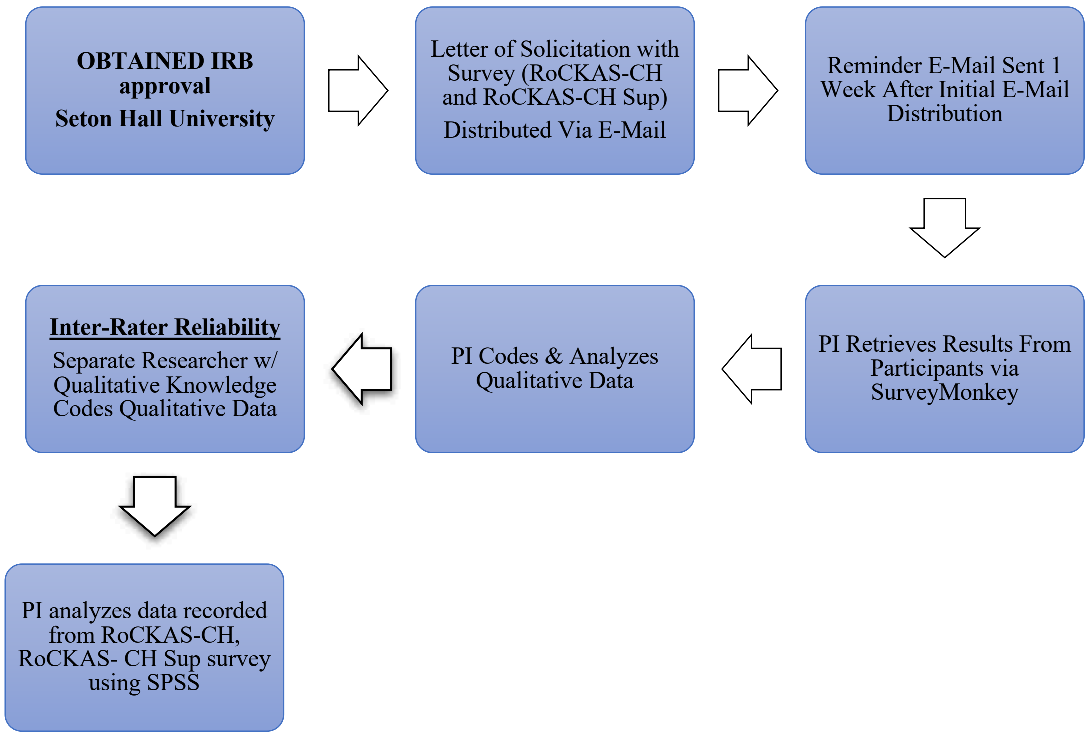

Figure 7. Flowchart summary of methodology up to and including post-IRB approval from Seton Hall University.

Analysis

Based on the triangulation design model, both types of data were analyzed independently and concurrently.

The quantitative data was analyzed using both descriptive and inferential statistics, using SPSS version 26.0. Parametric statistics were used where appropriate, otherwise, non-parametric statistics were used when the level of data was nominal or ordinal, if the sample size was small, or when the data were not normally distributed (Portney and Watkins, 2009). To determine if the data were normally distributed, Kolmogorov-Smirnov and Shaprio-Wilk tests for normality were performed for the dependent variables, as well as examining the Histogram, normal Q-Q plot, and box plot. The descriptive summary statistics (mean, standard deviation, and frequency) were used for the demographic data collected. The inferential statistics were correlations and comparison of means.

In order to identify if a factor is associated with or related to the dependent variables, knowledge and attitudes, as measured by the RoCKAS-HSCH, correlations were used. According to Portney and Watkins (2009), correlations are appropriate for exploratory analyses, where the purpose of the research question is to evaluate the relationship between two variables. Correlations describe the strength and direction of the relationship between two variables. If either of the two variables were not normally distributed, the Spearman Rho rank calculation was used. However, if the independent variable and dependent variables were normally distributed, Pearson's r calculation was used.

In order to analyze the difference between means of two independent groups (i.e. male, female), a parametric independent t test or nonparametric Mann Whitney U calculation was used. If the sample was large enough and the data was interval or ratio and normally distributed, a parametric, independent t test was used to analyze the differences between the means of two independent groups. If the sample was small or the data was not normally distributed and was ordinal or nominal, then the nonparametric Mann Whitney U test was used.

In order to analyze the difference between the mean of more than two groups (i.e. varsity coach, junior varsity coach, freshman coach), a parametric ANOVA or nonparametric Kruskal Wallis calculation was used. If the sample was large enough and the data was normally distributed, and interval or ratio a parametric, ANOVA was used to analyze the differences between the means of the groups. If the sample was small or the data was not normally distributed and was nominal or ordinal, then the nonparametric Kruskall Wallis was used.

For all the statistics analyses, significant differences were fixed at 0.05 α level and 0.2 β level with a corresponding power of 80%, which Portney and Watkins (2009) suggest is reasonable to protect against a type II error.

The qualitative data analysis started with coding the data, dividing the text from open-ended question responses into small units or phrases, and assigning a label to each unit. In vivo codes, labels from exact words or phrases of the participants, and pre-established codes from the literature were utilized. The participants' responses were transcribed and coded by one separate researcher individually in order to determine inter-coder agreement or reliability by calculating kappas. Rates were developed for the percentage of codes that were similar and the results from both types of analyses were used for interpretation.

A Priori G*Power Analysis

An *A Priori* G*Power Analysis was calculated to determine the sample size (Cohen, 1988) (Figure 8). This study required a total sample size of 184 high school coaches.

The effect size chosen was 0.3 (medium effect size). This is how strong the relationship is between the independent variable and the dependent variable). The alpha is set at 0.05- the level of significance-the probability of detecting a type 1 error (false positive).

The Power (1-beta) is listed at .80 which is the probability of detecting a true relationship or difference. Statistical power is the likelihood that a study will detect an effect when there is an effect there to be detected. Therefore, if the statistical power winds up being high, the probability of making a Type II error (concluding there is no effect when in fact there is one) goes down (Cohen, 1988).

The issue of sample size is an essential one, as it directly affects the statistical power of the study or the probability of detecting a true relationship or group difference (Portney and Watkins, 2009). A power analysis can reduce the risk for Type II errors (a false negative) by estimating in advance how big a sample is needed.

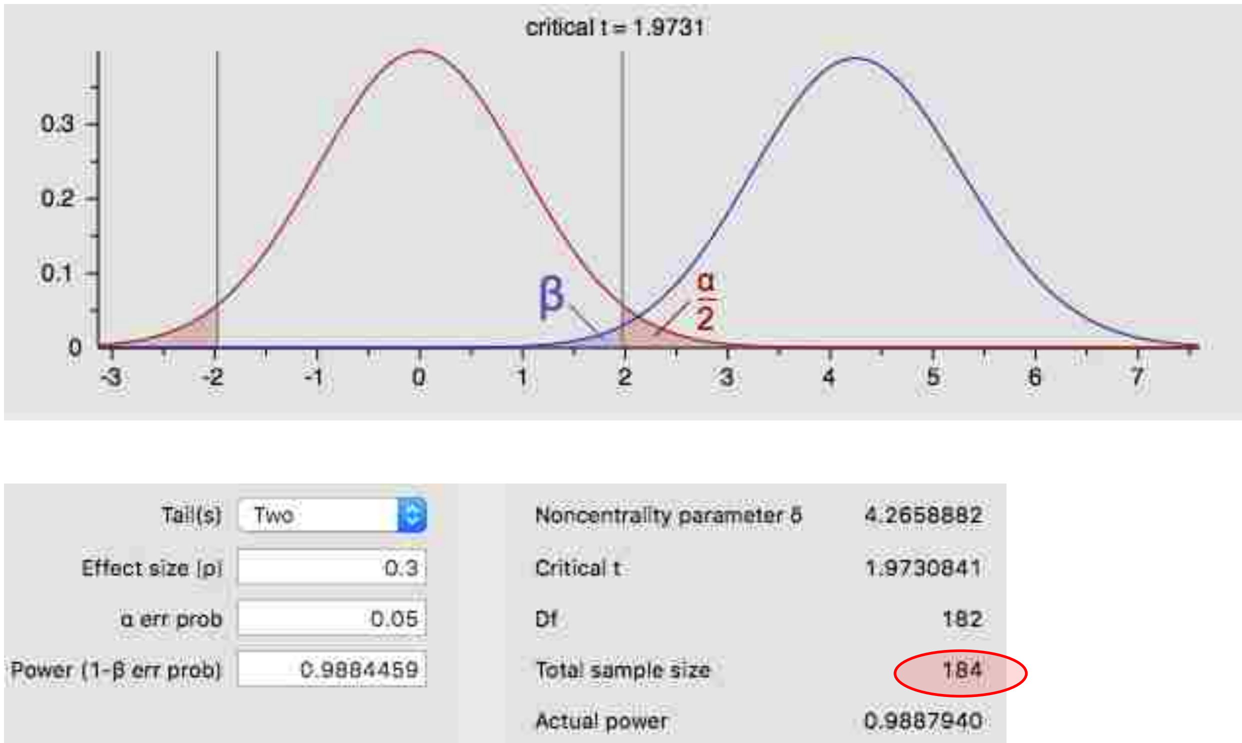

Figure 8. A Priori G*Power Analysis to determine sample size. With an effect size of .3, an alpha level set at .05, power of .80, one group (high school coaches) and 11 independent variables (gender, age, ethnicity, experience, degree, major, concussion education, professional development, gender coached, coaching position and level of sport coached), the expected and anticipated sample size is 184 participants for the survey instruments.

Chapter IV

RESULTS

Introduction

This chapter focuses on the results of the statistical tests of the dissertation study.

Characteristics of the Sample

The sample consisted of high-school coaches. One hundred eighty-three (183) high-school coaches completed the RoCKAS-HSCH. As mentioned earlier, the *a priori analysis* required 184 respondents. This study achieved 184 respondents (Figure 9) (Table I)

Gender of Respondents. More males than females took this survey. One hundred twenty-seven (127) were male and 56 were female. Specifically, 69% of respondents were male high-school coaches. All 184 participants answered this question (Figure 9) (Table II)

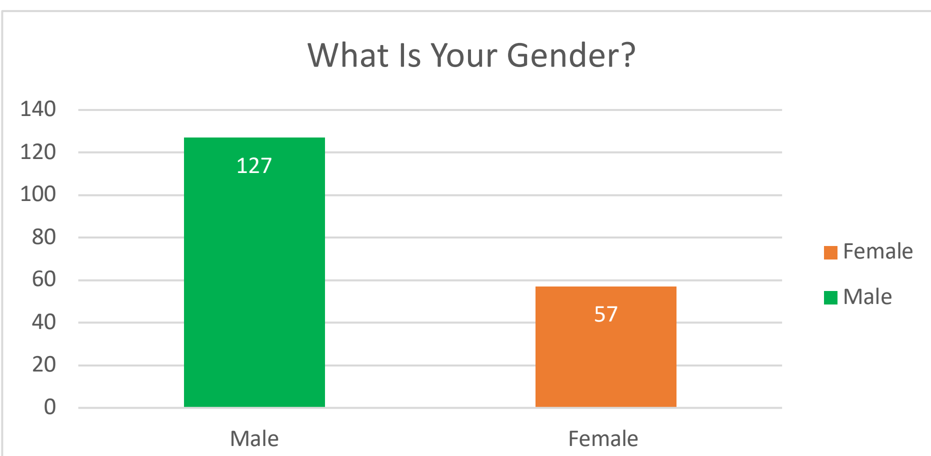

Figure 9. Bar graph of respondents according to gender. The largest group of respondents were male high-school coaches.

Table I.

Frequencies and Percentages of Respondents According to Gender

What Is Your Gender?	N=183	Percent (%)
Gender		
Male	127	69.4
Female	57	30.6

Age of Respondents. The majority of respondents were in the middle age range, which is 35-64. The 45-54 age group had the highest number of respondents. All 184 participants answered this question (Figure 10) (Table II).

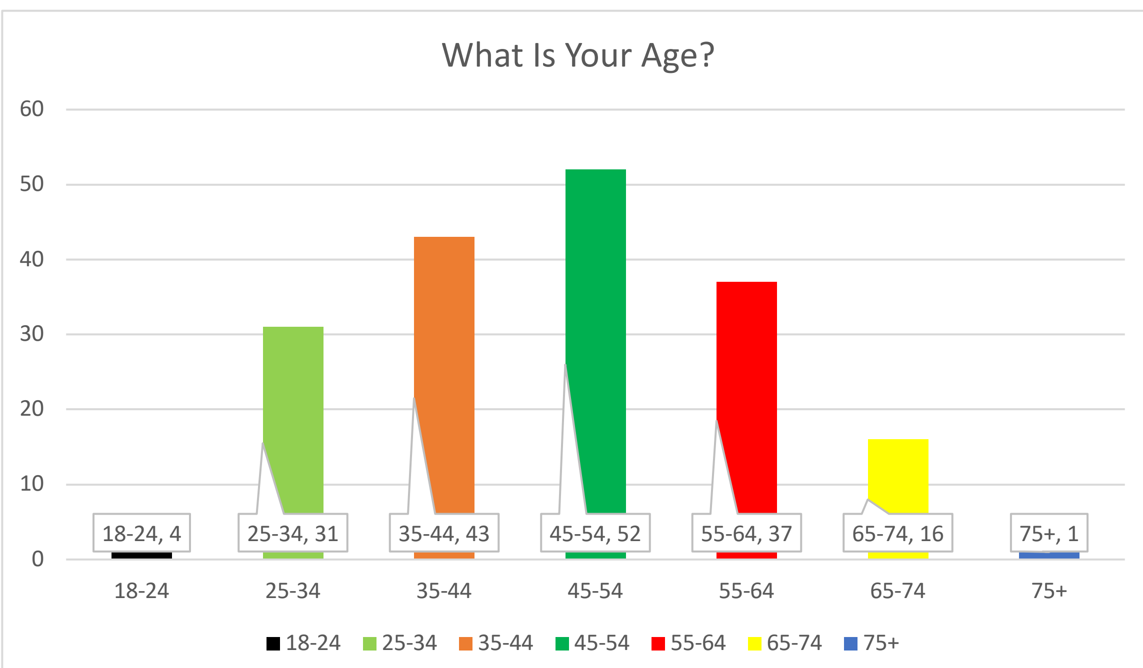

Figure 10. Bar graph illustrating age of respondents of high-school coaches. The majority of respondents were in the 45-54 age range category.

The results for age for this study are on par with the trends in statistics in the high-school coach population. This can be attributed to the tenure process at high schools with many coaches being at their current coaching positions for long periods of time without relinquishing their position.

Table II

Frequencies and Percentages of Respondents According to Age

What Is Your Age?	**N=183**	**Percent (%)**
18-24	4	2.2
25-34	31	16.8
35-44	43	23.4
45-54	52	28.3
55-64	37	20.1
65-74	16	8.7
75+	1	.5

Ethnicity of Respondents. The majority of the participants (169) in this study were white or Caucasian. Specifically, 92% of respondents were white or Caucasian and 8% were non-white or non-Caucasian. One hundred eighty-three participants out of the 184 participated in this question (Figure 11) (Table III).

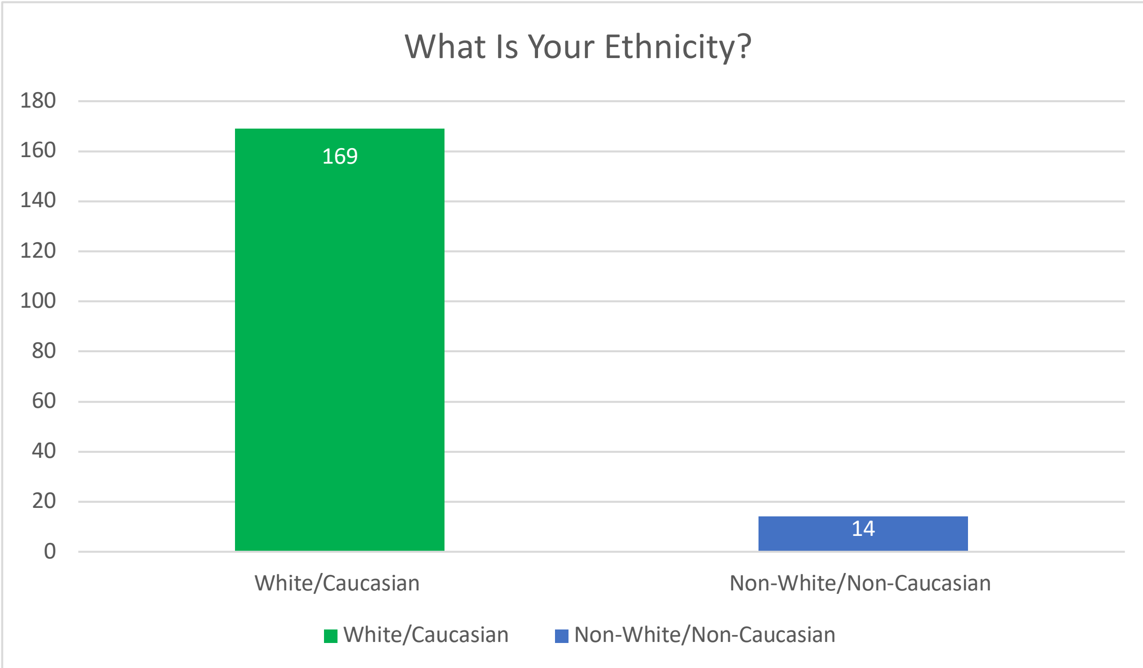

Figure 11. Bar graph of respondents according to ethnicity. The largest group of respondents were white/Caucasian high-school coaches.

Table III

Frequencies and Percentages of Respondents According to Ethnicity

Race/Ethnicity	N=183	Percent (%)
White or Caucasian	169	91.8
Non-White/Caucasian	14	8.2

Respondents' Number of Concussion Courses Taken. The majority of high-school coaches took 1 concussion course throughout their career. Specifically, to note, 100% of high-school coaches who answered this question had taken at least 1 course focusing on concussion education. One hundred sixty-nine (169) of the 184 participants answered this question (Figure 12) (Table IV).

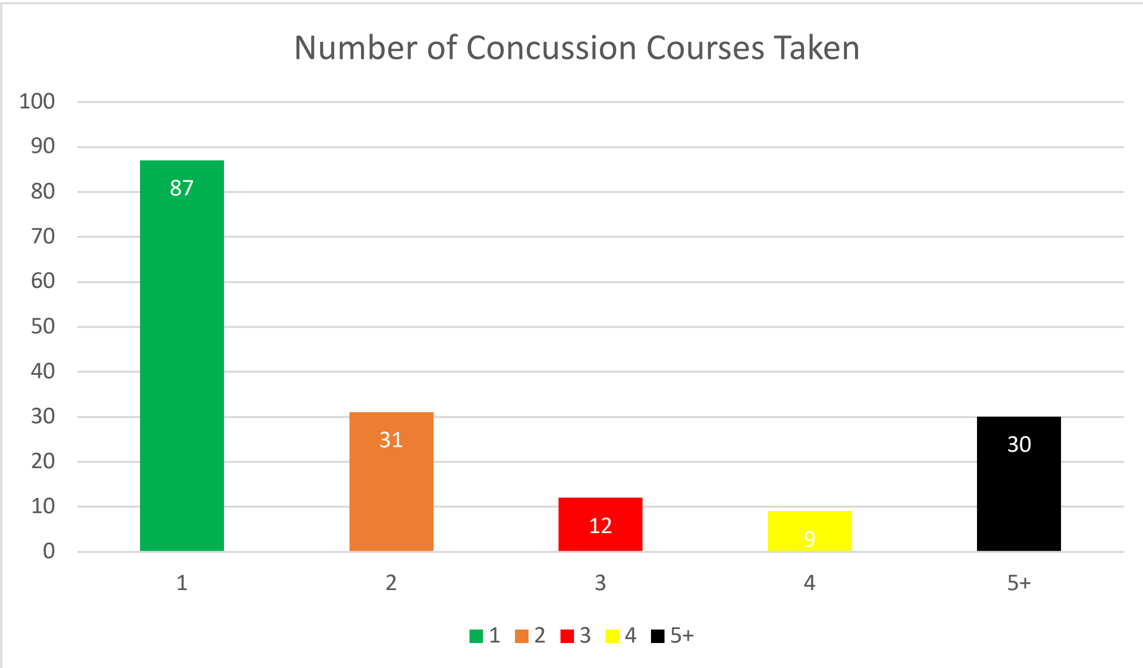

Figure 12. Bar graph of respondents according to number of concussion courses taken. The largest group of respondents were high-school coaches who took 1 concussion course.

Table IV

Frequencies and Percentages of Respondents According to Number of Concussion Courses Taken

Number of Concussion Courses Taken	**N= 169**	**Percentage (%)**
1	87	51.5
2	31	18.3
3	12	7.1
4	9	5.3
5+	30	17.8

Respondents' Number of Concussion Presentations Taken. The majority of high-school coaches participated in 5+ concussion presentations throughout their career. Specifically, to note, 65% of high-school coaches who answered this question had participated 5+ concussion presentations. One hundred eighty-one (181) of the 184 participants answered this question (Figure 13) (Table V).

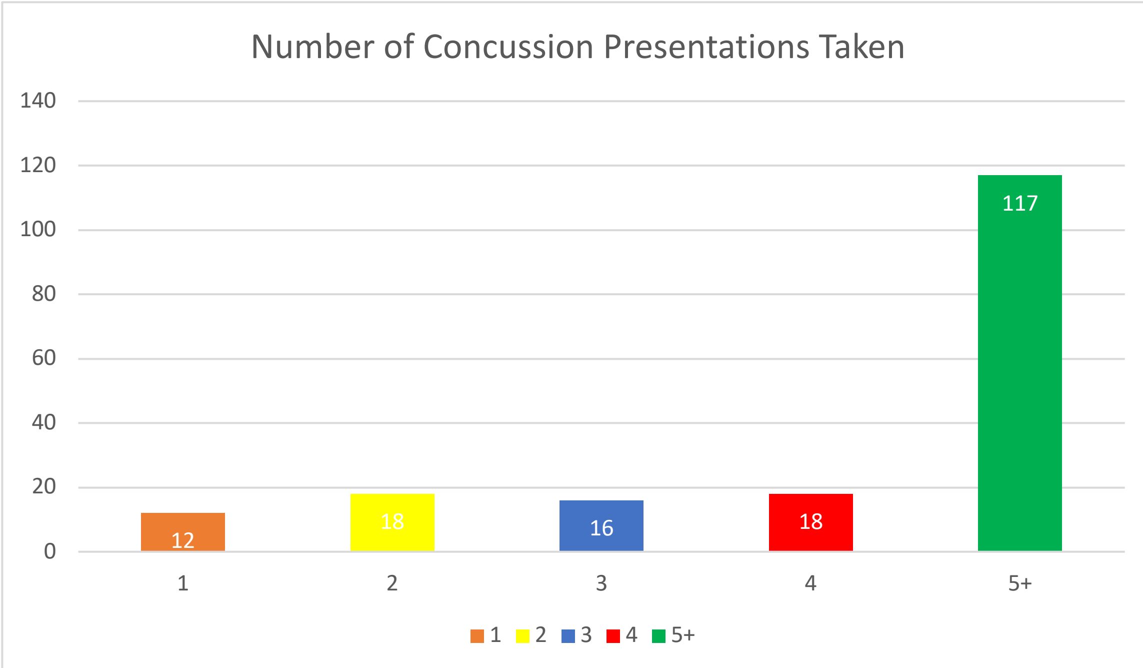

Figure 13. Bar graph of respondents according to the number of concussion presentations taken. The largest group of respondents were high-school coaches who took 5+ concussion presentations.

Table V

Frequencies and Percentages of Respondents According to Number of Concussion Presentations Taken

Number of Concussion Presentations	**N=181**	**Percentage (%)**
1	12	6.6
2	18	9.9
3	16	8.8
4	18	9.9
5+	117	64.6

Respondents' Gender Coached. The majority of high-school coaches coached both male and female athletes. Specifically, to note, 37% of high-school coaches who answered this question coached both male and female athletes with more high-school coaches coaching female sports (35%) than male (28%). All 184 participants answered this question (Figure 14) (Table VI).

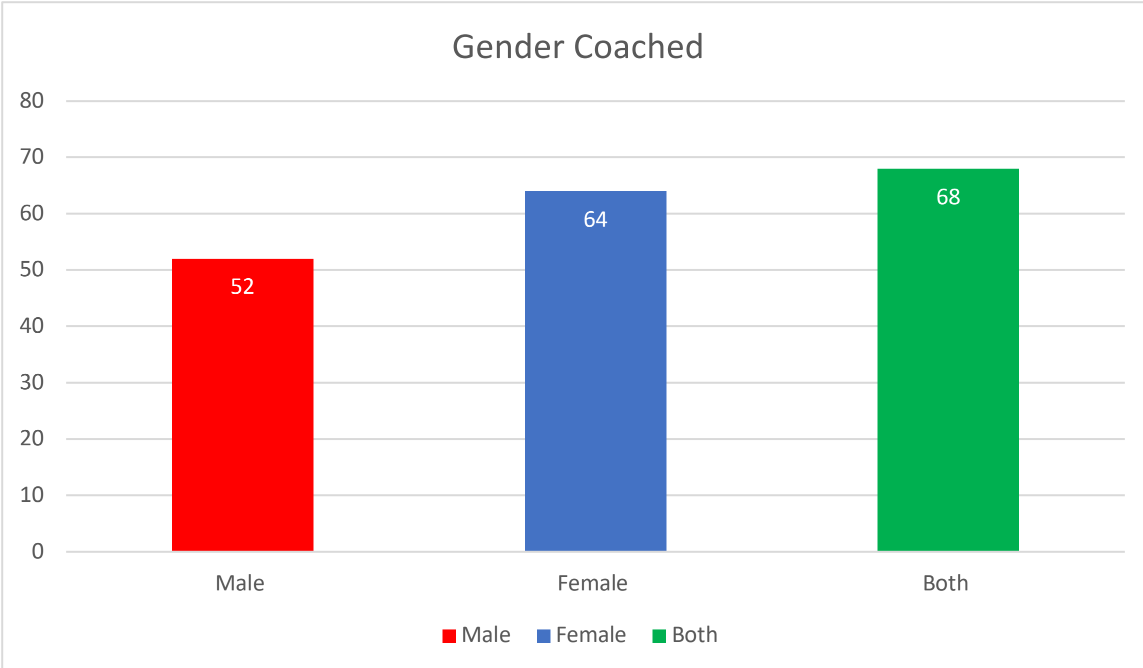

Figure 14. Bar graph of respondents according to the gender coached. The largest group of respondents were high-school coaches who coached both male and female athletes

Table VI

Frequencies and Percentages of Respondents According to Gender Coached

Gender Coached	**N=184**	**Percentage (%)**
Male	52	28.3
Female	64	34.8
Both	68	37.0

Respondents' Coaching Position. The majority of high-school coaches were head coaches. Specifically, to note, 78% of high-school coaches who answered this question were head coaches of their respective teams. All 184 participants answered this question (Figure 15) (Table VII).

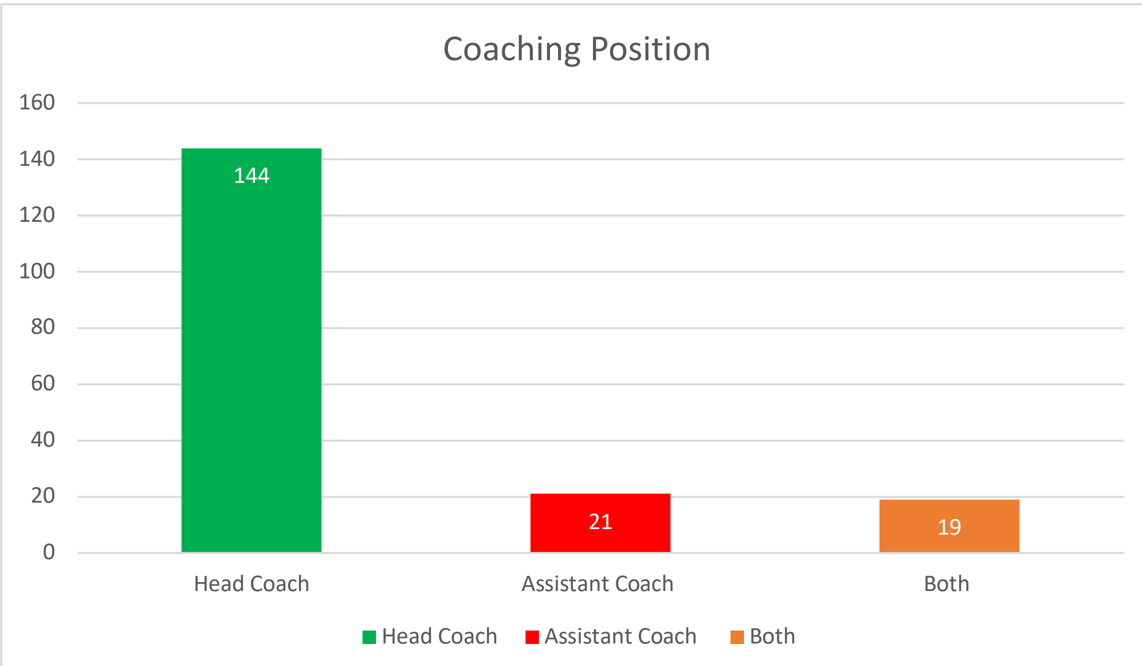

Figure 15. Bar graph of respondents according to coaching position. The largest group of respondents were high-school coaches who were head coaches.

Table VII

Frequencies and Percentages of Respondents According to Coaching Position

Coaching Position	N=184	Percentage (%)
Head Coach	144	78.3
Assistant Coach	21	11.4
Both	19	10.3

Respondents' Level of Sport Coached. The majority of high-school coaches coached at the varsity level. Specifically, to note, 65% of high-school coaches who answered this question were varsity level coaches. All 184 participants answered this question (Figure 16) (Table VIII).

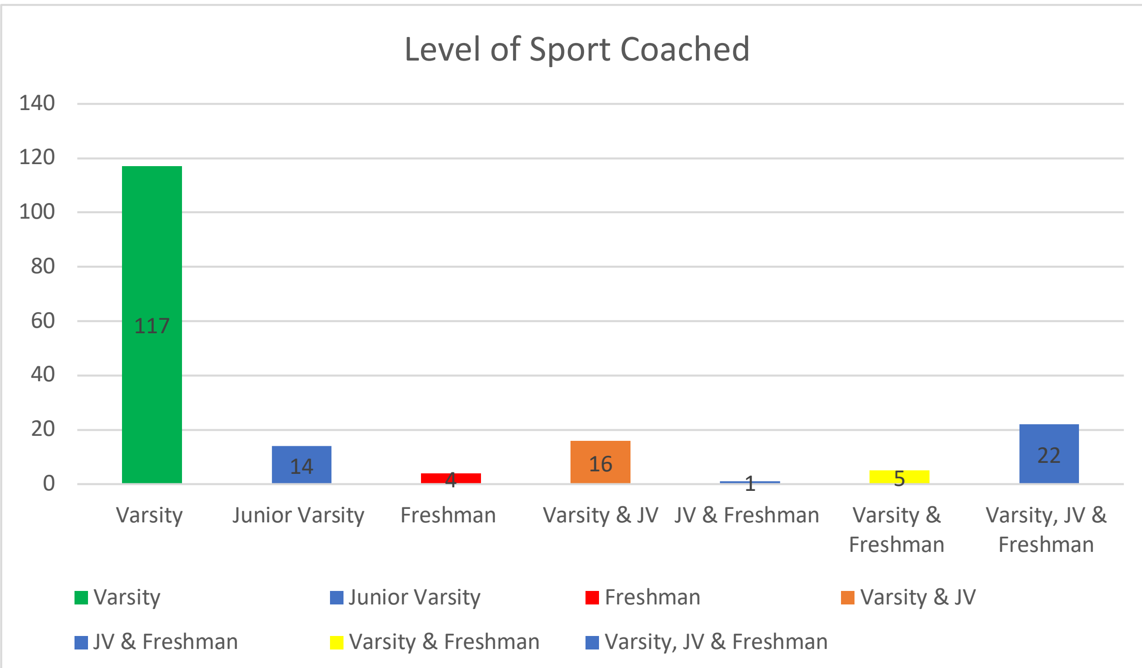

Figure 16. Bar graph of respondents according to the level of sport coached. The largest group of respondents were high-school coaches who were varsity level coaches.

Table VIII

Frequencies and Percentages of Respondents According to Level of Sport Coached

Level of Sport Coached	N=184	Percentage (%)
Varsity	117	65.4
Junior Varsity (JV)	14	7.8
Freshman	4	2.2
Varsity & JV	16	8.9
JV & Freshman	1	0.6
Varsity & Freshman	5	2.8
Varsity, JV & Freshman	22	12.3

The descriptive statistics for the knowledge and attitudes of the high-school coaches (N=184) currently coaching interscholastic sports at the high-school level on the east coast is as follows: the mean Overall Knowledge Score was 18.96 (SD=4.25) with a median score of 21.00 (Table IX). The mean Overall Attitude Score was 66.67 (SD=11.35) with a median score of 69.00 (Table X). Based on the results, using the RoCKAS-HSCH, it can be determined that the high-school coaches have adequate knowledge (scores close to max 25) and safe attitudes (scores close to max 75) toward sport-related concussions. This demonstrates statistical significance in the knowledge and attitudes of high school coaches on sport related concussions and for hypothesis (H1) and (H2) we rejected the null in favor of the alternate hypothesis.

Table IX.

Knowledge Scores of High School Coaches

Variable	Mean	Median	Min.	Max	SD
Knowledge	18.96	21.00	5.00	24.00	4.25

Table X

Attitude Scores of High School Coaches

Variable	Mean	Median	Min.	Max	SD
Attitudes	66.67	69.00	18.00	75.00	11.35

Quantitative Results

The results for analysis of the third hypothesis were grouped together by "factor". All of the statistical analyses performed to test H3, used parametric statistics.

For the factor of gender, there were two groups, male and female. To evaluate if there was a significant difference in the knowledge of high-school coaches between the factor of gender (H3a), an independent t-test was used. Levene's test for homogeneity of variances yielded a non-significant $p=.707$, indicating equal variances could be assumed. There was no statistically significant difference in the mean overall knowledge scores between the two different gender groups, $t=.137$, $p=.891$ (Table XI). Based on the results, H3a, for the factor of gender, we failed to reject the null hypothesis.

Table XI

Factor 1: Knowledge Scores of High School Coaches by Gender

	N	**Mean**	**SD**	**t=.137**	**p=.891**
Male	127	18.95	4.45		
Female	56	18.85	4.14		

To evaluate if there was a significant difference in knowledge scores of high-school coaches between the factor of age (H3b), a one-way ANOVA was used. Levene's test for homogeneity of variances yielded a non-significant p=.480, indicating equal variances could be assumed There were six groups for the factor of age, 18-24 years, 25-34 years, 35-44 years, 45-54 years, 55-64 years and 65+ years. To evaluate if there was a significant difference in the knowledge scores of the high-school coaches between the factor of age (H3b), a one-way ANOVA was used. There was no statistically significant difference in the mean overall knowledge scores between the four different age groups, F=.361, p=.875. Based on the results, H3b, for the factor of age, we failed to reject the null hypothesis (Table XII).

Table XII

Factor 2: Knowledge Scores of High School Coaches by Age

Age	N	Mean	SD	F= .361	p= .875
18-24	4	20.25	.957		
25-34	31	19.61	3.602		
35-44	43	18.53	4.742		
45-54	52	18.58	4.628		
55-64	37	19.03	3.905		
65+	17	18.88	5.337		

To evaluate if there was a significant difference in the overall knowledge scores of the high-school coaches between the factor of ethnicity (H3c) an independent t-test was used. Levene's test for homogeneity of variances yielded a non-significant p=.345, indicating equal variances could be assumed. The independent t-test for comparison of knowledge and ethnicity indicated that there was no statistically significant difference in the knowledge of the high-school coaches and ethnicity, t=.590, p=.556. Based on the results, H3c, for the factor of ethnicity we failed to reject the null hypothesis (Table XIII).

Table XIII.

Factor 3: Knowledge Scores of High School Coaches by Ethnicity

Ethnicity	**N**	**Mean**	**SD**	**t=.-.590**	**p=.556**
White/Caucasian	169	18.84	4.390		
Non-White/Non-Caucasian	15	19.53	3.997		

For the factor of coaching experience, there were three groups, 1-4 years, 5-9 years and 10+ years. To evaluate if there was a significant difference in the overall knowledge scores of high-school coaches between the different years of coaching experience (H3d), a one-way ANOVA was used. Levene's test for homogeneity of variances yielded a significant p=.000, indicating equal variances could not be assumed There was a statistically significant difference in the mean overall knowledge scores between the different years of coaching experience, F=5.014, p=.008. Based on the results, H3d, for the factor of coaching experience, we rejected the null hypothesis in favor of the alternate (Table XIV).

Table XIV

Factor 4: Knowledge Scores of High School Coaches by Coaching Experience

Experience	**N**	**Mean**	**SD**	**F= 5.014**	**p= .008**
1-4 Years	12	15.500	5.368		
5-9 Years	34	20.029	2.779		
10+ Years	138	18.913	4.451		

For the factor of received a college degree, there were two groups, yes and no. To evaluate if there was a significant difference in the overall knowledge scores of high-school coaches between them receiving a college degree or not, an independent t-test was used. Levene's test for homogeneity of variances yielded a non-significant p=.080, indicating equal variances could be assumed There was no statistically significant difference in the mean overall knowledge scores between those high-school coaches who received a college degree and those who didn't, t=1.081, p=.281. Based on the results, H3e, for the factor of received a college degree, we failed to reject the null hypothesis (Table XV).

Table XV

Factor 5: Knowledge Scores of High School Coaches by College Degree

Received A College Degree?	**N**	**Mean**	**SD**	**t=-1.081**	**p= .281**
Yes	173	18.809	4.395		
No	11	20.272	3.523		

To evaluate if there was a significant difference in knowledge scores of high-school coaches between the factor of college major (H3f), a parametric independent t test was used. Levene's test for homogeneity of variances yielded a significant p=.000, indicating equal variances could not be assumed The independent t-test for comparison of knowledge scores between college major indicated that there was no statistically significant difference in the knowledge scores between the different types of college majors, F=1.652, p=.179. Based on the results, H3f, for the factor of college major, we failed to reject the null hypothesis (Table XVI).

Table XVI

Factor 6: Knowledge Scores of High School Coaches by Major

Major	N	Mean	SD	F=1.652	p=.179
Social Sciences	71	18.647	4.760		
Natural Sciences	31	19.677	3.350		
Health Sciences	45	18.044	4.724		
Humanities	33	19.939	3.334		

For the factor of previous concussion education, there were five groups, 1 course, 2 courses, 3 courses, 4 courses and 5+ courses. To evaluate if there was a significant difference in the overall knowledge scores of high-school coaches between the different number of concussion education courses taken, a one-way ANOVA was used. Levene's test for homogeneity of variances yielded a non-significant p=.771, indicating equal variances could be assumed There was no statistically significant difference in the mean overall knowledge scores between the different number of concussion education courses taken, F=.227, p=.923. Based on the results, H3g, for the factor of previous concussion education, we failed to reject the null hypothesis (Table XVII).

Table XVII

Factor 7: Knowledge Scores of High School Coaches by Concussion Education

# College Courses Focused on Concussion Education	**N**	**Mean**	**SD**	**F=.227**	**p=.923**
1	87	18.965	4.230		
2	31	18.612	4.394		
3	12	18.250	5.361		
4	9	19.666	4.092		
5+	30	18.433	4.768		

To evaluate if there was a significant difference in the overall knowledge scores of high-school coaches between the factor of professional development (H3h), a one-way ANOVA was used. Levene's test for homogeneity of variances yielded a non-significant p=.224, indicating equal variances could be assumed. The one-way ANOVA test for comparison of knowledge scores indicated that there was no statistically significant difference in the knowledge scores between the number of professional development courses focusing on sport-related concussions that was taken, F=.664, p=.618. Based on the results, H3f, for the factor of professional development, we failed to reject the null hypothesis (Table XVIII).

Table XVIII

Factor 8: Knowledge Scores of High School Coaches by Professional Development

# Concussion Workshops/Presentations	N	Mean	SD	F=.664	p=.618
1	12	19.333	3.626		
2	18	18.666	4.789		
3	16	18.312	4.840		
4	18	17.444	4.780		
5+	117	19.102	4.261		

For the factor of gender coached, there were three groups, male, female and both. To evaluate if there was a significant difference in the overall knowledge scores of high-school coaches between the gender of the athletes they coached, a one-way ANOVA was used. Levene's test for homogeneity of variances yielded a significant p=.000, indicating equal variances could not be assumed There was a statistically significant difference in the mean overall knowledge scores between the gender the coaches coached, F=4.186, p=.017. Based on the results, H3i, for the factor of gender coached, we rejected the null hypothesis in favor of the alternate (Table XIX)

Table XIX

Factor 9: Knowledge Scores of High School Coaches by Gender Coached

Gender Coached:	**N**	**Mean**	**SD**	**F=4.186**	**p=.017**
Male Athletes	52	18.250	4.886		
Female Athletes	64	18.156	4.487		
Male & Female Athletes	68	20.088	3.518		

For the factor of coaching position, there were three groups, head coach, assistant coach and both. To evaluate if there was a significant difference in the overall knowledge scores of high-school coaches between different levels of coaching, a one-way ANOVA was used. Levene's test for homogeneity of variances yielded a non-significant p=.480, indicating equal variances could be assumed There was no statistically significant difference in the mean overall knowledge scores between different levels of coaching, F=.335, p=.715. Based on the results, H3j, for the factor of coaching position, we failed to reject the null hypothesis (Table XX).

Table XX

Factor 10: Knowledge Scores of High School Coaches by Coaching Position

Coaching Position	**N**	**Mean**	**SD**	**F= .335**	**p= .715**
Head Coach	144	18.784	4.44		
Assistant Coach	21	19.619	3.73		
Both	19	18.947	4.45		

To evaluate if there was a significant difference in the overall knowledge scores of high-school coaches between the factor of level of sport coached (H3k), a parametric one-way ANOVA was used. Levene's test for homogeneity of variances yielded a significant p=.030, indicating equal variances could not be assumed. The one-way ANOVA for comparison of knowledge scores indicated that there was no statistically significant difference in the knowledge scores between level of sport coached, F=.335, p=.480. Based on the results, H3k, for the factor of level of sport coached, we failed to reject the null hypothesis (Table XXI).

Table XXI

Factor 11: Knowledge Scores of High-School Coaches by Level of Sport Coached

Level of Sport Coached	**N**	**Mean**	**SD**	**F=1.288**	**p=.277**
Varsity	117	18.991	.414		
JV	14	18.500	1.11		
Freshman	10	17.200	1.48		
Varsity & JV	16	18.812	.913		
Varsity, JV & Freshman	22	20.590	.576		

The results for analysis of the fourth hypothesis were grouped together by "factor". All of the statistical analyses performed to test H4, used parametric statistics.

For the factor of gender, there were two groups, male and female. To evaluate if there was a significant difference in the attitudes of high-school coaches between the factor of gender (H4a), an independent t-test was used. Levene's test for homogeneity of variances yielded a non-significant p=.075, indicating equal variances could be assumed. There was no statistically significant difference in the mean overall attitude scores between the two different genders. groups, t=.727, p=.468. Based on the results, H4a, for the factor of gender, we failed to reject the null hypothesis (Table XXII).

Table XXII

Factor 1: Attitude Scores of High School Coaches by Gender

	N	Mean	SD	t=.727	p= .468
Male	104	67.67	9.02		
Female	49	66.38	12.35		

To evaluate if there was a significant difference in attitude scores of high-school coaches between the factor of age (H4b), a one-way ANOVA was used. Levene's test for homogeneity of variances yielded a non-significant p=.480, indicating equal variances could be assumed There were six groups for the factor of age, 18-24 years, 25-34 years, 35-44 years, 45-54 years, 55-64 years and 65+ years. To evaluate if there was a significant difference in the knowledge scores of the high-school coaches between the factor of age (H4b), a one-way ANOVA was used. There was no statistically significant difference in the mean overall attitude scores between the four different age groups, F=.901, p=.482. Based on the results, H4b, for the factor of age, we failed to reject the null hypothesis (Table XXIII)

Table XXIII

Factor 2: Attitude Scores of High School Coaches by Age

Age	N	Mean	SD	F= .901 p= .482
18-24	4	71.00	5.656	
25-34	29	64.13	14.788	
35-44	36	68.25	8.506	
45-54	40	65.77	11.461	
55-64	32	68.71	9.825	
65+	13	67.92	5.139	

To evaluate if there was a significant difference in the overall attitude scores of the high-school coaches between the factor of ethnicity (H4c) an independent t-test was used. Levene's test for homogeneity of variances yielded a non-significant p=.770, indicating equal variances could be assumed. The independent t-test for comparison of attitudes and ethnicity indicated that there was no statistically significant difference in the attitude of the high-school coaches and ethnicity, t=.797, p=.427. Based on the results, H3c, for the factor of ethnicity we failed to reject the null hypothesis (Table XXIV).

Table XXIV

Factor 3: Attitude Scores of High-School Coaches by Ethnicity

Ethnicity	N	Mean	SD	t=.797	Sig= .427
White/Caucasian	140	67.19	10.619		
Non-White/Non-Caucasian	14	64.78	12.273		

For the factor of coaching experience, there were three groups, 1-4 years, 5-9 years and 10+ years. To evaluate if there was a significant difference in the overall attitude scores of high-school coaches between the different years of coaching experience (H4d), a one-way ANOVA was used. Levene's test for homogeneity of variances yielded a significant p=.000, indicating equal variances could not be assumed There was a statistically significant difference in the mean overall attitude scores between the different years of coaching experience, F=4.708, p=.010. Based on the results, H4d, for the factor of coaching experience, we rejected the null hypothesis in favor of the alternate (Table XXV).

Table XXV

Factor 4: Attitude Scores of High School Coaches by Coaching Experience

Experience	N	Mean	SD	F= 4.708	p= .010
1-4 Years	8	57.000	22.032		
5-9 Years	31	69.774	4.112		
10+ Years	115	66.913	10.580		

For the factor of received a college degree, there were two groups, yes and no. To evaluate if there was a significant difference in the overall attitude scores of high-school coaches between them receiving a college degree or not, an independent t-test was used. Levene's test for homogeneity of variances yielded a non-significant p=.689, indicating equal variances could be assumed There was no statistically significant difference in the mean overall attitude scores between those high-school coaches who received a college degree and those who didn't, t=.493, p=.623. Based on the results, H4e, for the factor of received a college degree, we failed to reject the null hypothesis (Table XXVI).

Table XXVI

Factor 5: Attitude Scores of High School Coaches by College Degree

Received A College Degree?	N	Mean	SD	t=-.493	p= .623
Yes	144	66.861	11.001		
No	10	68.600	6.432		

To evaluate if there was a significant difference in attitude scores of high-school coaches between the factor of college major (H4f), a parametric independent t test was used. Levene's test for homogeneity of variances yielded a significant p=.225, indicating equal variances could be assumed. The independent t-test for comparison of attitude scores between college major indicated that there was no statistically significant difference in the attitude scores between the different types of college majors, F=.832, p=.478. Based on the results, H4f, for the factor of college major, we failed to reject the null hypothesis (Table XXVII).

Table XXVII

Factor 6: Attitude Scores of High School Coaches by College Major

Major	N	Mean	SD	F= .832	Sig=.478
Social Sciences	55	66.363	11.893		
Natural Sciences	29	67.896	9.581		
Health Sciences	36	65.500	13.387		
Humanities	31	69.322	5.121		

For the factor of previous concussion education, there were five groups, 1 course, 2 courses, 3 courses, 4 courses and 5+ courses. To evaluate if there was a significant difference in the overall attitude scores of high-school coaches between the different number of concussion education courses taken, a one-way ANOVA was used. Levene's test for homogeneity of variances yielded a non-significant p=.754, indicating equal variances could be assumed There was no statistically significant difference in the mean overall attitude scores between the different number of concussion education courses taken, F=.841, p=.501. Based on the results, H4g, for the factor of previous concussion education, we failed to reject the null hypothesis (Table XXVIII).

Table XXVIII

Factor 7: Attitude Scores of High School Coaches by Concussion Education

Concussion Education	N	Mean	SD	F=.841	p.=.501
1	73	67.054	10.691		
2	26	65.884	13.264		
3	9	70.444	4.666		
4	8	61.375	15.482		
5+	25	68.040	10.047		

To evaluate if there was a significant difference in the overall attitude scores of high-school coaches between the factor of professional development (H4h), a one-way ANOVA was used. Levene's test for homogeneity of variances yielded a non-significant p=.533, indicating equal variances could be assumed. The one-way ANOVA test for comparison of attitude scores indicated that there was no statistically significant difference in the attitude scores between the number of professional development courses focusing on sport-related concussions that was taken, F=.438, p=.781. Based on the results, H4f, for the factor of professional development, we failed to reject the null hypothesis (Table XXIX).

Table XXIX

Factor 8: Attitude Scores of High School Coaches by Professional Development

# Concussion Workshops/Presentations	N	Mean	SD	F=.438	p=.781
1	11	67.181	5.827		
2	14	69.428	4.941		
3	12	64.916	14.847		
4	13	64.615	13.288		
5+	101	67.118	11.085		

For the factor of gender coached, there were three groups, male, female and both. To evaluate if there was a significant difference in the overall attitude scores of high-school coaches between the gender of the athletes they coached, a one-way ANOVA was used. Levene's test for homogeneity of variances yielded a significant p=.002, indicating equal variances could not be assumed There was no statistically significant difference in the mean overall attitude scores between the gender the coaches coached, F=1.314, p=.272. Based on the results, H4i, for the factor of gender coached, we failed to reject the null hypothesis (Table XXX).

Table XXX

Factor 9: Attitude Scores of High School Coaches by Gender Coached

Gender Coached:	N	Mean	SD	F=1.314	p=.272
Male Athletes	41	65.902	13.406		
Female Athletes	52	65.788	13.412		
Male & Female Athletes	61	68.704	4.164		

For the factor of coaching position, there were three groups, head coach, assistant coach and both. To evaluate if there was a significant difference in the overall attitude scores of high-school coaches between different levels of coaching, a one-way ANOVA was used. Levene's test for homogeneity of variances yielded a non-significant p=.176, indicating equal variances could be assumed There was no statistically significant difference in the mean overall attitude scores between different levels of coaching, F=.1.076, p=.344. Based on the results, H4j, for the factor of coaching position, we failed to reject the null hypothesis (Table XXXI).

Table XXXI

Factor 10: Attitude Scores of High School Coaches by Coaching Position

Coaching Position	N	Mean	SD	F= 1.076	p= .344
Head Coach	119	67.369	9.827		
Assistant Coach	19	67.631	10.990		
Both	16	63.250	16.101		

To evaluate if there was a significant difference in the overall attitude scores of high-school coaches between the factor of level of sport coached (H4k), a parametric one-way ANOVA was used. Levene's test for homogeneity of variances yielded a significant p=.000, indicating equal variances could not be assumed. The one-way ANOVA for comparison of attitude scores indicated that there was a statistically significant difference in the attitude scores between level of sport coached, F=4.837, p=.001. Based on the results, H4k, for the factor of level of sport coached, we rejected the null hypothesis in favor of the alternate (Table XXXII).

Table XXXII

Factor 11: Attitude Scores of High School Coaches by Level of Sport Coached

Level of Sport Coached	N	Mean	SD	F= 4.837	p=.001
Varsity	97	67.855	8.027		
JV	14	56.000	22.374		
Freshman	7	64.285	19.310		
Varsity & JV	13	71.000	3.851		
Varsity, JV & Freshman	21	68.190	4.956		

Qualitative Results

The final questions of the survey included open-ended scenario questions. The first open-ended scenario question specifically asked the participant

"Your athlete tells you that he blacked out briefly and was seeing stars during a game after a collision with another player. He sits out of practice for the next couple of days during which he has headaches and can't remember what happened either before or after the collision. Is it ok for him to play in the next game? Why or why not?"

Using themes from the literature, the PI had pre-established themes that were expected to appear in the responses. The participants' responses were transcribed. The PI and another researcher both coded the transcribed response separately (Table 26). Once all of the responses were transcribed and labeled with a code for each theme, Cohen's Kappa was calculated to determine the inter-rater reliability. To calculate kappa, a contingency table was organized and the responses from the 167 participants. Themes that were in agreement between the two raters were placed in one of the diagonal cells, themes that were not agreed upon were placed in one of the off-diagonal cells. Row totals, column totals, and overall total were calculated. The percent of agreement calculated was 93% agreement. The expected frequency for the number of agreements that would have been expected by chance for each code was calculated with the equation:

$$Ef = \frac{\text{row total} * \text{column total}}{\text{Overall total}}$$

To calculate Cohen's Kappa the following equation was used:

$$K = \frac{\Sigma a - \Sigma ef}{N - \Sigma ef}$$

The calculated kappa totaled k=0.97 and it could therefore be concluded that the inter-rater reliability was satisfactory (k>0.7). One hundred sixty-seven (167) participants responded in total, leaving 16 of the participants who did not provide a response to this item. All 167 participants (100%) answered "no" that they would not allow the athlete to play in the next game. Reasons why they would not allow the athlete to play in the next game were all pre-determined themes from the literature and included requiring physician clearance (39.5%), still showing signs and symptoms (34.1%), the need to follow Return to Play Protocol (26.3%) and requiring ATC clearance (19.7%) (Figure 17). The results reveal that the high-school coaches would not allow a concussed athlete to play in the next game for reasons consistent with what is found in the literature.

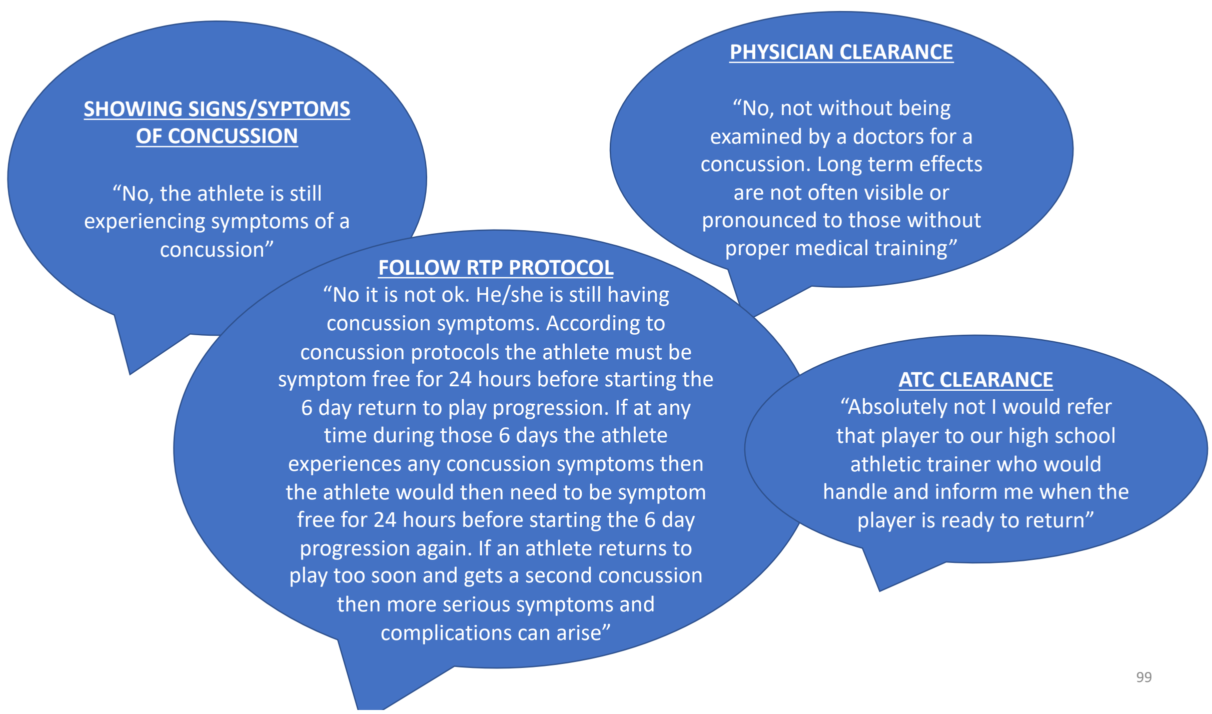

Figure 17. Most Penetrative Recorded Responses From Sample That Represented the Themes Open Ended Responses of High-School Coaches: Question 1

The second open-ended question specifically asked the participant,

> "Your star athlete takes a blow to the head in a game and is woozy as he comes off the field but symptom-free within 15 minutes and is allowed to return to the game. He suffers a hit in the head for a second time. He blacks out and doesn't regain consciousness for two minutes. He sits out the remainder of the game, but on the drive home is still disoriented, is mildly dizzy, has ringing in his ears and can't remember what happened. He appears fine the next day and wants to return to practice. The biggest game of the season is the following week and a Division I collegiate scout is going to be at the game as well to scout this athlete for a potential collegiate scholarship. Would you let him play in the next game? Why or why not?"

Nineteen (19) of the participants did not provide a response to this item. Using the definition of sport-related concussion from the literature, the PI had pre-established themes that were expected to appear in the responses. The participants' responses were transcribed. Of the 164 participants who answered the question, 163 answered "no" (98.1%). Responses were consisted with the literature and all pre-determined themes which included requiring medical professional clearance (57.2%), health being more important (21.8%), athlete still showing signs and symptoms (13.2%) and risk of long-term consequences (7.8%). The most penetrative and purposeful responses captured can be seen below (Figure 18). The PI and another researcher both coded the transcribed responses separately.

Once all of the responses were transcribed and labeled with a code for each theme, Cohen's Kappa was calculated to determine the inter-rater reliability. To calculate kappa, a contingency table was organized and the responses from the 164 participants. The percent of agreement calculated was 88% agreement. The calculated kappa totaled k=0.91 and it could therefore be concluded that the inter-rater reliability was satisfactory (k>0.7)

Figure 18. Most Penetrative Recorded Responses From Sample That Represented the Themes Open Ended Responses of High-School Coaches: Question 2.

The third and final open-ended scenario questions specifically asked the participant,

“An athlete of yours has a suspected concussion. An Athletic Trainer requests that the student receive medical clearance from a physician before returning to the field. The physician clears the athletes to return to sport. After practicing for a few hours, the athlete begins to develop a headache, dizziness, loss of memory and nausea that seem to be worsening. What would be your next steps as the coach of this athlete?”

Seventeen (17) of the participants did not provide a response to this item. Using the definition of sport-related concussion from the literature, the PI had pre-established themes that were expected to appear in the responses. The participants' responses were transcribed. Responses included removing athlete from play and contacting medical professional (78.9%) which was a pre-determined theme based on the literature. The remaining responses were all emerging themes based on the literature and included; call the parent (8.4%), sit the athlete out (5.4%), follow protocol (3%), send to hospital (1.8%), call 911 (1.2%) and let symptoms resolve (1.2%). The most penetrative and purposeful responses can be seen below (Figure 19). The PI and another researcher both coded the transcribed responses separately.

Once all of the responses were transcribed and labeled with a code for each theme, Cohen's Kappa was calculated to determine the inter-rater reliability. To calculate kappa, a contingency table was organized and the responses from the 166 participants. The percent of agreement calculated was 89% agreement. The calculated kappa totaled $k=0.91$ and it could therefore be concluded that the inter-rater reliability was satisfactory ($k>0.7$).

Figure 19. Most Penetrative Recorded Responses From Sample That Represented the Themes Open Ended Responses of High-School Coaches: Question 3.

Post-Hoc G*Power Analysis

The post-hoc G*Power Analysis resulted in a power of 0.9884 using an effect size of .30 that was calculated earlier based on the criteria set by Cohen (1988) based on a medium effect size. An alpha set at 0.05, 1 group and 11 dependent variables (Figure 20)

Recall the statistical power is the likelihood that a study will detect an effect when there is an effect there to be detected. Therefore, if the statistical power winds up being high, the probability of making a Type II error (concluding there is no effect when in fact there is one) goes down (Cohen, 1988). Therefore, with a power of 0.9884, this study was highly powered.

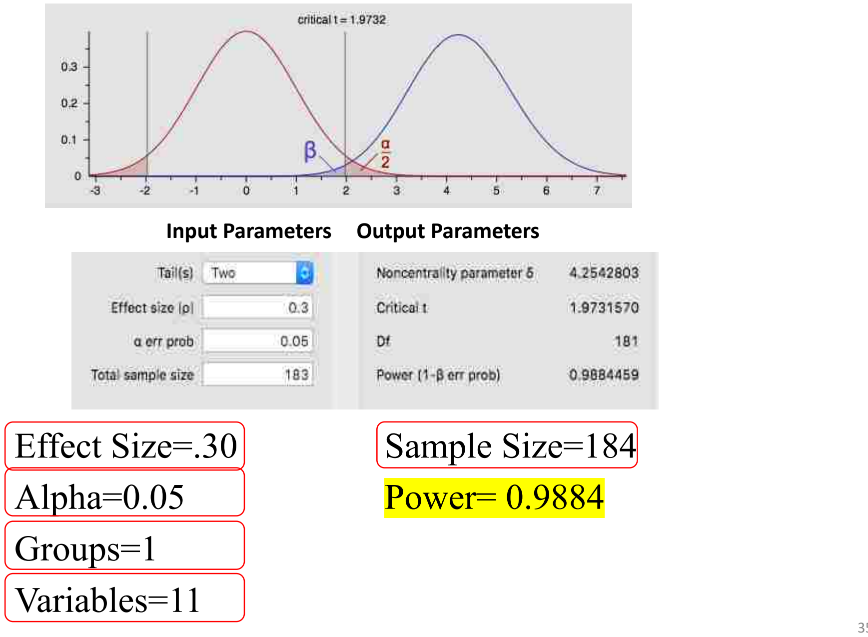

Figure 20. Post-hoc G*Power Analysis. With an effect size of .30, an alpha level set at 0.05, total sample size of 184 with 1 group and 11 dependent variables, the power=0.9884.

Summary of Findings

To summarize, the RoCKAS-HSCH and RoCKAS-HSCH Sup established excellent reliability of the tool (α = .799) according to Rosenbaum (2010).

The high-school coaches had adequate knowledge and good attitudes towards sport-related concussions with mean knowledge score of 18.96 and a standard deviation of 4.25 and mean attitude score of 66.67 with a standard deviation of 11.35.

For the *differences between knowledge and gender* males had a mean score of 18.95 and a standard deviation of 4.45 and females had a mean score of 18.85 and standard deviation of 4.14.

For the *difference between knowledge and age*, 18-24 years of age had a mean score of 20.25 and a standard deviation of .957, 25-34 had a mean sore of 19.61 and standard deviation of 3.602, 35-44 had a mean score of 18.53 and a standard deviation of 4.742, 45-54 had a mean score of 18.58 and standard deviation of 4.628, 55-64 had a mean score of 19.03 with a standard deviation of 3.905 and 65+ had a mean score of 18.88 and standard deviation of 5.337.

For the *difference between knowledge and ethnicity*, white/Caucasian high school coaches had a mean score of 18.84 and standard deviation of 4.390 and non-white/non-Caucasian coaches had a mean score of 19.53 and standard deviation of 3.997.

For the *difference between knowledge and coaching experience*, coaches with 1-4 years' experience had a mean score of 15.500 and standard deviation of 5.368, coaches of 5-9 years' experience had a mean score of 20.029 with a standard deviation of 2.779 and coaches with 10+ years' experience had a mean score of 18.913 and standard deviation of 4.451.

For *difference between knowledge and degree*, coaches with a college degree had a mean score of 18.809 with a standard deviation of 4.395 and coaches without a college degree had a mean score of 20.272 with a standard deviation of 3.523.

For *difference between knowledge and major*, those coaches who had a social science major had a mean score of 18.647 and a standard deviation of 4.760, natural science majors had a mean score of 19.677 with a standard deviation of 3.350, health science majors had a mean score of 18.044 with a standard deviation of 4.724 and those coaches who majored in humanities had a mean score of 19.939 and a standard deviation of 3.334.

For *difference between coaches knowledge and concussion education*, those who had taken 1 course on concussion education had a mean score of 18.965 and a standard deviation of 4.230, 2 concussion education courses had a mean score of 18.612 with a standard deviation of 4.394, 3 courses had a mean score of 18.250 and a standard deviation of 5.361, 4 courses had a mean score of 19.666 with a standard deviation of 4.092 and those coaches who took 5+ courses focusing on concussion education had a mean score of 18.433 and a standard deviation of 4.768.

For *difference between knowledge and professional development*, those high-school coaches who took 1 workshop/presentation focusing on concussions had a mean score of 19.333 with a standard deviation of 3.626, 2 workshop/presentations had a mean score of 18.666 with a standard deviation of 4.789, 3 workshop/presentations had a mean score of 18.312 with a standard deviation of 4.840, 4 workshops/presentations had a mean score of 17.444 with a standard deviation of 4.780 and 5+ had mean score of 19.102 with a standard deviation of 4.261.

For *difference between knowledge and gender coached*, those coaches who coached male athletes only had a mean score of 18.250 and a standard deviation of 4.886, coaches who coached female only athletes had a mean score of 18.156 with a standard deviation of 4.487 and those who coached both male and female athletes had mean score of 20.088 and a standard deviation of 3.518.

For *difference between knowledge and coaching position*, those who served as head coaches had a mean knowledge score of 18.784 with a standard deviation of 4.44, those who served as assistant coaches had a mean score of 19.619 with a standard deviation of 3.73 and those who served as both head coaches and assistant coaches had a mean score of 18.947 and a standard deviation of 4.45.

For the *difference between knowledge and level of sport coached*, those who coached varsity sports only had a mean score of 18.991 with a standard deviation of .414, those who coached junior varsity only had a mean score of 18.500, those who coached freshman only had a mean score of 17.200, those high-school coaches who coached both varsity and junior varsity sports had a mean score of 18.812 and a standard deviation of .913 and those who coached varsity, junior varsity and freshman had a mean score of 20.590 and a standard deviation of .576.

Looking at the attitude scores and the differences between the independent variables, when looking at the *difference between attitude scores and gender*, male coaches had a mean attitude score of 67.67 and a standard deviation of 9.02 and female coaches had a mean score of 66.38 and a standard deviation of 12.35.

For *difference between attitudes and age*, coaches between 18-24 years of age had a mean score of 71.00 and a standard deviation of 5.656, 25-34 had a mean score of 64.13 with a standard deviation of 14.788, 35-44 had a mean score of 68.25 and a standard deviation of 8.506, 45-54 had a mean score of 65.77 with a standard deviation of 11.461, 55-64 years of age had a mean score of 68.71 and a standard deviation of 9.825 and 65+ had a mean score of 67.92 with a standard deviation of 5.139.

For the *difference between attitudes and ethnicity*, white/Caucasian coaches had a mean score of 67.19 and a standard deviation of 10.619 and non-white/non-Caucasian coaches had a mean score of 64.78 and a standard deviation of 12.273.

For the difference between attitudes and coaching experience, coaches with 1-4 years' experience had a mean attitude score of 57.000 with a standard deviation of 22.032, 5-9 years' experience had a mean score of 69.774 with a standard deviation of 4.112 and 10+ years had a mean score of 66.913 with a standard deviation of 10.580.

For the *difference between attitude and degree*, those coaches who received a college degree had a mean score of 66.861 with a standard deviation of 11.001 and those who didn't had a mean score of 68.600 with a standard deviation of 6.432.

For the *difference between attitude and major*, social science majors had a mean score of 66.363 and a standard deviation of 11.893, natural science had a mean score of 67.896 and a standard deviation of 9.581, health sciences had a mean score of 65.500 and a standard deviation of 13.387 and humanities had a mean score of 69.322 with a standard deviation of 5.121.

For the *difference between high-school coaches attitudes and concussion education*, those coaches who had taken 1 course on concussion education had a mean score of 67.054 with a standard deviation of 10.691, 2 courses had mean score of 65.884 and a standard deviation of 13.264, 3 courses had a mean score of 70.444 with a standard deviation of 4.666, 4 courses had a mean score of 61.375 and a standard deviation of 15.482 and 5+ courses had a mean score of 68.040 with a standard deviation of 10.047.

For the *difference between attitudes and professional development*, those coaches who took 1 workshop/presentation focusing on concussions had a mean score of 67.181 with a standard deviation of 5.827, 2 workshops/presentations had a mean score of 69.428 with a standard deviation of 4.941, 3 workshops/presentations had a mean score of 64.916 and a standard deviation of 14.847, 4 workshops/presentations had a mean score of 64.615 with a standard deviation of 13.288 and 5+ workshops/presentations taken had a mean score of 67.118 and a standard deviation of 11.085.

For difference between attitude and gender coached, those who coached male only athletes had a mean score of 65.902 with a standard deviation of 13.406, those who coached female only athletes had a mean score of 65.788 with a standard deviation of 13.412and those who coached both male and female athletes had a mean score of 68.704 and a standard deviation of 4.164.

For the *difference between attitudes and coaching position*, those who served as head coaches had a mean score of 67.369 with a standard deviation of 9.827, those who served as assistant coaches had a mean score of 67.631 and a standard deviation of 10.990 and those who were both head coaches and assistant coaches had a mean score of 63.250 and a standard deviation of 16.101.

For the *difference between attitudes and level of sport coached*, those who coached at the varsity only level had a mean score of 67.855 with a standard deviation of 8.027, junior varsity only level had a mean score of 56.000 and a standard deviation of 22.373, freshman only level had a mean score of 64.285 and a standard deviation of 19.310, those who coached both varsity and junior varsity had a mean score of 71.00 and a standard deviation of 3.851 and those who coached all three, varsity, junior varsity and freshman had a mean score of 68.190 and a standard deviation of 4.956.

Review of Hypotheses (Fail To Reject or Reject)

Based on the previous summary of findings where the values indicated a significance of $p<.05$ for those variables (RQ3d: difference between knowledge and experience, RQ3i:difference between knowledge and gender coached, RQ4d: difference between attitudes and experience and

RQ4k: difference between attitudes and level of sport coached), we reject the null hypothesis in favor of the alternative (Figure 20).

Research Question 3d and Alternative Hypothesis. For the following, we reject the null hypothesis in favor of the alternative:

RQ3d. What is the difference between coach's *knowledge and coaching experience*?

$H3d_{a.}$ There will be a statistically significant difference in high school coaches' knowledge of sport-related concussions and experience as measured by RoCKAS-HSCH.

Research Question 3i and Alternative Hypothesis. For the following, we reject the null hypothesis in favor of the alternative:

RQ3i. What is the difference between coaches' *knowledge and gender coached*?

$H3i_{a.}$ There will be a statistically significant difference in high school coaches' knowledge of sport-related concussions and gender coached as measured by RoCKAS-HSCH

Research Question 4d and Alternative Hypothesis. For the following, we reject the null hypothesis in favor of the alternative:

RQ4d. What is the difference between coaches' attitudes and coaching experience?

$H4d_a$. There will be a statistically significant difference in high school coaches' attitudes of sport-related concussions and coaching experience as measured by RoCKAS-HSCH.

Research Question 4k and Alternative Hypothesis. For the following, we reject the null hypothesis in favor of the alternative:

RQ4k. What is the difference between coaches' attitudes and level of sport coached?

H4k$_a$. There will be a statistically significant difference in high school coaches' attitudes of sport-related concussions and level of sport coached as measured by RoCKAS-HSCH.

Reject or Fail to Reject?

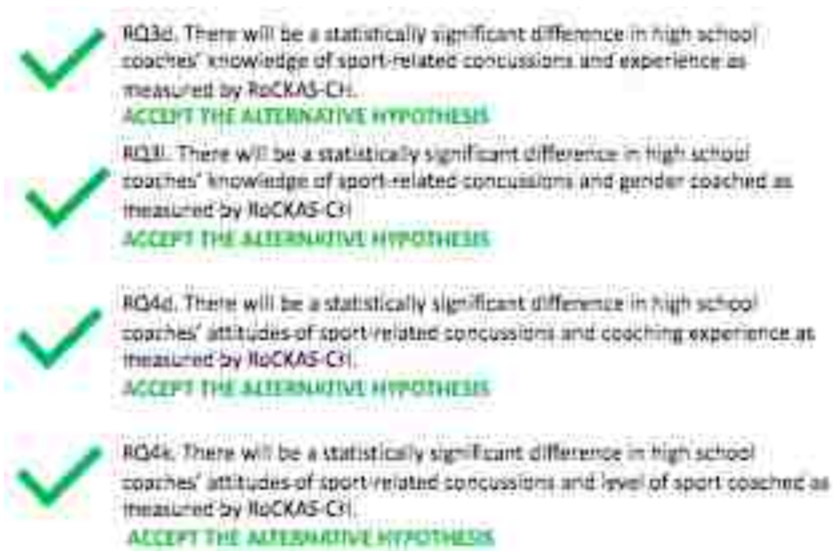

Figure 21. Reject or Fail to Reject? PI's hypotheses 3d, 3i, 4d, 4k and illustration that the alternative hypotheses were accepted for each.

Chapter V

Discussion

In this study, high-school coaches exhibited adequate levels of knowledge and safe attitudes toward sport-related concussions consistent with the findings seen in collegiate and youth coaches. Improved concussion knowledge and attitude levels, according to Register-Mihalik (2013), indicate the potential for decreasing the number of underreported sport-related concussions. This finding is further supported by this study's results that where we did find the high-school coaches in this study had adequate knowledge and safe attitudes towards sport-related concussions, but also further complicates the issues that despite their improved knowledge and attitudes high-school athletes continue to underreport sport-related concussions to coaches, especially in the absence of a medical professional. Given the importance of appropriate concussion care on the continuing health of high-school athletes, my findings regarding the knowledge level of these high-school coaches regarding sport-related concussion is important. The main purpose of my study was to identify and understand the knowledge and attitudes of high-school coaches on sport-related concussions.

The results observed in this study are consistent with findings of several other studies of high-school coaches' knowledge. O'Donoghue, Onate, Van Lunen and Peterson (2009) demonstrated a moderate level of knowledge of sport-related concussion was present in high-school level coaches. As well, Guilmette, Malia and McQuiggan (2007) reported that high-school coaches were significantly more knowledgeable about concussion than the general public but not all, coaches reported taking conservative approach to concussion management. Whereas, Mrazik, Bawani and Krol (2011) found that a majority of coaches at youth hockey level, reported limited knowledge about sport-related concussions but rated this knowledge as being important.

Valovich McLeod, Schwartz and Bay (2007) further supported the notion in youth sport coaches that several misconceptions about concussion still exist among coaches.

When looking at high-school coaches' attitudes on sport-related concussions, the results of my study were also consistent with those of other studies results in the literature. Covassin, Elbin and Sarmiento (2012) and Sarmiento, Mitchko, Klein and Wong (2010), showed positive knowledge and attitudes in high school level coaches with 60% of the coaches viewing concussions as a more serious injury and made proactive efforts to educate others, in particular their athletes, parents and other coaches about concussion injuries.

The quantitative analysis revealed very little significance between the factors and overall knowledge and attitude scores indicating there was no significant difference in overall knowledge and attitude scores due to these factors explored in this study. While one could question the factors chosen in this study for analysis, they were all part of the RoCKAS-HSCH supplement questionnaire which was demonstrated to be a valid and reliable tool for measuring concussion knowledge and attitudes in high-school coach population.

For age as a factor, there was no significant difference in overall knowledge or attitude scores between the two gender groups (male and female). Also, no significant difference in overall knowledge or attitude scores between gender, ethnicity, degree, major, concussion education, professional development and coaching position was found. Contrarily to my results, other studies, such as O'Donoghue, Onate, Van Lunen and Peterson (2009) have found that male coaches scored significantly higher than female coaches when looking at their knowledge and attitudes on sport-related concussions. Previous studies by Kurowski, Pomerantz, Schaiper and Gittelman (2014) have explored various factors that influence concussion knowledge and attitudes in high-school athletes but nothing to date has been studied on these factors in the high-school coach population outside of the factor for age which was discussed above.

For experience as a factor, there was a statistically significant difference in both overall knowledge and attitude scores between three levels of coaching experience (1-4 years, 5-9 years and 10+ years) as well as for the factor of gender coached (male, female or both). But again, no prior research in the literature exists that has examined these factors in the high-school coach population.

The same goes for when we looked at attitude and level of sport coached, I also found a statistically significant difference but no prior research to date has been reported in the literature that explored this factor.

Open-ended scenario questions posed at the end of the survey also helped to provide some explanation to the lack of significance in the quantitative results. The first question asked the participants

"Your athlete tells you that he blacked out briefly and was seeing stars during a game after a collision with another player. He sits out of practice for the next couple of days during which he has headaches and can't remember what happened either before or after the collision. Is it ok for him to play in the next game? Why?

Pre-determined themes were formed based on the definitions used in this study of sport-related concussions, which includes, physician clearance, showing signs and symptoms, following return to play protocol and athletic trainer clearance. The majority (100%) of the responses included descriptions that fell into these themes.

A second open-ended question asked, "Your star athlete takes a blow to the head in a game and is woozy as he comes off the field but symptom-free within 15 minutes and is allowed to return to the game. He suffers a hit in the head for a second time. He blacks out and doesn't regain consciousness for two minutes. He sits out the remainder of the game, but on the drive home is still disoriented, is mildly dizzy, has ringing in his ears and can't remember what happened. He appears fine the next day and wants to return to practice. The biggest game of the season is the following week and a Division I collegiate scout is going to be at the game as well to scout this athlete for a potential collegiate scholarship. Would you let him play in the next game? Why or why not?"

Again, pre-determined themes were formed based on the literature such as medical professional clearance, health being more important, showing signs and symptoms and risk of long-term consequences. Similarly, to the first question, all of the responses included these themes (100%). The third and final open-ended scenario question asked,

"An athlete of yours has a suspected concussion. An Athletic Trainer requests that the student receive medical clearance from a physician before returning to the field. The physician clears the athletes to return to sport. After practicing for a few hours, the athlete begins to develop a headache, dizziness, loss of memory and nausea that seem to be worsening. What would be your next steps as the coach of this athlete?"

Pre-determined themes were formed based on the literature such as remove the athlete a contact medical professional. The majority of the responses recorded fell into these themes. However, there were some percentages of responses that did not fall into these themes and therefore, in vivo coding was used and identified themes such as call the parent, sit the athlete out, follow protocol, send to hospital, call 911 and let symptoms resolve. These types of responses to the three open-ended scenario questions highlights the fact that the high-school coaches are in fact familiar with what sport-related concussions are and the treatment and management.

Conceptual Framework Revisited

Prior to data collection I applied the TPB and TRA and thought would help me understand my research problem. Upon reviewing and reflecting on the data presented in this study, the Theory of Planned Behavior (TPB) and Theory of Reasoned Action (TRA) framework helped me in understanding the knowledge and attitudes of the high-school coaches (Figure 1). Each theory has a component of each knowledge and attitude within but was not adequate in helping me explore the factors that maybe influencing the underreporting of sport-related concussions at the high-school level. Developing a more inclusive framework because so many factors as I have learned could potentially contribute to concussion symptom reporting, clinicians and researchers would benefit from using a theoretical framework to guide investigations of factors influencing concussion-reporting in an effort to better understand where to intervene and potentially identify more concussions in this vulnerable population (Figure 22) Applying the Knowledge Translation (KT) Theory (Figure 23) to my study which is a process of moving what we learned through research to the actual application of such knowledge in a variety of practice settings and circumstances, helped me better understand my research. The most widely used definition of knowledge translation is defined as a dynamic and iterative process that includes synthesis, dissemination, exchange and ethically-sound application of knowledge to improve the health, provide more effective health services and products. This process takes place within a complex system of interactions between researchers and knowledge users which may vary in intensity, complexity and level of engagement depending on the nature of the research and the findings as well as the needs of the particular knowledge user (Graham, 2010).

There are four elements of the Knowledge Translation Theory (KT). The first is synthesis, which in this context, means the contextualization and integration of research findings of individual research studies within the larger body of knowledge on the topic, in this case high school coaches' knowledge and attitudes of sport-related concussions. The second, dissemination, involves identifying the appropriate audience and tailoring the message and medium to the audience. Dissemination activities can include such things as educational sessions and engaging participants in developing and executing dissemination/implementation plan, tools creation and media engagement. The third part of the KT theory is the exchange of knowledge. This refers to the interaction between the participant and the researcher, resulting in mutual learning and a collaborative problem-solving method. The last component of the KT theory is the ethically sound application of knowledge. Ethically-sound KT activities for improved health are those that are consistent with ethical principles and norms, social values, as well as legal and other regulatory frameworks (Graham, 2010).

By applying the KT theory to my dissertation study we will be able to better understand the factors that may be influencing concussion reporting and the knowledge and attitudes of the high school coaches. More importantly, by applying the KT theory it leads us to believe that there may be more facilitating or barrier factors outside of the ones I studies within this dissertation that may be influencing the knowledge and attitudes of high school coaches' on the topic of sport-related concussions (Figure 22).

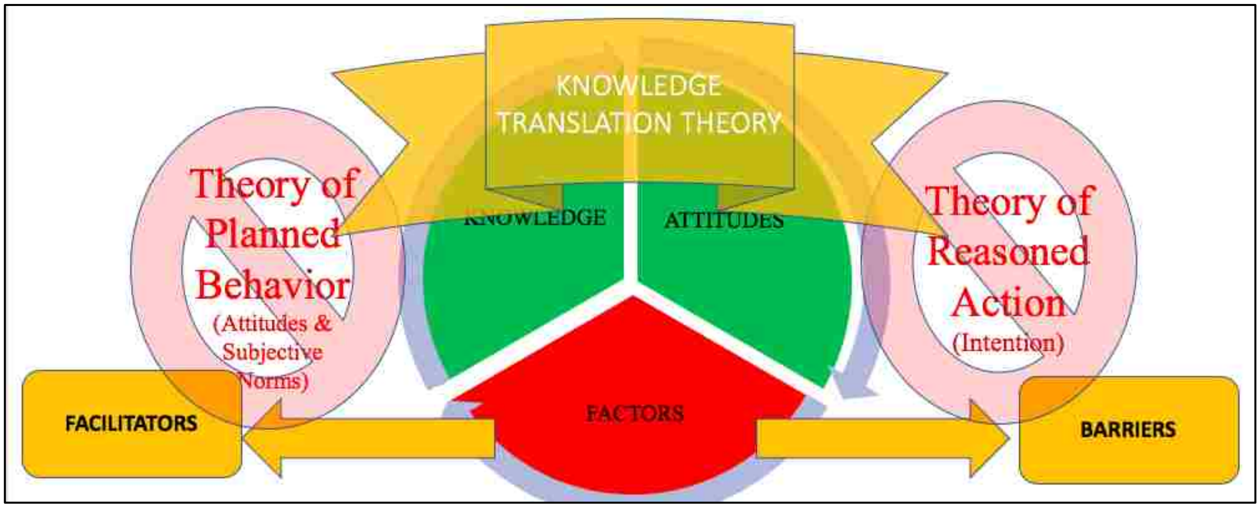

Figure 22. Inclusive framework post data collection developed to provide a more inclusive framework to understand the factors influencing sport-related concussion reporting. © 2020 Marc A. Mortellaro

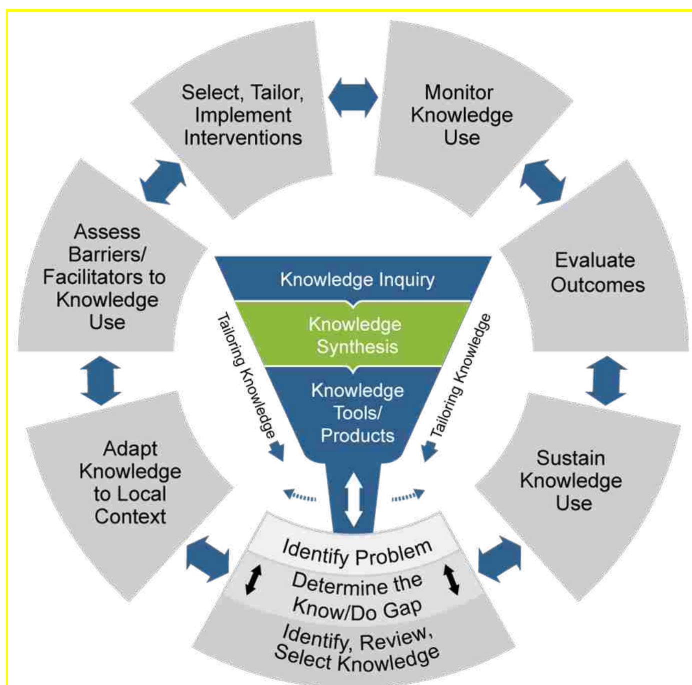

Figure 23. Knowledge Translation Theory Model. Adapted from "Lost in Knowledge Translation: Time for a Map?" Graham, I.D., Harrison, M.B., Straus, S.E., Tetroe, J., Caswell, W., Robinson, N. (2006). Journal of Continuing Education in the Health Professions, 26(1), 13-24.

Qualitative Themes

This following section illustrates examples of open-ended responses provided by respondents based on three questions at the end of the survey. Although these are not reflective of any particular statistical question, it is interesting to note a few thoughts of the survey respondents in order to put the study into perspective. These responses possibly open an avenue for further research evaluating the themes.

The open-ended scenario-based questions #1, 2 and 3 were as follows:

1. Your athlete tells you that he blacked out briefly and was seeing stars during a game after a collision with another player. He sits out of practice for the next couple of days during which he has headaches and can't remember what happened either before or after the collision. Is it ok for him to play in the next game? Why or why not?

AND

2. Your star athlete takes a blow to the head in a game and is woozy as he comes off the field but symptom-free within 15 minutes and is allowed to return to the game. He suffers a hit in the head for a second time. He blacks out and doesn't regain consciousness for two minutes. He sits out the remainder of the game, but on the drive home is still disoriented, is mildly dizzy, has ringing in his ears and can't remember what happened. He appears fine the next day and wants to return to practice. The biggest game of the season is the following week and a Division I collegiate scout is going to be at the game as well to scout this athlete for a potential collegiate scholarship. Would you let him play in the next game? Why or why not?

AND

3. An athlete of yours has a suspected concussion. An Athletic Trainer requests that the student receive medical clearance from a physician before returning to the field. The physician clears the athletes to return to sport. After practicing for a few hours, the athlete begins to develop a headache, dizziness, loss of memory and nausea that seem to be worsening. What would be your next steps as the coach of this athlete?

Majority of the themes based on upon the responses to these questions were pre-determined based on the literature that were relevant in the review of the literature section of this manuscript. This further supports the findings in my study that the high school coaches do have adequate knowledge and good attitudes of sport-related concussions. Detailed list of respondent's answers along with the themes pre-determined from the literature for each of the open-ended questions can be found in Figure 24-26..

Question #1

- **SHOWING SIGNS/SYPTOMS OF CONCUSSION**
  "No, the athlete is still experiencing symptoms of a concussion" [High School Coach]
- **FOLLOW RTP PROTOCOL**
  "No, it is not ok. He/she is still having concussion symptoms. According to concussion protocols the athlete must be symptom free for 24 hours before starting the 6 day return to play progression. If at any time during those 6 days the athlete experiences any concussion symptoms then the athlete would then need to be symptom free for 24 hours before starting the 6 day progression again. If an athlete returns to play too soon and gets a second concussion then more serious symptoms and complications can arise" [High School Coach]
- **PHYSICIAN CLEARANCE**
  "No, not without being examined by a doctors for a concussion. Long term effects are not often visible or pronounced to those without proper medical training" [High School Coach]
- **ATC CLEARANCE**
  "Absolutely not I would refer that player to our high school athletic trainer who would handle and inform me when the player is ready to return" [High School Coach]

Figure 24. Purposeful responses from open-ended scenario question 1

Question #2

- **MEDICAL PROFESSIONAL CLEARANCE**
  "No. I wouldn't have let him go back in the game in the first place. He needs to be cleared by his doctor and then the trainer before I let him practice again" [High School Coach]
- **SHOWING SIGNS & SYMPTOMS**
  "No, the athlete is experiencing concussion symptoms. If they subside over the course of the week and they work back into full play, then yes. Any symptoms remain in or out of practice, then no" [High School Coach]
- **RISK OF LONG TERM CONSEQUENCES**
  "No, another hit to the head could be fatal" [High School Coach]
- **HEALTH MORE IMPORTANT**
  "NO! His brain is more important than the game or the scout" [High School Coach]

Figure 25. Purposeful responses from open-ended scenario question 2 with pre-determined themes

Question #3

- **REMOVE ATHLETE/CONTACT MEDICAL PROFESSIONAL**
  "Athlete should immediately be seen by a physician qualified to diagnose and treat TBI. I would then question the athletic trainer to confirm that the state mandated return to practice protocol had been followed"

Figure 26. Purposeful responses from open-ended scenario question 3 with pre-determined themes

Practical Implications

There are four practical implications which are supportive of the meager information that is in the literature.

Implications from this study are that high school coaches are at the forefront of adolescent athlete's health. Educational efforts aimed at those who supervise high school sporting events could increase concussion reporting and decrease the number of athletes who play symptomatic, therefore reducing the chance of recurrent injury and risk of long-term consequences associated with concussion like SIS (Theye, 2004).

The need for continuous education on the topic of sport-related concussions to continue to improve the knowledge and attitudes of high school coaches and make informed decision when dealing with athletes who have suffered a sport-related concussion. Education may increase a coaches' knowledge and attitudes of concussions, which has been found to influence the reporting of concussive injuries to medical personnel. This is important because underreporting of sport-related concussions by athletes themselves continues to be a major concern (Register-Mihalik, et al., 2013).

A third implication of this study is that increasing knowledge of concussion symptoms, improving the culture of sport, and increasing the understanding of the seriousness of sport-related concussive injuries should be targets for future interventions. Educating the coaches' to be able to recognize sport-related concussion signs and symptoms is only the beginning. Coaches' need to understand the importance of quickly removing athletes from participation and reporting potential concussive injuries to qualified medical personnel (Broglio, et al., 2014).

The fourth practical implication of this study revolves around creating programs that should be implemented to increase the awareness, promote concussion reporting, and create a safe reporting environment in the sports community. As identifying an athlete with a concussion typically still depends on self-reporting of their symptoms, attention must also be paid to educating the athletes about recognizing signs and symptoms that are indicative of a concussion and the importance of reporting these injuries to qualified medical personnel, or to the coach in the absence of such medical professionals (Graham, 2014).

Limitations

Several limitations existed in this study. Self-reported findings are one limitation of this study and are the same as with all self-reported survey studies. Respondents may have answered according to their own perceptions of what the Principal Investigator may have wanted as correct answers. In addition, feelings may have been minimized or exaggerated depending on how they perceived the Principal Investigator's intention to be.

Lack of incentive to individuals for participating in the survey may have resulted in attrition or lack of survey participation. Had monetary or gifted incentive been addressed in the Letter of Solicitation (Appendix B), a higher chance may have existed for increased participation in the survey. In addition, survey fatigue could have been a major limiting factor within this study. Because the average time spend on the RoCKAS-HSCH, RoCKAS-HSCH Supplement and open-ended scenario questions was 14 minutes, participants may have not answered honestly the ending questions of the RoCKAS-HSCH, RoCKAS-HSCH Supplement or open-ended scenario questions due to fatigue.

Generalizability was another limitation in this study. The results of this study are only generalizable to the portion of the United States that participated in this case the high schools along the east coast covering Maine to Florida. Results are not generalizable to other countries since participants were excluded if they were not from the United States. Additionally, results are not generalizable to the high-school coaches as a whole. More research is necessary to see if the results of this study hold true across the entire high-school coach population across the United States.

Voluntary participation was another limitation of the current study. When participation is voluntary the characteristics of the participants who respond differ from those who choose not to respond. Respondents who had an interest in the subject matter of sport-related concussions may have been the ones who chose to respond. Individuals who strongly were opposed to the topic of sport-related concussions may have chosen to avoid the survey altogether.

Lastly, previously in this study I mentioned the repeated requests via email sent out weekly to the participants to complete the survey. This repeated email requests to complete the survey could have been perceived by the participants as annoying and can therefore backfire against the Principal Investigator and cause many of the participants to opt-out of the study.

Chapter VI

Conclusion

Future Research

This study was undertaken because there has been limited research conducted on the high-school coach population that addressed the knowledge and attitude levels on the topic of sport-related concussions.

Future research could include additional studies investigating the factors that influence sport-related concussion reporting in high-school athletes. As we know the diagnosis of sport-related concussions depends on the athletes subjectively reporting their symptoms to either a coach or medical professional, future studies should focus on the athletes themselves who are the ones sustaining these sport-related concussion injuries to see what factors are influencing their decisions on whether to report or not report a concussive injury, especially with the underreporting rates so high despite recent legislative and educational efforts.

Future research could include studies focusing on the facilitating and/or barrier factors that may be contributing to the underreporting of sport-related concussion in both the high-school coach and athlete population. As demonstrated in this study, we believe there may be additional factors outside of the ones studies within that could play a role in the underreporting of concussions.

A larger sample size looking at the knowledge and attitudes of high-school coaching knowledge and attitudes of sport-related concussions would allow us to look at those independent variables that we found to be significant in this study (Knowledge- experience & coaching position, Attitude- experience & level of sport coached) at a deeper level to really understand if there was a difference between the knowledge and attitude levels and each of those factors shown to be statistically significant.

Finally, future research should concentrate on assessing the knowledge and attitudes that other sample populations have on sport-related concussions, such as parents, athletes and school administrators. As demonstrated, there are many individuals involved in the care of adolescent athlete's when it comes to sport-related concussions of which many work together to educate each other as well as the athlete themselves. By understanding the knowledge and attitude levels in each individual that is involved in the care of the athlete we can see where any differences or similarities may lie in order to create targeted educational material where any significant differences may be present.

Dissertation Significance and Conclusion

The level of knowledge and attitudes of these high-school coaches, who will at times be the frontline caregivers, especially when medical professionals are not present, is significant, according to my results. Although the presence of Certified Athletic Trainers (ATC) is important to assess and protect high-school athletes following sport-related concussions, it is important to acknowledge the reality that they are not always available and that the coaches play a pivotal role in the assessment and management of concussion injuries.

Therefore, I believe that it is vital to understand the knowledge and attitudes that high-school coaches have about sport-related concussions and to persist with educational efforts and the assessment of their efficacy in a systemic and organized manner. Through ensuring that high-school coaches are educated about sport-related concussions, certified athletic trainers, medical professionals and coaches can work together to make sure that the best care is being provided to the athletes and develop initiatives to assist the coaches in helping them establish team cultures that are supportive of concussion safety. Together coaches, certified athletic trainers, parents and school administrators can ensure that the athletes are educated about sport-related concussion recognition and can work collaboratively to develop and implement concussion safety policies at their institutions.

With improved concussion knowledge and attitudes what we once thought was a contributing factor to the underreporting of sport-related concussions in high-school athletes we can now turn our attention to possible more external barriers and facilitator factors that may be contributing to the large issue of concussion underreporting. In order to prevent Second Impact Syndrome and catastrophic consequences of sport-related concussions in this vulnerable high-school level population of athletes a paradigm shift is needed to change the mindset of the coaches. Now that we know the coaches have adequate knowledge and safe attitudes toward sport-related concussions, we still are unsure why high-school coaches are not advocating for the athletes to report sport-related concussions and concussion like symptoms. Understanding more about the nature, variability and correlates of the contextual pressures that athletes experience after a head impact is critical for determining whether there are opportunities for targeted intervention.

High-school coaches are at the forefront of adolescent athlete’s health, especially when there is no medial professional at the games or practices. Educational efforts aimed at those who supervise high-school sporting events could increase concussion reporting and decrease the number of athletes who play symptomatic, therefore reducing the chance of recurrent or catastrophic injury. Education may increase a coach’s knowledge of concussions, which has been found to influence the reporting of concussive injuries to medical personnel. This is important because underreporting of concussions remains a concern. Educating coaches to be able to recognize concussion signs and symptoms is only the beginning. Coaches need to understand the importance of quickly removing athletes from participation and reporting potential concussive injuries to qualified medical personnel. As identifying athletes with concussions typically still depends on the self-reporting of symptoms, attention must also be paid to the educating the athletes about recognizing the signs and symptoms that are typically indicative of concussions and the importance of reporting these injuries to qualified medical personnel, or to the coach in the absence of a medical professional.

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APPENDIX A

Institutional Review Board (IRB) Approval

SETON HALL UNIVERSITY
1856

May 30, 2018

[redacted]

Dear Mr. Mortellaro,

The Seton Hall University Institutional Review Board has reviewed your research proposal entitled "Exploring the Perceptions of High School Coaches Related to Sports-related Concussion Practices: A Mixed Methods Analysis" and has categorized it as exempt.

Enclosed for your records is the signed Request for Approval form.

Please note that, where applicable, subjects must sign and must be given a copy of the Seton Hall University current stamped Letter of Solicitation or Consent Form before the subjects' participation. All data, as well as the investigator's copies of the signed Consent Forms, must be retained by the principal investigator for a period of at least three years following the termination of the project.

Should you wish to make changes to the IRB approved procedures, the following materials must be submitted for IRB review and be approved by the IRB prior to being instituted:

- Description of proposed revisions;
- *If applicable*, any new or revised materials, such as recruitment fliers, letters to subjects, or consent documents; and
- *If applicable*, updated letters of approval from cooperating institutions and IRBs.

At the present time, there is no need for further action on your part with the IRB.

In harmony with federal regulations, none of the investigators or research staff involved in the study took part in the final decision.

Sincerely,

Mary F. Ruzicka, Ph.D.

Mary F. Ruzicka, Ph.D.
Professor
Director, Institutional Review Board

cc: Dr. Deborah DeLuca
Dr. Terrence Cahill

Office of Institutional Review Board
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A HOME FOR THE MIND, THE HEART AND THE SPIRIT

APPENDIX B

Letter of Solicitation to Survey Participants

Understanding and Identifying Knowledge and Attitudes of High School Coaches on Sport-Related Concussions

Dear Coach,

My name is Marc Mortellaro, I am a doctoral candidate in the Department ofInterprofessional Health Science and Health
Administration, Seton Hall University and he is conducting a research project titled Exploring the Perceptions of High
School Coaches Related to Sport-Related Concussion Practices: A Mixed Methods Analysisas part of the requirement
for his Ph.D. degree.

Participation

If you are a coach, 18 years of age or older who currently coaches in high school athletics, you are invited to participate in this study because you are involved in sports with athletes who are at risk of sustaining a sport-related concussion injury.

This study will include completing questionnaires on the computer or on a phone or other internet-enabled device that will last no more than 30 minutes. The questionnaires are the Rosenbaum Concussion Knowledge and Attitude Survey (RoCKAS-CH), Rosenbaum Concussion Knowledge and Attitude Survey- High School Coach Supplement (RoCKAS-HSCH) and open-ended scenario questions.

Participation in this study is entirely voluntary and participantswill not be identified in any way. Participants in the study are free to withdraw at any timewithout penaltyand can skip questions that theyare not comfortable answering without penalty. No one in the athletic department will know who is or is not participating. Your identity will not be collected as part of this study. Your name, address, or other personal identifying information will not be collected. Only general demographic information will be collected. There will be no records identifying you. Your answers are anonymous. There will be no way to contact you or link your answers to you. The research data may be published at the end of the study. If it is, it will not identify any participant. Please also note that although SurveyMonkey® website is secure, as there is with anything online, there is a remote risk of hacking. When you complete the survey, please submit the survey by clicking on the "Submit" radio button. By doing this, your browser should automatically close but to be safe, please close your browser manually after you click the submit radio button.

Confidentiality
All information about this study will be kept confidential. The principal investigator (Marc Mortellaro) will not have access to any participant'sname or e-mail at any time.All electronic data will be stored on a password-protectedUSB memory key, which will also remain in a secured filing cabinet in Marc Mortellaro's home officefor three years along with all non-electronic data. After three years, the data will be destroyed.

Risks
There is no foreseeable risk factor or discomfort that is anticipated by participating in this research study. However, please be aware that as with any online survey the remote possibility exists that an account can be hacked. By participating in this survey research, you may be facilitating the education for future student-athletes about concussion knowledge and attitudes.

Whom to contact if you have questions about the study
If you have an interest in learning more about this topic or study please feel free to contact me through the office of Dr. Deborah DeLuca Chair in the Department of Interprofessional Health Sciences and Health Administration in the Seton Hall University School of Health and Medical Sciences, at 973-275-2842, Deborah.deluca@shu.edu. Should you have any questions about your rights as a participant in this research study, you may contact Dr. Mary Ruzicka, Director, Institutional Review Board in the Office of the IRB at Seton Hall University may be reached at 973-313-6314. You may send questions about subjects' rights as human subjects in a research study by email to: irb@shu.edu.

Thank you very much for your invaluable contribution to this project.

Sincerely,

Marc A. Mortellaro, Ph.D. Student
School of Interprofessional Health Sciences and Health Administration
Seton Hall University

APPENDIX C

Rosenbaum Concussion Knowledge and Attitude Survey- Coach Version

(RoCKAS-HSCH)

RoCKAS-CH

NOTE: The phrase "Return to play/competition" refers to being cleared to play in both practice and games

SECTION 1

DIRECTIONS: Please read the following statements and circle TRUE or FALSE for each question.			
1	There is a possible risk of death if a second concussion occurs before the first one has healed.	TRUE	FALSE
2	Running everyday does little to improve cardiovascular health.	TRUE	FALSE
3	People who have had one concussion are more likely to have another concussion.	TRUE	FALSE
4	Cleats help athletes' feet grip the playing surface.	TRUE	FALSE
5	In order to be diagnosed with a concussion, you have to be knocked out.	TRUE	FALSE
6	A concussion can only occur if there is a direct hit to the head.	TRUE	FALSE
7	Being knocked unconscious always causes permanent damage to the brain.	TRUE	FALSE
8	Symptoms of a concussion can last for several weeks.	TRUE	FALSE
9	Sometimes a second concussion can help a person remember things that were forgotten after the first concussion.	TRUE	FALSE
10	Weightlifting helps to tone and/or build muscle.	TRUE	FALSE
11	After a concussion occurs, brain imaging (e.g., CAT Scan, MRI, X-Ray, etc.) typically shows visible physical damage (e.g., bruise, blood clot) to the brain.	TRUE	FALSE
12	If you receive one concussion and you have never had a concussion before, you will become less intelligent.	TRUE	FALSE
13	After 10 days, symptoms of a concussion are usually completely gone.	TRUE	FALSE
14	After a concussion, people can forget who they are and not recognize others but be perfect in every other way.	TRUE	FALSE
15	High school freshmen and college freshmen tend to be the same age.	TRUE	FALSE
16	Concussions can sometimes lead to emotional disruptions.	TRUE	FALSE
17	An athlete who gets knocked out after getting a concussion is experiencing a coma.	TRUE	FALSE
18	There is rarely a risk to long-term health and well-being from multiple concussions.	TRUE	FALSE
19	A "bell ringer or ding" is a concussion.	TRUE	FALSE

SECTION 2

DIRECTIONS: Please read each of the following scenarios and circle TRUE or FALSE for each question that follows the scenarios.			
	Scenario 1: *While playing in a game, Player Q and Player X collide with each other and each suffers a concussion. Player Q has never had a concussion in the past. Player X has had 4 concussions in the past.*		
1	It is likely that Player Q's concussion will affect his long-term health and well-being.	TRUE	FALSE
2	It is likely that Player X's concussion will affect his long-term health and well-being.	TRUE	FALSE
	Scenario 2: *Player F suffered a concussion in a game. She continued to play in the same game despite the fact that she continued to feel the effects of the concussion.*		
3	Even though Player F is still experiencing the effects of the concussion, her performance will be the same as it would be had she not suffered a concussion.	TRUE	FALSE

SECTION 3

DIRECTIONS: For each question circle the number that best describes how you feel about each statement.		Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
1	I would continue playing a sport while also having a headache that resulted from a minor concussion.	1	2	3	4	5
2	I feel that coaches need to be extremely cautious when determining whether an athlete should return to play.	1	2	3	4	5
3	I feel that mouthguards protect teeth from being damaged or knocked out.	1	2	3	4	5
4	I feel that professional athletes are more skilled at their sport than high school athletes.	1	2	3	4	5
5	I feel that concussions are less important than other injuries.	1	2	3	4	5
6	I feel that an athlete has a responsibility to return to a game even if it means playing while still experiencing symptoms of a concussion.	1	2	3	4	5
7	I feel that an athlete who is knocked unconscious should be taken to the emergency room.	1	2	3	4	5
8	I feel that most high school athletes will play professional sports in the future.	1	2	3	4	5

TION 4

ECTIONS: For each question read the scenarios and circle the number that describes your view. (For the questions that ask you what *most athletes* feel, your answers on how you think MOST athletes would feel)	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
Scenario 1: *Player R suffers a concussion during a game. Coach A decides to keep Player R out of the game. Player R's team loses the game.*					
I feel that Coach A made the right decision to keep Player R out of the game.	1	2	3	4	5
Most coaches would feel that Coach A made the right decision to keep Player R out of the game.	1	2	3	4	5
Scenario 2: *Athlete M suffered a concussion during the first game of the season. Athlete O suffered a concussion of the same severity during the semifinal playoff game. Both athletes had persisting symptoms.*					
I feel that Athlete M should have returned to play during the first game of the season.	1	2	3	4	5
Most coaches would feel that Athlete M should have returned to play during the first game of the season.	1	2	3	4	5
I feel that Athlete O should have returned to play during the semifinal playoff game.	1	2	3	4	5
Most coaches feel that Athlete O should have returned to play during the semifinal playoff game.	1	2	3	4	5
Scenario 3: *Athlete R suffered a concussion. Athlete R's team has an athletic trainer on the staff.*					
I feel that the athletic trainer, rather than Athlete R, should make the decision about returning Athlete R to play.	1	2	3	4	5
Most coaches would feel that the athletic trainer, rather than Athlete R, should make the decision about returning Athlete R to play.	1	2	3	4	5

	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
Scenario 4: *Athlete H suffered a concussion and he has a game in two hours. He is still experiencing symptoms of concussion. However, Athlete H knows that if he tells his coach about the symptoms, his coach will keep him out of the game.*					
I feel that Athlete H should tell his coach about the symptoms.	1	2	3	4	5
Most coaches would feel that Athlete H should tell his coach about the symptoms.	1	2	3	4	5

TION 5

ECTIONS: Think about someone who has had a concussion. Check off the following signs and symptoms that you believe eone may be likely to experience AFTER a concussion.

✓		✓	
	Hives		Feeling in a "Fog"
	Headache		Weight Gain
	Difficulty Speaking		Feeling Slowed Down
	Arthritis		Reduced Breathing Rate
	Sensitivity to Light		Excessive Studying
	Difficulty Remembering		Difficulty Concentrating
	Panic Attacks		Dizziness
	Drowsiness		Hair Loss

APPENDIX D

Rosenbaum Concussion Knowledge and Attitude Survey-Coach Version Supplement (RoCKAS-HSCH Sup)

RoCKAS-HSCH Sup

SECTION 1—DEMOGRAPHIC INFORMATION

1. Sex (Circle one) Male Female
2. Age________________________
3. Race/Ethnicity________________

SECTION 2—OCCUPATIONAL INFORMATION

1. How many years of coaching experience do you have (include years as assistant coach, grad assistant, etc.)? ______
2. Have you received a college degree? (i.e., bachelors or associates) Circle one: YES NO **IF NO, PLEASE SKIP TO QUESTION 3**

   2a. What did you major in during college? ____

3. Please indicate the number of college courses that you have taken throughout your lifetime that have devoted some portion of the course to issues related to concussion (Circle one)
   0 1 2 3 4 5+
4. Please list the number of presentations (i.e., workshops, seminars, conferences, symposia, etc.) that you have attended over your lifetime that have devoted some portion of the presentation to issues related to concussion (Circle one)
   0 1 2 3 4 5+
5. Which HIGH SCHOOL sport(s) are you currently coaching? (please list all of the HIGH SCHOOL sports that you are currently coaching or have coached during the current academic year and the sports that you will be coaching during the current academic year)

		What is the sex of the athletes on this team? (Circle one)			What is your coaching position on this team? (Circle one)		At which level are you coaching this sport? (Circle one)			
Sport 1		Male	Female	Both Sexes	Head Coach	Assistant Coach	Varsity	JV	Modified/ Freshman	Other
Sport 2		Male	Female	Both Sexes	Head Coach	Assistant Coach	Varsity	JV	Modified/ Freshman	Other
Sport 3		Male	Female	Both Sexes	Head Coach	Assistant Coach	Varsity	JV	Modified/ Freshman	Other
Sport 4		Male	Female	Both Sexes	Head Coach	Assistant Coach	Varsity	JV	Modified/ Freshman	Other

SECTION 4—CONCUSSION QUESTIONS

		A little knowledge		An average amount of knowledge		A lot of knowledge
1.	When compared to the average high school coach, how much knowledge do you have about concussions? (Circle one)	1	2	3	4	5

2. When considering the severity of concussion, rank the importance of the following symptoms on a scale of 1-5. (1=Most important, 5=Least important)
   - Loss of consciousness (knocked out) ____
   - Amnesia (loss of memory before or after injury) ____
   - Headache for longer than 2 days ____
   - Headache for shorter than 2 days ____
   - Confusion ____

   PLEASE USE EACH NUMBER ONLY ONCE!

3. When considering the severity of an injury, rank the importance of the following injuries on a scale of 1-6. (1=Most serious, 6=Least serious)
   - Torn knee ligament ____
   - Pulled back muscle ____
   - Sprained ankle ____
   - Concussion ____
   - Cut on head ____
   - Elbow soreness ____

   PLEASE USE EACH NUMBER ONLY ONCE!

SCENARIO: Athlete X receives a concussion but is conscious. Athlete X's coach runs onto the field to check on Athlete X. An athletic trainer and physician also run onto the field to check on Athlete X.

3. When considering whose opinion is the most important with regard to when Athlete X can safely return to play, rank the importance of each decision maker's opinion on a scale of 1-5 (1=Most important opinion, 5=Least important opinion)
   - The athlete ____
   - The coach ____
   - The athletic trainer ____
   - The physician ____
   - The parent ____

   PLEASE USE EACH NUMBER ONLY ONCE!

Would you like to know more about concussion, and if so, what would you like to know more about?

____

SECTION 3—SCHOOL INFORMATION

NOTE: THE PHRASE "*Return to play*" REFERS TO BEING CLEARED TO PLAY IN BOTH PRACTICE & GAMES.

1. Consider the following scenario: An athlete sustains a concussion during a **practice**. Therefore, a decision needs to be made about whether that athlete can safely return to play during the same practice or if the athlete needs to remain out of the practice.
   When you think about the team(s) that you coach, who typically (i.e., greater than 60% of the time) makes that decision?
   CIRCLE ONLY ONE
   Coach Athletic trainer Physician The Athlete Other:________________

2. Consider the following scenario: An athlete sustains a concussion during a **game**. Therefore, a decision needs to be made about whether that athlete can safely return to play during the same game or if the athlete needs to remain out of the game.
   When you think about the team(s) that you coach, who typically (i.e., greater than 60% of the time) makes that decision?
   CIRCLE ONLY ONE
   Coach Athletic trainer Physician The Athlete Other:________________

APPENDIX E

Open-Ended Scenario Based Questions

Your athlete tells you that he blacked out briefly and was seeing stars during a game after a collision with another player. He sits out of practice for the next couple of days during which he has headaches and can't remember what happened either before or after the collision. Is it ok for him to play in the next game? Why or why not?

Your star athlete takes a blow to the head in a game and is woozy as he comes off the field but symptom-free within 15 minutes and is allowed to return to the game. He suffers a hit in the head for a second time. He blacks out and doesn't regain consciousness for two minutes. He sits out the remainder of the game, but on the drive home is still disoriented, is mildly dizzy, has ringing in his ears and can't remember what happened. He appears fine the next day and wants to return to practice. The biggest game of the season is the following week and a Division I collegiate scout is going to be at the game as well to scout this athlete for a potential collegiate scholarship. Would you let him play in the next game? Why or why not?

An athlete of yours has a suspected concussion. An Athletic Trainer requests that the student receive medical clearance from a physician before returning to the field. The physician clears the athletes to return to sport. After practicing for a few hours, the athlete begins to develop a headache, dizziness, loss of memory and nausea that seem to be worsening. What would be your next steps as the coach of this athlete?

APPENDIX F

Approval Letter To Utilize RoCKAS-HSCH and RoCKAS-HSCH Sup

On Tue, Jan 20, 2015 at 7:30 PM, Marc A. Mortellaro <marc.mortellaro@student.shu.edu> wrote:

January 20, 2015

Dr. Aaron M. Rosenbaum
523 Marjorie Mae St.
State College, PA 16803

Dear Dr. Rosenbaum

My name is Marc Mortellaro, I am a Ph.D. student at Seton Hall University in South Orange, New Jersey. Over the course of my doctoral journey I have become fascinated with your research on the topic of concussions, especially in the adolescent population. The RoCKAS tool you have developed through your research has interested me. I am looking to expand the field of concussions in adolescent athletes with my dissertation work and wanted to touch base with you to find out if you had any issues with me using your RoCKAS tool? If you do not have any issue with me using your tool, I wanted to know if there have been other studies that have validated as well as demonstrated the reliability of the RoCKAS tool, as well as if there are results of reliability by components. Upon completion of the tool I was also wondering if there was certain scoring criteria in which you used to interpret the results. With your permission to use the tool, I was also wondering if you would be able to answer any questions if necessary about the tool that may come about during completion of my research? I appreciate all of your time and consideration and I look forward to hearing from you and hopefully developing a great working relationship to help build on the topic of adolescent athletes and concussions. Please feel free to contact me either by phone or email at (845) 649-2092 or marc.mortellaro@student.shu.edu.

Sincerely,

Marc A. Mortellaro

On Thu, Jan 22, 2015 at 2:39 PM, Aaron Rosenbaum <amr262@gmail.com> wrote:

Hi Marc,

Thanks for contacting me. You have my permission to use the instrument. Also, I published an article detailing the validation of the instrument.

Here is the PubMed citation. If you have trouble getting your hands on it, just let me know and I can send you a PDF version (I just don't have a copy on this computer). I should let you know that I'm no longer in academia and I haven't done research in the concussion space since about 2010, but I'm happy to answer questions you have about the process.

Thanks and good luck with your work!

Aaron