# AN EXAMINATION OF CONCUSSION UNDERSTANDING AMONG PARENTS OF HIGH SCHOOL FEMALE STUDENT ATHLETES

by

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Liberty University

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## ABSTRACT

Few online concussion education programs have been developed specifically for parents, and those that have been tend to neglect the fact that concussion rates are higher in female rather than male student athletes (Donaldson et al., 2016; Macdonald & Hauber, 2016; Williamson et al., 2014). This quantitative study is important because it addressed gaps in the concussion education literature. The purpose of this study was to examine whether concussion symptoms knowledge and general youth sports-related concussion knowledge was significantly higher among parents of female student athletes who watched the Center for Disease Control and Prevention's Heads Up concussion videos (intervention group) than among parents of female student athletes who read an online concussion awareness fact sheet (control group). A quasi-experimental, posttest-only control-group design was used to compare concussion knowledge differences between parents who watched the videos and those who read the standard concussion awareness fact sheet. The experiment was conducted using the online survey platform Qualtrics®. The required sample size was 128 participants, with 64 in the intervention group and 64 in the control group. The participants came from the Qualtrics® study pool of participants who met study criteria and were randomly assigned to the intervention or control group. After random assignment and informed consent, parents clicked the screen link that took them to either the videos or the fact sheet. After completing the awareness fact sheet or watching the videos, parents answered an information survey and two questionnaires measuring parental knowledge of concussion symptoms and youth sports-related concussions, respectively. Descriptive statistics were run on participant data and the study dependent variables. Independent samples *t*-tests were conducted for hypothesis testing. The researcher found no significant difference in the understanding of concussion symptoms, as measured by the CSRS (McLeod et al., 2007), between parents of girls who play organized sports at the high school level who read an online concussion awareness fact sheet (control group) versus those who viewed the CDC's Heads Up concussion training videos (intervention group). Additionally, there was no significant difference in the understanding of youth sports-related concussion knowledge, as measured by the CDC's (2004) Heads Up CYSS, between parents of girls who play organized sports at the high school level who read an online concussion awareness fact sheet (control group) versus those who viewed the CDC's Heads Up concussion training videos (intervention group).

*Keywords*: female athletes, concussion, parental knowledge, organized sports

## Dedication

I would like to acknowledge the love and support that my parents, Roslyn and Lee, have provided me during my entire academic journey.  Their emotional and financial assistance throughout the years have allowed me to remain focused on my studies and to achieve this wonderful accomplishment.  Additionally, I would like to thank my husband, Miguel, who was my daily motivator and kept me encouraged during the doctoral process.  Last, my daughter Nylah gave me the final push for completion.  She was born during the dissertation process, and I want her to grow up to value the success that comes from the completion of a task.

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## List of Abbreviations

American Academy of Neurology (AAN)

Centers for Disease Control and Prevention (CDC)

Child Sports Concussion Assessment Tool 3 (Child-SCAT3)

Concussion in Youth Sports Survey (CYSS)

Concussion Symptom Recognition Survey (CSRS)

Immediate Post-Concussion Assessment and Cognitive Testing (ImPACT)

Institutional Review Board (IRB)

Kuder-Richardson Formula 21 (KR-21)

Lateral Fluid Percussion (LFP)

Loss of Consciousness (LOC)

Multivariate Analysis of Variance (MANOVA)

National Collegiate Athletic Association (NCAA)

National Federation of State High School Associations (NFHS)

National Football League (NFL)

Return-to-Play (RTP)

Sports Concussion Assessment Tool 3 (SCAT3)

Statistical Package for the Social Sciences (SPSS)

Theory of Planned Behavior (TPB)

Traumatic Brain Injury (TBI)

University of North Carolina (UNC)

# CHAPTER ONE: INTRODUCTION

## Overview

This quantitative study, which used a quasi-experimental, posttest-only control-group design, examined whether watching the Centers for Disease Control and Prevention (CDC, 2015a, 2015b) Heads Up videos on concussions (intervention group) versus reading a fact sheet on concussions (control group) resulted in significant posttest differences in concussion symptom and youth sports-related concussion knowledge among parents of adolescent girls who play sports. The purpose of this chapter is to present a comprehensive review of the study's parameters. The chapter opens with a background section, followed by the statement of the problem and the purpose and significance of the study. Subsequent to this information is a fact sheet of the study research questions. The chapter ends with a section that defines terms pertinent to the study.

## Background

Concussions among student athletes emerged as a critical pediatric medical concern in the late 2000s, "at the intersection of medicine and sports," in response to the increasing media focus on the long-term health consequences of traumatic brain injuries among National Football League (NFL) and other professional athletes and to the advances in medical technologies, especially those involving brain imagining (Institute of Medicine and National Research Council, 2014, p. iv). The growing concerns among school personnel, parents, and those in the sports and medical communities led in 2012 to a request that the Institute of Medicine and the National Research Council provide an overview of the existing scholarly literature on the topic and provide empirical and applied recommendations on the prevention and reduction of concussions among student athletes and military members (Hobbs, Young, & Bailes, 2016; Institute of

Medicine and National Research Council, 2014). The resulting report revealed alarming statistics: (a) the overall concussion rates in 12 elementary through high school sports increased from 1.7 per 1,000 athletes during the 1988–89 school year to 3.4 per 1,000 athletes during the school year 2003–04; (b) the number of sports- and recreation-related traumatic brain injuries increased from 150,000 in 2001 to 250,000 in 2009; and (c) between 1.6 and 3.8 million sports-related concussions occur among high school student athletes in the United States every year, a substantial increase from the rate of 300,000 concussions reported in 2004 (Institute of Medicine and National Research Council, 2014).

A concussion is a type of traumatic brain injury (TBI) in which the brain is abruptly shifted back and forth inside the skull due to a fall, jerk, or blow to the head (Bryan, Rowhani-Rahbar, Comstock, & Rivara, 2016; Hobbs et al., 2016). A concussion causes an interruption of the normal processes of the brain, leading to neurochemical and metabolic cascades that can alter neurotransmitter connections, glucose, and blood flow; cause oxidative injuries to brain cell proteins, membranes, and DNA; result in potentially long-term axonal damage; and lead to acute and chronic pituitary dysfunction (Institute of Medicine and National Research Council, 2014). Clinicians tend to classify concussion symptoms into four clusters: (a) somatic/physical signs (e.g., headache, fatigue, nausea); (b) emotional changes (e.g., irritability, emotional lability); (c) cognitive impairments (e.g., amnesia, confusion, poor concentration); and (d) sleep disturbance (e.g., extreme fatigue and drowsiness, interruption of the normal sleep pattern; CDC, 2013; Miyashita, Diakogeorgiou, & VanderVegt, 2016).

It can take several weeks, even months, for a concussion to heal in children and adolescents (Evans, 2013; Renjilian & Grady, 2017). If the student athlete returns back to sports with any symptoms of a concussion, he or she could be at risk for other neuropsychological sequelae. One such sequela is *second impact syndrome*, which causes diffuse cerebral swelling. *Post-traumatic headache* is another health outcome that occurs in 25% to 78% of patients after a mild TBI and can begin 7 days to 3 months after injury. In addition, athletes who have sustained a concussion are at a twofold increased risk of epilepsy within the first 5 years after the injury (Evans, 2013; Renjilian & Grady, 2017). Repeated concussions can cause cumulative neuropsychological deficits, where there is an increase in severity and duration of mental status abnormalities after each separate incident. Some of these abnormalities include a change in behavior or personality, thoughts of suicide, Parkinson's-like symptoms, and speech and gait abnormalities (Evans, 2013).

Due to the high prevalence of concussions among high school football players—who are overwhelmingly male—it would be easy to conclude that concussion prevalence rates are substantially higher in male versus female student athletes. Healthcare and research data, however, have shown that this is not the case: female student athletes are, on average, twice as likely to experience a concussion as are male student athletes playing the same sports (National Collegiate Athletic Association [NCAA], 2016; Prevacus, 2016; Thurman, 2016). In general, female athletes are 1.4 times more likely than their male peers to receive a concussion (Covassin, Moran, & Elbin, 2016). An examination of two specific sports found that female basketball and softball players are, on average, 1.7 and 3.2 times more likely to experience a concussion in comparison to male players (NCAA, 2016; Prevacus, 2016). Girls' soccer has a rate of 33 per 100,000 girls getting concussions, the highest of all sports (NCAA, 2016; Prevacus, 2016). Not only are female student athletes at increased risk for experiencing a concussion in comparison to male student athletes, they also report a higher number of concussion symptoms, longer recovery periods, and have more severe and prolonged concussion-related health problems in comparison to male student athletes (Covassin et al., 2016; NCAA, 2016).

In an effort to ensure the health and safety of young athletes, in 2015 the CDC developed the *Heads Up: Concussion in Youth Sports* initiative to offer information about concussions to coaches, parents, and athletes involved in youth sports. The Heads Up initiative provides information regarding preventing, recognizing, and responding to a concussion. This program includes factsheets, concussion information sheets, concussion cards, videos, and online training courses for the parents (CDC, 2017). Little else has been done on a comprehensive and broad level to educate parents, in particular parents of female athletes, on sports-related concussions or to examine the efficacy of concussion programs on enhancing sports-related concussion assessment, identification, and management knowledge among parents of female student athletes. Therefore, the Heads Up concussion training model may be a more useful tool for delivering information to parents regarding preventing, recognizing, and responding to concussion rather than the pre-season concussion check offs for concussion that many parents receive from the school. If research can demonstrate that there is a statically significant difference in concussion understanding in parents of female athletes who watch the CDC Heads Up videos compared to those who review a concussion fact sheet, parents and children can benefit. This information will also be helpful to school administration because they can provide parents access to the video concussion training in addition to or in lieu of their current concussion fact sheets.

The theory that guided this study was Mayer's multimedia theory, which was developed by Richard E. Mayer in 2002 (Reed, 2006). This theory draws from several cognitive theories, including Baddeley's model of working memory, Paivio's dual coding theory, and Sweller's theory of cognitive load (Reed, 2006). Mayer's theory has been used to study multimedia research that combines words and pictures in order to maximize learning effectiveness (Sorden, 2012). The theory indicates that students learn better from words and pictures than from words alone. It also indicates that learning is better when the words and pictures are presented simultaneously rather than successively (Reed, 2006). Based on the application of Mayer's theory to this study, the researcher expected that the independent variable, the type of concussion training, would influence the dependent variables of parental recognition and knowledge of concussions because parents who watched the CDC's Heads Up videos regarding concussions would have higher scores on the symptom quiz than parents who only reviewed the traditional fact sheet regarding concussions and the type of sport played by the female student. Therefore, the problem was that there is a lack of parent awareness, knowledge, and understanding of concussions in regard to their daughters who play sports.

## Problem Statement

The problem addressed in this study was the lack of parental awareness, knowledge, and understanding of concussions in regard to their daughters who play sports. The alarming statistics on concussions among female student athletes emphasize the need of parents of female student athletes to have a sound understanding and knowledge of the assessment, identification, and management of sports-related concussions. Reviews of the literature on studies that have examined numerous empirical and evaluation topics of sports-related concussions (Bonds, Edwards, & Spradley, 2014; Clay, Glover, & Duane, 2012; Conder & Conder, 2015; Graham, Rivara, Ford, & Spicer, 2014) have shown that surprisingly few empirical or program evaluation studies have focused on parents; emphasis has been placed on student athletes themselves or coaches and other school personnel, such as school principals and school nurses. The empirical studies that do exist have consistently documented less than adequate levels of knowledge regarding the assessment, identification, and management of sports-related concussions among parents of student athletes (Clay et al., 2012; Graham et al., 2014).

Little empirical attention has been given to the evaluation of programs aimed at enhancing parents' knowledge of the assessment, identification, and management of sports-related concussions (Bonds et al., 2014; Conder & Conder, 2015; Graham et al., 2014). It is not that concussion education programs do not exist: in 2014, the Journal of Neurosurgery devoted an entire issue to empirical evaluations of concussion education programs (Echlin et al., 2014), and concussion education programs have been evaluated in studies by Lin, Ramadan, et al. (2015), Provvidenza, Kissick, Purcell, and Johnston (2013), and Williamson et al. (2014). The problem is that few concussion education programs recognized in the literature for utilizing pertinent theoretical frameworks have been developed specifically for the parent audience (for an exception, see Lin, Ramadan, et al., 2015). Currently, literature focuses on coaches and athletes, but the literature regarding parents' understanding of concussions is sparse and even more so in regard to parents of female athletes. It has been found that female student athletes have a higher concussion rate, have more persistent symptoms of concussions, and often have more severe concussion effects than male student athletes (Cajigal, 2007; Covassin et al., 2016; Prevacus, 2016; Thurman, 2016). These attributes can be most notably seen among soccer and basketball. Girls who play high school soccer sustain concussions 68% more often than boys, and girls who play high school basketball have almost three times more concussions than boys (Cajigal, 2007; Covassin et al., 2016; Prevacus, 2016; Thurman, 2016).

There is no national initiative focused on increasing student-athlete concussion awareness and knowledge among parents. Parents may often rely on the child's coach to inform them if their child sustained a concussion; however, many coaches still receive little or no concussive training. Today, there are more than 3.5 million youth coaches in the United States, and there has been no adoption of a national program to certify these coaches with a standard set of knowledge-based symptom recognition skills (McLeod, Schwartz, & Bay, 2007). Furthermore, one study found that "42% [of coaches] thought that LOC [loss of consciousness] was required for a concussion to occur, 32% did not think that a Grade 1 concussion required removal from competitions, and 26% would let a symptomatic athlete return to play" (McLeod et al., 2007, p. 141). Parents of both male and female student athletes receive the same standard concussion education. While this is a helpful guide that helps parents recognize the signs and symptoms of concussion, it has been shown the male and female student athletes often report different signs and symptoms (Frommer et al., 2011). For example, it has been found that males tend to report more cognitive symptoms, and females report more neurobehavioral and somatic symptoms (Frommer et al., 2011). To date, there has not been any research studying the parental knowledge of concussion based on a child's gender.

Additionally, parents can also not rely on the student athlete to inform them of his or her concussive symptoms. Research has shown that student athletes have a hard time recognizing concussion symptoms. A quasi-experimental survey of high school athletes revealed that the athletes were unaware of the signs and symptoms of a concussion, and of those who had experienced a concussion, only 47% reported it (Gourley, Valovich McLeod, & Bay, 2010). Many athletes feel that concussions are not serious and that they are an accepted part of playing the game (Broglio et al., 2010). In addition, students have cited fear of losing playing time or their spot in a lineup as reasons for not reporting their symptoms to coaches (Kroshus, Baugh, Daneshvar, & Viswanath, 2013). Therefore, it is necessary to improve parental understanding of concussions so that they can encourage their student athlete not to participate if exhibiting symptoms, despite pressure from coaches or teammates. Additionally, it is important for parents to have concussion awareness so that they can seek appropriate medical care.

According to current research, student athletes and coaches have a difficult time recognizing the signs and symptoms of concussion (Gourley et al., 2010). Furthermore, the minority percentage of student athletes who are able to recognize concussion symptoms are still highly likely to continue to participate in the game and not notify their coaches. Likewise, the minority of coaches who are able to recognize concussion symptoms still allow their players to continue to participate. Coaches are even more likely to allow continued participation if it is during a competition event (as opposed to practice). Therefore, parents need to have an understanding of concussions so that they feel comfortable having a conversation with their child about the symptoms of a concussion. Parents of females also need to be aware that girls may present different concussion symptoms than boys. With this knowledge, parents can encourage them not to participate if experiencing symptoms despite pressure that they may receive from coaches or other players to continue to play at the time of the incident. Parents can also better monitor symptoms along with their healthcare provider and discourage future participation until 100% symptom free. Parental knowledge will help ensure that players have the support they need from their parents and can feel confident in their decision to sit out if they have a head injury and become symptomatic. The choice of the student athlete not to participate if symptomatic reduces the likelihood of a second more serious TBI occurrence.

The majority of the current literature regarding concussion understanding focuses on information for coaches or student athletes. Some literature does exist that focuses on parental understanding of concussions; however, it has been limited. One study involved parents of minor league hockey children who were 13 to 14 years old (Coghlin, Myles, & Howitt, 2009). Another study focused on caring for the student athlete following a concussion and discussed how school personnel, the athlete, and the family have to work together following a concussion injury in order for the optimal recovery process to occur (Piebes, Gourley, & Valovich McLeod, 2009). One of the larger studies in the field looked at concussion awareness and evaluated student athletes and parents across multiple sports but consisted of a small sample size of only 100 participants (Gourley et al., 2010). This current study examined the baseline understanding that parents of female student athletes have of concussion because, to date, there has not been a study that researches the best way for parents to receive concussion knowledge. Further, this study assessed current parental knowledge of concussion symptoms, administered an educational instruction treatment either by a traditional fact sheet method or by a video method, and evaluated the efficacy of each method as a means of improving how parents receive concussion education.

## Purpose Statement

The purpose of this quantitative study, which used a quasi-experimental, posttest-only control-group design, was to examine if parental knowledge of female student athletes' concussion symptoms and youth sports-related concussions significantly differed between parents who watched the CDC's Heads Up concussion videos (intervention group) and those who read an online fact sheet on concussions (control group). Mayer's (2002) multimedia theory formed the framework of this study. In this study, the independent variable was the group (e.g., intervention or control). The intervention that the parents received was defined as exposure to two CDC Heads Up concussion videos that are each 1.5 minutes in duration. The control group of parents was asked to read a short online fact sheet on concussions. The two dependent variables were parental knowledge of concussion symptoms, as measured by the Concussion Symptom Recognition Survey (CSRS; McLeod et al., 2007), and parental knowledge of youth sports-related concussions, as measured by CDC's (2004) Heads Up Concussion in Youth Sports Survey (CYSS).

## Significance of the Study

Research regarding parental understanding of concussions is limited, and no research has been performed that examines the best way for parents to receive this information. Parental understanding of concussions is critical to help fill the gap of concussion knowledge between coaches and student athletes. Additionally, it will aid parents in determining the degree of medical care needed for their child. Only a few online concussion education programs have been developed specifically for parents, and those that have been tend to neglect the fact that concussion rates are higher in female rather than male student athletes (Donaldson et al., 2016; Macdonald & Hauber, 2016; Williamson et al., 2014). Current research in this field consists of small sample sizes with narrow age ranges of the student athletes, as in Gourley et al. (2010). Other studies have focused on parental knowledge in only one particular sport, such as a study that only examined parents of minor league hockey children (e.g., Coghlin et al., 2009). Encouragingly, one study found that if coaches suspected a concussion, they notified the athletes' parents 72.3% of the time (Covassin, Elbin, & Sarmiento, 2012). While this percentage may seem high, an estimated 1.6 to 3.8 million sports-related concussions occur annually (CDC, 2013), so there are still many parents who must rely on their student athlete or themselves to recognize the symptoms of a concussion. This percentage also demonstrates that there is still a disconnect between coaches and communication with parents, which is unfortunate because most parents cannot be present at all practices and games and therefore depend on communication from the coach for reports of a potential concussion occurrence.

This study allowed parents of female student athletes to participate regardless of sport type played by the female athlete. Using Qualtrics® allowed parents from all regions of the United States to participate in order to allow for an increase in diversity among the sample population. This diversity minimized the limitation of parents from only a single area of the country being able to participate in the study.

The results of this study bring more awareness about concussion signs and symptoms to girls' parents and help identify if there is a more effective means of relating concussion information to parents. Additionally, it should improve communication between parents and their student-athlete children when discussing the symptoms of concussions since parents should feel more informed and knowledgeable about the symptoms. Open communication between the student and their parents will ensure that appropriate measures are taken to ensure that no further brain injury occurs. Last, the study demonstrated that parents need to take an active role in their children's health.

## Research Questions

Over the past decade, the effort to increase the awareness of concussion signs and symptoms has predominately been among student athletes and coaches (Bagley et al., 2012; Rivara et al., 2014; Wojtys et al., 1999). There has also been some research in the area of parental understanding of concussions. The current literature regarding parental understanding involves small samples sizes or evaluates parents of student athletes of one particular sport. The current research study sought to determine the most effective way to educate parents about concussions. The proposed research questions for this study were:

**RQ1:** Is there a difference in the understanding of concussion symptoms, as measured by the CSRS (McLeod et al., 2007), between parents of girls who play organized sports at the high school level who read an online concussion awareness fact sheet (control group) versus those who view the CDC's Heads Up concussion training videos (intervention group)?

**RQ2:** Is there a difference in the understanding of youth sports-related concussion knowledge, as measured by the CDC's (2004) Heads Up CYSS, between parents of girls who play organized sports at the high school level who read an online concussion awareness fact sheet (control group) versus those who view the CDC's Heads Up concussion training videos (intervention group)?

## Definitions

Terms pertinent to this study were the following:

1. *Concussion*—According to Wojtys et al. (1999), a concussion is:

> Any alteration in cerebral function caused by a direct or indirect (rotation) force transmitted to the head resulting in one or more of the following acute signs or symptoms: a brief loss of consciousness, light-headedness, vertigo, cognitive and memory dysfunction, tinnitus, blurred vision, difficulty concentrating, amnesia, headache, nausea, vomiting, photophobia, or a balance disturbance. Delayed signs and symptoms may also include sleep irregularities, fatigue, personality changes, and inability to perform daily activities, depression, or lethargy. (p. 676)

The following are the grade levels of concussion as defined by the American Academy of Neurology (AAN, 2010):

a. *Grade 1 Concussion*—Occurs when mental status changes resolve in < 15 minutes after the trauma.

   b. *Grade 2 Concussion*—Occurs when mental status changes resolve in > 15 minutes after the trauma.
   c. *Grade 3 Concussion*—Occurs when there is an associated loss of consciousness (either brief or prolonged) after the trauma.
2. *Embodiment principle*—People learn more deeply when onscreen agents display humanlike gesturing, movement, eye contact, and facial expressions (Mayer, 2014b).
3. *High-impact sports*—Sports such as football, girls' soccer, boys' ice hockey, girls' lacrosse, and cheerleading, which have a high concussion risk (Marar, McIlvain, Fields, & Comstock, 2012).
4. *Low-impact sports*—Sports such as girls' volleyball, boys' baseball, swimming, diving, and track and field, which have a lower risk of concussion (Marar et al., 2012).
5. *Personalization principle*—People learn more deeply when the words in a multimedia presentation are in a conversational style rather than formal style (Mayer, 2014b).
6. *Social cues*—Aspects of multimedia instructional messages, such as conversation style and human voice, that encourage the learner to view the tutor as a social partner (Mayer, 2014b).

# CHAPTER TWO: LITERATURE REVIEW

## Overview

Today, there is an abundance of information and research regarding concussions. This literature review will examine current related research in the field of concussions and will consist of a synthesis of topics that form the framework for the necessity of parents to have an understanding of concussions. The literature review will also demonstrate the lack of research in the area of parental knowledge of concussions. It will discuss a relevant body of knowledge, including what concussions are, the physiology of concussions, recovery issues, cumulative effects of head injuries, concussion awareness programs, current understanding of concussions by coaches/players/parents, high- versus low-impact sports, and concussion gear. It will also examine the theoretical framework of the theory of planned behavior (TPB) and the theory of multimedia learning.

## Theoretical Framework

### Theory of Planned Behavior

The TPB was proposed by Icek Ajzen in 1985 and is considered today to be the most popular model for the prediction of social behavior (Ajzen, 2004). This theory assumes that human behavior is planned. According to the theory:

> Human social behavior is guided by three kinds of considerations: beliefs about the behavior's likely positive and negative outcomes, beliefs about the normative expectations of others, and beliefs about the presence of factors that may facilitate or impede performance of the behavior. (Ajzen, 2004, p. 793)

These considerations are sometimes referred to by shortened terminology: *behavioral beliefs*, *normative beliefs*, and *control beliefs*, respectively. Behavioral beliefs include one's attitude about the behavior, such as whether the action is considered a good or bad thing to do. The normative belief is used to consider the norms of the society in which an individual is living. It consists of the social pressure that one feels to conform or not conform to the societal norm. Last, control beliefs are used to describe one's sense of perceived control about his or her behavior in a situation. Generally, the greater one feels about the first two beliefs, behavior and normative, the greater he or she feels about the third belief, control (Ajzen, 2004).

Since these beliefs are essential to the TPB, further explanation is required. Behavioral beliefs also encompass one's attitude toward a behavior. Ajzen (1991) noted that according to the TPB, "Attitudes develop reasonably from the beliefs people hold about the object of the attitude" (p. 191). Therefore, people form beliefs about an object or situation by associating it with certain attributes and outcomes. Each belief that the individual has is theoretically linked to a certain outcome, and the behavior has a cost to the individual if he or she chooses to perform or not perform the action. In another sense, each action is linked to a positive or negative outcome. Over time, an individual "learns to favor behaviors we believe have largely desirable consequences and we form unfavorable attitudes toward behaviors we associate with mostly undesirable consequences" (Ajzen, 1991, p. 191).

The second belief about the TPB proposed by Ajzen (1991) is that of normative beliefs. Normative beliefs are part of what the individual views as societal norms. This belief states that the individual will look to certain groups of people to see if they approve or disapprove of a certain behavior. The person performing the behavior preforms an internal evaluation and "rate[s] the extent to which 'important others' would approve or disapprove of their performing a given behavior" (Ajzen, 1991, p. 195). These "important others" could be the society in which the person lives or a more specific group of people such as his or her church, friends, or parents.

The third and last belief is the belief of control. Using the belief of control, the individual draws upon his or her past experiences with the behavior. However, he or she will also be influenced by information from secondary sources as well, such as friends and family. The individual will look to see how the particular action affected that individual and consider the advice that that person gives about the experience. All of these factors are then weighed and are "factors that increase or reduce the perceived difficulty of performing the behavior in question" (Ajzen, 1991, p. 196). During the analysis process, the more "resources and opportunities individuals believe they possess, and the fewer obstacles or impediments they anticipate, the greater should be their perceived control over the behavior" (Ajzen, 1991, p. 196).

The TPB has been applied when studying athletes and athletic trainers' behavior in regard to concussion injuries. Although most states now have mandatory concussion training for student athletes and athletic trainers, there has been limited research to evaluate the effectiveness of these training modules. As Kroshus, Baugh, Daneshvar, Nowinski, and Cantu (2015) pointed out, "One relevant behavioral target of concussion education is symptom reporting" (p. 243). The TPB is important to understand in the reporting process of concussions since many of the concussion symptoms are not visible to others. Therefore, the athletes' self-report of symptoms is a key component of the removal-from-play process (Kroshus et al., 2015). The TPB examines the psychosocial elements beyond that of knowledge that affect a person's decision-making process. It has been assumed in the past that athletes tend to underreport concussion symptoms (Warner, 2012). However, a 2013 study by Kroshus et al. explored the importance of understanding concussion reporting among late adolescent and young male ice hockey players using the TPB. This study found that the TPB model was supported "with all pathways significant in the theory-consistent direction and good model fit" and that the reporting of symptoms among athletes were based on short-term outcomes with negative associations such as not being able to return to the game, letting down the team's performance, and not being allowed to play again when the player feels that he or she is "ready" (Kroshus et al., 2013, p. 273).

Additionally, the TPB has been used to explore athletic trainers' beliefs toward managing a concussion using athletic trainers from the National Athletic Trainers Association (Rigby, Vela, & Housman, 2013). Rigby et al.'s (2013) study found that proper concussion management has increased among athletic trainers since the 1990s and that the majority of athletic trainers do use a multifaceted approach to diagnose a concussion; however, only a small percentage use all of the recommended tools. When the TPB examined why athletic trainers are not using all of the recommended tools, various reasons were cited. Some of the reasons related to control beliefs such as a lack of support from the coach, administrator, or parent. There was also the factor of burnout associated with their job, as well as insufficient funds to purchase equipment. Overall, the study found that the "most successful intervention for increasing attitudes toward a specific behavior is to present information that will change an individual's perspective of that behavior" (Ribgy et al., 2013, p. 642). The athletic trainers needed to be given information for them to believe that using a multifaceted approach results in better outcomes for the athletes and therefore is worth the extra time and effort that it may take to proceed through each of the steps. Additionally, greater information may help the athletic trainer continue through the protocol despite resistance he or she may receive from a coach or athlete.

**Mayer's Multimedia Theory**

The cognitive theory of multimedia learning, as proposed by Mayer (2002, 2014a), is a theory that specifically incorporates multimedia learning. Mayer's cognitive theory of multimedia learning is based on three principles. First, the individual is able to process the information via two cognitive pathways. Second, each of these pathways has a limited capacity. Third, active learning must involve coordination of both of these separate pathways (Ayres, 2015). Other theorists such as Paivio, Baddeley, and Sweller helped to shape Mayer's theory (Reed, 2006). According to Reed (2006), in his book *Multimedia Learning*, Mayer

> borrows from Paivio the proposal that information can be encoded by using either a verbal or visual code. He borrows from Baddeley the idea of a limited-capacity working memory that can be managed by an executive process. He adopts Sweller's distinction between extraneous and intrinsic cognitive load, and proposes the goal of devising ways to reduce extraneous cognitive load. (p. 91)

The theory of multimedia posits that people learn better from words and pictures when they are combined than from using just words alone. The words can be "spoken or written, and the pictures can be any form of graphical imagery including illustration, photos, animation, or video" (Sorden, 2012, p. 1). Mayer's own research refers to this as the multimedia principle, where deeper learning occurs from words and pictures together than from pictures alone (Ayres, 2015). Mayer's research resulted in seven principles for the design of multimedia instruction:

1. Multimedia principle: Students learn more deeply from multimedia presentations involving words and pictures than from words alone.
2. Spatial contiguity principle: Students learn better when corresponding words and pictures are presented near, rather than far from, each other on the page or screen.
3. Temporal contiguity principle: Students learn better when corresponding words and pictures are presented simultaneously rather than successively.
4. Coherence principle: Students learn better when extraneous words, pictures, and sounds are excluded.

5. Modality principle: Students learn better from animation and narration than from animation and onscreen text.
6. Redundancy principle: Students learn better from animation and narration than from animation, narration, and onscreen text.
7. Individual differences principle: Design effects are stronger for low-knowledge learners than for high-knowledge learners and for high-spatial learners than for low-spatial learners. (Reed, 2006, p. 91)

The theory of multimedia learning, by definition, must include at least two modalities. It is theorized that learners use multimedia learning to build mental models from the words and pictures (Ayres, 2015) and therefore are better able to understand and retain information. However, it should be noted that if multimedia learning is not constructed in an organized format and has a lot of extraneous material, it will actually require an increase in cognitive demand and lead to ineffective learning. If multimedia is used appropriately, then the brain uses the visual and textual pathway in conjunction with one another, which is superior to using one or the other subsystem alone (Ayres, 2015). Mayer (2014b) noted that social cueing is important. Mayer found that using a human voice rather than a machine voice is more effective and that onscreen agents should show humanlike behaviors and gestures rather than artificial movements.

In education, verbal instruction, both oral and written, has dominated instruction. Lectures and textbooks have been the primary means of relaying information to students. However, pictorial modes of instruction have been increasing dramatically due to the increasing access to the Internet around the world (Mayer, 2002).

Prior knowledge of the subject matter "stored in long-term memory has to be integrated with new information held in working memory to build new knowledge. Prior knowledge is also deemed essential to support the limited capacity of working memory through chunking strategies" (Ayres, 2015, p. 632). A deeper learning process can occur through the use of multimedia instruction. Based on this theory, using at least two modalities in the CDC Heads Up concussion videos, audio and video, should allow the parents to better understand concussion material.

## Related Literature

### Concussions

The word concussion is derived from the Latin word *concutere,* which means to strike together (Grady, 2010). A concussion is considered a type of TBI. One of the most comprehensive and universally accepted definitions of concussions, defined at the third International Conference on Concussion in Sports (in 2008), is as follows:

1. Concussions 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.
2. Concussions typically result in the rapid onset of short-lived impairment of neurological function that resolves spontaneously.
3. Concussions may result in neuropathological changes, but the acute clinical symptoms largely reflect a functional disturbance rather than a structural injury.
4. Concussions result 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, postconcussive symptoms may be prolonged.
5. Concussions show no abnormality on standard structural neuroimaging studies. (as cited in Grady, 2010, p. 155)

Concussions often present vague symptoms such as headache, nausea, imbalance, or confusion. However, some people believe that LOC must occur for a concussion to take place. Interestingly, according to the CDC, LOC only occurs in the minority of concussions; the CDC estimates that LOC occurs in less than 10% of concussions (as cited in Grady, 2010). Recognition is needed to identify concussive symptoms because recognition is the cornerstone of concussion management (Zirkel & Brown, 2014). Many students, coaches, and parents do not realize that there are different grades of concussions. One of the most widely accepted and used grading systems for concussion is the AAN practice parameters. According to AAN guidelines, a Grade 1, or mild, concussion is one where there is no LOC and the confusion resolves in less than 15 minutes. A Grade 2, or moderate, concussion consists of no LOC, but the concussive symptoms last more than 15 minutes. A Grade 3, or severe, concussion is when a person loses consciousness for either a brief or a prolonged period of time (Lovell, Collins, Iverson, Johnston, & Bradley, 2004).

In 2009, the CDC clarified that the symptoms of concussions fall into four main categories: physical, cognitive, emotional, and sleep (as cited in Zirkel & Brown, 2014). Physical symptoms include headache, nausea, vomiting, balance problems, dizziness, visual problems, fatigue, sensitivity to light, sensitivity to noise, numbness or tingling, and being dazed or stunned. Cognitive symptoms include feeling mentally foggy, feeling slowed down, having difficulty concentrating, having difficulty remembering, being forgetful of recent information/conversations, being confused about recent events, answering questions slowly, and repeating questions. Emotional symptoms include irritability, sadness, heightened emotions, and nervousness. Last, sleep symptoms include drowsiness, sleeping less than usual, sleeping more than usual, and trouble falling asleep (Zirkel & Brown, 2014). Currently, diagnosis of a concussion for a student athlete is primarily based on these symptoms when reported by the student athlete.

**Physiology**

One of the important aspects of concussions is the pathophysiology that occurs in the brain after a traumatic injury. A lot of the current understanding about concussions comes from animal models. According to Grady (2010), the "lateral fluid percussion (LFP) brain injury model [as demonstrated in rats] has emerged as the model most applicable to concussion and mild TBI" (p. 155). In this animal model, a device was used to cause a small, localized head injury to a rat that resulted in a small brain contusion with a small amount of hemorrhage. These types of studies help to reveal what happens to the brain at the cellular level and provide a better understanding of the injury and recovery period of concussed student athletes.

Grady (2010) noted that a concussion can be divided into two parts. The first part is the insult of injury, and the second part is the inflammatory response that occurs from the initial insult. The rat models have shown that after the head injury occurs, a release of excitatory amino acid neurotransmitters causes a loss of integrity to the cell wall. This change causes sodium to enter the cells and potassium to exit the cell, which alters the pH level and in turn causes calcium to enter the cell. This change in the pH level of the cell results in damage at the cellular level. If the cells are severely injured and the pH level is altered significantly, the death of the cell occurs. After the cell dies, it releases cytokines, which cause the inflammatory response to take place.

The shifting of the ions that occur on a molecular level takes time, and the ensuing inflammatory response that results also takes time; therefore, it is understandable that students who have had a head injury can worsen over the following hours even if they appear relatively asymptomatic right after the injury. This process is in direct opposition to the "common assumption that recovery from a concussion is a linear phenomenon and that presentation is the most severe immediately after injury" (Field, Collins, Lovell, & Maroon, 2003, p. 522).

**Evaluation**

Any student athlete who sustains a head injury during practice or a competitive athletic event should be taken out immediately and evaluated. The athlete should be assessed for signs and symptoms of concussion. If the student athlete has signs and symptoms of a concussion, he or she should be taken to a medical center for further evaluation. According to Purcell (2014), the medical evaluation, which includes both neurological and cognitive assessment, should be done as soon as possible to confirm a concussion diagnosis. If the athlete does not exhibit signs and symptoms of a concussion immediately after a head injury, he or she should still be closely monitored by a responsible adult for the next 48 hours for any signs of deterioration because symptoms could develop or worsen in the hours or days after an injury. Additionally, some student athletes may be at a higher risk for a prolonged recovery period from a concussion. Some of these risk factors include those student athletes who have had a previous history of a concussion or other head injury as well as students with a history of prior migraines, mental health disorders, sleeping difficulties, and learning disabilities. During the initial evaluation, parents and athletes should be counseled that the athlete should not return to sporting activities until he or she is symptom free and has been medically cleared. One good motto to live by during a concussion sideline evaluation is "if in doubt, sit them out!" (Purcell, 2014, p. 2)

**Concussion Work-Up**

Currently, two assessment tools aid in the medical evaluation of potentially concussed athletes. These evaluation tools are known as the Sport Concussion Assessment Tool 3 (SCAT3) and the Child-SCAT3 (Purcell, 2014). The SCAT3 is recommended for patients 13 years or older, and the Child-SCAT3 is recommended for children ages 5 to 12 years old. The Child-SCAT3 differs from SCAT3 in that it also includes a symptom report for parents as well as more age-appropriate cognitive tests. Both of these tools allow for "a brief neuropsychological assessment of attention, concentration and memory on the field" (Purcell, 2014, p. 2).

Regarding diagnostic imaging, it is important to remember that a concussion is a functional brain injury; therefore, it does not result in structural changes. Thus, routine structural neuroimaging such as skull X-rays, CTs, and MRIs are not recommended unless a structural injury is suspected in addition to the functional injury (Purcell, 2014).

**Recovery Issues**

The recovery process from a concussion is affected by age. This fact may not be known by student athletes, coaches, and parents. According to Grady (2010), "It is well accepted that high-school-aged athletes take longer to heal than older athletes" (p. 159). Although this phenomenon is not completely understood, "animal model data suggest that the developing brain may be more sensitive to the pathological release of excitatory amino acid neurotransmitters following trauma than adult brains" (Grady, 2010, p. 159). Grady further noted that after an adult sustains a concussion, cognitive function returns to normal 3 to 5 days after the injury; a college athlete takes about 5 to 7 days to return to baseline. Athletes at the high school level take longer to heal and usually average 10 to 14 days for neurological function to return to normal. Therefore, when comparing adults, college athletes, and high school athletes, the younger the athlete, the longer it takes for brain recovery. Similar results were found in a study that compared mild concussions in high school and college athletes. According to Field et al. (2003), "High school football and soccer participants, when compared with matched control subjects, had significant memory impairment at least 7 days after injury. Conversely, college football/soccer athletes…had significant memory deficits only within the first 24 hours" (p. 552). It has been hypothesized that the younger brain may experience "more diffuse and more prolonged cerebral swelling…[and that] children may be at a greater risk for secondary intracranial hypertension and ischemia" (Field et al., 2003, p. 552). This hypothesis would explain why the high school student athlete has a delayed recovery period compared to an adult. Additionally, the increase in severity of cerebral swelling could make high school athletes more susceptible to a permanent deficit if they sustained another head injury during their recovery period (Field et al., 2003). Student athletes younger than high school level have not been studied concerning this phenomenon, but speculation suggests that it could take them longer than 2 weeks to fully recover from a concussion injury.

When Field et al. (2003) examined memory impairment of high school football and soccer athletes compared to college football and soccer athletes, they found that high school athletes have a more significant and longer memory impairment (a minimum of 7 days) after their injury. This was a vast difference since college athletes only had significant memory impairment for 24 hours following the injury. This discrepancy further emphasizes the need to watch for concussion signs and symptoms in the K–12 student athlete.

The recovery process for athletes at the K–12 level is further complicated by the cognitive demands necessary for schoolwork. The American Academy of Pediatrics "emphasized the need to monitor student performance upon returning to the increasing cognitive demands and to adjust academic demands and delivery until concussion resolution" (Zirkel & Brown, 2014, p. 99). If appropriate measures are not taken in the classroom, it may intensify the severity of symptoms and increase the number of symptomatic episodes that the student experiences. This action in turn could lengthen the total recovery time for the student. One study found that “additional cognitive overexertion during this fragile period of neurometabolic imbalance will extend the recovery time” (Zirkel & Brown, 2014, p. 100). Therefore, physical and cognitive rest are both necessary in the recovery process for student athletes. The return-to-play protocols that are developed by schools need to ensure that the athlete is symptom free in the classroom as well as on the field.

According to Purcell (2014), students who have sustained a concussion should undergo a graduated return-to-learn protocol as well as a graduated return-to-play protocol. A graduated return-to-learn protocol consists of five stages: cognitive rest, increased cognitive tasks, resumed modified school attendance, increased school attendance, and return-to-play protocol. During the cognitive rest period, the student should not be attending school and should limit cognitive tasks such as reading and screen time. In the increased cognitive tasks stage, the student still does not attend school but works to increase cognitive task function in the home environment in 15- to 20-minute increments. Resumption of modified school attendance is the first stage where the child actually returns to the classroom environment. It is recommended that the child begins with half-days, avoids certain classes such as gym, music, and shop, and limits homework to 15- and 20-minute blocks. During the increased school attendance phase of the return-to-learn protocol, the student should gradually increase school attendance to full days. Additionally, the student should limit tests to one per day. Once the student is symptom free and back to full time school attendance without accommodations, the student can begin his or her graduated return-to-play protocol.

Purcell (2014) further noted that once the student athlete is cleared to a graduated return-to-play protocol, there are six stages of rehabilitation, and the student should be in each stage for a minimum of 24 hours. Therefore, there should be no same-day return to play. The first stage overlaps with the return-to-learn protocol, so no activity is recommended. Stage 2 is light aerobic exercise in order to gradually increase heart rate. In Stage 3, the student works toward sport-specific exercise while avoiding impact activities. Stage 4 allows the student to progress to noncontact training drills, and he or she may begin to add progressive resistance training to the regimen. This stage allows for exercise, coordination, and increased cognitive load. During Stage 5, the athlete is allowed full contact practice after medical clearance has been granted. Last, Stage 6 allows normal game play.

**Cumulative Effects**

Current research has also revealed that concussions have cumulative effects on the brain. Grady (2010) noted, "A history of 3 previous concussions has been well fact sheeted as a risk factor for both increased recovery time and future re-injury in high school and college athletes" (p. 160). High school and college athletes who were followed in a longitudinal study showed either long-term neurological deficits or a decline in cognitive function after they had sustained three concussive injuries (Grady, 2010). Studies have also shown that there are no cumulative effects after one or two concussions, which suggests that the brain is able to recover pretty well from only one or two insults (Grady, 2010). However, it has been found that student athletes who have had one concussion are more likely to sustain a second concussion (Kurowski, Pomerantz, Schaiper, Ho, & Gittleman, 2015).

Another study that evaluated high school and college athletes using the Immediate Post-Concussion Assessment and Cognitive Testing (ImPACT) program also found that athletes with multiple concussions were "7.7 times more likely to demonstrate a major drop in memory performance than the athletes with no previous concussion" (Iverson, Gaetz, Lovell, & Collins, 2003, p. 440). ImPACT is a baseline, computerized cognitive test that athletes can take and then repeat in the future in order to determine the effect of a head injury. With the use of this test, Iverson et al. (2003) also found that young athletes who had sustained multiple concussion reports have more symptoms and lower memory scores on their baseline ImPACT test.

Animal studies have also been used to study the effects of single versus multiple concussive injuries. Using animal models, Iverson et al. (2003) found that “after a single subconcussive impact, no change was observed in animal behavior or histology. In contrast, repetitive subconcussive episodes between 5- and 20-s intervals often resulted in permanent injury” (p. 435).

**Concussion Awareness Programs**

Over the past few years, programs and increased educational materials to aid in the awareness of concussions for parents, athletes, and coaches have been established. At the high school level in particular, there have been “numerous educational resources made available…that focus on the prevention, recognition, and response of sports-related concussion” (Covassin et al., 2012, p. 234). These additional materials include educational videos, fact sheets, posters, and websites.

One of the largest endeavors to increase the awareness of concussions was by the CDC through the Heads Up program. The CDC has launched two initiatives: “Heads Up: Concussion in High School Sports” and “Heads Up: Concussion in Youth Sports” (Covassin et al., 2012, p. 243). These two initiatives aim to provide education to parents, coaches, and physicians. Each targeted group has specific concussion material tailored for its specific understanding and needs. The goal of the CDC Heads Up awareness program is to offer knowledge of concussion signs and symptoms and improve prevention and management practices at each level.

The Zurich Guidelines have also focused more awareness on the return-to-play protocols after a concussive injury. These guidelines present the standard care of management for reintegrating athletes back into their sport (Grady, 2010, p. 163). They consist of a six-step process of graduated return to play. The athlete "progresses from one step to the next as long as he remains asymptomatic for 24 hours at each step; if he becomes symptomatic during one of these steps, he returns to the previous step for at least 24 hours" (Grady, 2010, p. 164). This protocol outlines specific activities that can and cannot be completed at each step. These guidelines, briefly condensed here, begin with no activity, increase to low levels of physical activity, next add moderate running such as running drills, then add full contact during practices, and finally culminate in a resumption of normal game activity (Grady, 2010).

**Coaches' Knowledge of Concussions**

It is recommended by medical professionals that an athlete not return to play until free of all symptoms because recurrent concussions "demonstrate longer symptoms resolution time, increased time out of play, and higher likelihood of loss of consciousness than the first concussion" (Clay et al., 2012, p. 347). Some coaches who may not fully understand the risks associated with concussions may put a student athlete back into the game despite having symptoms of a concussion. Some coaches perform a cursory evaluation of the athlete on the field and place the player back in the game based on a quick self-report from the athlete. This type of mentality from coaches "clearly violates the current consensus statement on sports-related concussion, which recommends that no adolescent athlete who sustains a concussion should return to play the day of the injury" (Marar et al., 2012, p. 754). Since 2002, a multifaceted approach has been recommended when evaluating an athlete for a concussion (Rigby et al., 2013). If followed in its entirety, it consists of six steps and is usually completed by an athletic trainer. The six steps include a clinical examination, a symptom checklist, a postural-control assessment, neuropsychological testing, baseline testing when available, and a return-to-play protocol (Rigby et al., 2013).

Coaches frequently have a misconception that *dings* and *bell-ringers* are not the same as a concussion and, furthermore, feel that returning to play for these minor impairments are different from a concussion (Saunders, Burdette, Metzler, Joyner, & Buckley, 2013). Many coaches still believe that LOC is required for a concussion to occur and that a Grade 1 concussion does not require removal from competition (McLeod et al., 2007). More disturbing is that 26% of coaches would let a symptomatic athlete return to play (McLeod et al., 2007). Often, a coach relies solely on the athlete's self-report of the injury and bases the return to play on that factor alone (Field et al., 2003). Therefore, there is a large deficit in concussion knowledge among youth and high school coaches, and many times, there is no athletic trainer or team coach available on the sidelines to examine the athlete.

Student athletes tend to underreport their symptoms and "the athlete can be influenced by a general naiveté of the potential severity of the injury, desire to return to action, or by belief that one must 'play through' injury to be successful, even at the high school level" (Field et al., 2003, p. 553). Current guidelines recommend a stepwise approach for return to play for the athletes. One of the key pieces of information in these guidelines is that student athletes should take approximately 1 week after becoming completely asymptomatic before resuming their normal level of sporting activities (Marar et al., 2012).

Since younger athletes represent the largest group of athletes who participate in organized collision sports (Lovell et al., 2004), it is important for coaches to familiarize themselves with their return-to-play protocol. Youth athletic teams are less likely to have athletic trainers or other professional medical care available on the sidelines to aid in the diagnosis of a concussion, making the role of the coach in recognizing concussed athletes even more critical. Broglio et al. (2010) questioned youth soccer coaches and found that the majority of coaches understood that having a single concussion increases the risk of having a second injury. However, when the coaches were asked to identify the signs and symptoms of a concussion, the "majority of coaches were able to accurately identify signs and symptoms not associated with concussion, but were less accurate in identifying those that are commonly associated with concussion" (Broglio et al., 2010, p. 420). All of the coaches who were interviewed for Broglio et al.'s study did not have any formal concussion training, but the majority of them felt that the athlete should be symptom free before returning to play, and all of them were in agreement that a medical professional should make the final decision as to when the athlete should be ready to return.

Nearly all states have passed legislation on youth sports-related concussions to protect athletes from sustaining further injury. According to Rivara et al. (2014):

> Washington's Zackery Lystedt Law, enacted in 2009, was the first such comprehensive effort in the country, mandating the education of coaches about concussions, signing of an information sheet on concussions by parents and athletes, removal of the athlete from practice or play at the time of a suspected concussion, and written clearance by a licensed health care provider. (p. 1198)

Despite the passage of these laws that require training for coaches, many states have been slow to implement them, which could in part be due to trying to find the most effective means to train all coaches within a state. Ironically, even in states where the laws have required coaches to participate in training, many of them still fail to recognize concussion symptoms (Covassin et al., 2012). One report found that only 61% of coaches could correctly identify the signs and symptoms of concussion; some of the common misunderstandings among coaches were that the player needed to have LOC for a concussion to occur and that it was acceptable to allow players to return to play before their symptoms were completely resolved (Covassin et al., 2012). A study that compared high school football and soccer players with college football and soccer players found that "only 11% of our high school sample as compared with 34% of college athletes had LOC after injury" (Field et al., 2003, p. 552). These data could be counterintuitive to coaches since college athletes recover more quickly than their high school counterparts despite having complete LOC. It is the high school athlete who takes a longer recovery time, even without any LOC. This knowledge indicates that further training of coaches is necessary since the vast majority of concussions do not have LOC associated with them, and the guidelines prohibit a student athlete from returning to play the same day that the concussion occurred. It is also important for coaches to be able to identify a concussion since "80% of same season concussions reinjuries occur within 10 days of the initial injury" (Grady, 2010, p. 164). Therefore, the first concussion needs to be correctly identified so that the student athlete does not have more severe or prolonged symptoms from the second injury.

Coaches need to be particularly astute to Grade 1 concussions because they are the most difficult to diagnose on the field due to the vagaries of the symptoms; however, they also represent the most common type of concussive injury (Lovell et al., 2004). Grade 1 concussed athletes have no LOC and do not show obvious signs of distress on the field. Additionally, student athletes who have experienced a Grade 1 concussion will still be likely to pass a basic sideline test (Lovell et al., 2004).

Research has also found that a coach's age, sex, level of education, coaching experience, and certification had no bearing on whether the coach was more or less aware of whether his or her athletes had suffered a concussion (Rivara et al., 2014). This lack of awareness is unfortunate because the majority of athletes continue to play while symptomatic, which could in part be because the students themselves cannot properly distinguish concussive symptoms. In fact, a study by Rivera et al. (2014) found that "40% [of the students] reported that their coaches were not aware of their concussive symptoms, despite [the students] having to sign a statement at the beginning of the season stating that concussive symptoms should be reported to the coach" (p. 1200).

A study by Covassin et al. (2012) found that high school coaches who had educational resources available to them such as coaches' associations and conferences found these avenues of learning about concussions at least moderately helpful. High school football coaches reported that the "Heads Up: Concussion in High School Sports" videos were the most useful source of information for them. The Heads Up program provides a packet of information regarding concussions to coaches, and coaches noted that the fact sheet and the magnet were the most useful materials in that packet. More specifically,

> 50% of coaches reported realizing that concussions were more serious than they previously thought, while 38% of coaches made future changes when dealing with a concussion. Moreover, 68% of coaches used this medium to educate other coaches, parents and athletes. (Covassin et al., 2012, p. 234)

These findings are promising since coaches are looked upon as leaders of student athletes and parents. Covassin et al.'s (2012) study demonstrated that the education of coaches can have a positive impact on both the parents and the athletes. Coaches need to have the tools necessary for them to make an informed decision about when to remove a player from a game and how to evaluate for a concussion type injury. Coaches also serve as a liaison between the athlete and the athlete's parents, and the study found that the majority of the time, youth sports coaches notified the parents of a suspected injury. Coaches need to be able to confidently explain to parents why their child was removed from the game as well as explain signs and symptoms for parents to watch for while at home.

**Coaches' Concussion Training**

To date, there is no specific national concussion training guidelines for coaches. Instead, coaches' requirements for concussion training vary depending on the state in which they coach. Besides the CDC's Head's Up concussion training, the National Federation of State High School Associations (NFHS) is one of the most popular providers of information on concussions to coaches, and the association has national professional credentials. NFHS (2018) has a 51-member state association and provides information to coaches at over 19,000 high schools across the country. Recently, as of June of 2018, NFHS partnered with the CDC and revised the "Concussion in Sports" online course for the NFHS. The NFHS's "Concussion in Sports" has been its "most popular course on the Learning Center, with more than 2.2 million courses delivered in the past eight years" (NFHS, 2018, para. 2). The NFHS concussion training is a free module that "aims to educate coaches and others on the significance of concussions, how to recognize their signs and symptoms, how to respond to a suspected concussion and the proper steps to help players return safely after recovering" (NFHS, 2018, para. 2).

Texas and Iowa provide some state-specific examples of required coaches' concussion training. Texas education code requirements states that athletic coaches must complete concussion training (2 hours every other year or 1 hour annually), and both the every-other-year and annual modules are online courses (University Interscholastic League, 2015). The State of Iowa partners with its Department of Education and requires a one-time annual course that consists of a 30-minute video; after viewing it, coaches receive a certificate (Iowa High School Athletic Association, 2017).

**Players' Knowledge of Concussions**

Over the years, there has been research dedicated to studying youth athletes' level of concussion knowledge. It is paramount that these players understand the signs and symptoms of a concussion and the long-term consequences that can occur from an improperly managed concussion. It is known that "in general, athletes underreport concussions" (Kurowski et al., 2015, p. 21). Sometimes concussions, especially Grade 1 concussions, are minimized by sideline terminology such as *getting your bell rung* or *dinger*. These terms tend to diminish the severity of a concussion and may cause a student athlete not to take the symptoms he or she is experiencing as serious.

Concussion research has shown that many times athletes fail to report concussions. Guskiewicz and McLeod (2011) noted that "only 47 % reported the injury so that it could be diagnosed as a concussion at the time of injury. Approximately two thirds of the non-reporters did not think the injury warranted medical attention" (p. 355). One of the main reasons cited for not reporting the injury was the fear of being removed from the competition.

A youth soccer study conducted in Italy by Broglio et al. (2010) found that the most common reason for not reporting a concussion was that the player did not think that the injury was serious. Other reasons cited for not reporting the injury—in order from the second most common to the least common—included that concussions are considered part of the game, the player did not know it was a concussion, the player did not want to be removed from the game/practice, and the player did not want to let the team down. When the youth athlete did report his or her concussive symptoms to someone, the most frequent person notified was the coach, followed by his or her parents, his or her physiotherapist, his or her physician, and, least likely, a teammate. However, while some athletes chose to report their symptoms, Broglio et al. found that 60% of concussions remained unreported by the youth soccer athlete. Meanwhile, Clay et al. (2012) noted that older athletes may become hesitant to report injury because of potential scholarships, scouting, or progression to professional status. Researchers have found that “older adolescents, males, and football players are likely to have poorer concussion-related behaviors and attitudes” (Kurowski, Pomerantz, Schaiper, & Gittelman, 2014, p. 16). Therefore, there must be a change among student athletes in the current culture that negatively influences self-reporting. According to AMSUS (2015), “If the youth sports community can adopt the belief that concussions are serious injuries and emphasize care for players with concussions until they are fully recovered, then the culture in which these athletes perform and compete will become much safer” (p. 124).

**Parental Knowledge of Concussions**

It is important for parents to take an active role in their child’s health. Being part of an organized sporting team is popular for American children. While sports offer many health and social benefits, it is important for parents to be educated about the risks that are involved as well. Over the past few years, an increasing number of students have chosen to participate in sports. Youth athletes “between the ages of five and eighteen account for 65% of all sport- and recreation-related traumatic brain injuries (including concussions) treated in US emergency departments annually” (Covassin et al., 2012, p. 233). At the high school level, “athletics has increased for years, with more than half of all high school students, over 3.1 million girls and 4.2 million boys, participating in sports during the 2009-2010 school year” (Marar et al., 2012, p. 747). With more students participating in sports, there is an increased likelihood of concussions occurring. As noted previously, some students fail to report symptoms to their coaches for fear of being removed from the game or for fear of what their fellow teammates might think; however, it has also been found that some students do not tell their parents about their symptoms (Rivara et al., 2014).

It is important for parents to be able to recognize the signs and symptoms of a concussion as well as have updated concussion information. Parents often have "misconceptions about concussions; for example, parents who played sports as children were often taught that mild head injuries did not warrant medical evaluation or necessitate rest from athletic or academic involvement" (Lin, Salzman, et al., 2015, p. 125). Parents of these athletes play a major role in both identifying concussive symptoms and managing at-home recovery. This can be challenging for parents because athletes can present different symptoms depending on the exact part of the brain that was injured. There are different biomechanical and structural differences in the pediatric athlete as compared to the adult athlete (Lin, Salzman, et al., 2015).

Often, people use the words *signs* and *symptoms* interchangeably, but these are very different terms. A symptom is something that the athlete will report feeling; it is his or her experience. Common symptoms of a concussion include headache, nausea, vomiting, balance problems, dizziness, double/blurry vision, sensitivity to light, sensitivity to noise, feeling sluggish, concentration problems, confusion, or not "feeling right" (Grady, 2010, p. 157). A sign is a physical manifestation caused by the symptoms; it is something that the parent can actually witness the athlete doing. Common signs of a concussion include appearing dazed, being confused about assignments, forgetting an instruction, moving clumsily, answering questions slowly, showing personality changes, and being unable to recall events prior to the injury or after the injury (Grady, 2010).

It is important for parents to understand how to manage their student athletes' return to school after a concussion. While much of this information might be provided by a healthcare professional during a clinical evaluation of the athlete, it would be helpful if parents had tools such as fact sheets perhaps provided by the school that discussed the return-to-school process. Grady (2010) noted that it is generally recommended that an athlete stay home from school (the days vary depending on the severity of the concussion) for cognitive rest because concussion symptoms typically worsen with increased cognitive demands, and the majority of the time, teachers expect a student athlete to function normally once he or she returns to school since he or she appears normal. This expectation level could also be the same for parents. They may expect their children to function normally in the home environment and not understand the importance of rest after a concussion injury. It should also be understood that just because an athlete is cleared to return to school does not clear him or her for return to physical activity (Grady, 2010).

To date, there have been few online concussion education programs that have been developed specifically for parents (Donaldson et al., 2016; Macdonald & Hauber, 2016; Williamson et al., 2014). None of the parental online education programs evaluated parents of solely female high school athletes. The majority of schools across the United States provide parents with a concussion fact sheet. However, with the increasing access to technology, online concussion education for parents may serve as a better avenue to receive and retain this information.

**High- versus Low-Impact Sports**

Students participate in a variety of sports. The numbers of organized sports that are offered at schools continues to grow. Some sports are notably more concussion prone than others. One of the most recognized concussion-occurring sports in recent years is football. Both the NFL and local-level football teams have placed a new emphasis on concussion awareness. However, nearly every sport poses a concussion risk. In addition, within those sports that have a higher incidence of concussion than others do, there are some positions that have a higher risk of concussion than other positions. Epidemiology reports of concussions in sports are helpful in assessing which sports are at high risk for the likelihood of sustaining a concussion and which sports are at lower risk. These reports can also be helpful in determining which parents of student athletes need to have a better understanding of concussion symptoms since their child is at higher risk for sustaining the brain injury.

Clay et al. (2012) conducted a literature review of 62 articles and noted that various concussion factors among athletes could be identified when examining high school and college students. They found that the "highest reported incidences of concussion, in descending order, are football, female and male soccer, wrestling, and female basketball. Overall, football accounts for the highest proportion of concussion" (p. 236). Similarly, the CDC conducted a surveillance study that found the "highest overall injury rates in football, followed by wrestling, soccer (both boys' and girls'), and girls' basketball" (Lincoln et al., 2011, p. 959).

Within football, the linebacker is the position that is most associated with concussions among high school and college athletes; this may be different from the public's perception of the most concussed football player, which in the NFL is the quarterback (Clay et al., 2012). Some researchers believe that high school football players may be at "a greater risk because teams run more and pass less than in college and players are less skilled in tackling and blocking techniques" (Shankar, Fields, Collins, Dick, & Comstock, 2007, p. 303). Another study found that goal keepers were at the greatest risk of concussion during soccer (Delaney, Lacroix, Leclerc, & Johnson, 2002).

Multiple studies revealed that athletes are at a three to 14 times higher risk of concussion during a competition than during a practice (Clay et al., 2012). These revelations were noted across a variety of sports for both male and female athletes alike. Collision sports had a higher cumulative incidence of concussion. When 20 high school sports were compared, it was found that player-player contact caused the majority of concussions (Marar et al., 2012). Therefore, contact sports such as football, ice hockey, and lacrosse have a higher incidence of concussion than do noncontact sports such as volleyball, swimming, and diving (Marar et al., 2012).

In sports played by both males and females, the female incidences of concussions were consistently higher than males except in lacrosse, where males had a more frequent incident rate (Clay et al., 2012). However, some researchers have hypothesized that females may report their symptoms more readily than males, thus explaining the higher concussion incidence among females (Daneshvar, Nowinski, McKee, & Cantu, 2011). In these gender-comparable sports, there is "evidence that female athletes may generally be more honest about reporting injuries than male athletes" (Marar et al., 2012, p. 754). It is also worth noting that in gender-comparable sports, except track and field and swimming and diving, females had a higher number of repeat concussions than males (Marar et al., 2012).

**Concussion Gear**

According to the literature regarding concussions, there is conflicting data about the benefits of protective equipment such as headgear. Purcell (2014) noted, "The wearing of certain helmets in certain sports has been shown to protect against other head injuries such as skull fracture" (p. 6). Unfortunately, although some form of protection is necessary, "it may cause players to develop a false sense of security, tackle harder, or cause more aggressive heading and head challengers, leading to increased risk of injury" (Clay et al., 2012, p. 247). In one study, it was found that both men and women lacrosse players had an increase in concussions after the introduction of a new helmet (Clay et al., 2012). Interestingly, in sports, “the percentages of concussion were highest in the helmeted sports of football and boys’ lacrosse” (Lincoln et al., 2011, p. 962).

There is “no evidence that mouthguards or facial protection reduce concussion risk, although such protective equipment protects against other injuries” (AMSUS, 2015, p. 124). Overall, protective equipment should be well fitted, worn properly, and well maintained for its best benefit (Purcell, 2014). Parents, coaches, and athletes must be made aware that protective gear does not make the student concussion proof. Therefore, it is important to enforce rules and standards for safe play along with using appropriate sport protective equipment.

**The Law**

Continued media attention has sparked a debate about the legal obligations of sports teams and educational institutions regarding concussions. All states have passed legislation that requires concussion education of coaches and parents. Some states have enacted laws that additionally require concussion education of the student athlete (Kurowski et al., 2015). These state laws each have three main components: first, educate coaches, parents, and athletes about concussion though training or a concussion information sheet; second, remove the athlete from play immediately if there is believed to be a concussion; and third, obtain permission to return to play from a healthcare professional (Williamson et al., 2014). There are additional state laws for criteria for removal from play (AMSUS, 2015). Currently, 49 states and the District of Columbia have passed laws involving concussed student athletes and return to play; however, only three states have laws that require schools to implement classroom accommodations following a sports concussion (Zirkel & Brown, 2014). There is variation among the state laws about the specific educational requirements that are needed for coaches, student athletes, and parents. Federal law provides students with the option of an Individualized Educational Program under the Individuals with Disabilities Education Act based on the severity and duration of symptoms (Zirkel & Brown, 2014). All of the laws are aimed at protecting the health and safety of the players of any sport at any level.

**Gender Differences in Concussion**

Several studies have noted various gender differences regarding reporting concussions. It has been documented that girl athletes report more concussions than boys, and girls who play high school sports have a higher rate of concussion, and concussions account for more of their injuries than boys (Cajial, 2007). The *Journal of Athletic Training* found that girls who played high school soccer sustained concussions 68 percent more often than boys, and the disparity was also seen for basketball (Gessel, Fields, Collins, Dick, & Comstock, 2007). Marar et al. (2012) found that girls had a higher rate of concussion than boys in all gender-comparable sports. Additionally, it was found that in “all gender-comparable sports, except track and field and swimming and diving, girls had a higher proportion of recurrent concussion than boys” (Marar et al., 2012, p. 754). This finding indicates that not only are there more reported concussions in girl athletes, but they might potentially be at a higher risk for recurrent concussions and in turn have poorer post-concussive outcomes. Lincoln et al. (2011) also found that girls had a consistently higher rate of concussion than boys in sports where the boys’ and girls’ games are similar. This rate was approximately a twofold risk of concussion in girls as compared to boys. When examining girls’ sports alone, Lincoln et al. discovered that soccer represented the highest proportion of concussion overall. This was followed by cheerleading, basketball, and lacrosse.

The difference among the concussion rates may be explained by biomechanical and sociological factors, as well as by differences in playing styles (Gessel et al., 2007). Examination of the mechanism of concussion from different playing styles between girls and boys has revealed that girls' concussions are associated more with surface or ball contact, whereas boys' concussions more often result from player-to-player contact (Lincoln et al., 2011). Biomechanically, girls have smaller ball-to-head ratios and weaker necks, which may partially explain why they are more susceptible to concussion than boys (Gessel et al., 2007). In animal models, it was found that when both female and male rats were given additional estrogen before an induced brain injury, the female rats had exacerbated effects as well as higher mortality rates (Frommer et al., 2011). Estrogen and progesterone are both associated with the inflammatory process in the brain, and further complicating the effects in adolescent females is the fact that their hormone levels vary.

There are also cultural influences that play a factor as well. Cultural tendencies may encourage girls to report injuries more than boys, who have been expected in the past to tough it out (Cajial, 2007). This evidence suggests that females are more willing than males to report their concussive symptoms, which is turn could allow for an increase in detection of their injuries. It has been found that girls are also more likely to report a future concussion after receiving an educational intervention (Miyashita et al., 2016). Therefore, the concussion education of the female student athlete has been shown to be beneficial and results in a change in behavior in terms of their concussion reporting.

Retrospective studies have shown that "females tended to fare worse than their male counterparts, with longer hospitalizations, longer residual disabilities, and higher mortality rates" (Frommer et al., 2011, p. 76). This finding could mean that high school girls that sustain a concussion may require more monitoring and more aggressive treatment than boys. It is also important to note that males and females tend to report different types of symptoms. Males tend to report more cognitive symptoms such as amnesia and confusion/disorientation, whereas females report more neurobehavioral and somatic symptoms such as drowsiness and sensitivity to noise (Frommer et al., 2011). Therefore, multi-symptom evaluation and physical exams are needed on the sidelines for high-school-aged student athletes. This practice is important because it is the foundation for return-to-play decisions.

## Summary

Over the past decade, there has been increased awareness of the dangers of concussions though the news, journals, and social media. Out of this have come prevention efforts and education of student athletes, school officials, and coaches. Some concussion education efforts have involved parents of student athletes; however, current literature in this area is extremely limited. One of the largest promoters of concussion awareness is the CDC. In 2015, the CDC developed the Heads Up concussion awareness program to spread information about concussions to coaches, athletes, and their parents. Little else has been done on a comprehensive and broad level to educate parents, in particular parents of female athletes, on sports-related concussions or to examine the efficacy of concussion programs on enhancing sports-related concussion assessment, identification, and management of knowledge among parents of female student athletes.

Nearly all states have laws in effect with requirements for concussion education for the parents of student athletes. These laws require the schools to provide education to the parents about concussions though training or a concussion information sheet (Williamson et al., 2014), and schools are allowed to decide which method of delivery they will use for the information.

However, there is not a study to date that examines the most effective way to deliver this information to parents. Current literature has not evaluated if a training session or an information sheet is the best way for parents to understand the signs and symptoms of concussions. Therefore, the use of Mayer's (2002) multimedia theory, which draws from several cognitive theories including Baddeley's model of working memory, Paivio's dual coding theory, and Sweller's theory of cognitive load (Reed, 2006), will be used in this study to determine whether the multimedia Heads Up video that combines words and pictures, which should maximize learning effectiveness of the parents, is more effective than a fact sheet. Mayer's theory indicates that students learn better from words and pictures (video) than from words alone (information sheet).

As discussed in this chapter, current literature in the field shows the recovery issues that players can have if signs and symptoms are not identified and managed properly. The research also shows the devastating cumulative effects that concussions can have on the developing brain, which makes prevention key. Therefore, education on the recognition of the signs and symptoms of concussions must include school personnel, the student athletes, and their parents. Since some concussion symptoms could take hours or days to develop, it is important that everyone involved has the concussion education they need to make the best decision for the student athlete.

# CHAPTER THREE: METHODS

## Overview

Few online concussion education programs have been developed specifically for parents, and those that have been developed tend to neglect the fact that concussion rates are higher in female rather than male student athletes (Donaldson et al., 2016; Macdonald & Hauber, 2016; Williamson et al., 2014). In this quantitative study, the researcher addressed these two gaps in the concussion education literature. The study utilized a posttest control-group design to determine if concussion knowledge is significantly higher among parents of female student athletes randomly assigned to the CDC's Heads Up video-based concussion education intervention group than among parents of female student athletes randomly assigned to the control group (i.e., parents who are simply given a fact sheet on sport-related concussions). This chapter provides a comprehensive overview of the study's research methodology. The chapter opens with a discussion and rationale of the research design and a restatement of the research questions and hypotheses. The chapter continues with sections on the study population and sample, instruments, and methodological procedures. A data analysis section concludes the chapter.

## Design

This study was a quantitative quasi-experimental, posttest-only control-group design. Moreover, the scientific method informs the methodology, analysis, and conclusions of this study. A study guided by the scientific method entails a review of and discernment of gaps in the relevant empirical literature, which informs the development of research questions that have null and alternative hypotheses (Haig, 2014; Kowalczuk-Walędziak, 2015). A specific research design that aligns with the structure of the research questions and hypotheses is proposed and implemented by gathering numerical data derived from valid and reliable instruments from participants (Haig, 2014; Kowalczuk-Walędziak, 2015). Statistical analyses of the numerical data are then conducted to address the proposed research questions and hypotheses and derive conclusions about the study (Haig, 2014; Kowalczuk-Walędziak, 2015).

The purpose of this study was to determine if parents of female student athletes report significantly higher levels of concussion symptoms and general concussion knowledge after viewing the CDC Heads Up concussion education videos than do parents of female student athletes in the control condition who simply read an online fact sheet on concussions. In this study, the independent variable was the group (i.e., intervention or control) and the two dependent variables were concussion symptom knowledge, measured using the CSRS (MacLeod et al., 2007), and general youth sports-related concussion knowledge, measured using the CDC's (2004) Heads Up CYSS.

The goals of this study were met by employing a quasi-experimental posttest-only control-group design. The rationale, according to Gall, Gall, and Borg (2007), is that "almost any study that can be conducted with a single-group design can be carried out more satisfactorily with a control-group design" (p. 405). The posttest-only control-group design can be delineated as

$$\begin{array}{lll} R & X & O_I \\ R & & O_C \end{array}$$

where R indicates the random assignment of participants to the control or intervention group, X is the intervention group, $O_I$ is the posttest for the intervention group, and $O_C$ is the posttest for the control group (Phan & Ngu, 2016). The inability to randomly select study participants from the population (i.e., all parents in the United States who have at least one high-school-aged daughter participating in organized sports) precluded the use of a true experimental design. However, by partnering with Qualtrics®, the researcher was able to randomly assign study participants to the intervention or control conditions. Randomization of participants to conditions helped reduce the limitation of not having a pretest and resulted in improved study internal validity. In the study, control-group participants were asked to read (online) a concussion awareness fact sheet, which is the typical form of concussion communication given to parents by the school at the beginning of the sport season (Frommer et al., 2011). In contrast, the intervention group watched the CDC Heads Up concussion videos. The benefit of the control group was the ability "to assess the effect of extraneous factors on participants' posttest performance" (Gall et al., 2007, p. 405).

## Research Questions

For this study, the researcher proposed two research questions:

**RQ1:** Is there a difference in the understanding of concussion symptoms, as measured by the CSRS (McLeod et al., 2007), between parents of girls who play organized sports at the high school level who read an online concussion awareness fact sheet (control group) versus those who view the CDC's Heads Up concussion training videos (intervention group)?

**RQ2:** Is there a difference in the understanding of youth sports-related concussion knowledge, as measured by the CDC's (2004) Heads Up CYSS, between parents of girls who play organized sports at the high school level who read an online concussion awareness fact sheet (control group) versus those who view the CDC's Heads Up concussion training videos (intervention group)?

## Hypotheses

The null hypotheses for this study were:

**$H_0$1:** There is no significant difference in the understanding of concussion symptoms, as measured by the CSRS (McLeod et al., 2007), between parents of girls who play organized sports at the high school level who read an online concussion awareness fact sheet (control group) versus those who view the CDC's Heads Up concussion training videos (intervention group).

**$H_0$2:** There is no significant difference in the understanding of youth sports-related concussion knowledge, as measured by the CDC's (2004) Heads Up CYSS, between parents of girls who play organized sports at the high school level who read an online concussion awareness fact sheet (control group) versus those who view the CDC's Heads Up concussion training videos (intervention group).

## Participants and Setting

### Participants

Participants in this study were a convenience sample ($n$ = 128) of American parents ($n$ = 62 per intervention and control group) who have at least one daughter in ninth through 12th grade who plays and has played for at least one year at least one organized sport at the high school level. NFHS (2017) reported that 3.3 million American female adolescents in ninth through 12th grade participated in high school varsity sports during the 2015–2016 school year. NFHS did not include data on girls who participated in a private- or home-school-affiliated organized sports, nor did it consider in its calculations girls who participated in community, organizational, or recreation center league sports team not affiliated with their school. When including these girls, the population for this study was approximated to be 8 million parents of daughters in ninth through 12th grade who are involved and have been involved for a minimum of 1 year in at least one organized sport.

The sampling procedure for this study was implemented using online survey services provided by Qualtrics®, a research survey organization that has been certified as meeting and sustaining research ethics standards required by CFR 45.46 (Federal Guidelines for Human Research; Snow, 2012). Qualtrics® utilizes non-probability *crowdsourced convenience samplin*g. A crowdsourced convenience sample is comprised of individuals who have been recruited or who have independently registered online to be potential survey panel members (Palmer & Strickland, 2016). Qualtrics® recruits by partnering with other study panel recruitment companies as well as businesses and corporations in which participants are employees; recruitment of survey panel participants can be *open enrollment* or *by invitation only* (Snow, 2012). Open enrollment recruitment is conducted via direct email and online marketing channels. By invitation only recruitment is conducted by partnering with companies that provide employee contact information. Qualtrics® also obtains hard-to-reach populations by working with survey panel companies on tailored recruitment campaigns. A survey panel may be comprised of participants obtained through any of these three types of recruitment processes or who have willingly registered to participate in online surveys (Snow, 2012).

All individuals who serve on Qualtrics® online study panels must sign an informed consent form upon initial registration and on an annual basis (Snow, 2012). Qualtrics® has established processes to verify participant identity and information, including technology that can compare information provided by the participant (e.g., email addresses and demographic information) to information about the participant found online. To exclude duplication and ensure validity, Qualtrics® checks every IP address and uses a sophisticated digital fingerprinting technology to prevent duplication of responses. Once the individual is verified, he or she is assigned an individual ID number that allows Qualtrics® to record the individual's survey participation history. Qualtrics® uses this information to ensure that the participant meets specific study criteria and is not being over-contacted and thus oversampled (Snow, 2012). Qualtrics® can randomly assign participants to control and intervention groups.

In regard to the sample size, an *a priori* power analysis using G*Power (Faul, Erdfelder, Lang, & Buchner, 2007) determined the minimum sample size for this study. The power analysis was conducted for an independent samples *t*-test, the statistical analysis used for hypothesis testing. The number of analyzed groups was set to two (i.e., intervention and control). The significance level was set to $p < .05$, and the power was set to 0.80. The effect sizes reported in studies evaluating the effects of online and video-based concussion education initiatives, including the CDC Heads Up program (e.g., Glang, Koester, Beaver, Clay, & McLaughlin, 2010; Glang et al., 2015; Thomas, Silverman, & Nelson, 2015), have been quite robust, with most reporting large effect sizes. To err on the side of caution, the effect size for this study was set to medium, Cohen's $d = 0.50$. The power analysis results revealed that $n = 128$, or $n = 64$ per group, was the required sample size for this study.

The participants had to meet all of the below sample criteria to participate in the study (in addition to providing informed consent). The participant had to be a parent or legal guardian of a girl in 9th through 12th grade who plays and has played an organized sport for at least 1 year. The sport could be school or community affiliated. In addition, the study required that the parent and daughter must not have had a concussion or TBI in the past 5 years (post-November 2012). The parent must have not attended a youth sports-related concussion awareness and education program, seminar, or class in the past year (post-March 2016). Participants had to provide the appropriate responses to these questions, which can be found in Appendix D, in order to be able to access the video/online fact sheet and complete the study survey.

**Setting**

The setting for this study was the virtual setting of Qualtrics®. Since the mid-2000s, advances in technology have enhanced the validity, reliability, and empirical quality of online research (Dance, 2015; Hewson & Stewart, 2016). Online surveys have been emerging as a viable alternative because they can reach a larger target population and allow for quicker results because there is no need to manually process paper surveys (Dance, 2015; Hewson & Stewart, 2016). Moreover, scholars and practitioners have recognized the value of implementing online concussion awareness and education initiatives (Coulson, 2015; Dance, 2015), and the published evaluation literature, albeit limited, has shown that such initiatives have been effective in increasing knowledge and understanding of concussions and concussion symptoms among medical personnel, coaches, and students (Covassin et al., 2012; Glang et al., 2010).

A Qualtrics® administrator selected 128 participants who met the study criteria from its online panel member pool. Qualtrics® typically recruits a sample that is 10% larger than what is required and requested in order to enhance quality assurance purposes; the extra recruitment is provided at no additional charge (Snow, 2012). The administrator employed the Qualtrics® survey flow randomizer procedure to randomly assign a minimum of 64 study participants to the intervention condition and a minimum of 64 participants to the control condition. The intervention condition entailed 64 participants watching the CDC Heads Up concussion education videos, while the control condition had 64 participants reading an online fact sheet on concussions.

## Instrumentation

In this study, the researcher utilized two instruments, the CSRS (McLeod et al., 2007) and the CDC's (2004) Heads Up CYSS, to evaluate the efficacy and impact of the CDC Heads Up video intervention on parents' knowledge of youth sports-related concussion symptoms and of youth sports-related concussions in general, respectively (see Appendices B and C for instruments). Permission was sought and granted to use the CSRS (see Appendix G). The Heads Up CYSS is in the public domain and can be accessed for free. Parents in the intervention condition (i.e., participants who viewed the CDC Heads Up videos on youth sports-related concussions) and parents in the control condition (i.e., participants who only viewed a fact sheet on youth sports-related concussions) answered the surveys immediately prior to the condition activity (pretest) and immediately after the condition activity (posttest).

Participants also completed the participant information survey, which can be found in Appendix D. Information gleaned from this survey is reported for descriptive purposes only. The parents took approximately 20 minutes to complete the posttests and information survey. Information on the two surveys used to evaluate the CDC Heads Up program and the participant information survey are presented in the following sections.

### Concussion Symptom Recognition Survey Instrument

The CSRS (see Appendix B) was used to measure parents' recognition of the true symptoms of a concussion. The researcher received permission to use the CSRS (see Appendix G). The CSRS contains a list of 16 symptoms in total; however, eight of them are actually symptoms of concussions, and the other eight are not (McLeod et al., 2007). Parents completed the CSRS by correctly identifying the eight concussion symptoms out of a list of 16 possible choices. Per the guidelines by McLeod et al. (2007), parents were not informed that the checklist contains eight correct and eight incorrect symptoms; they could select as many (up to all 16) or as few (zero) of the 16 symptoms as desired. The survey took approximately 10 minutes to complete. The ratio-coded CSRS is scored by summing the number of *correct* responses. Scores can range from 0 to 8 points, with a higher score denoting higher levels of parents' knowledge regarding concussion symptoms (McLeod et al., 2007). The 16-question survey was initially validated by McLeod et al., who found evidence of construct validity and inter-item reliability. The CSRS has been used in later studies conducted with coaches (e.g., Glang et al., 2010; Glang et al., 2015) as well as with parents of youth who play sports (e.g., Gourley et al., 2010; Saunders et al., 2013), and these studies have attested to the psychometric strength of the CSRS. The KR-21 values, indicators of inter-item reliability, have ranged between .70 and .85 for this scale (McLeod et al., 2007).

**CDC Heads Up Concussion in Youth Sports Survey Instrument**

Parents' general knowledge of concussions was measured using CDC's (2004) Heads Up CYSS, a nine-item true/false survey (see Appendix C). The survey is in the public domain, accessible for free to researchers. The ratio-coded scale score is derived by summing the number of correct items, and the scale score can range from 0 to 9, with a higher score denoting higher levels of knowledge regarding youth sports-related concussions. The time spent taking the survey is approximately 5 minutes. The CDC Heads Up CYSS was developed as part of the CDC Heads Up program and was shown to have good construct validity and inter-item reliability (CDC, 2004). Later studies have shown evidence to support its psychometric adequacy (Caron, Bloom, Falcão, & Sweet, 2015; Kurowski et al., 2014; Kurowski et al., 2015; Sarmiento, Hoffman, Dmitrovsky, & Lee, 2014). The inter-item reliability is sound, with KR-21 values ranging from .75 to .92 (Caron et al., 2015; Sarmiento et al., 2014).

**Participant Information Survey**

Participants completed the participant information survey, which can be found in Appendix D. This is a 16-item information questionnaire. All survey questions were close-ended; the majority of questions were categorically coded. The questions on the parent information survey can be classified into four categories: (a) questions on the number of (female) children/athletes in the household; (b) questions specific to the female athlete (e.g., grade and age of daughter; number and type of organized sport played by daughter); (c) the participant's knowledge and experience of concussions (e.g., ever had a concussion; number of concussions); and (d) participant demographics (e.g., gender, age group). Information gleaned from this survey is reported for descriptive purposes only.

## Procedures

The Institutional Review Board (IRB) packet was submitted and approved prior to beginning research. Appendix H includes the IRB approval form. All data were collected online using the Qualtrics® online survey services. Qualtrics® notified through email those individuals who qualified as study participants and invited them to participate in the study (Snow, 2012). Emails were automatically randomized to reduce bias. The email provided a description and information on the study and on the individual's responsibilities as a study participant should he or she wish to participate. The email also contained the study link and directed the individual to click on the link should he or she wish to participate in the study. Participants were able to answer the study surveys as well as view or read the study information all online. The study website was configured to respond to participants' responses and to provide assurance that potential participants who did not provide consent or who did not meet study criteria would be unable to answer the survey questions, view the videos, read the fact sheet, or otherwise engage in the study.

The individual could choose not to participate in the study by declining the invitation. If the individual chose to participate in the study, he or she clicked on the link and completed the requirements of the study (Snow, 2012). Clicking on the survey link opened the study website, and all participants first viewed the informed consent form. Participants were asked to read the consent form. If they clicked No (do not consent), they were redirected to a new screen. If the individual consented to participate in the study, they clicked on the Yes box, which took them to the next screen. This screen contained the seven criteria questions; participants had to meet all study criteria to advance to the next screen. If the individual did not give informed consent and/or did meet study criteria, he or she was redirected to a new webpage that contained language thanking him or her for his or her interest in the study, but since he or she did not provide informed consent and/or did not meet the study criteria, he or she was unable to participate in the study. As stated earlier, Qualtrics'® recognition of the participant's computer IP address precluded the ability of the individual to access study materials by backspacing or to re-enter the study link and re-answer the study criteria questions.

The Qualtrics® administrator ran the survey flow randomizer procedure to randomly assign $n$ = 64 parents to the intervention condition, whose participants viewed the CDC Heads Up videos, and randomly assigned $n$ = 64 parents to the control condition, whose participants read an online fact sheet on concussions (Qualtrics® survey flow randomizer procedure directions can be found at https://www.youtube.com/watch?v=d_L6UNmb_JA). Participants who provided informed consent and met study criteria were redirected to a new webpage that asked them to either read an online fact sheet on concussions (control group) or watch the CDC

Heads Up videos (intervention group). Once the participants completed reading the fact sheet/watching the videos, they clicked *Next* to move on to answering the study survey, which was posted on a new screen. The study survey contained questions on the number of children/daughters they have and the number of children/daughters they have who play organized sports. The study survey also included the CSRS and the CDC Heads Up CYSS surveys. Once the participants completed the posttest survey, they completed their responsibilities for participation in the study.

## Data Analysis

Once the data collection was complete, the data were downloaded into an Excel spreadsheet and transferred to a Statistical Package for the Social Sciences (SPSS) 24.0 data set. SPSS 24.0 was used for all statistical analyses, and statistical findings are reported. Tables and figures augment findings. First, descriptive statistics were conducted on the parent information variables (see Appendix A). Next, the mean, standard deviation, and minimum and maximum scores were reported for the interval or ratio-coded survey items (e.g., number of organized sports played by daughter, age of daughter). Frequencies and percentages were reported for categorically-coded variables (e.g., gender, ever had a concussion, ethnicity).

Kuder-Richardson Formula 21 (KR-21) statistics were applied to determine the inter-item reliability of the CSRS concussion symptom knowledge scale and the CDC's Heads Up CYSS general concussion knowledge scale. As with a Cronbach's alpha, a KR-21 between .70 and .79 is considered acceptable, alphas between .80 and .89 are considered good, and alphas greater than .90 are considered excellent (Agresti, 2013). The CSRS and Heads Up CYSS scale scores were calculated, and descriptive statistics (e.g., mean, standard deviation, minimum and maximum scores) were run and reported for the two scales.

The statistic used to test this study's hypotheses was an independent samples *t*-test. Specific results from the two independent samples *t*-tests conducted to address the two research questions are reported. The *t*-test is the appropriate statistical analysis, according to Gall et al. (2007), since

> one group is to receive an experimental treatment and the other is to serve as a control group. If research participants have been assigned randomly to the two groups, the groups should have equivalent mean pretest scores. If this is the case, you can use *t*-tests to determine the statistical significance of the mean gain scores. (p. 440)

The results include the respective *t*-value and its associated significance value (with $p < .05$ indicating significance). A significant ($p < .05$) *t*-value indicates that the dependent variable mean score of one study group is significantly higher/lower than the dependent variable mean score of other study group (Tabachnick & Fidell, 2013). The eta$^2$ ($\eta^{2)}$ is reported as an indicator of effect size for both *t*-tests.

The independent samples *t*-test has two key assumptions of the data: variable normality and equality of variances (Fay & Proschan, 2010; Ghasemi & Zahediasl, 2012; Tabachnick & Fidell, 2013; Treiman, 2014). The first assumption is dependent variable normality; that is, the dependent variable scores are normally distributed (Fay & Proschan, 2010; Treiman, 2014). Calculation of $z_{skewness}$ values (i.e., skewness divided by the standard error of skewness) for the CSRS and CYSS addressed the assumption of normality. A $z_{skewness}$ value less than 3.29 indicates that the normality assumption has been met; that is, the dependent variable scores follow a normal curve (Kim, 2013).

Since lack of normality is often the result of outliers (Kim, 2013), data were examined for outliers should the $z_{skewness}$ values indicate non-normality. The SPSS 24.0 unusual cases function and the computation of boxplots on the two dependent variables provided information on outliers. If outliers were present, they were *winsorized*; that is, the outlier was replaced with the next highest or lowest score (Garson, 2012).

If skewness remained after the removal of outliers, frequencies and percentages of dependent variable responses were to be calculated and examined for extreme skewness indicated by a large percentage of participants providing the same answer response (e.g., if 60% of participants scored a 9, the highest score on the CDC's [2004] nine-item Heads Up CYSS concussion knowledge scale). A large percentage of same responses on either of the two dependent variable measures could require categorical recoding of these variables, which could result in a categorical independent variable and categorical dependent variables. The categorical coding of both variables could require the use of a non-parametric statistic (Agresti, 2013).

The non-parametric chi-square ($\chi^2$) test of independence was utilized in hypothesis testing to determine if the dependent variables needed to be recoded as categorical. The chi-square ($\chi^2$) and associated significance level (with $p < .05$) were reported for the respective research question. A significant ($p < .05$) chi-square ($\chi^2$) indicates significant differences in the frequencies/percentages of participants across independent and dependent variable categories (Agresti, 2013). The lambda ($\lambda$) was reported as an indicator of effect size for each chi-square ($\chi^2$) test.

The second assumption for the independent samples *t*-test is homogeneity of variances; that is, dependent variable scores have similar distributions for both research groups (e.g., intervention and control groups; Fay & Proschan, 2010; Treiman, 2014). The computation of a Levene's $F$ test for equality of variances for each of the respective study research questions was used to address this assumption. A non-significant ($p > .05$) Levene's $F$ indicates that the homogeneity of variance assumption has been met (Garson, 2012). If the Levene's *F* is significant for either *t*-test, the Welch-Satterthraite adjusted *t*-value ($t_{adj}$) should be reported, with significance set at $p < .05$ (Agresti, 2013).

# CHAPTER FOUR: FINDINGS

## Overview

The purpose of this study was to examine whether concussion symptoms knowledge and general youth sports-related concussion knowledge were significantly higher among parents of female student athletes who watch the Center for Disease Control and Prevention's Heads Up concussion videos (intervention group) than among parents of female student athletes who read an online concussion awareness fact sheet (control group). A quasi-experimental, posttest-only control-group design was used to compare concussion knowledge differences between parents who watch the videos and those who read the standard concussion awareness fact sheet. This chapter provides factual data and a summary of the results from the statistical analyses conducted in hypothesis testing. The chapter opens with a review of the study research questions and associated null hypotheses. The chapter continues with a presentation of descriptive information for the study participants. Last, the results section contains a discussion and interpretation of the statistical tests. Based on these interpretations, a determination was made to either reject or fail to reject the null hypothesis.

## Research Questions

The following research questions guided this study:

**RQ1:** Is there a difference in the understanding of concussion symptoms, as measured by the CSRS (McLeod et al., 2007), between parents of girls who play organized sports at the high school level who read an online concussion awareness fact sheet (control group) versus those who view the CDC's Heads Up concussion training videos (intervention group)?

**RQ2:** Is there a difference in the understanding of youth sports-related concussion knowledge, as measured by the CDC's (2004) Heads Up CYSS, between parents of girls who play organized sports at the high school level who read an online concussion awareness fact sheet (control group) versus those who view the CDC's Heads Up concussion training videos (intervention group)?

## Null Hypotheses

The null hypotheses for this study were as follows:

**$H_0$1:** There is no significant difference in the understanding of concussion symptoms, as measured by the CSRS (McLeod et al., 2007), between parents of girls who play organized sports at the high school level who read an online concussion awareness fact sheet (control group) versus those who view the CDC's Heads Up concussion training videos (intervention group).

**$H_0$2:** There is no significant difference in the understanding of youth sports-related concussion knowledge, as measured by the CDC's (2004) Heads Up CYSS, between parents of girls who play organized sports at the high school level who read an online concussion awareness fact sheet (control group) versus those who view the CDC's Heads Up concussion training videos (intervention group).

## Descriptive Statistics

The study data set contained data from a sample of 146 parent participants. Mahalanobis and Cook's distances were computed for each participant to identify multivariate outlier cases. Per statistical recommendations (Tabachnick & Fidell, 2013), cases with a Mahalanobis distance value greater than the critical value of 18.46 and a Cook's distance value greater than 4/*N*, or .027, were considered to be multivariate outliers. The multivariate outlier cases were removed from the data set. Eight cases were identified as multivariate outliers and removed from the data set. The removal of the eight cases resulted in a final sample of 138 participants, or 94.5% of the original sample. Of these 138 cases, *n* = 70 (50.7%) were intervention group participants, and *n* = 68 (49.3%) were control group participants.

**Descriptive Statistics: Participant Demographics**

Descriptive data (e.g., frequencies and percentages) regarding demographic information of the parent participants are presented in Table 1. As denoted in Table 1, the majority of the 138 participants were female (*n* = 116, 84.1%) and European American (*n* = 105, 76.1%). There was variability with regard to parents' highest level of education. The largest group of participants were parents with some college experience but no degree (*n* = 37, 26.8%), followed by parent participants with a high school degree/GED (*n* = 35, 25.4%). Participants' ages ranged from 24 years of age or younger to 70–74 years of age. The majority of participants (*n* = 88, 63.7%) were between the ages of 35 and 49. Table 1 provides additional information on participant demographics.

**Descriptive Statistics: Children and Female Athletes in Household**

The participants answered questions regarding the number of children and female athletes in their household. Descriptive statistics (e.g., mean, standard deviation, and minimum and maximum scores) for these variables are presented in Table 2. The mean number of children in the household was 2.12 (*SD* = 1.29), and the number of children in the household ranged from 1.00 to 8.00. The mean number of children in the household who played an organized sport was 1.53 (*SD* = 1.29). The number of children in the household who played an organized sport ranged from 1.00 to 6.00. The mean number of female athletes in the household was 1.23 (*SD* = 0.56), with the number of female athletes in the household ranging from 1.00 to 4.00. The mean number of female athletes in the household who played an organized sport was 1.19 (*SD* = 0.49), with the number of female athletes in the household who played an organized sport ranging from 1.00 to 4.00.

Table 1

*Descriptive Statistics: Participant Demographics (n = 138)*

| Variable | Frequency *n* | Percentage % |
|---|---|---|
| Gender | | |
| Male | 22 | 15.9 |
| Female | 116 | 84.1 |
| Ethnicity | | |
| African American | 10 | 7.2 |
| Asian American | 3 | 2.2 |
| European American | 105 | 76.1 |
| Hispanic | 7 | 5.1 |
| Two or more ethnicities | 13 | 9.4 |
| Highest Level of Education | | |
| Less than high school | 1 | 0.7 |
| High school degree/GED | 35 | 25.4 |
| Technical or vocational degree | 10 | 7.2 |
| Some college, no degree | 37 | 26.8 |
| Associate's (2-year) degree | 21 | 15.2 |
| Bachelor's (4-year) degree | 20 | 14.5 |
| Graduate school (master's/doctorate) | 14 | 10.1 |
| Age Group | | |
| 24 or younger | 2 | 1.4 |
| 25–29 | 1 | 0.7 |
| 30–34 | 14 | 10.1 |
| 35–39 | 34 | 24.6 |
| 40–44 | 23 | 16.7 |
| 45–49 | 31 | 22.5 |
| 50–54 | 19 | 13.8 |
| 55–59 | 9 | 6.5 |
| 60–64 | 1 | 0.7 |
| 65–69 | 3 | 2.2 |
| 70–74 | 1 | 0.7 |

Table 2

*Descriptive Statistics: Number of Children and Female Athletes in Household (n = 138)*

| Variable | *M* | *SD* | Min | Max |
|---|---|---|---|---|
| Number of children in household | 2.12 | 1.29 | 1.00 | 8.00 |
| Number of children in household who play an organized sport | 1.53 | 0.88 | 1.00 | 6.00 |
| Number of female athletes in household | 1.23 | 0.56 | 1.00 | 4.00 |
| Number of female athletes in household who play an organized sport | 1.19 | 0.49 | 1.00 | 4.00 |

**Descriptive Statistics: Female Athletes' Age and Grade**

Participants answered questions about their daughter's age and grade. Table 3 provides the associated descriptive statistics (e.g., frequencies and percentages). The mean age of the participants' daughters was 15.58 years ($SD = 1.24$). Female athletes ranged from age 13 to age 18. The largest age groups for the female athletes were age 14 ($n = 26$, 18.8%), age 15 ($n = 36$, 26.1%), and age 17 ($n = 32$, 23.3%). The female athletes were in ninth through 12th grade. The largest group of female athletes ($n = 55$, 39.9%) were in ninth grade, followed by 33 (23.9%) female athletes in 10th grade, 32 (23.2%) in 11th grade, and 18 (13.0%) in 12th grade.

Table 3

*Descriptive Statistics: Female Athletes' Age and Grade (n = 138)*

| Variable | Frequency *n* | Percentage % |
|---|---|---|
| Age | | |
| 13 | 5 | 3.6 |
| 14 | 26 | 18.8 |
| 15 | 36 | 26.1 |
| 16 | 34 | 24.6 |
| 17 | 32 | 23.3 |
| 18 | 5 | 3.6 |
| Grade | | |
| 9th | 55 | 39.9 |
| 10th | 33 | 23.9 |
| 11th | 32 | 23.2 |
| 12th | 18 | 13.0 |

**Descriptive Statistics: Team Membership and Sports Type and Duration**

Participants provided information on the types of team and sport played by the female athlete. As seen in Table 4, 91(65.9%) of the female athletes played on a school sports team, 20 (14.5%) played on a non-school (e.g., league) team, and 27 (19.6%) female athletes played on both a school team and a non-school team. Table 4 also provides information on the frequency and percentage of female athletes who played 15 various types of sports. The largest group of female athletes played softball ($n$ = 38, 27.5%), volleyball ($n$ = 36, 26.1%), soccer ($n$ = 30, 21.7%), basketball ($n$ = 29, 21.0%), and track and field ($n$ = 27, 19.6%). The female athletes participated in an organized sport an average of 4.75 years ($SD$ = 3.22). The range of years that the female athlete participated in an organized sport was 1.00 to 15.00 years.

Table 4

*Descriptive Statistics: Team Membership and Type of Sport Played by Female Athlete (n = 138)*

| Variable | Frequency $n$ | Percentage % |
|---|---|---|
| Type of Team Played | | |
| A school sports team | 91 | 65.9 |
| A non-school sports team | 20 | 14.5 |
| Both school and non-school sports team | 27 | 19.6 |
| Type of Sport Played[a] | | |
| Baseball | 7 | 5.1 |
| Basketball | 29 | 21.0 |
| Cross Country | 6 | 4.3 |
| Dance/Drill | 14 | 10.1 |
| Field Hockey | 5 | 3.6 |
| Football | 2 | 1.4 |
| Gymnastics | 8 | 5.8 |
| Lacrosse | 4 | 2.9 |
| Soccer | 30 | 21.7 |
| Softball | 38 | 27.5 |
| Spirit Squad | 17 | 12.3 |
| Swimming | 6 | 4.3 |
| Tennis | 8 | 5.8 |
| Track & Field | 27 | 19.6 |
| Volleyball | 36 | 26.1 |

The total frequency exceeds 138 and the total percentage exceeds 100% because the female athlete could play more than one sport.

**Descriptive Statistics: Concussion Information**

The study survey included questions that inquired about the participant's experiences of concussions, both to him/herself and his/her daughter. None of the parents reported that their female athlete ever had a concussion or a TBI. None of the parents reported ever having a concussion themselves. Of the 138 parents, 122 (88.4%) reported that they would seek medical attention if their female athlete had her "bell rung." One (0.7%) parent reported that he/she would not seek medical attention, and 15 (10.9%) were not sure if they would seek medical attention if their female athlete had her "bell rung."

**Descriptive Statistics: CSRS and the CDC Heads Up CYSS**

Descriptive statistics (e.g., mean, standard deviation, minimum and maximum scores) were calculated for the CSRS and the CDC Heads Up CYSS and are presented in Table 5. The mean CSRS scale score was 6.61 ($SD$ = 1.72), and the CSRS scale scores ranged from 0.00 to 8.00 points. The mean score for the CDC Heads Up CYSS scale was 7.69 ($SD$ = 0.82), and the CYSS scale scores ranged from 5.00 to 9.00 points. Both mean scores indicated that the participants reported a relatively high degree of knowledge of concussion symptoms and sports-related concussions.

**Inter-item reliability**. KR-21s were computed for each of the three scales. A KR-21, analogous to the Cronbach's alpha, is an indicator of the inter-item reliability of a dichotomously coded (e.g., coding of 0 and 1) scale (Sarmah & Hazarika, 2012). As with the Cronbach's alpha, a KR-21 between .65 and .69 is considered adequate, between .70 and .79 is considered good, between .80 and .89 is considered very good, and a KR-21 that is .90 or higher is considered excellent (Sarmah & Hazarika, 2012). The CSRS had a KR-21 of .81, indicating very good inter-item reliability. The CDC Heads Up CYSS had good inter-item reliability, as denoted by a KR-21 of .70.

Table 5

*Descriptive Statistics: CSRS and the CDC Heads Up CYSS (n = 138)*

| Variable | *M* | *SD* | Min | Max | KR-21 |
|---|---|---|---|---|---|
| CSRS | 6.61 | 1.72 | 0.00 | 8.00 | .81 |
| CDC Heads Up CYSS | 7.69 | 0.82 | 5.00 | 9.00 | .70 |

*Note*. Possible scores on the CSRS can range from 0.00 to 8.00 points. Possible scores on the CYSS can range from 0.00 to 9.00 points.

**Testing of Assumptions for Independent Samples *t*-Test**

The statistic used to test this study's hypotheses was an independent samples *t*-test. The independent samples *t*-test has two key assumptions of the data: variable normality and equality of variances (Ghasemi & Zahediasl, 2012; Tabachnick & Fidell, 2013). Normality was addressed in two ways. First, Mahalanobis and Cook's distance values were calculated to identify cases that were multivariate outliers. Six cases exceeded Mahalanobis and Cook's distance critical values, indicating that they were multivariate outliers. These six cases were removed from the data set, resulting in a final sample of 138 participants, $n = 70$ (50.7%) participants in the intervention group and $n = 68$ (49.3%) in the control group.

Second, the $z_{skewness}$ value was computed for the CSRS and for the CDC Heads Up CYSS to determine if the respective scale displayed adequate univariate normality. A $z_{skewness}$ value less than +/−1.96 (at $p < .05$) indicates that the variable shows relative normality in the distribution of scale scores (Tabachnick & Fidell, 2013). As noted in Table 6, the $z_{skewness}$ value for the CSRS was −1.49, and the $z_{skewness}$ value for the CDC Heads Up CYSS was -1.66. Both $z_{skewness}$ values were less than +/−1.96, indicating normality. Therefore, the assumption of normality was met for this study.

The appropriate statistical analysis to test the assumption of equality of variances for each of the respective study research questions was Levene's *F* test for equality of variances (Tabachnick & Fidell, 2013). A significant (at $p < .05$) Levene's *F* indicates that the equality of variances assumption is violated (Tabachnick & Fidell, 2013). Results from the Levene's *F* tests are presented in Table 6. Results showed that the CSRS was skewed, resulting in a significant Levene's $F = 5.00$, $p = .027$. Thus, the equality of variances assumption was violated for the CSRS data. In accordance with statistical recommendations (Imbens & Kolesar, 2016;

Tabachnick & Fidell, 2013), the Welch-Satterthraite adjusted *t*-value ($t_{adj}$) and associated adjusted degrees of freedom ($Df_{adj}$) and adjusted *p*-value ($p_{adj}$) were reported for the independent sample *t*-test findings for the CSRS.

As seen in Table 6, the Levene's *F* was not significant ($F = 1.53$, $p = .218$) for the CDC Heads Up CYSS variable. Therefore, the assumption of equality of variances was met for the CYSS data. The non-adjusted *t*-value and associated degrees of freedom (*Df*) and *p*-value were reported for the independent samples *t*-test results for the CDC Heads Up CYSS.

Table 6

*Assumptions of Normality and Equality of Variances: CSRS and CDC Heads Up CYSS (n = 138)*

| Variable | $Z_{skewness}$ | Levene's *F* (*p*) |
|---|---|---|
| CSRS | −1.49 | 5.00 ($p = .027$) |
| CDC Heads Up CYSS | −1.66 | 1.53 ($p = .218$) |

## Results

### Research Question 1

The first research question posed in this study was the following:

**RQ1:** Is there a difference in the understanding of concussion symptoms, as measured by the CSRS (McLeod et al., 2007), between parents of girls who play organized sports at the high school level who read an online concussion awareness fact sheet (control group) versus those who view the CDC's Heads Up concussion training videos (intervention group)?

The null hypothesis for the first research question was the following:

**$H_0$1:** There is no significant difference in the understanding of concussion symptoms, as measured by the CSRS (McLeod et al., 2007), between parents of girls who play organized sports at the high school level who read an online concussion awareness fact sheet (control group) versus those who view the CDC's Heads Up concussion training videos (intervention group).

An independent samples *t*-test was conducted to determine if the two parent groups had significantly different CSRS mean scores. Results are presented in Table 7 and denote no significant CSRS mean score differences by parent group, $t_{adj}(123.38) = 1.63$, $p_{adj} = .108$. The CSRS mean scale score of $M = 6.84$ ($SD = 1.44$) for the parents in the intervention group was not significantly different than the CSRS mean scale score of $M = 6.37$ ($SD = 1.95$) for the control group of parents. Due to the lack of significant results, the study failed to reject the null hypothesis for the first research question.

Table 7

*Independent Samples t-Test: Parent Group and CSRS (n = 138)*

| Variable | *M* | *SD* | $t_{adj*}$ | $Df_{adj}$ | $p_{adj}$ |
|---|---|---|---|---|---|
| CSRS | | | 1.63 | 123.38 | .108 |
| Intervention Group: CDC Video (*n* = 70) | 6.84 | 1.44 | | | |
| Control Group: Fact Sheet (*n* = 68) | 6.37 | 1.95 | | | |

* Adjusted values were used because data violated the assumption of equality of variances.

**Research Question 2**

The second research question for the study was the following:

**RQ2:** Is there a difference in the understanding of youth sports-related concussion knowledge, as measured by the CDC's (2004) Heads Up CYSS, between parents of girls who play organized sports at the high school level who read an online concussion awareness fact sheet (control group) versus those who view the CDC's Heads Up concussion training videos (intervention group)?

The associated null hypothesis for the second research question was the following:

**$H_0$2:** There is no significant difference in the understanding of youth sports-related concussion knowledge, as measured by the CDC's (2004) Heads Up CYSS, between parents of girls who play organized sports at the high school level who read an online concussion awareness fact sheet (control group) versus those who view the CDC's Heads Up concussion training videos (intervention group).

A second independent samples *t*-test, with the parent group (i.e., CDC video intervention group as compared to the concussion fact sheet control group) as the independent variable and the Heads Up CYSS as the dependent variable, addressed the second research question. Results from the independent samples *t*-test are presented in Table 8. The results were not significant, $t(136) = 0.38$, $p = .707$. The intervention parents did not have a significantly different CDC Heads Up CYSS mean score compared to control parents, $M = 7.71$ ($SD = 0.76$) and $M = 7.68$ ($SD = 0.87$), respectively. Because the results were not significant, the study failed to reject the null hypothesis for the second research question.

Table 8

*Independent Samples t-Test: Parent Group and CYSS (n = 138)*

| Variable | *M* | *SD* | *t* | *Df* | *p* |
|---|---|---|---|---|---|
| CDC Heads Up CYSS | | | 0.38 | 136 | .707 |
| Intervention Group: CDC Video (*n* = 70) | 7.71 | 0.76 | | | |
| Control Group: Fact Sheet (*n* = 68) | 7.68 | 0.87 | | | |

# CHAPTER FIVE: CONCLUSIONS

## Overview

The purpose of this final chapter is to review and analyze the study's findings. The first section of this chapter is the Discussion section, in which the research questions and null hypothesis are restated. Each null hypothesis will either be accepted or there will be a failure to accept the null hypothesis. The chapter continues with the Implications section, which includes an analysis of the study findings in regard to the guiding theories and prior empirical work. The Limitations section follows Implications, and the Recommendations for Future Research in the field of concussions concludes the study.

## Discussion

The purpose of this quantitative study that employed a quasi-experimental, posttest-only control group design was to examine whether concussion symptoms knowledge and general youth sports-related concussion knowledge were significantly higher among the intervention group of parents of female student athletes who viewed the CDC Heads Up concussion videos than a control group of parents of female student athletes who read an online concussion awareness fact sheet. The study participants were 138 parents (116 mothers, 22 fathers) of at least one female athlete. The parents were predominantly European American (76.1%), with most (63.7%) between the ages of 35 and 49 and having some college experience (26.8%). The parents, on average, had two children, one of whom was a female athlete. The mean age of the female athletes was 15.5 years, and the majority (63.8%) were in ninth or 10th grade. The female athletes played a variety of organized sports, the most common being softball, volleyball, soccer, and basketball.

The research questions, along with the corresponding null hypotheses, are presented below:

**RQ1:** Is there a difference in the understanding of concussion symptoms, as measured by the CSRS (McLeod et al., 2007), between parents of girls who play organized sports at the high school level who read an online concussion awareness fact sheet (control group) versus those who view the CDC's Heads Up concussion training videos (intervention group)?

**$H_0$1:** There is no significant difference in the understanding of concussion symptoms, as measured by the CSRS (McLeod et al., 2007), between parents of girls who play organized sports at the high school level who read an online concussion awareness fact sheet (control group) versus those who view the CDC's Heads Up concussion training videos (intervention group).

For the first research question, the researcher failed to reject the null hypothesis. There was no significant difference between the parents who read the online concussion awareness fact sheet and those who viewed the training videos as measured by the CSRS, and the null hypothesis was retained. The results of the independent sample t-test were not significant when measured for the CSRS.

This result contradicts Mayer's multimedia theory of learning. Parents who read the handout scored comparable to those who watched the video. Mayer's (2002) theory of multimedia postulated that people learn better from words and pictures when they are combined than from using just words alone. Mayer noted, "The presentation of material using both words and pictures" is postulated to expose individuals to multimedia messages to develop both verbal and visual mental models and to also create connections between the two (p. 27). According to

Mayer, there should be a deeper learning that occurs from words and pictures together than from pictures alone (Mayer, 2002); however, in this study, that conclusion was not borne out.

The TPB, as proposed by Ajzen (1991), is one of the most popular models that regards the prediction of human behavior. One question in particular on the CSRS dealt with that element, as follows: "An athlete who displays any sign or symptom of concussion should not be allowed to return to play" (McLeod et al., 2007). There were 87.5% participants who marked this answer *True* compared to only 12.5% who marked the answer *False*. This question could fall into Ajzen's category of behavioral and normative beliefs. Behavioral beliefs, according to Ajzen, are one's attitude about the behavior, such as whether the action is considered a good or bad thing to do. The normative belief is used to consider the norms of the society in which an individual is living. It consists of the social pressure that one feels to conform or not conform to the societal norm. This question could imply to some participants that allowing an athlete to return to play with signs and symptoms of a concussion is a "bad" thing to do. A participant may have marked the *True* response because he/she felt like that was the correct answer based to societal norms.

It is important to note that, according to the theory, a "particular behavior is most likely to occur when a person has a strong intention to perform it and the knowledge and skill to do so and the person has performed the behavior previously" (Montano & Kasprzyk, 2015, p. 105). Therefore, the participants who responded *True* to this question may have previously taken their student athlete out of a practice or game before (for an injury that may have not been a true concussion) and been supported by coaches or other parents who reinforced that it was the "right thing to do."

**RQ2:** Is there a difference in the understanding of youth sports-related concussion knowledge, as measured by the CDC's (2004) Heads Up CYSS, between parents of girls who play organized sports at the high school level who read an online concussion awareness fact sheet (control group) versus those who view the CDC's Heads Up concussion training videos (intervention group)?

**$H_0$2:** There is no significant difference in the understanding of youth sports-related concussion knowledge, as measured by the CDC's (2004) Heads Up CYSS, between parents of girls who play organized sports at the high school level who read an online concussion awareness fact sheet (control group) versus those who view the CDC's Heads Up concussion training videos (intervention group).

For the second research question, the researcher failed to reject the null hypothesis. There was no significant difference between the parents who read the online concussion awareness fact sheet and those who viewed the training videos as measured by the CYSS, and the null hypothesis was retained. The results from the independent samples *t*-test were not significant.

This result was somewhat surprising since the videos that were used were the CDC's videos for concussion training and the Heads Up CYSS is the CDC survey to assess concussion knowledge. The findings demonstrate that parents who read the fact sheet scored comparable to those who watched the video. This result again contradicts Mayer's (2002) multimedia theory, which postulated that the parents from the video group who were exposed to both words and pictures, as compared to the control group with fact sheet alone, should have scored significantly better on the CYSS survey. The participants of the intervention group who were exposed to the video should have been able to process more information by using two different cognitive pathways, according to Mayer's theory.

Again referencing Ajzen's (1991) TPB, three factors determine one's intent to perform a behavior and resultant behavior: (a) attitudes toward the behavior; (b) subjective norms regarding the behavior; and (c) behavioral control. It is important to note that "no matter how people arrive at their behavioural, normative and control beliefs, their attitudes toward the behavior is said to be reasoned or planned" (Ajzen, 2011, p. 1116). In regard to concussions, "beliefs produce attitudes, intentions and behaviours consistent with these beliefs" (Ajzen, 2011, p. 1116). The overwhelming majority of participants from both groups marked that they would seek medical attention for their student athlete if they suspected a concussion. Only 12.5% answered that they were "not sure" if they would seek medical attention for their student athlete if they suspected a concussion, and 0% of respondents indicated "no." One aspect the TPB does not account for is the effect of emotion on a rational person. As Ajzen (2011) noted, "Emotions can have indirect effects on intentions and behavior by influencing the kinds of beliefs that are salient in a given situation" (p. 1117). Therefore, some of the parents or legal guardians who participated in this study may perform different actions than anticipated when faced with a concussed athlete based on their emotions. Some may feel as if the symptoms are not severe enough to warrant medical care. In this study, exposure to the CDC Heads Up concussion knowledge video intervention was expected to increase parental attentiveness and responsiveness to sports-related concussions, making them more apt to seek medical attention for their student athlete. The non-significant findings in the study did not support this theoretical premise.

The mean scores on both the CSRS and the CYSS indicated that parents (in both groups) had a relatively high knowledge of concussions and related symptoms. Their high degree of concussion knowledge may have led to a more vigilant attitude and/or a higher degree of control toward protecting their daughter against concussion and/or knowing what to do if their daughter had a concussion.  A descriptive finding from the study was that 88.4% of parents reported that they would seek medical attention if their daughter had her "bell rung."  This finding exemplifies Ajzen's (1991) theoretical concept of subjective norms.

There were several screening questions that were included to help boost validity, such as if the participant's child-athlete or another of their children had ever had a concussion or traumatic brain injury.  Participants who indicated *Yes* were excluded from the study.  Additionally, they were excluded if the athlete or any of their other children ever had a medical injury that caused severe and persistent bodily injury or disability requiring long-term medical care.  The last exclusion criteria was if they had participated in a sports-related concussion awareness and education program, seminar, or class within the past year.  Despite this validity screening, there was no statistical significant difference found in this study.

There are several possibilities as to why there was not a statistical significant difference found.  The concussion material presented on the handout and video contained very basic concussion knowledge.  Due to lack of complexity of the material, the modality in which the parents receive this information may not significantly matter.  While parents or guardians were excluded if they had received sports-related concussion awareness training such as an education program, seminar, or class within the past year, they may have had some sort of concussion training within the past few years, perhaps in the past two to five years, and may have more substantial prior knowledge.  Even if the parent may not have had any formal recent concussion awareness information, there has been a large influx of concussion awareness over the past decade on a national level.  Parents may be inundated with related materials such as school forms denoting policies and concussion fact sheets available at schools, pediatrician offices, and even stores. There is even general concussion material available online and on social media that could have played a role in both groups having such high levels of knowledge.

## Implications

This study adds to the existing body of research on parental/guardian concussion education in regard to female student athletes. This study is unique and addressed the gap in literature since there is no previous study that examines the best way for parents of female high school athletes to receive concussion education. It was the first study to evaluate the effectiveness of the CDC Heads Up concussion video intervention with parents. By knowing if there is a better way to educate parents about concussion, it helps bridge the concussion knowledge between coaches and student athletes. The results of this study are important because they reveal that parents learn about concussion signs and symptoms comparatively well whether they are exposed to a fact sheet or a video.

A majority of schools opt to use a fact sheet for mandatory concussion communication that is given to parents at the beginning of the sport's season (Frommer et al., 2011). It has been shown that this form of communication is an effective learning modality for them when compared to a video. Schools may consider giving the parents an option of how they would like to receive their mandatory concussion information. With the increasing access to technology, online concussion education for parents may serve as a better avenue to receive and retain this information. Some parents may prefer to receive their concussion education via factsheet whereas others may prefer video. The CDC Head's Up program offers many avenues of learning for parents that include factsheets, concussion information sheets, concussion cards, videos, and online training courses for the parents (CDC, 2017). Schools could take a similar approach to offer the parents of student athletes their preferred way of receiving this information; however, if schools continue to provide parents with only the fact sheet, this study confirms that they are receiving adequate concussion information so that they might recognize the signs and symptoms of concussion. Since parents have demonstrated comparable knowledge on the CSRS and the CYSS regardless of being shown the fact sheet or video, they should be able to fill the gap between the student athlete and coach to aid in observation of the signs and symptoms of a concussion head injury.

## Limitations

This study had some limitations. One threat to internal validity pertained to the study design, which was a quasi-experimental posttest-only control group design. The use of this design precluded the ability to measure parents' pretest scores on the CSRS and CDC Heads Up CYSS survey. It is not known if concussion knowledge of the parents—in either group—increased pretest to posttest. As Harris et al. (2006) stated, "The absence of a pretest makes it difficult to know whether a change has occurred" in knowledge.

The posttest-only design also introduced the possibility of confounds, or unmeasured variables, associated with the dependent variables of concussion symptoms and sports-related concussion knowledge. The possibility of confounds is also another threat to internal validity. The researcher did not control for any potential confound variables. Parent and daughter demographic information (e.g., age, ethnicity, socioeconomic status) and the type of sports played by the daughter are variables significantly associated with concussion knowledge in prior research (e.g., Daneshvar et al., 2011; Kurowski et al., 2014). The study findings may have differed had the researcher controlled for demographic and sports-related factors.

In addition, the two parent groups were not equivalent; that is, parents were not selected randomly. Although the participants were randomly assigned, lack of random sampling increased the likelihood that the parents were not representative of the population of parents of adolescent daughters who play organized sports, which reduces the external validity of the study. Another threat to external validity is non-probability sampling, which is associated with the self-selection bias. The parents who participated in this study may have been more involved in their daughters' sports activities, may play more sports themselves, and/or may be more knowledgeable of sports-related concussions than those parents who chose not to participate.

## Recommendations for Future Research

Recommendations for future research include examining the efficacy of interventions on concussion knowledge for parents whose female athletes are the most at risk to sustain a concussion—which would be soccer followed by basketball (Clay et al., 2012). There is a need to conduct studies with parents of daughters who play these high-risk sports and to compare knowledge of concussion across parents whose daughters play low- as opposed to high-risk sports. It may be beneficial for parents of those participating in high-risk sports to have a better understanding of concussion since their athlete has a higher probability of a concussion compared to those who participate in another sport.

It would also be beneficial to compare multiple forms of concussion-learning modalities for parents, such as factsheets, concussion information sheets, concussion cards, videos, and online training programs, that are provided by the CDC or to examine if a parent receives more than one of these interventions at a time if they demonstrate a statistically significant difference on the CSRS and the CYSS.

Studies that examine concussion knowledge interventions with different parent groups are also needed. Parents in this study had adolescent daughters who played an organized sport for almost 5 years. The age of the daughters and the relatively long period of time they played organized sports likely influenced parents' knowledge of sports-related concussions and concussion symptoms. Studies conducted with different parent groups, including parents of children just beginning to play organized sports and parents who have more than one child playing an organized sports, are warranted.

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# APPENDIX A: STUDY INFORMED CONSENT FORM

## CONSENT FORM

AN EXAMINATION OF CONCUSSION UNDERSTANDING AMONG PARENTS OF HIGH SCHOOL FEMALE STUDENT ATHLETES

Kelly Hartley
Liberty University
School of Education

You are invited to be in a research study to better understand parental understanding of the signs and symptoms of concussions in regards to their female student athlete. You were selected as a possible participant because you are a parent of a female student athlete where the student athlete is part of an organized sports team at the high school grade level.

Kelly Hartley, a doctoral candidate in the School of Education at Liberty University, is conducting this study.

**Background Information:** The purpose of this study is to examine whether concussion symptoms knowledge and general youth sports-related concussion knowledge is significantly higher among parents of female student athletes who watch the Center for Disease Control and Prevention's *Heads Up* concussion videos than among parents of female student athletes who read an online concussion awareness fact sheet.

**Procedures:** If you agree to be in this study, I would ask you to do the following things:

1. Read the concussion awareness fact sheet OR watch the Center for Disease Control videos. These groups will be randomly assigned via Qualtrics®. You may or may not receive the intervention as part of your participation. Estimated time 5 minutes.
2. Answer the Concussion Symptom Recognition Survey and the Concussion in Youth Sports Survey. Estimated time 5 minutes.
3. Answer basic demographic information. Estimated time 5 minutes.

**Risks:** The risks involved in this study are minimal, which means they are equal to the risks you would encounter in everyday life.

**Benefits:** Participants should not expect to receive a direct benefit from taking part in this study.

Benefits to society may reveal the best way for parents to understand concussion signs and symptoms of their student athlete.

**Compensation:** Participants will not be compensated for participating in this study.

**Confidentiality:** All participants in the study will remain anonymous. Data will be stored on a password locked computer and may be used for future publications or presentations. After three years, all electronic records will be deleted.

**Voluntary Nature of the Study:** Participation in this study is voluntary. Your decision whether or not to participate will not affect your current or future relations with Liberty University. If you decide to participate, you are free to not answer any question or withdraw at any time prior to submitting the survey without affecting those relationships.

**How to Withdraw from the Study:** If you choose to withdraw from the study, please exit the survey and close your internet browser. Your responses will not be recorded or included in the study.

**Contacts and Questions:** The researcher conducting this study is Kelly Hartley. You may ask any questions you have now. If you have questions later, **you are encouraged** to contact her at klhartley@liberty.edu. You may also contact the researcher's faculty advisor, Dr. Judy Sandlin, at jsandlin@liberty.edu.

If you have any questions or concerns regarding this study and would like to talk to someone other than the researcher, **you are encouraged** to contact the Institutional Review Board, 1971 University Blvd., Green Hall Ste. 1887, Lynchburg, VA 24515 or email at irb@liberty.edu.

***Please notify the researcher if you would like a copy of this information for your records.***

**Statement of Consent:** I have read and understood the above information. I have asked questions and have received answers. I consent to participate in the study.

(NOTE: DO NOT AGREE TO PARTICIPATE UNLESS IRB APPROVAL INFORMATION WITH CURRENT DATES HAS BEEN ADDED TO THIS DOCUMENT.)

ELECTRONIC CONSENT: Please select your choice below.

Clicking on the "agree" button below indicates that:
• you have read the above information.
• you voluntarily agree to participate.
• you are at least 18 years of age.

If you do not wish to participate in the research study, please decline participation by clicking on the "disagree" button.

☐ Agree

☐ Disagree

# APPENDIX B: CONCUSSION SYMPTOM RECOGNITION SURVEY

**APPENDIX C: HEADS UP: CONCUSSION IN YOUTH SPORTS SURVEY**

| | True | False |
|---|---|---|
| 1. A concussion is a brain injury. | T | F |
| 2. Concussions can occur in an organized or unorganized sport activity. | T | F |
| 3. Some athletes may not experience concussion symptoms until hours or days after the injury. | T | F |
| 4. Following rules of the sport, practicing good sportsmanship, and using proper sports equipment are all ways that athletes can prevent a concussion. | T | F |
| 5. Concussions can be caused by a fall, a bump, or a blow to the head or body. | T | F |
| 6. A concussion can happen even if the athlete hasn’t lost consciousness. | T | F |
| 7. Nausea, headaches, sensitivity to light or noise, and difficulty concentrating are some symptoms of a concussion. | T | F |
| 8. Athletes who have a concussion can return to play within a week if they are symptom free. | T | F |
| 9. A repeat concussion that occurs before the brain recovers from the first concussion does not usually result in longer recovery. | T | F |

# APPENDIX D: PARTICIPANT CRITERIA QUESTIONS AND INFORMATION SURVEY

## Study Criteria Questions

1) [After reading online informed consent form] Do you give informed consent to participate in this study?
    1) Yes
    2) No
        - If participant answers no, he/she is prevented from accessing study materials and is redirected to a new screen that states that the participant does not meet study criteria.

2) Does your computer/laptop/tablet have video and audio capabilities?
    1) Yes
    2) No
        - If participant answers no, he/she is prevented from accessing study materials and is redirected to a new screen that states that the participant does not meet study criteria.

3) Do you have a female athlete in 9th through 12th grade who participates in an organized sport? An organized sport is competitive athletic team play governed by a set of rules and customs that can occur in a school or non-school setting.
    1) Yes
    2) No
        - If participant answers no, he/she is prevented from accessing study materials and is redirected to a new screen that states that the participant does not meet study criteria.

4) Has your female athlete participated in an organized sport for at least one year?
    1) Yes
    2) No
        - If participant answers no, he/she is prevented from accessing study materials and is redirected to a new screen that states that the participant does not meet study criteria

5) Has your female athlete or any of your other children ever had a concussion or traumatic brain injury (TBI)?
    1) Yes
    2) No
        - If participant answers yes, he/she is prevented from accessing study materials and is redirected to a new screen that states that the participant does not meet study criteria.

6) Has your female athlete or any of your other children ever had a medical injury that has caused severe and persistent bodily injury or disability requiring long-term medical care?
    1) Yes
    2) No
        - If participant answers yes, he/she is prevented from accessing study materials and is redirected to a new screen that states that the participant does not meet study criteria.

7) In the past year, since March 2016, have you ever participated in a sports-related concussion awareness and education program, seminar, or class?
    1) Yes
    2) No
        - If participant answers yes, he/she is prevented from accessing study materials and is redirected to a new screen that states that the participant does not meet study criteria.

**Information Survey**

Please answer the following four questions about your children.

1) How many children (younger than 18) do you have who reside in your household?

| | |
|---|---|
| 1) 1 | 6) 6 |
| 2) 2 | 7) 7 |
| 3) 3 | 8) 8 |
| 4) 4 | 9) 9 |
| 5) 5 | 10) 10 or more |

2) How many of your children (younger than 18) who reside in your household play an organized sport?

| | |
|---|---|
| 1) 1 | 6) 6 |
| 2) 2 | 7) 7 |
| 3) 3 | 8) 8 |
| 4) 4 | 9) 9 |
| 5) 5 | 10) 10 or more |

3) How many female athletes (younger than 18) do you have who reside in your household?

| | |
|---|---|
| 1) 1 | 6) 6 |
| 2) 2 | 7) 7 |
| 3) 3 | 8) 8 |
| 4) 4 | 9) 9 |
| 5) 5 | 10) 10 or more |

4) How many of your female athletes (younger than 18) who reside in your household play an organized sport?
    1) 1
    2) 2
    3) 3
    4) 4
    5) 5
    6) 6
    7) 7
    8) 8
    9) 9
    10) 10 or more

You are participating in this study because you have a female athlete who attends 9th through 12th grade and who plays an organized sport. Thinking about your daughter, please answer the following questions.

5) In what grade is your female athlete?
    1) 9th grade
    2) 10th grade
    3) 11th grade
    4) 12th grade

6) How old is your female athlete?
    1) 12 years of age
    2) 13 years of age
    3) 14 years of age
    4) 15 years of age
    5) 16 years of age
    6) 17 years of age
    7) 18 years of age
    8) 19 years of age

7) Is your female athlete a member of ___?
    1) A school sports team/teams
    2) A non-school sports team/teams (such as a league team)
    3) Both school and non-school teams

8) What <u>organized</u> sports does your female athlete play? You may select more than one.
    1) Baseball
    2) Basketball
    3) Crew
    4) Cross Country
    5) Dance/Drill
    6) Fencing
    7) Field Hockey
    8) Football
    9) Golf
    10) Gymnastics
    11) Hockey
    12) Lacrosse
    13) Rugby
    14) Skiing-Alpine
    15) Skiing-Cross Country
    16) Soccer
    17) Softball
    18) Spirit Squad/Cheerleading
    19) Squash
    20) Swimming and Diving
    21) Tennis
    22) Track and Field
    23) Volleyball
    24) Wrestling
    25) Other: ______________
    26) Other: _______________
    27) Other: _______________

9) For how many years has your female athlete participated in organized sports?
   1) 1 year
   2) 2 years
   3) 3 years
   4) 4 years
   5) 5 years
   6) 6 years
   7) 7 years
   8) 8 years
   9) 9 years
   10) 10 years
   11) 11 years
   12) 12 years
   13) 13 years
   14) 14 years
   15) 15 years
   16) 16 years
   17) 17 years
   18) 18 years

Please answer these questions about yourself.

10) On a scale from 1 to 7, where 1 = very poor and 7 = excellent, how would you rate your knowledge of sports-related concussions?

| 1 | 2 | 3 | 4 | 5 | 6 | 7 |
|---|---|---|---|---|---|---|
| Very Poor | | | Neither Poor nor Excellent | | | Excellent |

11) Have you ever had a concussion?
   1) Yes
   2) No
   3) Not Sure

12) If you have had a concussion, how many concussions have you had?
   1) 1
   2) 2
   3) 3
   4) 4
   5) 5
   6) 6
   7) 7
   8) 8
   9) 9
   10) 10 or more

13) What is your gender?
    1) Female
    2) Male

14) What is your highest level of education?
    1) Less than high school
    2) High school degree/GED
    3) Technical or vocational degree
    4) Some college, no degree
    5) Associate's (2 year) degree
    6) Bachelor's (4 year) degree
    7) Some graduate school, no additional degree
    8) Master's degree
    9) Doctorate degree (PhD, MD, JD)

15) With what ethnic group do you identify? You may choose more than one selection.
    1) African American/Black
    2) Asian American
    3) Caucasian/European American
    4) Hawaiian/Pacific Islander
    5) Hispanic/Latino(a)
    6) Multiracial/Biracial
    7) Native American/American Indian
    8) Other: ____________________________

16) What is your age group?
    1) 24 or younger
    2) 25–29
    3) 30–34
    4) 35–39
    5) 40–44
    6) 45–49
    7) 50–54
    8) 55–59
    9) 60–64
    10) 65–69
    11) 70–74
    12) 75–79
    13) 80 or older

17) Would you seek medical attention for your child if they had their "bell rung"?
    1) Yes
    2) No
    3) Not Sure

# APPENDIX E: INFORMATION FOR STUDENT ATHLETES AND PARENTS/LEGAL CUSTODIANS

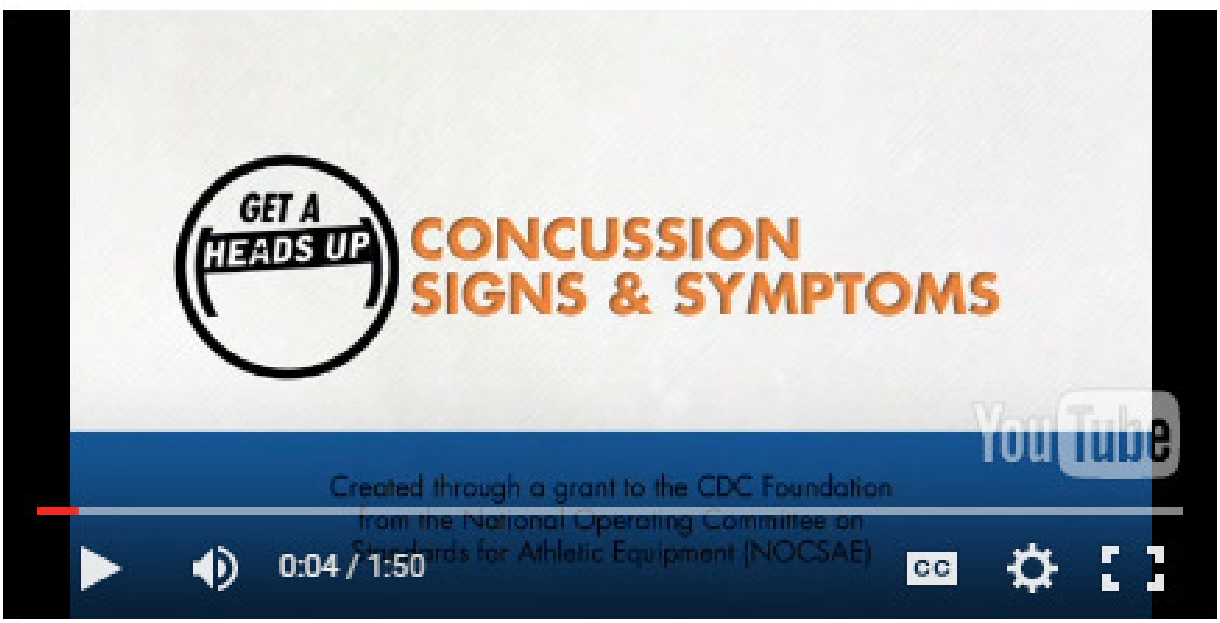
https://cdn3.sportngin.com/attachments/document/0029/2431/9e-_GWSchoolConcussionInfosheet_2018-19.pdf

**APPENDIX F: HEADS UP VIDEOS**

**What Is a Concussion?**


http://www.cdc.gov/headsup/basics/concussion_whatis.html

**Concussion Signs & Symptoms**




http://www.cdc.gov/headsup/basics/concussion_symptoms.html

# APPENDIX G: PERMISSION TO USE CONCUSSION SYMPTOM RECOGNITION SURVEY

**WOLTERS KLUWER HEALTH, INC. LICENSE TERMS AND CONDITIONS**

Apr 06, 2017

This Agreement between Kelly Hartley ("You") and Wolters Kluwer Health, Inc. ("Wolters Kluwer Health, Inc.") consists of your license details and the terms and conditions provided by Wolters Kluwer Health, Inc. and Copyright Clearance Center.

| | |
|---|---|
| License Number | 4083171482351 |
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| Licensed Content Publisher | Wolters Kluwer Health, Inc. |
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| Licensed Content Author | Tamara Valovich McLeod, Christian Schwartz, and R Bay |
| Licensed Content Date | Jan 1, 2007 |
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| Licensed Content Issue | 2 |
| Type of Use | Dissertation/Thesis |
| Requestor type | Individual |
| Portion | Figures/table/illustration |
| Number of figures/tables/illustrations | 2 |
| Figures/tables/illustrations used | 2 and 3 |
| Author of this Wolters Kluwer article | No |
| Title of your thesis / dissertation | A QUASI-EXPERIMENTAL PRETEST TO POSTTEST EXAMINATION OF AN INTERVENTION ASSESSING PARENTAL SENSE OF CONCUSSION UNDERSTANDING AMONG PARENTS OF HIGH SCHOOL LEVEL FEMALE STUDENT ATHLETES IN HIGH-IMPACT VERSUS LOW-IMPACT SPORTS WHO |

| | |
|---|---|
| | RECEIVE A STANDARD STATE CONCUSSION FORM VERSUS THOSE WHO WATCH THE CDC'S HEADS UP |
| Expected completion date | Jul 2017 |
| Estimated size(pages) | 120 |
| Requestor Location | Kelly Hartley<br>8701 Houston Ridge Road<br><br>CHARLOTTE, NC 28277<br>United States<br>Attn: Kelly Hartley |
| Publisher Tax ID | 13-2932696 |
| Billing Type | Invoice |
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## APPENDIX H: IRB APPROVAL

LIBERTY UNIVERSITY
INSTITUTIONAL REVIEW BOARD

April 6, 2018

Kelly Hartley
IRB Exemption 3193.040618: An Examination of Concussion Understanding Among Parents of High School Female Student Athletes

Dear Kelly Hartley,

The Liberty University Institutional Review Board has reviewed your application in accordance with the Office for Human Research Protections (OHRP) and Food and Drug Administration (FDA) regulations and finds your study to be exempt from further IRB review. This means you may begin your research with the data safeguarding methods mentioned in your approved application, and no further IRB oversight is required.

Your study falls under exemption category 46.101(b)(2), which identifies specific situations in which human participants research is exempt from the policy set forth in 45 CFR 46:101(b):

> (2) Research involving the use of educational tests (cognitive, diagnostic, aptitude, achievement), survey procedures, interview procedures or observation of public behavior, unless:
> (i) information obtained is recorded in such a manner that human subjects can be identified, directly or through identifiers linked to the subjects; and (ii) any disclosure of the human subjects' responses outside the research could reasonably place the subjects at risk of criminal or civil liability or be damaging to the subjects' financial standing, employability, or reputation.

Please note that this exemption only applies to your current research application, and any changes to your protocol must be reported to the Liberty IRB for verification of continued exemption status. You may report these changes by submitting a change in protocol form or a new application to the IRB and referencing the above IRB Exemption number.

If you have any questions about this exemption or need assistance in determining whether possible changes to your protocol would change your exemption status, please email us at irb@liberty.edu.

Sincerely,

**G. Michele Baker, MA, CIP**
*Administrative Chair of Institutional Research*
**The Graduate School**

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UNIVERSITY.
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