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School-Based Concussion Management: Implementation Characteristics of Student Services Personnel

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by

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Abstract

Concussion is an injury that disproportionately affects children and adolescents and has the potential to negatively impact school performance. Currently, a significant proportion of youth with concussion go unreported due to a lack of effective concussion surveillance procedures. Additionally, many individuals who have daily contact with youth (e.g., parents, teachers) lack training in how to assess or manage a concussion. Schools may be the ideal setting to address both of these problems as they have a high level of access to students and employ personnel (e.g., school psychologists, nurses, social workers, counselors) with experience in assessment and intervention. What is not known is how to best design a school-based concussion management (SBCM) procedure in order to facilitate concussion surveillance and management. Accordingly, the overall purpose of this study was to identify and describe factors (i.e., provider implementation characteristics, concussion referral communication) which may inform the design and implementation of SBCM programming. Examining the relationship between relevant SBCM outcomes and factors associated with strong school programming may help build the foundation for future SBCM procedures. Factors that influence program fidelity and outcomes are called school programming implementation characteristics and they reside at multiple levels (i.e., community, school, climate, program, provider) and are positively related to successful outcomes across varied programming. This exploratory study which utilized secondary analysis of existing data focused on the provider level with the primary aim of identifying and describing student services personnel (SSP; n = 144) implementation characteristics. Indicators of provider implementation characteristics consisted of their beliefs,

training, and experiences in order to quantify how these characteristics predict perceptions of the impact of concussion on academics, perception of current informal procedures, and the number of students with concussions served. The independent variables primarily under investigation in this study (role, career experience, recent concussion experience, and training subscale) align with empirically supported personnel implementation characteristics. The second aim of this study was to explore pre-existing communication patterns between SSP utilizing the independent variable referral source. It is of note that the school district from which the data were collected had no formal SBCM programming; therefore, all SSP implementation characteristics examined were viewed as baseline characteristics. Results indicated that as all SSP groups (i.e., school psychologists, nurses, counselors, social workers) perceive a need for SBCM as indicated by dissatisfaction with current procedures and agreement that concussion can negatively impact student performance. Although all groups indicated that they did not believe current concussion procedures to be effective, school psychologists and nurses reported the highest levels of dissatisfaction Additionally, nurses were found to have the highest levels of training in concussion assessment and management, and received significantly more concussion referrals per year when compare to the other SSP. These findings suggest that nurses may be effective in delivering concussion related service and establishing effective concussion surveillance procedures. Although more research is needed, this study represents the first step in bridging the gap between experimental concussion research and the successful delivery of these innovations through SBCM programming in order to help students recover from a concussion.

Chapter 1: Introduction

Statement of the Problem

It is estimated that 1.7 to 3.8 million traumatic brain injuries (TBIs) occur in the U.S. annually (Langlois, Rutland-Brown, & Wald, 2006) with roughly 70-90% of all TBIs being considered a mild TBI (mTBI) and/or a concussion (Cassidy et al., 2004). The symptoms of concussion may be considered mild when compared to moderate and severe brain injury, but a concussion is far from the innocuous injury it was once thought to be. Multiple mechanisms of concussion pathophysiology are noted in the literature and include neurochemical changes, mico-structural damage, and macro-structural damage (Croall et al., 2014, Giza & Hovda, 2001, Iverson et al., 2012, Smits et al., 2011; Smits et al., 2008). Although many individuals experience a rapid recovery form concussion it is estimated that 10-20% experience symptoms for longer than 7-10 days (McCrory et al., 2013). Concussion symptoms may include physical, cognitive, emotional-behavioral, and sleep impairments (Rieger et al., 2013).

Children and adolescents seem to be at particular risk for a protracted recovery as Eisenberg and colleagues (2014) found that 77%, 32%, and 15% experience concussion symptoms at one week, one month, and three months, respectively. Some children who have particular profiles are at risk for both suffering a concussion and/or experiencing an abnormal recovery. Risk factors that are believed to increase the chance of incurring a TBI or concussion include; history of TBI (Guskiewicz et al., 2007), adverse family events, being a male (McKinlay, Kyonka, Grace, Horwood, Fergusson, & MacFarlane, 2010), or having ADHD (Alosco, Fedor, & Gunstad, 2014). Similarly, Zemek and colleagues (2013) found that

symptoms can last longer if the child had a previous TBI, a learning or behavioral disability, or experienced specific acute symptoms (i.e., vomiting/nausea, headache, loss of consciousness). Additionally, symptom severity is thought to be influenced by loss of consciousness, injury by motor vehicle collision, and abnormal neuroimaging (Taylor et al., 2010).

All concussion symptoms have the potential to affect the ability of students to attend and learn in school (Jantz, Davies, & Bigler, 2014; Parsons, Bay, & Valovich-McLeod, 2013; Ransom et al., 2015). Although there has been a significant amount of research regarding how to return an athlete to the playing field (i.e., Return to Play) after sustaining a concussion (Harmon et al., 2013; King, Brughelli, Hume, & Gissane, 2014; McCrory et al., 2013), little is known about how to return a child successfully to the classroom. The most empirically supported concussion management procedures include concussion-specific psychoeducation (Ponsford, et al. 2001) and a graduated return to the learning environment (Arbogast et al., 2013; McAvoy, 2012).

School services personnel (SSP), including school psychologists, counselors, social workers, and school nurses, are in a unique position to assist students who have suffered a concussion in successfully returning to the educational environment. These four groups of SSP are trained in prevention, consultation, assessment, and treatment, all of which could be utilized in a comprehensive school-based concussion management (SBCM) program. Unfortunately, there is very little empirical evidence describing these four groups in terms of their concussion training, beliefs regarding informal concussion procedures, and their perceptions regarding the impact of concussion symptoms on academic performance. It is also not known if there are differences in how students are referred for concussion related services between these four groups. Additionally, it is unknown if SSP implementation characteristics (career experience,

number of students with concussion served, role, training) predict concussion beliefs and the number of students served with a concussion. In order to effectively implement a comprehensive SBCM protocol the SSP implementation characteristics of these four groups need to be examined (Barrett, Eber, & Weist, 2013; Durlak & DuPre, 2008; Janz & Becker, 1984; Rosenstock, Strecher, & Becker, 1988).

Theory of Change

The theory that underpinned this study is implementation science. Implementation science is a field of inquiry that spans varied programming by examining how to best implement innovations in an applied setting (Damschroder et al., 2009). Knowing how to best implement services in a real world setting is important as it has been shown to be positively associated with student outcomes across diverse school-based initiatives (Barrett et al., 2013; Durlack & DuPre, 2008). In this study we specifically examined SSP implementation factors as they relate to SBCM. By understanding these factors schools may be able to better design, execute, and sustain SBCM programming in order to help prevent, identify, and manage students recovering from a concussion.

Purpose Statement and Research Questions

The purpose of this exploratory study, which utilized secondary data analysis, was to identify and describe the beliefs, training, and experiences of SSP and to quantify their prediction of perceptions regarding the impact of concussion on academics, perception of informal procedures, and the number of students with concussions served. An additional focus of this study was to examine patterns of concussion referrals among school service personnel (SSP). Both of these study objectives may inform the design and implementation of SBCM

programming. To investigate these relationships the following research questions were examined:

1a) *What are perceptions of the impact of concussion on student academic performance among school service personnel?*

1b) *What are the current levels of concussion training among school service personnel?*

1c) *What are perceptions of the effectiveness of current school-based concussion management procedures among school service personnel?*

2) *What is the relationship between training in concussion, job type, career experience, recent concussion experience and the level at which individuals believe concussions can negatively impact academic performance?*

3) *What is the relationship between training in concussion, job type, career experience and the number of students referred to school service personnel in the past year?*

4) *What is the relationship between training in concussion, job type, career experience, number of students with concussion referred in the past year, and the level of belief in the effectiveness of informal concussion management procedures?*

5a) *What are the most common concussion referral sources endorsed by school service personnel?*

5b) *Is there a difference in concussion referral source by role?*

Significance of the Study

Between 1.7 to 3.8 million TBIs annually occur in United States (Langlois et al., 2006) with the vast majority being considered a mTBI and/or a concussion (Cassidy et al., 2004). This is especially important as youth are disproportionally affected by concussion (Anderson & Moore, 1995; Eisenberg et al., 2014). Due to their training and frequent student contact, SSP are

in the unique position to support students suffering with concussion symptoms (physical, cognitive, emotional-behavioral, sleep; Rieger et al., 2013). The school is also an ideal system to implement a concussion management protocol as academics can be negatively impacted by the symptoms of concussion (Jantzet al., 2014; Parsons et al., 2013; Ransom et al., 2015). What is not known is how to best train and utilize SSP based on their training, beliefs, number of students served with concussion, and concussion referral patterns when designing and implementing SBCM programming. These are essential questions to be asked as research has demonstrated that the understanding of key implementation factors (e.g., SSP characteristics) are positively related to successful outcomes across varied programming (Barrett et al., 2013; Durlack & DuPre, 2008). This study examined SSP implementation characteristics as it is an essential first step in the design and implementation of a comprehensive and successful SBCM protocol.

Key Terms

Career Experience. Years in current profession.

Concussion. The brain moving inside of the skull resulting in a disruption of brain function that does not rise to the level of moderate or severe brain injury (e.g., abnormal imaging, loss of consciousness over 30 minutes, post-traumatic amnesia over 24 hours).

Concussion Symptoms. The constellation of symptoms (physical, cognitive, emotional-behavioral, sleep) lasting no longer than 7-10 days after the brain moves inside the skull.

Informal Procedures. Concussion management procedures which have not been formalized by the school or school district.

Persistent Post-concussion Symptoms (PPCS). Concussion symptoms (physical, cognitive, emotional-behavioral, sleep) lasting longer than 3 months.

Post-concussion Symptoms (PCS). Concussion symptoms (physical, cognitive, emotional-behavioral, sleep) lasting longer than 7-10 days but less than 3 months.

Recent Concussion Experience. Number of students with concussions referred in the past year.

Referral Source. Individual/organization who connected the student with a concussion to the SSP.

Return to Learn (RtL). Step-wise procedures to return a student to the educational setting.

Return to Play (RtP). Step-wise procedures to return a student-athlete to competitive sporting activities.

Role. Profession type. In the current study profession types include school psychologist, social worker, nurse, and guidance counselor.

School-based Concussion Management (SBCM). Comprehensive concussion programming for all students.

Student Services Personnel (SSP). Includes school psychologists, social workers, guidance counselors, and school nurses.

Student Services Personnel Implementation Characteristics. Variables at the provider level which are positively related to program implementation and effectiveness.

Chapter 2: Literature Review

This chapter provides a review of the recent literature on implementation science, concussion, concussions impact on learning, and current school-based concussion management (SBCM) practices. It is important to understand the pathophysiology of concussion as recent research has demonstrated that these disordered physiologic processes are directly related to the expression of symptomology, recovery, and subsequently, the ability to learn. Our understanding of these changes (neurochemical, micro- and macro-structural) has helped shape current practices in SBCM, including prevention, assessment, communication, and treatment. Only with the physiologic underpinnings of concussion understood is it then possible to design and implement SBCM programming.

Although basic science informs school practices, implementation research helps bridge the divide between what we observe under stringent experimental conditions and what works in applied settings such as the school. Across varied programming, the understanding of key implementation factors has been shown to positively relate to successful outcomes (Barrett et al., 2013; Durlack & DuPre, 2008). Research supports that the provider level (i.e., school service personnel; SSP) is critical to successful programming implementation. Specifically, essential components include key SSPs' skill proficiency, self-efficacy, perceived need, and perceived benefit of programming (Durlack & DuPre, 2008; Janz & Becker, 1984; Rosenstock, Strecher, & Becker, 1988). Currently, SSP implementation factors that influence SBCM have been unexplored. The goal of this study was to examine SSP implementation factors and to investigate their relationship with SBCM. This study also examined existing communication

patterns in the school as they relate to concussion referrals. With an understanding of SSPs' beliefs, skills, and communication patterns, the basic scientific findings relating to concussion can then be translated to the schools through the informed implementation of SBCM programming. Ultimately, these findings may help support effective SBCM programming and result in better physical, psychological, and educational outcomes for students who have suffered a concussion.

Implementation Science

Since the 1970s researchers have been increasingly interested in how to best implement innovations in applied settings, this field of inquiry is often referred to as implementation science (Damschroder et al., 2009; Fullan & Pomfret, 1977). Implementation science spans varied programming and can be found in professional literature ranging from public health, law enforcement, social welfare, and education. In this study I examined the implementation of SBCM programming which could be considered at the intersection of public health and education. Evidence based implementation research is central to the execution of policy as it has been shown to be directly related to diverse programming outcomes (Barrett et al., 2013; Durlack & DuPre, 2008). If SBCM programming is to contribute to positive outcomes for students we must first understand how to integrate these procedures into the educational setting.

Implementation factors can reside at multiple levels and can be measured by diverse indicators. Although the specific indicators differ greatly between studies, the levels commonly explored in the educational setting include: provider, program, school climate, and school and community structure (Payne & Eckert, 2010). At the foundation of all school-based programming are the providers who deliver services to students and their families (Payne & Eckert, 2010). In this study I specifically explored measurable provider indicators that will be

referred to as SSP characteristics. The provider level was examined as that is the data available for analysis. SSP characteristics that have been found to affect implementation quality include motivation (Rohrbach, Grana, Sussman, & Valente, 2006), attitude towards program (Rohrbach et al., 2006), familiarity of programming delivery and content (Rohrbach, D'Onofrio, Backer, & Mongomery, 1996), self-efficacy (Gingiss, Roberts-Gray, & Boerm, 2006), and experience/background of provider (Glasgow, Lichtenstein, & Marcus, 2003; Rohrbach et al., 2006).

The variables chosen for this study mirror many of the previously mentioned provider indicators (Durlak & DuPre, 2008) and are also supported by the empirically supported Health Belief Model (Janz & Becker, 1984; Rosenstock, Strecher, & Becker, 1988). SSP characteristics included in this study were role, career experience, concussion experience, training, impact, and informal procedures. The training subscale is a composite score that takes into account SSPs' training in assessment and treatment of both the psychosocial and the physical symptoms of concussion. Role is similar in that it measures the type of pre-service training and occupation of the provider (i.e., nurse, school psychologist, social worker, counselor). Career experience measures the amount of time that the individual has been in their current profession whereas recent concussion experience measures how many students with a concussion have been referred to the provider within the past year. The impact subscale measures how important the provider believes treating concussion in the school is and informal procedures measures how the provider perceives their school is currently managing the symptoms of students with a concussion in the absence of formalized SBCM programming. Implementation science was at the core of this study; by understanding how SSP characteristics predict the beliefs and practices of providers the gap can be bridged between innovations in concussion management and the educational setting.

Concussion Specifics

In order to best manage concussion in the school it is essential to have a comprehensive understanding of the injury. Aspects to consider include prevalence, biomechanics, and the pathophysiologic changes, which are expressed as problematic and varied symptomatology. Concussion is considered by many to be an epidemic that disproportionately affects school aged youth. This disproportionality is compounded by the fact that students are under constant cognitive demand in order to meet and exceed academic expectations. Fortunately, recent findings have allowed us to better understand the biomechanics of concussion as well as the subsequent neurochemical and structural changes that are directly related to observable symptomatology. Findings regarding the biomechanics of the concussion injury and the resulting biologic changes inform the development and application of informed prevention, assessment, and treatment of concussion in the schools. The following sections will discuss the current literature on concussion's prevalence, phenomenology, subtypes, controversy, pathophysiology, risk factors and patterns of recovery.

Prevalence and Demographics. Concussion or milder traumatic brain injury (mTBI) represents approximately 70-90% of all traumatic brain injuries (Cassidy et al., 2004). This percentage is significant as it is estimated that 1.7 to 3.8 million TBIs occur in the U.S. annually (Langlois et al., 2006). This annual estimate should be considered conservative as many concussions are not treated and therefore go undocumented (Reddy, Collins, & Gioia, 2008). Compared to adults, children and adolescents appear to be more susceptible to sustaining a concussion (Anderson & Moore, 1995).

Much of the media spotlight related to concussion focuses on the high prevalence of sports related concussions experienced by children and adolescents. Although a large number of

concussions are the result of sporting collisions, an equivalent percentage (50%) in youth occurs in non-sporting activities (Bakhos, Lockhart, Myers, & Linakis, 2010). These non-sport related concussions are often the result of falls, assaults, motor vehicle accidents, and other "struck by or against" accidents. Unfortunately, these types of injuries are largely unaccounted for in the growing exploratory and treatment literature, which primarily focuses on returning the student-athlete to the playing field. Additionally, existing student-athlete procedures, more often than not, only address the athletes' return to the playing field while not accounting for the academic and psychosocial aspects of the students' lives.

A subsequent effect of focusing primarily on athletes can be seen in the content of recent policies regarding youth concussion. Policymakers have implemented requirements for students returning to the playing field, but largely omit any consideration towards their return to academics. Lack of attention from media, research, and policy coupled with the fact that roughly half of all concussions occur off of the playing field leaves a significant amount of students vulnerable to a prolonged recovery and the associated physical, psychosocial, and academic consequences. Additionally, the student-athletes who do have the benefits of public awareness, research, and policy often are only supported to the extent that the support relates to their return to the playing field. Thus, concerns for the whole student are often overlooked. This study addressed both the student as well as the student-athlete in their return to the classroom by examining factors that influence the implementation and subsequent effectiveness of SBCM programming for all students.

Symptom Phenomenology. Concussions are complex in both their presentation and classification. There is much debate over what constitutes a concussion. Some experts argue that a concussion is a distinct form of brain injury, while others consider it a subset of mTBI. In

this next section, a working description of the phenomenon of concussion and its related syndromes and subtypes will be provided. It is important to note that the terms (e.g., post-concussion symptom, persistent post-concussion symptom) and classifications (e.g., concussion, mTBI) included in the upcoming sections will evolve in the coming years as the biologic underpinning of concussion become clearer through systematic observation and experimentation, and as new expert opinions and professional consensus emerge.

Concussion Injury. Concussion is widely considered a significant public health concern about which we know very little (Graham, Rivara, Ford, & Spicer, 2014; Virji-Babul et al., 2013). This is evident by the absence of diagnostic consensus which in turn hinders the development of a coherent research base from which subsequent inquiry can emerge. The lack of scientific consensus can be attributed to two conditions: relative dearth of scientific focus until recently and the absence of reliable and valid biomarker technology needed to directly measure the presence of concussion and subsequent recovery. Currently, a concussion is presumed to have occurred when there is a hit to the head resulting in symptoms (e.g., physical, emotional, cognitive). Conversely, the diminishment of these observable symptoms is considered recovery. These are indirect forms of measurement at best and are inadequate as research has demonstrated that the injury may be present in the absence of acute symptoms (Talavage et al., 2014) and may linger even after observable symptoms have dissipated (Miller et al., 2014). Concussion appears to be a highly complex phenomenon that we are just beginning to understand.

In this study, concussion was referred to as a subset of mTBI defined by movement of the brain inside of the skull resulting in a disturbance of brain function (McCrory et al., 2013) that does not rise to the level of moderate or severe brain injury (e.g., abnormal imaging, loss of consciousness over 30 minutes, post-traumatic amnesia over 24 hours). The disruption of brain

function after sustaining a concussion is thought to result in a constellation of cognitive, somatic, physical, affective, and sleep symptomatology known as post-concussion symptoms (CDC, 2014; McCrory et al., 2013). In many cases these symptoms are brief in duration with 80-90% of individuals experiencing concussion symptoms for only 7 to 10 days (McCrory et al., 2013). Although symptoms resolve quickly in most cases, there is evidence that symptoms may be slower to resolve in 10-20% of the population, including children and adolescents (Field, Collins, Lovell, & Maroon, 2003; Pellman, Lovell, Viano, & Casson, 2006).

Concussion Subtypes. In this study the terms of concussion symptom(s), post-concussion symptom(s) (PCS), and persistent post-concussion symptom(s) (PPCS) rather than syndromes were used. The omission of the term syndrome was decided as there is no empirical evidence to support that the accumulation of three symptoms represent a different injury construct compared to groups where only one symptom is present (Wojcik, 2014). In the educational setting it does not matter if one or three symptoms are affecting a child. Any symptom demands action, hence the applicability of a conservative approach in an academic setting (Parsons et al., 2013; Vaughan, Gioia, & Sady, 2013). However, it must be noted that the duration of symptom(s) (i.e., concussion symptoms, PCS, PPCS) do matter. Different symptom durations represent distinct phenomena necessitating differentiated patterns of school-based assessment and treatment.

Controversy. One of the major barriers in concussion research and applied practice is the current lack of agreement on how to define a concussion. Some researchers argue that concussion should be included under the sub-spectrum of mTBI while others consider it a completely independent and less severe phenomenon (Bodin, Owens, & Klamar, 2012). Additionally, the terms PCS/syndrome and PPCS/syndrome do not have universally accepted

definitions. Often the diagnostic definitions characterized in the DSM-5 or ICD-10 are utilized, which describe the conditions as the convergence of three or more symptoms after a brain injury. This is controversial, as the validity of requiring three or more symptoms has not been established (Wojcik, 2014).

In sum, the diagnostic uncertainty of concussion makes it difficult to communicate ideas in both the empirical literature as well as in applied settings such as schools. It would be of benefit to the study of concussion if consensus could be reached on what to call the various symptom manifestations after the brain moves in the skull. Until consensus is reached, the numerous names analogous to concussion will continue to be a barrier in the implementation of SBCM programming.

Pathophysiology. In order to both prevent and manage concussion it is important to understand the level of force and directionality needed to result in a brain injury. If this injury threshold is understood, schools can implement prevention policies that limit both the occurrence and level of student head impact. Prevention policies include anti-bullying programs, positive behavioral supports, bike helmet and seat belt promotion, as well as modified sporting rules for contact athletics. All of these programs have the possibility to decrease the likelihood that a student will be hit in the head or body with enough force to cause a brain injury. Anti-bullying and positive behavioral supports may limit the total number of assaults in the school (McCurdy, Mannella, & Eldridge, 2003), which subsequently may lower the number of hits to the head among students. Bike helmet and seat belt promotion may help mitigate the overall level of incurred force during an accident in addition to preventing skull fracture. Additionally, there is strong empirical basis for rule changes in athletics decreasing the total incidence of sports-related concussion. Since implementing rules changing how players can tackle, the National Football

League has seen a 36% decrease in concussions since 2013 (Glauber, 2015). Taken as a whole, prevention programs have the possibility to decrease the likelihood of a student's brain reaching the biomechanical threshold needed to sustain a concussion. If a concussion does occur, three distinct biologic processes may arise including neurochemical changes and the possibility of both micro- and macro-structural brain tissue damage. These processes are described below.

Biomechanics. The rapid acceleration and deceleration of the brain inside of the skull is thought to be the impetus for both the neurochemical and structural changes associated with concussion, as well as their subsequent resulting observable symptomatology. The threshold of gravitational force (g) needed to induce a concussion has been estimated to range from 80-100 g. With the introduction of rotational forces, the threshold needed to induce a concussion is significantly lowered when compared to exclusive linear force (McCrea & Klamar, 2012). For reference, 100 g is equivalent to an individual in a car striking a brick wall at 25 miles per hour and the person's head hitting the dashboard (McCrea & Klamar, 2012). It must be noted that the 80-100 g threshold is likely a very loose estimate as the force needed to incur a concussion has been found to range from 60-120 g with the vast majority of measured impacts over 80 g not resulting in a concussion (Guskiewicz et al., 2007). Collectively, these findings lend to a general benchmark of force needed, but gravitational force alone is not solely sufficient to predict or explain a concussive event. Schools would benefit from limiting activities that might result in student head acceleration and deceleration. The goal of prevention policy and contact sporting rule changes should focus on limiting impacts over 80 g as well as rotational impacts.

It is of note that most research on concussion has omitted the pediatric population. This is of concern when translating the sparse knowledge of biomechanics as it is largely derived from adult samples. Children and adolescents differ greatly from adults in terms of

neuroanatomical development: skull suture elasticity and shape, brain water and blood volume, and ever changing levels of axonal myelination (Kirkwood, Yeates, & Wilson, 2006). When pediatric samples are utilized they often are comprised of youth who have incurred sport-related concussions. This is of concern as sport-related injuries are believed to generally be biomechanically different and lesser in severity than non-sporting injuries (Rabinowitz, Li, & Levin, 2014). It is theorized that athletes may innately recover quicker due to superior physiology, may absorb contact more effectively, and that greater force is exuded in non-sport related injury (e.g., assault, motor-vehicle accidents). Rabinowitz and colleagues also posit that differences in concussion outcomes may not be completely different than nonsporting injuries and may be confounded by the fact that athletes typically under-report symptoms in an effort to return to competition. A clearer understanding of sport versus non-sport related injury is needed in order to determine if direct comparison across groups is appropriate.

Neurochemical Changes. When the brain moves inside the skull during a concussion, it is thought to result in complex brain fluctuations often referred to as a neurometabolic cascade (Giza & Hovda, 2001). These acute changes in neurochemistry include rapid increases in calcium, potassium, glucose, glutamate, and a decrease in cerebral blood flow. In the post-acute phase, cerebral blood flow continues to be depressed with a concurrent decrease in brain glucose metabolism. Acute neurometabolic changes after a concussion have been positively correlated with the severity of self-reported symptoms, thus substantiating the clinical significance of this complex process (Henry, Tremblay, Boylanger, Ellember, & Lassonde, 2010).

Micro-structural Changes. In addition to neurometabolic changes, there is growing evidence indicating the occurrence of micro-structural brain injury, such as diffuse axonal injury. The developing brain is particularly susceptible to this type of injury (Bouix et al., 2013; Mayer

et al., 2012). The degree of axonal injury has been correlated with symptom severity, indicating another possible relationship between pathophysiology and expressed symptomatology (Croall et al., 2014; Smits et al., 2011; Virji-Babul et al., 2013).

***Macro-structural Changes*.** An additional indicator of concussion severity directly related to observable brain changes can be derived from the presence or absence of abnormal neuroimaging. The definition of abnormal neuroimaging typically denotes cerebral injury including hemorrhage, contusion, edema and sometimes depressed skull fractures (Iverson et al., 2012), while normal imaging has no observed injury. A concussion with typical neuroimaging is considered an uncomplicated concussion, while the presence of abnormal neuroimaging is considered a complicated concussion and is indicative of more severe and slower to resolve symptoms (Iverson et al., 2012; Smits et al., 2008). Diagnostically, relying on neuroimaging can be challenging as many individuals who suffer a concussion do not present for medical evaluation (Reddy et al., 2008). When imaging is performed, about 10% of concussions are considered complicated with 1% indicating need for acute neurosurgical intervention (af Geijerstam & Britton, 2003; Kuppermann et al., 2009). Overall, neuroimaging may be restricted from a clinical standpoint due to acute need, cost, availability, risk of radiation exposure, and physician selection (Atabaki, 2013; Klig & Kaplan, 2010; Kuppermann et al., 2009). Macro-structural changes often have "red flag" symptoms. These symptoms denote that the student needs to be evaluated immediately by a medical professional as their neglect could result in significant brain tissue damage and even death. These red flags and how they fit into SBCM will be discussed at further length when assessment procedures are discussed.

Symptom Duration and Progression. A key student outcome for any SBCM program is the decrease in severity, duration, and incidence of concussion symptomatology. To decrease

these three problematic aspects of symptom expression it is essential to understand their associated risk factors. Knowledge about these risk factors can then inform concussion management plans in terms of targeted prevention, assessment, and treatment. In the sections below the current science regarding typical and atypical symptoms, as well as risk factors will be discussed. It is important to differentiate between typical and atypical symptom profiles as the literature supports that they are distinct phenomena that schools should view and manage as such.

Typical. Post-concussion symptoms differ between individuals both in terms of their phenomenology and duration. Physical symptoms are normally present in the acute phase and include loss of consciousness and posttraumatic amnesia. The most common somatic symptoms of concussion include: headache, sleep disturbance, fatigue, visual disturbances, and dizziness. Common cognitive symptoms include impairments in concentration, processing, and working memory (Eisenberg et al., 2014; Lundin, de Boussard, Edman, & Borg, 2006). Affective symptoms including irritability, depression, and anxiety are also common and tend to appear, as well as persist, later into recovery (Eisenberg et al., 2014).

Atypical. Post-concussion symptom duration is a central indicator of concussion recovery. While in most populations 80-90% of individuals will experience symptomology recovery in seven to 10 days (McCrory et al., 2013), a significant proportion (10-20%), including children and adolescents, will continue to experience a protracted recovery (i.e., post-concussion symptoms & persistent post-concussion symptoms). Eisenberg and colleagues (2014) examined symptom duration in a prospective cohort of youth aged 11-22 years (n= 280) who presented in the emergency department (ED) with an uncomplicated concussion. The most commonly reported acute symptoms of concussion were headache, fatigue, dizziness, and slowed cognitive

processing. The symptoms that had the longest median duration were irritability (16 days), sleep disturbance (16 days), poor concentration (14 days), and frustration (14 days). After 30 days, 25% of youth still experienced headaches, 20% reported slowed thinking, and 20% complained of fatigue. Overall, 77% of youth who reported acute symptoms also reported symptoms one week post injury, 32% reported symptoms at one month, and 15% at three months. The two most common symptoms reported at three months were headache (5.2%) and slowed thinking (4.3%).

Risk Factors. There is evidence supporting several risk factors that may influence the incidence, severity, and duration of post-concussion symptoms. While the risk factors highlighted below are not exhaustive or without controversy among experts (Zemek, Farion, Sampson, & McGahern, 2013), the application of these findings in the school can help aid in the targeted and efficient delivery of a tiered SBCM program.

Incidence. McKinlay and colleagues (2010) examined the pre-injury risk factors that are associated with the spectrum of pediatric TBI. Utilizing a longitudinal sample (*n*=1265) followed since birth, they found that having four or more adverse family life events (e.g., loss of job, divorce), and being male were most predictive of incurring TBI. Other risk factors for suffering a concussion include history of head injury (Guskiewicz et al., 2003) and pre-morbid Attention-Deficit/Hyperactivity Disorder (ADHD; Alosco, Fedor, & Gunstad, 2014; Mautner, Sussman, Axtman, Al-Farsi, & Al-Adawi, 2014). Children with these risk factors should be at highest priority for assessment as a jolt to their brain has a higher chance of resulting in a concussion.

Symptom Severity. Symptom severity can be measured as the number of symptoms experienced, as well as the intensity of symptoms experienced. Taylor and colleagues (2010)

compared the concussion symptoms of children between the ages of 8-15 years old who sustained a mTBI (n = 186) with those who sustained an orthopedic injury (n = 99). After controlling for age, sex, socioeconomic status, and pre-injury symptoms they found that higher levels of concussion symptoms (number and severity) were associated with motor-vehicle trauma, loss of consciousness, abnormal neuroimagining, and hospitalization. Other studies have also found being a female (McCrory et al., 2013; Zuckerman et al., 2014) and/or having a history of head injury to be associated with greater levels of symptom severity (Graham et al., 2014). Children with these risk factors may benefit from extended rest and symptom severity assessment as they have a higher risk for severe symptoms. Severe symptoms are important to consider because they often are predictive of a slower recovery (Foley, Gregory, & Solomon, 2014).

Atypical Recovery. It is expected that most post-concussion symptoms will resolve within a relatively short amount of time, although some groups have shown to take longer to recover. Zemek and colleagues (2013) conducted a systematic review of the literature to identify which factors best predicted slowed recovery after a concussion. When examining the larger prospective studies, which included youth 2-18 years of age, they found that PCS (defined as symptoms present for a month or longer) was most prevalent in older children who experienced loss of consciousness, headache, or nausea/vomiting. They also found that studies with small samples (n < 200) indicated that children with previous head injuries, learning difficulties, or behavioral problems are also at an increased risk for prolonged symptoms.

Negative Educational Outcomes

In order to benefit from instruction in the classroom setting, students need to attend school and have the cognitive ability to retain and apply knowledge. Although concussion

symptoms would seem to directly affect both attendance and the ability to learn, there is a paucity of research empirically exploring the impact of a concussion on educational outcomes. This is of concern to educators, as it is believed that missing just a few days of instruction due to absence can potentially be detrimental to students' academic success. Additionally, when students do return to school their ability to learn may be compromised for a significant length of time (Jantz et al., 2014). Although the evidence base is limited, these studies provide insight into the direct and indirect impact of concussion on educational outcomes, specifically absences and learning.

Absences. School absences following a concussion have been related to both acute symptoms as well as symptoms three days post-injury. These symptoms include disturbance of balance, slowed processing, fatigue, confusion, drowsiness, sleep problems, irritability, and symptom severity (Parson et al., 2013). Parson and colleagues also found a negative relationship between absences after a concussion and self-reported health related quality of life.

Learning. Ransom and colleagues (2015) examined the relationship between learning and concussion recovery among elementary (n = 17), middle (n = 74), and high school students (n = 124). It was found that both high levels of symptoms reported and symptom severity were related to learning difficulties (e.g., difficulty studying for tests, paying attention, completing homework). They also found that students experienced increased symptoms when asked to engage in activities that required cognitive effort. Exacerbation of symptomatology due to cognitive exertion is of specific concern for educators, as it is expected that students exhibit a significant amount of cognitive exertion when engaged in a learning environment.

Psychosocial Concerns. There is no known study that explores a causal relationship between the psychosocial symptoms of concussion and students' academic success. This is of

concerns as it is known that many individuals suffering from a concussion will experience symptoms that are psychosocial in nature (e.g., depression, frustration, irritability; Eisenberg et al., 2014). Although there is a lack of direct empirical support, it is generally accepted that psychosocial symptoms after a concussion have the potential to negatively impact educational outcomes. This assumption is based on other fields of research that have firmly established that psychosocial symptoms can negatively impact academic success (Suldo, Gormley, DuPaul, & Anderson-Butcher, 2014).

School-Based Concussion Management

There are two main concussion management concepts utilized in today's schools, one for athletics and the other for academics. The term "return to play" (RtP) has been coined to describe procedures used to manage student-athletes' return to the playing field while "return to learn" (RtL) has been used to describe plans that facilitate students returning to the classroom. There has been significant research on how and when a student should return to athletic activities with relatively little empirical basis for how and when a student should return to the learning milieu. This discrepant knowledge base likely exists because much of what we know about concussion has been learned from professional and collegiate athletes as well as other adult (non-education based) samples. Although this is a limitation, much has still been learned that can inform RtL procedures. Fortunately, more attention has recently been given to helping students return to classroom after a concussion (Sady, Vaughn, & Gioia, 2011). However, this literature base is still nascent in its development with most procedures largely based on theory and expert opinion with no known comprehensive efficacy studies to date.

District's Concussion Policy. The school district that participated in the needs assessment did not have a SBCM program in place. However, the district did have a

documented, but limited, RtP procedure for athletes. Although there is no documented SBCM procedure in place, SSP did assist students when they were identified as having a history of concussion. The nature in which they assisted students is unknown. Additionally, since the procedures are undocumented the processes are believed to be informal and variable between schools and individual SSP.

Upon request, the school district provided two documents; the first outlines the school district's RtP policy as developed by the district school board (Appendix A). This procedure is two paragraphs in length and describes two components. The first component is pre-season education for coaches, student athletes, and parents/guardians of student-athletes about the nature and risks of head injury, including concussion. The second component explains that a student should be removed from physical activity if he or she is suspected of incurring a head injury and only return once they are cleared by a medical provider licensed in Florida.

The second document is part of the school district's athletic trainer's manual and has two relevant sections. The first section outlines concussion assessment and management (Appendix B) and the second section describes care of the student with a suspected concussion (Appendix C). It is of note that there is no mention of the educational setting, school, or learning in this document. This document is strictly a RtP procedure meant for use solely by athletic trainers.

Return to Play Overview. The first International Conference on Concussion in Sport met in Vienna, Austria in November of 2001 with the aim of providing recommendations to improve the safety and health of athletes with a history of concussion (Aubry et al., 2002). From this conference experts created the RtP protocol, a stepwise procedure outlining the rehabilitation process of athletes who experience a concussion. These steps include rest, light aerobic exercise, sport-specific exercise, non-contact training drills, full-contact practice, and finally, a return to

competition. Decisions to move athletes between the RtP steps are dictated by measurable changes in symptoms. For example, when an athlete is completely asymptomatic in a specific stage they progress to the next stage. Similarly, if the athlete's symptoms reoccur or worsen he or she may move back to the previous step in the RtP process. Ideally, within 10-14 days, progress is made to a point where the athlete can fully participate in sporting activities again (Aubry et al., 2002; McCrory et al., 2013).

Return to Learn Overview. The design of comprehensive SBCM programming is in its infancy and only a few documented protocols are known to be employed, BrainSTEPS in Pennsylvania, and the Concussion Management Guidelines put out by the Colorado Department of Education. Both of these protocols seek to help athletes, as well as nonathletes, recover from a concussion and have procedures to assist students in their return to the classroom. Although both of these programs are on the cutting edge of SBCM, they are heavily reliant on local factors (e.g., funding, local academic institutions) which has limited their ability to be replicated in other states. The next step in SBCM programming is to find generalizable factors (e.g., SSP implementation characteristics) which allow for the informed design and implementation of SBCM programming in various settings and in differentiated conditions.

Most published conceptual RtL protocols are not comprehensive like BrainSTEPs and the Colorado Management Guidelines, but instead are relatively myopic in their focus and heavily based upon the stepwise RtP processes developed for athletics. This stepwise progression focuses on the student's physical symptoms and should begin immediately after a student experiences a concussion. Progression through stages is determined by symptom reduction. These decisions should be made by data and team-based problem solving. If students' symptoms decline they move on to the next step. If symptoms remain constant they may stay at the current

step, and if symptoms worsen they may revert to the previous step. Similar to the RtP approach, the overall goal is to progress through the steps in as timely a manner as possible while remaining conservative in progression decision to prevent setbacks.

Typically, the first step is to provide the student with complete cognitive rest for 24 or 48 hours after the initial injury (Arbogast et al., 2013; Brown et al., 2014; Sady et al., 2011). Complete cognitive rest is defined as no reading, homework, text messaging, video game playing, online activity, or similar activities, with minimal amounts of watching television/movies and listening to music (Brown et al., 2014).

The next step of the RtL protocol is for the student to return to school for a partial day. This step should occur when the student has recovered enough to be able to focus on schoolwork for 30 minutes (McAvoy, 2012) to one to two hours (Arbogast et al., 2013). When the student is asymptomatic after returning to school for a partial day he or she may progress to a full school with day with maximal supports. The next step includes a full school day with moderate supports, minimal supports, and lastly the withdrawal of all supports while continuing to monitor symptoms throughout (Arbogast et al., 2013).

Tiered System of Supports for School-based Concussion Management. A limitation of the traditional RtL approach is its student-centered focus and lack of prevention. This step-wise process does not take into account the full ecology of a multi-student educational environment. This traditional RtL approach also begins with the injury, therefore leaving out preventative procedures, which could greatly decrease overall incidences of brain injury including concussion. A tiered system of support for concussion management may be a better model for schools to adopt as it addresses both of these limitations. Figure 1 presents a tiered system that utilizes a traditional RtL step-wise progression, addresses both aforementioned

limitations, and also includes tier specific assessment, progress monitoring, and intervention (Bradley-Klug, Garofano, Lynn, DeLoatche, & Lam, in press). This framework not only focuses on the steps to take once a student has incurred a concussion, but also highlights preventative measures. The literature on PCS and PPCS informs the different tiers of support with Tier I incorporating the literature on typical concussion symptoms and recovery, Tier II taking into account findings on PCS, and Tier III incorporating findings on how to treat students with PPCS. The tiered approach is described here in order to help conceptualize a more comprehensive and innovative model of SBCM.

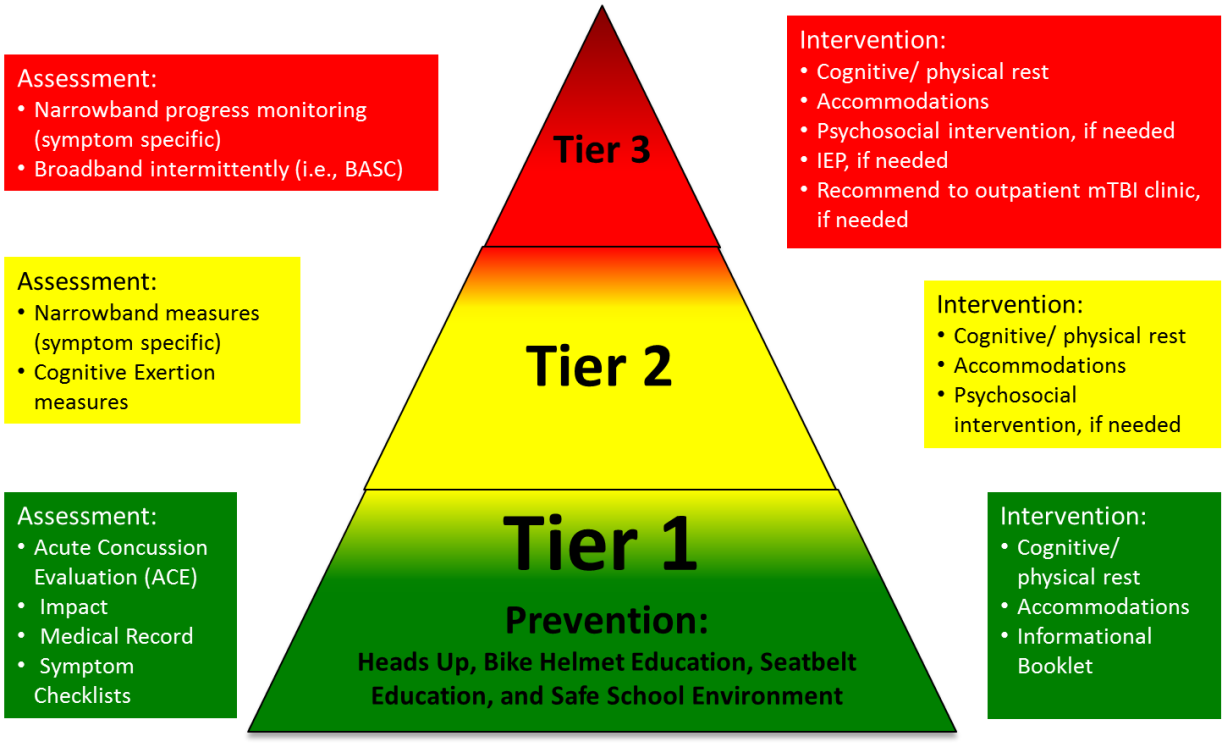

Figure 1. Tiered System of Supports for School-based Concussion Management.

SBCM Components. The literature bases exploring the biology of concussions, as well as the applied domain of concussion management, are quickly developing. Basic sciences have provided the theoretical underpinnings while animal, adult, and athletic samples have allowed for the development of testable concussion management components with mixed, although

promising, results. These derived concussion management principles have since been translated to pediatric and school based samples again with mixed, but encouraging results. Rather than testing comprehensive concussion management protocols, the applied fields are still in their nascent stages of development and rely almost entirely on small scale studies that examine specific assessment or treatment components. To date, there is no known empirically tested comprehensive SBCM program. Although there currently is no comprehensive and empirically based protocol to apply in the schools, there is sufficient evidence for specific components to allow states, districts, and schools to develop and experiment with their own comprehensive concussion management plans. Many articles and position statements have been published that outline key principles and components that educators and schools can integrate into their specific protocol (Halstead et al., 2013; Masters, Gioia, Leddy, & Grady, 2012; McAvoy, 2012; Sady et al., 2011). Major components fall under four domains: prevention/education, assessment/progress monitoring, communication, and treatment (i.e., accommodations and interventions).

Prevention/Education. Much of the conceptual literature on SBCM, RtL, and RtP begins with the initial injury. This approach fails to account for preventative measures that may limit overall concussion occurrence. Some RtP programs, like the Heads Up program (CDC, 2015), focus on training coaches, athletic trainers, athletes and their parents on both safe sporting techniques (i.e., not tackling with the head down) as well as education related to the early identification and possible consequences associated with concussions. These same principles are key SBCM components. School staff, students, and their parents can benefit from understanding both the signs and consequences associated with concussion as well as educational programs that limit head injury. These programs include seat belt promotion (Morrongiello & Kiriakou, 2006),

bike helmet promotion (Englander, Cleary, O'Hare, Hall, & Lehmkubl, 1993) and behavioral programs that limit assault (McCurdy et al., 2003). Preventative measures provided through education are a key component of, and form the basis for, a comprehensive SBCM program.

Assessment. The early assessment of concussion is paramount to any SBCM program. Initially, assessment should focus on "red flags" that indicate immediate medical attention (i.e., seizures, repeated vomiting, weakness or numbness in limbs, fluctuations in consciousness) as they may indicate the presence of a complicated concussion or a more severe TBI (Piebes, Gourley, & McLeod, 2009). Although these red flags may occur in the minutes directly after injury, their presentation can occur anytime within the first 48 hours.

Although medical professionals often categorize acute brain injury using severity assessments such as the Glasgow Coma Scale (Teasdale & Jennett, 1974), which measures sensory response (visual, verbal, motor), the school-based assessment of concussion is primarily non-acute and should instead focus on symptoms (i.e., cognitive, somatic, physical, affective, and sleep). These symptoms often appear at different time points in recovery (Eisenberg et al., 2014) and their measurement can facilitate the continuous progress monitoring of recovery. Symptom assessment should be provided at the time points when symptoms typically develop. For example, a typical pattern of symptoms starts off as physical manifestations (i.e. sensitivity to light, nausea, headaches) and either resolves completely or moves towards more psychosocial symptoms (i.e. irritability, anxiety, depression) within 7-30 days (Eisenberg et al., 2014). An appropriate SBCM assessment procedure would anticipate and mirror this typical symptom progression and build in assessments that measure these symptoms directly. It is important to know that symptom duration can be highly variable from student to student and that symptom overlap often occurs. For example, a student may still be experiencing sensitivity to light at day

20 and also be more irritable than before the injury. When a symptom is observed it should be serially monitored until it resolves (Gioia, Schneider, Vaughan, & Isquith, 2009). This is important as the graded RtL progression is built upon continual assessment in order to measure recovery and timely intervention if symptoms increase or do not resolve at an adequate pace. Overall, symptom assessment and serial monitoring are key to the RtL process as both indicate initial symptom load, as well as serve as a baseline for the progress monitoring of recovery.

Communication. Communication is central for intra- and inter-system problem solving, and concussion management is no different (Gioia, 2014). Although communication is valued by school and non-school providers' alike, common barriers to communication include identification of concussion, terminology, desire to participate in sports, reimbursement for services, and differing views on child development (Bradley-Klug, Sundman, Nadeau, Cunningham, & Ogg, 2010; DeMatteo et al., 2010; Lewandowski & Rieger, 2009; Reddy et al., 2008). All components previously discussed are dependent on effective and continuous communication between stakeholders. The identification and effective utilization of preexisting communication structures between SSP, community service providers, and families can provide the backbone for a comprehensive SBCM program. Currently there is no known literature on the pre-existing communication pathways connecting SSP and concussion referrals. This study sought to describe these communication patterns.

The ambiguity of concussion related terminology is a barrier to effective communication in the schools. As discussed previously, the line between concussion and mTBI is often blurred and these terms are used interchangeably by some, while others use these terms to describe distinct forms of brain injury. A consensus on terminology needs to be reached in order to resolve communication within the schools and communication between the schools and other

community stakeholders including hospitals, clinics, and non-school athletics. Until this consensus is reached SSP should work on streamlining what terms they will use in both their documentation and practice in order to develop a common language in their SBCM program.

Decisions between terminology are not straight-forward and thought needs to be put into deciding between using the term concussion or mTBI. The term most SSP, parents, and students are familiar with is concussion. Although familiarity is a strength of the term, it also may be taken less seriously than the mTBI. This is important as recent scientific findings have revealed that concussion is not the innocuous injury it was once thought to be. Using the term mTBI may allow for both SSP and families to take this injury more seriously which in turn may result in greater adherence to SBCM (DeMatteo et al., 2010). Although choosing a common language in the school is important for SBCM, SSP also need to maintain flexibility in terminology as other systems, such as hospitals, clinics, and other community services, may utilize different terminology. Interestingly, communicating concussion related information to students after they incur a concussion has been shown to reduce anxiety and less overall symptoms experienced (Ponsford, et al. 2001). Not only is it necessary to understand and facilitate current communication patterns, developing a common language between all parties likely will facilitate programming adherence and possibly offer a simple and efficacious treatment for students with concussion.

Treatment. The most evidence based and commonly accepted treatments for concussion will be discussed below as it is beyond the scope of this literature review to describe all current conceptual and evidence based treatments for concussion. It must be noted that there is no panacea for the concussion injury (Burke, Fralick, Nejatbakhsh, Tartaglia, & Tator 2014). Currently, pharmaceutical treatments have been shown to be largely ineffective, while most

accepted psychosocial and behavioral interventions have shown mixed empirical support. A significant drawback to the treatment of students with concussion is that most treatment studies have utilized adult samples (Burke et al, 2014). Additionally, most treatment studies have focused on sports related concussions. Both adult samples (Davis & Purcell, 2014) and sports related concussions (Halstead et al., 2013) limit the generalizability of a significant amount of treatment research as both groups seem to have different recovery patterns compared to youth and non-sport related concussions. Generally, children and adolescents experience more protracted and symptom heavy concussions compared to adults and sports-related concussions which tend to be less severe (Foley et al., 2014). With these considerations in mind, it is still generally accepted to draw conclusions from adult and sport related concussion treatment studies and to conservatively apply these findings to the management of youth with concussion (DeMatteo et al., 2015).

The treatment with the greatest expert and empirical support is rest, both cognitive and physical (Moser, Glatts, & Schatz, 2012). Generally, rest is seen as the most important overall aspect of both the RtL and RtP treatments and is a core component of SBCM. Rest is thought to increase the brain's ability to recover as biologic resources can be devoted primarily to returning to neurologic homeostasis, while not competing with the demands of cognitive or physical activity (Grady, Master, & Gioia, 2012). How rest is recommended (e.g., self-guided, step-wise, standardized letter) and the type of rest recommended (strict versus gradual) also appears to be important in recovery (Arbogast et al., 2013; Thomas, Apps, Hoffmann, McCrea, & Hammeke, 2015). Gibson and colleagues (2013) found that simply recommending rest did not assist in recovery while Thomas and colleagues (2015) found that recommending a brief rest period of 1-2 days is optimal for recovery when compared to recommending strict rest for a week. The

SBCM implications of these findings are that rest with a gradual return to activities should be recommended to the student and also followed up with, as a one-time recommendation seems to be insufficient. If a student reports he or she did not rest directly after the concussion a follow-up will allow for an additional recommendation of rest. This is important because research has shown that rest at any point during recovery may offer benefits (Moser et al., 2012). Students should also not take extended time off from school. After an initial 1-2 days of rest, the student should begin the RtL process. Interestingly, there is limited evidence that increasing physical activity through active rehabilitation (i.e., vestibular therapy, oculomotor exercise, subsymptom aerobic exercise) may decrease physical, psychosocial, and cognitive concerns during PCS and PPCS (Gagnon, Galli, Friedman, Grilli, & Iverson, 2009; Vidal, Goodman, Colin, Leddy, & Grady, 2012).

Traditional psychosocial interventions (i.e., counseling, behavior management plans) are appropriate and recommended for students suffering from all forms of traumatic brain injury (Jantz et al., 2014). There are currently no concussion specific treatments for psychosocial symptoms like depression, anxiety, irritability, and other changes in behavior. Schools should respond to these students as they would any other student experiencing similar concerns. For example, if a student reports depressive symptoms the student may benefit from individual or group counseling. A caveat to this is that SSP should explore if physical reasons are the cause of why the student is experiencing their symptoms. For example, if a student is experiencing increased irritability they may also be experiencing ongoing headaches which are affecting their mood; another possibility could be problems with sleep resulting from the concussion. In both instances treating the underlying physical symptoms through behavioral intervention (i.e., additional rest, sleep hygiene planning) may alleviate the presenting irritability.

Predictors of Concussion Management Beliefs

In accordance with provider centered implementation science, the focus of this study examined if SSP implementation characteristics can predict concussion management beliefs and practices. Durlak and DuPre (2008) conducted a literature review of 542 quantitative studies as well as 5 meta-analyses that examined the factors influencing implementation, as well as how overall program outcomes are influenced by implementation. They outlined four provider characteristics that affect implementation: perceived need, perceived benefit, self-efficacy, and skill proficiency. Similarly, the Health Belief Model is one of the most well-known, widely used, and empirically supported frameworks in health behaviors research to describe and predict health-related behaviors (Janz & Becker, 1984; Rosenstock, Strecher, & Becker, 1988) and includes many of the same core elements described by Durlak and DuPre (2008). Specifically, they share the common core constructs of perceived benefits, perceived severity, perceived barriers, and self-efficacy. The four predictors utilized in this study (role, career experience, recent concussion experience, and training subscale) map directly onto the four described by Durlak and DurPree (2008) and the Health Belief model (Janz & Becker, 1984; Rosenstock, Strecher, & Becker, 1988). By examining and understanding how these factors predict outcomes (impact subscale, informal procedures subscale, recent concussion experience), SBCM programming can be developed and implemented.

Research supports that the understanding of factors that impact implementation are positively related to successful program outcomes (Barrett et al., 2013; Durlack & DuPre, 2008). Further research has shown that while provider characteristics are essential, the most predictive factor related to positive outcomes is program structure (Payne & Eckert, 2010). Since the school district that was examined in this study currently has no formal SBCM structures in place,

understanding provider factors will be the first step in the development of a strong SBCM program.

Roles. The diverse professions (Roles) of SSP included in this study have different pre-service training backgrounds. School nurses are trained as health care providers while school psychologists, social workers, and counselors are not traditionally considered health care providers (Weber, Welch, Parsons, & McLeod, 2014). As health care providers school nurses have a unique training background that prepares them to play a critical role in the SBMC. Nurses are trained to prevent, identity, and treat medical concerns including nutrition, health, illness, and injury so it is hypothesized that they will be familiar with the concussion injury and understand the possible impact that a brain injury has on a student's ability to function in an educational setting.

The other SSP included in this study, school psychologists, social workers, and school counselors do not necessarily have the same level of healthcare training as nurses (Davies, Sandlund, & Lopez, 2015; Lewandowski & Rieger, 2009; Weber et al., 2014). These SSP can largely be considered educational and mental health SSP. It is hypothesized that the information and skills these group have relating to the prevention, identification, and treatment of medical conditions is likely the result of common knowledge gained through experience and to a lesser extent from formal education. This hypothesis may not hold true in all situations as some individuals, such as school psychologists trained in pediatric school psychology, may have advanced skills and knowledge as it relates to medical concerns. However, the overall knowledge of educational and mental health SSP is likely less focused on medical concerns compared to nurses and more focused on the domains of education and mental health.

Career Experience. It is reasonable to hypothesize that the more overall experience (quantified as years in the field) an individual has will be related to their level of competence and understanding of key issues and practices. Supporting this hypothesis, Weber and colleagues (2014) found a significant relationship between years of experience among school nurses and their knowledge of concussion related accommodations. It should be noted that these findings may not always hold true. Concussion research and the popular beliefs regarding concussion have undergone a drastic transformation recently from once being thought of as a harmless injury to now being considered a public health epidemic with potential long term consequences (Eisenberg et al., 2014). Consequently, it is possible that early career SSP will have more formal training in SBCM when compared to those trained over 10 years ago; young SSPs went through their training in a time of increased concussion awareness while more veteran student services personnel did not.

Training. Findings from Canto and colleagues (2014) indicate considerable gaps in the training of SSP in how to help students with a traumatic brain injury. Professional development in concussion and TBI in general is a logical step in addressing these gaps in knowledge and skill. Trainings can be comprehensive and focus on pathophysiology, symptoms, prevention, communication, assessment, and treatment or it can focus more narrowly on a one or two of these domains. Direct training on SBCM would logically seem to increase one's understanding and appreciation of the phenomenon of concussion as well as the skills needed to both identify and treat the injury. Davies and Ray (2014) examined the effects of TBI specific training among SSP and found that the knowledge and skills gained from training were retained for two months but that the gains dissipated when follow-up assessment was conducted one year later. It was hypothesized that professional development alone was not adequate without ongoing practice,

mentoring, feedback, and/or consultation (Glang, Todis, Sublette, Brown, & Vaccaro, 2010). Continued support after initial professional development appears to be essential to actualizing impactful and SBCM trainings (Davies et al., 2015).

Recent Concussion Experience. Recent concussion experience is similar to career experience, but more direct. It is reasonable that high levels of recent concussion experience, when compared to those with lower levels of recent experience, would indicate a higher familiarity with the impact of concussion as well as serve as a direct outcome for number of students with concussion served (Davies et al., 2015). In other words, individuals who have worked with children suffering from a concussion will have a greater appreciation for the injury and its impact on educational outcomes. These individuals also will likely be able to draw upon these recent experiences when treating subsequent children with a concussion.

Communication Patterns

Communication has been indicated as the primary barrier when working with students who have suffered a brain injury (Canto et al., 2014). Different professions are likely to communicate with different education stakeholders regarding concussion. Understanding these communication patterns as it relates to concussion referral patterns will help to inform SBCM and implementation (Chrisman, Quitiquit & Rivara, 2013; Duff & Stuck, 2014). For example, if school psychologists are typically informed of students with concussions by parents, gym teachers, and administrators, it would be reasonable that incorporating these naturally occurring referral patterns into the development of a SBCM program could increase identification fidelity.

Literature Summary

Recent research has shown that concussion consists of possible neurometabolic and structural changes that are directly related to acute symptoms and patterns of recovery. We also

know that certain groups are at more risk for receiving a concussion and/or experiencing severe or protract symptom recovery. These findings help inform the empirically supported components involved in SBCM for both athletes and students. What is not known is how to best integrate these components into the implementation of a comprehensive SBCM program for students in an educational setting. Implementation science has revealed that provider characteristics are central to programming implementation and consequently student outcomes. This study investigated SSP implementation characteristics that can be used to inform the development and implementation of comprehensive SBCM programming.

Chapter 3: Method

The purpose of this exploratory study was to identify and describe the beliefs, training, and experiences of school service personnel (SSP) and to quantify their relation to perceptions of the impact of concussion on academics, current concussion management procedures, and number of students with concussions served. An additional focus of this study was to examine patterns of concussion referrals among SSP. Findings from both descriptive and predictive questions may inform both the design and implementation of school-based concussion management (SBCM) programming. Quantitative methods were used to answer research questions regarding the relationships between perceptions of the impact of concussion on academics, perceptions of current informal procedures, and SSP implementation characteristics (i.e., training, career experience, role, type of school, and referral source). This section outlines the participants, measures, and procedures, as well as the analyses conducted.

Participants

The data investigated in this study were part of a preexisting database. Participants in this study were SSP (n =144) from a rural school district in the southeastern United States (see Table 1). SSP included 32 school psychologists, 33 nurses, 52 counselors, and 27 social workers who participated in a mandatory student service division meeting in January, 2014. The majority of the sample was female (n=130). The participants were employed in a large school district that includes 79 schools and approximately 70,000 students. The student population served was majority Caucasian (68%) with the largest minority group being Hispanic (19%).

Table 1.

Descriptive Statistics for Student Services Personnel

Variable	*n*	%
Gender		
Male	14	9.7
Female	130	90.3
Role		
School Psychologist	32	22.2
Nurse	33	22.9
Counselor	52	36.1
Social Worker	27	18.8
School Type		
Pre-K	32	22.2
Elementary	95	66.0
Middle	60	41.7
High	48	33.3

Measures

The participants in this study attended a mental health training conducted by Dr. Shannon Suldo from the University of South Florida (USF). The training focused on the theory supporting a tiered mental health service delivery model and ended with a four page mental health needs assessment. The last page of the survey contained 13 items relating to SBCM (Appendix D). The mental health training focused on the links between academics and mental health as well as the rationale for a tiered mental health service delivery model. Concussion was not discussed during the training. The mental health needs assessment was conducted in order to assess the school district's current mental health delivery system before transitioning to a tiered mental health service delivery model. The mental health needs assessment survey was created by Dr. Shannon Suldo and members of her research lab. The survey included questions about:

- Respondents' background (professional role, years of experience, school levels served)
- Mental health needs of their students (types of student problems that are referred most often for mental health services)

- Student mental health services currently available at their schools, including services at the Tier 1, Tier 2, and Tier 3 levels
- Professional development desired pertinent to student mental health services
- Concussion-specific items

Responses from concussion items and select items from the demographics section were the only data that were included for analysis in this study.

Procedures

The needs assessment survey was administered at the end of the afternoon mental health training session. Three student research assistants, including this author, from the USF school psychology program distributed the assessment to participants while Dr. Suldo instructed the participants to progress through the assessment in a linear manner and to ask research assistants for support as needed. The research assistants, along with Dr. Suldo, answered assessment related clarifying questions from participants during the administration. The mental health needs assessment took approximately 20 minutes to complete.

Data Input and Checking. Once data were collected, student research assistants began the process of entering the data into a database. Data input was typically conducted by two research assistants at a time. After data entry was complete, research assistants systematically checked the data for errors by inspecting every 10^{th} assessment. If inconsistencies were found, the research assistants documented and corrected the data and then proceeded to look for corresponding systematic errors by checking the survey above and below the error.

Institutional Review Board. There were no known risks to participants and all data were de-identified. The original data collection procedure was determined not to be research by the University of South Florida Institutional Review Board (IRB). A separate application was

submitted for this study as findings from this study may contribute to generalizable knowledge. The IRB reviewed this study's application and deemed it to be exempt as it did not meet the definition of human subject research.

Variables

Table 2 includes variable names that have been used in this study as well as their corresponding items on the needs assessment. These items are part of the demographic and concussion section of the mental health needs assessment (Appendix D). In this study the dependent variables included recent concussion experience, role, impact subscale, and the informal procedures subscale. Independent variables included career experience, role, recent concussion experience, referral source, and the training subscale. The variables role and recent concussion experience were used as both a dependent and independent variable depending on the particular research question. Variables in Table 2 that are not listed above as dependent or independent variables were included in the Table 4 (i.e., Impact Subscale, Training Subscale, Informal Procedures Subscale).

Table 2

Variables and Corresponding Items

Variable	Item	Codes
Role	What is job role?	1 = School Psychologist 2 = School Counselor 3 = Social Worker 4 = Nurse (the original coding was changed to dummy variables for regression analyses)
Gender	What is your gender?	0 = Male 1 = Female
Career Experience	How many years have you worked in this professional role (including full-time internship)?	Exact number
School Type	What grades or age groups are on your case load this school year (2013 – 2014)?	1 = Elementary 2 = Middle 3 = High 4 = Other
Recent Concussion Experience	From January 2013 to December 2013, approximately how many students came to your attention for concussion?	Exact number
Referral Source	At your schools, who typically brings students with a concussion to your attention? (check all that apply) • Athletic trainer • Community-based medical professional (e.g., family doctor, pediatrician, neurologist) • Parent/guardian • School administrator • School nurse • Sports coach • Student self- referral • Teacher • Other:_____ • N/A (I have not had any contact with students with concussion in past year)	0 = No 1 = Yes
Impact Physical	Student academic performance can be negatively impacted by the physical symptoms of concussion	1 = Strongly disagree 2 = Disagree 3 = Neutral 4 = Agree 5 = Agree Strongly

Table 2 (Continued)

Variables and Corresponding Items

Variable	Item	Codes
Impact Psychosocial	Student academic performance can be negatively impacted by the psychosocial symptoms of concussion	1 = Strongly disagree 2 = Disagree 3 = Neutral 4 = Agree 5 = Agree Strongly
Training Identification Physical	How much training (professional development, college-level coursework) do you have with identifying the physical symptoms of concussion?	1 = No training 2 = Some Training 3 = Moderate Training 4 = Significant Training 5 = Extensive Training
Training Identification Psychosocial	How much training (professional development, college-level coursework) do you have with identifying the psychosocial symptoms of concussion?	1 = No training 2 = Some Training 3 = Moderate Training 4 = Significant Training 5 = Extensive Training
Training Treatment Physical	How much training (professional development, college-level coursework) do you have with managing the physical symptoms of concussion?	1 = No training 2 = Some Training 3 = Moderate Training 4 = Significant Training 5 = Extensive Training
Training Treatment Psychosocial	How much training (professional development, college-level coursework) do you have with managing the psychosocial symptoms of concussion?	1 = No training 2 = Some Training 3 = Moderate Training 4 = Significant Training 5 = Extensive Training
Informal Identification Physical	I believe my school(s) has effective procedures for identifying students with physical symptoms of concussion	1 = Strongly disagree 2 = Disagree 3 = Neutral 4 = Agree 5 = Agree Strongly
Informal Identification Psychosocial	I believe my school(s) has effective procedures for identifying students with psychosocial symptoms of concussion	1 = Strongly disagree 2 = Disagree 3 = Neutral 4 = Agree 5 = Agree Strongly
Informal Treatment Physical	I believe my school(s) has effective procedures for managing a student's physical symptoms of concussion	1 = Strongly disagree 2 = Disagree 3 = Neutral 4 = Agree 5 = Agree Strongly

Table 2 (Continued)

Variables and Corresponding Items

Variable	Item	Codes
Informal Identification Psychosocial	I believe my school(s) has effective procedures for managing a student's physical symptoms of concussion	1 = Strongly disagree 2 = Disagree 3 = Neutral 4 = Agree 5 = Agree Strongly

Data Analyses Plan

The following section presents the overall study design, analysis of missingness, and research questions with their corresponding statistical analysis. All analyses were conducted using Version 22 of IBM Statistical Package for the Social Sciences (SPSS).

Study Design. All data were previously collected from a district wide needs assessment. Therefore, all data analyzed in this study are considered secondary analyses.

Analysis of Missingness. Missing data and their relationship with other variables were examined.

Research Question 1. *What are the current levels of concussion training among SSP? What are perceptions of the impact of concussion on student academic performance among SSP? What are perceptions of the effectiveness of current SBCM procedures among SSP?*

Analysis of Research Question 1. To address research question one (a,b,c), the sample descriptives (i.e., frequency, mean, standard deviation, range, skewness, kurtosis) were analyzed for all continuous variables of interest. Additionally, Cronbach's alpha was calculated for subscales formed (e.g., impact, training, informal procedures).

Research Questions 2, 3, and 4. *What is the relationship between training in concussion, job type, career experience, recent concussion experience and the level at which individuals believe concussions can negatively impact academic performance?*

What is the relationship between training in concussion, job type, career experience and the number of students referred to SSP in the past year?

What is the relationship between training in concussion, job type, career experience, number of students with concussion referred in the past year, and the level of belief in the effectiveness of informal concussion management procedures?

Analysis of Research Question 2, 3 and 4. Prior to multiple linear regression modeling the assumptions of regression were analyzed (e.g., linear relationship, normality of residuals, normality of error variance, independence). If the assumptions were deemed to be violated, follow-up statistical testing and/or transformations were conducted. After this was performed, predictors were entered into the multiple linear regressions which align with research questions two, three, and four.

Research Question 5. *What are the most common concussion referral sources endorsed by SSP? Is there a difference in concussion referral source by role?*

Analysis of Research Question 5. The differences in rate of source referral by role was examined to answer research question five by utilizing a 4 (role) x 2 (specific referral: yes/no) matrix. The Fisher's Exact Test was then conducted to determine if there were differences in referral source by role.

Chapter 4: Results

In this chapter the data previously collected were analyzed to address the five research questions. The first research question describes the beliefs, training, and experiences of school service personnel (SSP). Research questions two, three, and four measure the utility of SSPs' beliefs, training, and experiences in predicting perceptions regarding the impact of concussion on academics, current concussion management procedures, and the number of students with concussions served. Lastly, research question five examines patterns of concussion referrals among SSP.

Analysis of Missingness

Missing data and their relationship with other variables were examined. Although no missing demographic data were found, eight cases (5.6%) were found to have missing concussion-specific data. There did not appear to be any pattern in the eight cases with missing concussion-specific data so these cases were deleted list-wise and removed from analyses.

Research Question 1

1a) *What are perceptions of the impact of concussion on student academic performance among SSP?*

1b) *What are the current levels of concussion training among school service personnel?*

1c) *What are perceptions of the effectiveness of current school-based concussion management procedures among school service personnel?*

To answer research question one (a,b,c) the sample descriptives (i.e., frequency, mean, standard deviation, range, skewness, kurtosis) were calculated for all continuous variables of interest and were reported both by role and overall (Table 3).

Table 3

Descriptive Statistics for Variables by Role

Variables	n	Mean (SD)	Range	Skewness	Kurtosis
Career Experience[1]					
School Psychologist	32	13.23 (11.05)	39.50	1.43	0.81
Nurse	32	12.73 (9.57)	37	0.44	-0.35
Counselor	52	12.96 (8.69)	29.00	0.46	-0.96
Social Worker	27	15.41 (8.98)	31	-0.23	-0.80
Total	136	13.26 (9.46)	41	0.66	-0.11
Recent Concussion Experience[2]					
School Psychologist	32	0.25 (0.88)	4	3.71	13.37
Nurse	33	4.21 (4.05)	17	1.43	1.99
Counselor	52	0.35 (0.86)	4	2.90	8.34
Social Worker	27	0.22 (0.58)	2	2.57	5.68
Total	136	1.16 (2.63)	17	3.34	14.13
Impact Physical[3]					
School Psychologist	31	4.65 (0.55)	2	-1.27	0.76
Nurse	33	4.61 (1.00)	4	-3.12	9.59
Counselor	50	4.24 (0.85)	4	-1.33	2.83
Social Worker	26	4.26 (0.51)	1	0.16	-2.15
Total	136	4.46 (0.79)	4	-2.08	6.01
Impact Psychosocial[3]					
School Psychologist	31	4.58 (0.72)	3	-2.02	4.58
Nurse	33	4.52 (1.06)	4	-2.53	6.03
Counselor	50	3.94 (0.85)	4	-1.19	0.66
Social Worker	26	4.27 (0.67)	2	-0.36	-0.64
Total	136	4.36 (0.86)	4	-1.68	3.45
Training Identification Physical[4]					
School Psychologist	32	1.56 (0.88)	3	1.63	2.06
Nurse	33	3.55 (0.52)	3	-0.33	-0.34
Counselor	52	1.29 (0.63)	2	2.04	2.79
Social Worker	26	1.54 (0.91)	3	1.81	2.66
Total	136	1.90 (1.20)	4	1.00	-0.38
Training Identification Psychosocial[4]					
School Psychologist	32	1.47 (0.80)	3	1.71	2.26
Nurse	33	2.88 (1.02)	4	-0.12	-0.65
Counselor	52	1.23 (0.51)	2	2.19	4.19
Social Worker	26	1.42 (0.76)	3	2.08	4.56
Total	136	1.71 (1.00)	4	1.27	0.53

Table 3 (Continued)

Descriptive Statistics for Variables by Role

Variables	n	Mean (SD)	Range	Skewness	Kurtosis
Training Treatment Physical[4]					
School Psychologist	31	1.29 (0.59)	2	1.96	2.97
Nurse		3.48 (0.97)	3	-0.28	-0.92
Counselor	48	1.21 (0.54)	2	2.60	5.78
Social Worker	26	1.38 (0.80)	3	2.16	4.07
Total	136	1.79 (1.17)	4	1.26	0.28
Training Treatment Psychosocial[4]					
School Psychologist	31	1.45 (0.61)	2	1.08	0.22
Nurse	33	2.85 (1.09)	4	0.01	-1.14
Counselor	48	1.17 (0.48)	2	2.97	8.32
Social Worker	26	1.38 (0.75)	3	2.26	5.29
Total	136	1.71 (0.99)	4	1.27	0.53
Informal Identification Physical[3]					
School Psychologist	31	2.00 (0.93)	3	0.27	-1.27
Nurse	33	2.76 (1.06)	4	0.02	-0.76
Counselor	48	2.48 (1.19)	4	0.17	-0.91
Social Worker	26	2.85 (1.00)	4	-0.18	-0.05
Total	136	2.52 (1.10)	4	0.10	-0.83
Informal Identification Psychosocial[3]					
School Psychologist	31	2.03 (0.91)	3	0.26	-1.19
Nurse	33	2.42 (0.86)	3	-0.06	-0.58
Counselor	48	2.33 (1.06)	3	-0.05	-1.32
Social Worker	26	2.58 (0.81)	3	-0.52	-0.07
Total	136	2.35 (0.95)	3	-0.11	-1.02
Informal Treatment Physical[3]					
School Psychologist	31	2.03 (0.98)	3	0.38	-1.08
Nurse	33	2.76 (0.97)	4	0.09	-0.25
Counselor	48	2.52 (1.09)	4	-0.16	-0.86
Social Worker	26	2.73 (0.92)	3	-0.42	-0.43
Total	136	2.53 (1.04)	4	-0.08	-0.77
Informal Treatment Psychosocial[3]					
School Psychologist	31	2.06 (0.93)	3	1.33	-1.32
Nurse	33	2.48 (0.87)	3	-0.25	-0.56
Counselor	48	2.44 (0.99)	3	-0.44	-1.11
Social Worker	26	2.54 (0.76)	3	-0.73	0.06

Table 3 (Continued)

Descriptive Statistics for Variables by Role

Variables	n	Mean (SD)	Range	Skewness	Kurtosis
Total	136	2.40 (9.2)	3	-0.35	0.41

Note: [1] = years. [2] = number of concussions serviced per year. [3] = 5 point Likert (1= Strongly Disagree – 5= Agree Strongly). [4] = 5 point scale (1= No Training – 5= Extensive Training).

Correlation of Variables. The creation of subscales was explored in order to address research questions one, two, three, and four. The utilization of subscales was explored as groupings of similar variables may be more appropriately analyzed as composite variables rather than individually. The first step in creating subscales was analysis of item content in order to determine if the items theoretically represented a similar construct. For example, four items on the needs survey all appeared to represent the underlying construct of "training." These items used the identical stem of "How much training (professional development, college-level course work) do you have with" followed by either "Identifying the physical symptoms of concussion", "Identifying the psychosocial symptoms of concussion", "Managing the physical symptoms of concussion", or "Managing the psychosocial symptoms of concussion." Next, Cronbach's alpha was utilized to see if the item scores within the subscale were internally consistent. The size of Cronbach's alpha is affected by several factors including the number of items within the subscale. Specifically, Cronbach's alpha will tend to be lower when the subscale is comprised of a small number of items. Cronbach's alpha was computed for three potential subscales: Impact Subscale, Training Subscale, and Informal Procedures Subscale. A high Cronbach's alpha (> .80) was found for each subscale: Impact (.95), Training (.96), and Informal Procedures (.96). Intra-scale correlations ranged from .79 to .93 and inter-scale correlations ranged from .02 to .27. Subscales were then converted to a single variable for further description (i.e., frequency, mean, standard deviation, range, skewness, kurtosis) and analysis (i.e., multiple linear regression) using

the mean of the items within the subscale (Table 4). These subscales were next utilized to answer research questions 1a, 1b, and 1c.

Research question 1a measured the perceptions of the impact of concussion on student academic performance among SSP. When all SSP groups (i.e., school psychologists, nurse, counselors, social workers) were combined they had a mean impact subscale level of 4.41 (*SD* = 0.80) which indicates that SSP in this sample agree to strongly agree that the symptoms of concussion can negatively impact academics. These data did not have a normal distribution. The distribution was skewed to the left ($\alpha_3 = -1.88$) and leptokurtic ($\alpha_4 = 5.10$). Individually, all groups in this sample reported a mean score between agree to agree strongly when asked how they perceived the impact of concussion on academics.

Research question 1b measured the current levels of concussion training among SSP in this sample. When all SSP groups were combined they had a combined mean training subscale level of 1.77 (*SD* = 1.04) which indicates no training to some training. These data had a reasonably normal distribution ($\alpha_3 = 1.22$, $\alpha_4 = 0.34$). When mean concussion related training was analyzed by role, school psychologists, counselors, and social workers reported no training to some training and nurses reported moderate training.

Research question 1c measured the perceptions of the effectiveness of current SBCM procedures among SSP. When all SSP groups were combined they had a mean informal procedure subscale level of 2.43 which indicates disagreement to neutrality regarding how effective they perceived current informal procedures to be. These data were not normally distributed. Although the distribution was mesokurtic ($\alpha_4 = -0.98$), the data were skewed to the right ($\alpha_3 = 2.43$). All groups (i.e., school psychologists, nurse, counselors, social workers)

reported a mean score between disagree to neutral when asked if they perceived current informal concussion procedures to be effective.

Table 4

Descriptive Statistics for Subscales Variables by Role

Variables	*n*	Mean(SD)	Range	Skewness	Kurtosis
Impact Subscale[1]					
School Psychologist	31	4.61(0.62)	2	-1.38	0.98
Nurse	33	4.56(1.02)	4	-2.84	7.96
Counselor	50	4.21(0.83)	4	-1.30	3.08
Social Worker	26	4.37(0.54)	1.50	0.17	-1.61
Total	140	4.41(0.80)	4	-1.88	5.10
Training Subscale[2]					
School Psychologist	32	1.45(0.66)	2.50	1.75	2.52
Nurse	33	3.19(0.86)	3.25	0.08	-0.88
Counselor	52	1.23(0.51)	2	2.37	4.88
Social Worker	26	1.43(0.76)	3	2.18	4.90
Total	143	1.77(1.04)	4	1.22	0.34
Informal Procedures Subscale[1]					
School Psychologist	31	2.03(0.90)	2.50	0.08	-1.50
Nurse	33	2.61(0.87)	3	-0.20	-0.66
Counselor	48	2.44(1.02)	3.50	-0.21	-1.05
Social Worker	26	2.67(0.81)	3	-0.78	0.11
Total	137	2.43(0.94)	3.50	2.43	-0.98

Note: [1] = 5 point Likert (1= Strongly Disagree – 5= Agree Strongly). [2] = 5 point Likert (1= No Training – 5= Extensive Training).

Research Question 2, 3, and 4

2) *What is the relationship between training in concussion, job type, career experience, recent concussion experience and the level at which individuals believe concussions can negatively impact academic performance?*

3) *What is the relationship between training in concussion, job type, career experience and the number of students referred to school service personnel in the past year?*

4) *What is the relationship between training in concussion, job type, career experience, number of students with concussion referred in the past year, and the level of belief in the effectiveness of informal concussion management procedures?*

The assumptions of multiple linear regression were analyzed in order to answer research questions two, three, and four. Next the predictors were simultaneously entered in their respective multiple linear regressions in order to determine the level at which they predict school-based concussion management (SBCM) relevant outcomes. The impact subscale, informal procedures subscale, and recent concussion experience were used as the dependent variables in the multiple regression analyses.

Analysis of Assumptions. There are four major assumptions of multiple linear regression that are not robust to significant violation. All assumptions were assessed through the visual analysis of data with follow up statistical analysis if violations were suspected. The first assumption, and arguably the most important assumption, is independence of error. To test this assumption scatter plots of the residuals versus independent variables were created. Overall, for all independent variables the residuals were generally, randomly, and symmetrically distributed around zero. For all three multiple linear regression models it is unlikely that the assumption of independence was violated. All observations were treated as independent.

The second assumption is that the residuals associated with the dependent variables are normally distributed. Visual analysis and follow up statistical analysis of the dependent variable in research questions two, three, and four revealed possible violation of this assumption. Several transformations of the original subscales were performed (e.g., inverse, natural log, square), but they did not improve the distribution of the residuals. Subsequently, analysis ultimately did not utilize transformation.

The third assumption is that the variance of error is equally distributed across all predictor variables. Visual analysis of residuals versus predicted values indicated that this assumption was not violated. The fourth assumption is that relationships are not curvilinear.

Visual analysis of residuals versus predicted values indicated that this assumption was not violated.

Prediction. Multiple linear regression analysis was utilized to address research questions two, three, and four (Table 5). Multiple linear regression is a statistical approach that models the relationship between a dependent variable and several independent variables. Statistical significance for all three models was set at $p \leq .05$. The R^2 for model one, which addressed research question two related to prediction of perceived impact of concussion on academics, did not reach statistical significance ($p > .14$) and accounted for 7% of the variability for the level at which SSP believed concussions can negatively impact academics. Being a school psychologist was found to be a statically significant ($p < .05$) predictor in this model. The R^2 for model two, which addressed research question three related to the prediction of number of students with concussion served in the past year, was statistically significant ($p < .01$) and accounted for 42% of the variability in the number of concussions serviced by SSP. Nurses reported a significantly ($p < .01$) greater number of concussions when compared to counselors. The R^2 for model three, which addressed research question four which related to the prediction of perception of informal concussion procedures, was statistically significant ($p < .01$) and accounted for 19% of the variability in how effective SSP perceived their current informal concussion procedures. Compared to counselors, nurses ($p < .01$) and school psychologist ($p < .01$) reported lower perceptions of the efficacy of current informal concussion procedures. Additionally, being trained in concussion assessment and intervention ($p < .01$) was found to significantly predict higher belief in the perceived effectiveness current informal concussion procedures.

Table 5

Predictive Models of School Services Personnel Implement Characteristics

Outcome Variable	*Predictor Variables*	*B*	*Beta*	*Std. Error*	*Sig.*	R^2
Impact Subscale	School Psychologist	0.37	0.19	0.18	.04	.07
(*n*=139)	Nurse	-0.12	-0.06	0.31	.70	.
	Social Workers	0.13	0.06	0.19	.51	
	Training Subscale	0.16	0.21	0.10	.11	
	Career Experience	0.00	0.01	0.01	.95	
	Recent Concussion Experience	0.04	0.12	0.04	.28	
Recent Concussion Experience	School Psychologist	-0.02	0.00	0.43	.97	.42
(*n*=142)	Nurse	4.37	0.75	0.63	.01	
	Social Workers	-0.10	-0.02	0.46	.84	
	Training Subscale	-0.40	-0.17	0.24	.10	
	Career Experience	0.03	0.12	0.02	.07	
Informal Procedures Subscale	School Psychologist	-0.50	-0.23	0.20	.01	.19
(*n*=137)	Nurse	-0.88	-0.40	0.34	.01	
	Social Workers	0.12	0.05	0.21	.55	
	Training Subscale	0.44	0.49	0.11	.01	
	Career Experience	0.01	0.08	0.01	.33	
	Recent Concussion Experience	0.07	0.17	0.04	.10	

Note. Guidance counselor was set as the reference category for all multiple linear regressions.

Research Question 5

5a) *What are the most common concussion referral sources endorsed by SSP?*

5b) *Is there a difference in concussion referral source by role?*

To answer research question five, the differences in rate of source referral by role was examined. Referral source was examined by utilizing a 4 (role) x 2 (specific referral: yes/no) matrix. Fishers Exact Test was used to determine if differences by referral source were found as several cells had an expected value of less than 5. An alpha level of $p < .05$ was utilized to indicate statistical significance. Taken as a whole, 55.6% of school service personnel reported no concussion referral source in the past year, 10.4% reported one source, 18.8% reported two sources, 8.3% reports three sources, and 7% reported four or more sources.

Results of the Fishers Exact Test (Table 6) indicate that nurses receive referrals for students with a concussion through athletic trainers (38.1%) more than the other three groups (i.e., school psychologist, social workers, counselors; $p < .01$). Nurses also receive more referrals than the other three groups (all $p < .01$) through community-based medical professionals (36.4%), parents/guardians (66.7%), sport coaches (30.3%), student self-referrals (27.3%), and teachers (33.3%). In terms of "other" referral sources, both nurses (21.2%) and social workers (21.2%) receive more referrals than school psychologists and counselors ($p < .01$). There was no difference in referral source by role for school administer ($p < .19$) or school nurse ($p < .79$). Overall, when difference existed, nurses appear to receive the greatest proportion of referrals across possible referral sources.

Table 6

Patterns of Referral Communication

	School Psychologist (*n* = 32)	Nurse (*n* = 33)	Counselor (*n* = 52)	Social Worker (*n* = 27)	Fisher's	*p*-value
Athletic Trainer	0%	38.1%	1.9%	0%	19.17	.01
Community-based Medical Professional	12.5%	36.4%	5.8%	3.7%	16.02	.01
Parent/Guardian	21.9%	66.7%	15.4%	22.2%	25.98	.01
School Administrator	12.5%	15.2%	3.8%	3.7%	4.62	.19
School Nurse	12.5%	15.2%	21.2%	18.5%	1.15	.79
Sports Coach	6.3%	30.3%	0%	0%	22.22	.01
Student Self-Referral	3.1%	27.3%	3.8%	3.7%	12.90	.01
Teacher	15.6%	33.3%	1.9%	11.1%	16.52	.01
Other	6.3%	21.2%	0%	21.2%	12.47	.01
N/A	56.3%	6.1%	65.4%	55.6%	34.77	.01

Note. Each participant could list multiple referral sources. The percentages represent what percentage of the school psychologists checked yes that an athletic trainer was the referral source vs percentage of the nurses checked yes that an athletic trainer was the referral source vs percentage of the counselors checked yes that an athletic trainer was the referral source vs percentage of the social workers checked yes that an athletic trainer was the referral source. This was done for each referral source (athletic trainer, community-based medical professional, parent/guardian, school administrator, school nurse, sports coach, student self-referral, teacher, other, N/A).

Chapter 5: Discussion

As a field we are just beginning to understand the impact concussions may have on the ability of students to participate in the learning environment (Parson et al., 2013; Ransom et al., 2015). As our depth in understanding the potential impact of concussion deepens so does our need to effectively implement effective prevention, identification, and management procedures (Sady, Vaughn, & Gioia, 2011). Because the vast majority of students regularly attend schools filled with diversely trained and capable school service personnel (SSP), we have an avenue to increase our ability to help through effective school-based concussion management (SBCM) programming. Although we have some empirically supported identification (Gioia et al., 2009) and management procedures (Moser, Glatts, & Schatz, 2012), there are no data on how to best design and implement the delivery of these services. A greater understanding of this can be gained through examining implementation characteristics (Durlak & DurPree, 2008; Janz & Becker, 1984; Rosenstock, Strecher, & Becker, 1988) and naturally occurring lines of communication (Gioia, 2014).

The overall purpose of this exploratory study was to inform the design and implementation of SBCM programming through the identification and description of concussion related beliefs, training, and experiences of SSP and to quantify the prediction of perceptions regarding the impact of concussion on academics, perception of informal procedures, and the number of students with concussions served. Patterns of concussion referrals among SSP were also examined. In this section, the results from this study will be discussed and tied into the

nascent SBCM literature base. Additionally, study limitations, future directions, and how these findings can inform future practice will be explored.

Research Question 1

1a) *What are perceptions of the impact of concussion on student academic performance among SSP?*

1b) *What are the current levels of concussion training among SSP?*

1c) *What are perceptions of the effectiveness of current SBCM procedures among SSP?*

To answer these exploratory questions descriptive statistics (i.e., frequency, mean, standard deviation, range, skewness, kurtosis) were calculated for all variables of interest. Descriptive statistics were provided for all SSP and by specific role (i.e., school psychologist, nurse, counselor, social worker; Table 3). Additionally, subscales (i.e., training, impact, informal procedures) were created for items that represented a similar construct and had a high Cronbach's alpha (> .80; Table 4). Table 4 includes subscale descriptives (i.e., frequency, mean, standard deviation, range, skewness, kurtosis) both as a sample and by role.

Several noteworthy findings were uncovered when examining concussion related training, beliefs, and experiences of SSP. Key findings are discussed below based on the SBCM literature and visual analysis of group differences.

Subscales were computed to answer research question 1a as subscales allow for similar items to be examined as a unified group. For example, to answer this research question the impact subscale was calculated by taking two theoretically similar items (e.g., "Student academic performance can be negatively impacted by the physical symptoms of concussion", "Student academic performance can be negatively impacted by the psychosocial symptoms of concussion") and calculating Cronbach's alpha. A Cronbach's alpha of was .95 was found

which is greater than the target Cronbach's alpha of .80; because of this the impact subscale was deemed reliable. When examining the impact subscale, the mean responses for all SSP ranged from agree to agree strongly that concussion has the potential to negatively impact students' academic success. There was little variation by role when examining the items which make up this subscale (i.e., impact psychosocial, impact physical). The implication of this finding is that the SSP in the sample, regardless of role, believe concussion can be a problem for students. A possible explanation for this overwhelming endorsement may be attributed to the recent media attention regarding professional and youth athletic concussions (e.g., second impact syndrome, chronic traumatic encephalopathy). Regardless of the reason why this belief is present, the Health Belief Model (Janz & Becker, 1984) and implementation science (Durlak & DuPre, 2008) support that perceiving an issue as a problem/need may potentially lead to higher programming buy-in, behavior change, and ultimately positive student outcomes (Barrett et al., 2013). In terms of SBCM, protocol implementation may be reinforced and operated with higher fidelity when all SSP involved believe they are addressing a need of students.

Subscales were created to answer research question 1b. The training subscale is a composite variable composed of four theoretically and statistically similar items (i.e.., "How much training do you have with identifying the physical symptoms of concussion?", "How much training do you have with identifying the psychosocial symptoms of concussion?", "How much training do you have with managing the physical symptoms of concussion?", How much training do you have with managing the physical symptoms of concussion?"). Apparent differences were found by role when examining the training subscale. On average, nurses endorsed moderate training while the mean of other professional groups ranged from no training to some training. This finding was consistent when examining the four items which make up the training subscale.

This suggests that nurses in this sample are trained, at least moderately, in treating and assessing symptoms of concussion, whereas the other three groups (e.g., school psychologist, social workers, counselors) reported little to no training. This makes intuitive sense when considering that nurses are specifically trained as health care professionals (Davies, Sandlund, & Lopez, 2015; Lewandowski & Rieger, 2009; Weber et al., 2014). A relatively high level of training among personnel is supported by the Health Belief Model (Janz & Becker, 1984) and implementation science (Durlak & DuPre, 2008) as a key variable in predicting programming fidelity, behavior change, and positive student outcomes (Barrett et al., 2013).

When designing a SBCM procedure, nurses will likely need less basic training and also may be able to help train school psychologists, counselors, and social workers in both concussion assessment (Gioia, et al., 2009) and intervention (Arbogast et al., 2013; Jantz et al., 2014; Moser et al., 2012; Sady et al., 2011). Compared to the other three groups, nurses appear to be best suited for delivery of concussion related service in a SBCM protocol due to their self-reported moderate levels of concussion specific training in both assessment and intervention.

Subscales were created to answer research question 1c. The informal procedures subscale is a composite variable composed of four theoretically and statistically similar items (i.e., "I believe my school has effective procedures for identifying the physical symptoms of concussion?", "I believe my school has effective procedures for identifying the psychosocial symptoms of concussion?", "I believe my school has effective procedures for managing the physical symptoms of concussion?", "I believe my school has effective procedures for managing the psychosocial symptoms of concussion?"). For the purpose of this study informal procedures were any concussion management procedures not formalized at the school or school district level. All four groups indicated that they disagreed, or were neutral, in their belief that their

school's current informal concussion procedures were effective. There was little variation, by role or total, when examining the items which made up this subscale. This is important as the district has only a limited RtP procedure with no RtL or SBCM procedures in place. This overall belief that current practices are ineffective may potentially increase staff treatment compliance/fidelity as SSP perceived a need for more effective SBCM programming. Implementation research supports that perceiving a need is a key factor in implementation fidelity and ultimately student outcomes (Barrett, et al., 2013; Durlak & DuPre, 2008; Janz & Becker, 1984).

Two important variables which were not included in a subscale are career experience (i.e., number of years in their profession) and recent concussion experience (i.e., number of concussions served in the past year). Individuals across all professions had a mean of 13.26 (σ = 9.46) years in their current occupation with little variation between professions. Additionally, number of years in their current occupation was normally distributed ($\alpha_3 = 0.66$, $\alpha_4 = -0.11$). These findings are important as it is evidence that this study's sample was balanced in terms of experience both as a whole and by profession which may aid in the generalizability of findings.

Contrary to the balance found in number of years in the field, the number of students with concussions served differed greatly by role. Nurses reported that they served 4.21 students per year which dwarfs the other three professions who reported a range of 0.22 to 0.35 concussions per year. This relatively high rate of students with concussions served by nurses, when compared to the other professions surveyed, may be indicative of nurses having higher self-efficacy in helping students with a concussion. This is a potentially important finding for future SBCM design and implementation as self-efficacy is a key component in both implementation science (Durlak & DuPre, 2008) and the Health Belief Model (Janz & Becker, 1984). It must be

noted the item which measured number of concussion served per year did not explicitly measure self-efficacy. Future research should directly measure self-efficacy as it relates to SSP concussion management.

Nurses worked with more students with a concussion than the other three groups. This experience, combined with their higher levels of training, strengthens the argument that nurses should play a key role in a SBCM protocol. Although school psychologists, social workers, and counselors lack the skills and experience that nurses have, they recognize the ineffectiveness of current informal concussion procedures and the negative impact concussion can have academic achievement. In sum, all four professions have the potential to be utilized in a SBCM protocol with nurses likely needing less initial training and the other groups potentially needing more opportunities to both learn and practice concussion related skills (Davies et al., 2015; Glang et al., 2010).

Research Question 2

What is the relationship between training in concussion, job type, career experience, recent concussion experience and the level at which individuals believe concussions can negatively impact academic performance?

A multiple linear regression was conducted to predict the beliefs of SSP that concussion can negatively impact academic functioning based on specific profession (i.e., school psychologist, nurse, social workers, counselors), training in concussion related assessment and intervention, years in the field, and the number of concussion served in the last year. A nonsignficant regression equation was found ($F(6,132)=1.63$, $p < .14$), with an R^2 of .07. In this sample, being a school psychologist ($p <.04$) was the only significant predictor found when guidance counselor was set as the reference and training, career experience, and recent

concussion experience were controlled. Compared to the constant of guidance counselors, being a school psychologist increased belief in the impact of concussion on academics by 0.38 points. Although the overall model was not statistically significant, being a school psychologist significantly predicted a higher perceived impact. The implication of this finding is that school psychologists may not require as much initial psychoeducational training regarding the importance of concussion management in the schools because they already perceive it to be a concern when compared to the other groups; this makes school psychologists an ideal participant, especially in the initial stages of SBCM programming design and implementation (Durlak & DuPre, 2008; Janz & Becker, 1984; Rosenstock, Strecher, & Becker, 1988). With the impact of concussion on academics already a salient concern, school psychologists may be able to rapidly grasp and integrate into their practice information from initial SBCM professional trainings which emphasize impact, need, and benefit. This early and seemingly profession-specific belief in the impact of concussion also opens the possibility that school psychologists may be suited to spearhead initial planning regarding the design and implementation of SBCM.

Research Question 3

What is the relationship between training in concussion, job type, career experience and the number of students referred to SSP in the past year?

A multiple linear regression was conducted to predict the number of concussions served in the past year by school personnel based on specific profession (i.e., school psychologist, nurse, social workers, counselors), training in concussion related assessment and intervention, and years in the field. A significant regression equation was found ($F(5,136)=19.28$, $p < .01$), with an R^2 of .42. In this sample, being a nurse ($p < .01$) was the only significant predictor found when guidance counselor was set as the constant and controlling for training and career

experience. Being a nurse predicts 4.37 more concussions served a year compared to guidance counselors. This finding is supported by the literature as nurses are trained as medical professionals whereas the other groups traditionally are not (Davies, Sandlund, & Lopez, 2015; Lewandowski & Rieger, 2009; Weber et al., 2014). The implication of this finding is that nurses may be suited to work with students who have sustained a concussion since they are already servicing these students in a district that does not have formal SBCM programing. When designing and implementing a SBCM protocol nurses may be best placed on the front lines of concussion management (e.g., assessment, intervention) as this appears to be an already established and naturally occurring service which they deliver.

Research Question 4

What is the relationship between training in concussion, job type, career experience, number of students with concussion referred in the past year, and the level of belief in the effectiveness of informal concussion management procedures?

A multiple linear regression was conducted to predict belief in efficacy of current informal SBCM procedure by school personnel based on specific profession (i.e., school psychologist, nurse, social workers, counselors), training in concussion related assessment and intervention, years in the field, and number of students with concussion served in the past year. A significant regression equation was found ($F(6,130)=5.14$, $p < .01$), with an R^2 of .19. In this sample, being a nurse ($p <.01$) and a school psychologist ($p <.01$) were significant predictors when guidance counselor was set as the constant. Compared to guidance counselors, being a nurse and school psychologist predicted a -0.88 and -0.50 point change in beliefs of informal effectiveness of SBCM procedures. In other words, compared to counselors, being a nurse or school psychologist predicted less belief in the effectiveness of current informal SBCM

procedures. This may indicate that school psychologists and nurses perceived a need for an effective and formalized SBCM (Durlak & DuPre, 2008; Janz & Becker, 1984; Rosenstock, Strecher, & Becker, 1988).

Training in concussion assessment and intervention significantly predicted beliefs in efficacy of informal SBCM procedures (p <.01). Each one point change in training in concussion assessment and intervention predicts a 0.44 point change in belief in informal SBCM procedures. In other words, the more training a SSP had in these skills the more they reported that their school's current informal procedures were effective. This finding is interesting as it would be reasonable to hypothesize that the better training in concussion assessment and intervention a SSP has, the more they would realize the ineffectiveness of current informal procedures. One possible explanation of this finding is that a lack of formal SBCM programing combined with the known gap in TBI knowledge among SSP (Canto et al., 2014) causes these more highly skilled individuals to operate in silos. By working in silos they may see their relative higher skills being used more frequently and/or effectively and infer that others are doing the same as well. Because there is no interconnected framework (e.g., SBCM), this assumption would be in error and an artifact of perception when operating in a silo. This finding is somewhat counterintuitive and a more nuanced methodological approach is needed for its analysis. It would be of value to explore if indeed siloing exists with the relatively higher skilled individuals, and if siloing does exist, whether or not it mediates the relationship between training and perception of informal procedure.

Research Question 5

5a) *What are the most common concussion referral sources endorsed by SSP?*

5b) *Is there a difference in concussion referral source by role?*

Fisher's Exact Test was utilized to detect a significant difference in proportions in referral source by role. When a significant difference by proportion was found the percentages were visually examined to reasonably judge which group(s) contributed to the difference. Utilizing this approach, nurses overwhelmingly received the highest frequency of concussion referrals from numerous sources when compared to school psychologists, social workers, and guidance counselors. Nurses reported receiving a high percentage of referrals (all proportion differences, $p < .01$) when referrals originated from athletic trainers (38.1%), community-based medical professionals (36.4%), parents (66.7%), sport coaches (30.3%), student self-referral (27.3%), and teachers (33.3%). Social workers and nurses both reported 21.2% of referrals from "other" sources ($p < .01$). There was no difference in the proportion of concussion related referrals originating from school administrators and school nurses based on SSP occupation (i.e., school psychologist, nurse, counselor, social worker). Interestingly, 55.6% of all school personnel reported not receiving any concussion referrals (e.g., identified concussed students themselves, did not work with any students suffering from a concussion). This finding is supported by the literature in terms of concussion being a relatively prevalent injury which is often underreported and/or under-identified (Coronado et al, 2012; Gioia, 2014; Reddy et al., 2008).

Several implications may be drawn from these findings. First, nurses are overwhelmingly referred more students for concussion than the other three professionals and their referral sources are diverse. When designing a SBCM protocol it would be wise to place school nurses in critical concussion identification and communication positions since these data suggest that nurses currently receive concussion referrals in a district without formal programing. Social workers also may be useful in receiving concussion related referrals especially when it

entails nontraditional sources. Nontraditional sources are any sources other than athletic trainers, community medical professionals, parent/guardians, administrators, nurses, coaches, students, and teachers. These findings are noteworthy as communication has been indicated as a primary barrier for working with students who have suffered a concussion/TBI (Canto et al., 2014). If communication can be enhance by fortifying naturally occurring lines of communication then overall SBCM surveillance likely has a better likelihood of identifying the pervasive issue of concussion under identification (Chrisman, Quitiquit & Rivara, 2013; Duff & Stuck, 2014).

Limitations

One limitation of this study was that similar items, in both meaning and wording, were presented in close proximity on the survey. This clustering of similar items may limit response variability (e.g., physical vs. psychosocial, identification vs. management). Data from teachers were not available for inclusion in this study because they did not participate in the mental health needs assessment. This is noted as a study limitation because teachers are important direct service providers in SBCM and their feedback may have been informative. Additionally, this study utilized secondary data analysis which limited the content and type of items included in analyses. Finally, it is possible that some schools were disproportionately represented during data collection resulting in significant nesting of SSP. This nesting would impact analysis as independence is an assumption of regression. However, the data available did not allow for a nuanced analysis of independence. Because the SSP came from 79 schools it is reasonable to assume that they represented different schools which may mitigate any statistical confounds associated with nesting. It is therefore believed that significant nesting of personnel did not occur and that independence of observations was not significantly violated.

Recommendations for Future Research

The results of this study indicate a need for future research in SBCM communication and implementation characteristics. To begin with, the counterintuitive finding that higher training predicts beliefs that informal procedures are effective needs to be examined with greater methodological complexity in order to determine if confounds, such as siloing, impacted these results. This is important as research has found considerable gaps in training among SSP in how to help students with a concussion/TBI (Canto et al., 2014).

Teachers are a group which will be highly involved in any permutation of SBCM procedures in terms of supporting classroom accommodations and intervention, as well as symptom progress monitoring. This study did not examine the training, experiences, and beliefs of teachers as they related to students with concussion. In addition to teachers, parents and students are also critical stakeholders and will be important to include in future SBCM implementation research. Including all additional stakeholders (e.g., teacher, parents, students) is the next logical step in understanding how to best design and implement SBCM programming. A mixed methods approach may be appropriate when trying to better understand the needs of all stakeholders involved in SBCM programming.

Finally, communication of concussion referrals should be examined further. Although this study discovered how vital nurses are to the communication/referrals, it did not investigate the methods with which they received these referral (e.g., phone calls, email, reaching out to families, product of dispensed preventative/ psychoeducational resources). Understanding and supporting the mechanisms of successful referral communication may further reinforce naturally occurring lines of communication and help address the pervasive under identification of

individuals with concussion (Gioia, 2014; Reddy et al., 2008). This study serves as only the first step of many in understanding how to design and implement a successful SBCM program.

Implications for Practice

Several findings from this study have the potential to impact the design and implementation of SBCM programming. Perhaps the most informative and impactful finding from this study is how important nurses can be when functioning as a hub of concussion referral communication. In this school district without formal SBCM procedures nurses fielded the vast majority of concussion referrals both in terms of volume and diversity of source when compared to school psychologists, social workers, and counselors. A district designing a SBCM program should be encouraged to place their nurses in situations where these naturally occurring strengths can be utilized. Schools would also do well to reinforce these lines of communication through informed design. For example, a school district may send out fliers to parents at the start of the year that directs parents to call the school nurse if they suspect that their child has suffered a concussion. The benefit of this approach is twofold. First, parents already contact nurses at a higher rate than other SSP, and secondly, this helps address the communication/surveillance concern which has been noted in the literature as a major barrier in concussion assessment and intervention (Gioia, 2014; Reddy et al., 2008).

The second finding of note is that the SSP examined in this sample reported that they agreed to agreed strongly that concussion is an injury that can negatively impact academic performance. This finding can be interpreted that these groups view concussion as a problem for students which should to be addressed. Literature on health behaviors and implementation characteristics would suggest that this perception of a need indicates a desire to address the problem (Durlak & DuPre, 2008; Janz & Becker, 1984). School psychologists seem particularly

attuned to the need for helping students with a concussion which indicates that they may be prime candidates for early programming leadership roles. Similarly, perception of need is also demonstrated by dissatisfaction with current informal concussion procedures. If SSP do not believe what the school currently offers is effective in terms of services for students with a concussion it is reasonable to assume that they would prefer to see these processes changed, the way to change an informal process is to implement a formal process. These data suggest that school psychologists and nurses are dissatisfied with current practices. The implications of this finding supports that both school psychologists and nurses may act as possible programming leaders, trainers, and contribute to the design and implementation of SBCM programming.

A third finding that may impact SBCM design and implementation is the high level at which nurses are trained in identification and assessment of concussion when compared to the other groups. On average, nurses endorsed that they had moderate levels of concussion specific training whereas the other three groups indicated no training in concussion related services. This is an important distinction as considerable gaps have been found in concussion/TBI training among SSP (Canto et al., 2014). School districts may benefit from designing SBCM procedures that place nurses in positions to deliver concussion related assessment and intervention services. Additionally, nurses may serve as ideal trainers in helping other SSP learn the skills necessary to deliver services in a SBCM program.

Conclusion

Provider implementation characteristics are central to programming outcomes. In this study, SSP characteristics were examined and their ability to predict concussion related beliefs and practices were quantified. An additional aim of this study was to explore communication referral patterns among SSP. Findings from this study highlight the important role both nurses

and school psychologists can play in the design and implementation of a SBCM protocol. Nurses appear to be ideally suited for referral based communication, service delivery, and the training of others. Nurses and school psychologists both appear to sense the need for formal SBCM programming when compared to social workers and counselors. This perceived need may indicate that they are prime candidates to spearhead roles related to the design and implementation of SBCM procedures. School psychologists and pediatric school psychologists who are highly trained in consultation and a systems-based approach may be best suited for leadership roles do to their training and beliefs. Although more research is needed, this study represents the first step in bridging the gap between experimental concussion research and the successful delivery of these innovations through SBCM programming in order to help students recover from a concussion.

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Appendices

Appendix A: School Districts Return to Play Policy

2431.03 - CONCUSSIONS AND HEAD INJURIES

It is the policy of the Board that the Principal provide the materials developed by the Florida High School Athletic Association (FHSAA) to educate coaches, student athletes, and parents/guardians of student athletes about the nature and risks of concussions and head injuries, including continuing to play after a concussion or head injury, before any student athlete is allowed to participate in any interscholastic athlete activity or practice for any school-sanctioned athletic team. Student athletes and their parents shall be required to sign the FHSAA EL3CH form before participating in any practice or interscholastic competition. Per the FHSAA rules and this policy, coaches and licensed trainers shall document completion of the online training program provided by the FHSAA annually.

During any athletic season, a coach or licensed trainer who suspects that a student athlete may have sustained a concussion or head injury shall remove the student athlete from participation or competition at that time. For purposes of this policy, a "student athlete" is any student who tries out for or participates on any athletic team sponsored by the District. When a student athlete is removed from an interscholastic athletic activity or other competition, including any practice session, because of a suspected head injury or concussion, that student athlete may not return to the contest or the practice until written clearance to participate from a medical provider licensed in Florida has been provided.

Appendix B: AT Manual- Assessment and Management of Concussions

a. Concussion checklist
i. Increasing headache
ii. Nausea and vomiting
iii. Unequal pupils
iv. Disorientation
v. Progressive impairment of consciousness
vi. Gradual rise in blood pressure
vii. Decreased pulse rate
1. Grade 1 Concussion
a. Most difficult to recognize
b. Most frequent
c. No loss of consciousness
d. Post-traumatic amnesia less than 30 minutes
e. Impairment of cortical function – recent memory, assimilating & interpreting new information
f. Immediate removal from game
2. Grade 2 Concussion
a. Loss of consciousness less than 5 minutes or post-traumatic amnesia greater than 30 minutes but less than 24 hours.
b. Mental status exam
c. Pupillary reflexes
d. Extra-ocular movements
e. Remainder of cranial never exam
f. Romberg test
g. If brief loss of consciousness & no neck pain, removal on a spine board is not necessary
h. Otherwise manage in same manner as grade 3
i. Transport via EMS
3. Grade 3 Concussion
a. Loss of consciousness greater than 5 minutes or post-traumatic amnesia greater than 24 hours
b. Treat as c-spine fracture, i.e., leg roll
c. Assess ABC's
d. Transport via EMS on spine board with head & neck immobilized
e. Remove facemask and mouthpiece
f. Follow the ALL OR NONE RULE if further equipment needs to be removed, i.e., helmet and shoulder pads together.
III. Return to Athletic Participation
A. Grade 1 Concussion
First concussion – return after asymptomatic for one week with physician documentation of event
Second concussion – return after a minimum of two weeks, must be asymptomatic for one week and provide documentation from physician
Third concussion – terminate season and document termination
B. Grade 2 Concussion
First concussion – return after asymptomatic for one week with physician documentation of event

Second concussion – return after a minimum of one month, must be asymptomatic for one week and provide documentation from physician
Third concussion – terminate season and document termination
C. Grade 3 Concussion
First concussion – return after one month if asymptomatic for one week with physician documentation of event
Second concussion – terminate season and document termination
D. It becomes incumbent upon the athletic trainer to inform coaches and athletic directors that student athletes must be excluded from athletic events when any of the previous conditions are met. Athletic trainers will document their notices to coaches and athletic directors advising them of the athlete's need for exclusion.
IV. Referral for Definitive Medical Care
A. LOSS OF CONSCIOUSNESS OR COMA
B. Prolonged mental confusion or prolonged amnesia
C. Increasing or persistent head ache
D. Pupils unequal or failed to react to light
E. In-coordinate or involuntary eye movements
F. Abnormal breathing patterns
G. Indications of possible skull fracture (clear fluid or blood coming from the ears, Battle's sign, raccoon eyes, skull depressions)
H. Unusual slowing of the heart rate and increasing blood pressure
I. A positive test for any of the cranial nerves
J. Any doubt regarding the presence of an intracranial lesion

Appendix C: AT Manual- Care of the Student with a Suspected Concussion

Concussion and the resulting potential complications, such as second impact syndrome, are potentially life-threatening situations that student athletes may suffer as a result of their athletics participation. Concussions may occur in almost any contact activity. Nine of every 10 head injuries in football are reported as concussions. Since no head injury should be considered trivial, proper evaluation and sound decision making are imperative before the sports medicine profession permits the student athlete to return to activity.

The definition of concussion is a post-traumatic impairment of neural status. While loss of consciousness and amnesia have been viewed as the primary components of this injury and have formed the basis for most grading scales, some of the mild concussions, the so called "bell rung" or "ding," with no resulting loss of consciousness or post-traumatic amnesia, may go unrecognized by coaches, athletic trainers, fellow players or team physicians. The symptoms of concussion (Table 1) vary, depending on the degree and extent of injury. **A student athlete rendered unconscious for any period of time should not be permitted to return to the practice or game in which the head injury occurred. In addition, no student athlete should be allowed to return to athletics activity while symptomatic.** Prolonged unconsciousness and neurologic abnormalities suggesting intracranial pathology may require urgent neurosurgical consultation or transfer to a trauma center. If there are any questions as to the severity of past head trauma, or if the trauma required intracranial surgery, clearance of the student athlete should be deferred until further records are obtained or neurosurgical evaluation is performed.

Several grading scales have been proposed to characterize the degrees, potential severity and return-to-play criteria of concussion. Unfortunately, these categorizations vary and are not universally accepted. Based on the current lack of consensus among the medical community on management of concussions, the NCAA does not endorse any specific concussion grading scale or return-to-play criteria. Although the grading scales and return-to-play criteria currently in the literature may assist in the clinical decision making for the student-athlete who has suffered a concussion, these grading scales and return-to-play criteria should not be substituted for the clinical judgment of the examining physician.

Post-Concussion Syndrome

After a head injury, the student athlete may report multiple symptoms (Table 1). While these symptoms usually are short-lived and resolve spontaneously, some individuals may have persistent symptoms after a concussion. Characteristics of post-concussion syndrome are symptoms such as impaired memory and concentration, persistent headache, fatigue, mood and sleep disturbances and dizziness. The student-athlete with symptoms of post-concussion syndrome should not be considered for return to physical activity until resolution of symptoms occurs. Diagnostic studies such as MRI or CT imaging and/or neuropsychological testing may be indicated and referral to a neurologist or neurosurgeon should be considered.

Multiple Concussions

The student athlete who suffers one concussion may be at greater risk for another. Evidence of cognitive impairment and neuroanatomical damage has been reported in some individuals. The number and degree of concussions necessary for permanent impairment is unknown. Return-to-play decisions should be made on an individual basis after the

student athlete has full recovery of neuronal function and can be informed of the potential risks for subsequent concussion and possible complications. As with all concussions, careful review of the mechanism of injury and appropriate changes in the environment that can be made to reduce the likelihood of subsequent concussion should be undertaken.

Second-Impact Syndrome

The medical staff needs to be aware of the rare but often fatal consequence of the second-impact syndrome. This occurs when an individual sustains a second, often minor trauma to the head before the initial symptoms of the first head injury have resolved. The resulting loss of autoregulation of the brain's blood supply could result in vascular engorgement and herniation of the lower brain, causing death. There is a high mortality rate associated with second-impact syndrome.

Summary

The attending medical staff should not allow a player to resume participation in physical activity while the injured student-athlete is recovering from his/her post-concussive symptoms. All individuals involved in sports, including coaches, athletic trainers, team physicians, student athletes and parents, should be educated in the symptoms of concussion and the need for medical attention in the event of such an injury. With regard to injury prevention in football, coaches, athletic trainers and medical student services personnelshould strive to help educate players in proper tackling techniques so that these injuries can be minimized. Neck-strengthening exercises are important in preventing rapid acceleration/deceleration injuries that can occur without a direct blow to the head. In addition, proper equipment and maintenance, including adequate helmet fit (inflation of air bladder in helmet) and shock-absorbing mouthpieces, can be beneficial in preventing concussions. All medical student services personnelneed to be reminded that they should suspect all unconscious student athletes to have suffered a cervical spine injury until proven otherwise. Special care to the cervical spine should always be used in transporting an unconscious player.

Appendix D: Needs Assessment Form

Demographic Specific (p.1)
Background Information

1	What is job role?			
School Psychologist	Guidance Counselor	Social Workers	Nurse	
2	How many years have you worked in this professional role (including full-time internship)?	Number = _____		
3	What is your gender?	Male	Female	
4	What grades or age groups are on your case load this school year (2013 – 2014)? (Circle all that apply)			
Infants and toddlers and/or preschoolers	K-5th grades	6-8th grades	9-12th grade	
5	How many of each of the following school buildings are you current assigned to serve:			
Elementary: ____	Middle:____	High: ____	Other: (please specify):_____	
6. In the last few years, have you had professional development about student mental health issues?	Yes	No		
If YES, list or describe trainings you have attended related to mental health issues: _____ _____ _____ _____				

Concussion Specific (p.8)
Spotlight on Serving Students with Brain Injury

17.	From January 2013 to December 2013, approximately how many students came to your attention for:		
Concussion:	_____ (*number*)	Moderate/Severe Traumatic Brain Injury (TBI):	_____ (*number*)
18.	At your schools, who typically brings students with a concussion to your attention? (*check all that apply*)		
___ Athletic trainer ___ Community-based medical professional (e.g., family doctor, pediatrician, neurologist) ___ Parent/guardian ___ School administrator ___ School nurse ___ Sports coach ___ Student self- referral			

___ Teacher
___ Other:_____
___ N/A (I have not had any contact with students with concussion in past year)

Physical Symptoms of concussion include: headache, fatigue, concentration difficulties, sensory sensitivity, and impairment in processing/cognition/memory.
Psychosocial Symptoms of concussion include: impulsivity, depression, anxiety, personality change, disruptive behaviors (e.g., oppositional defiant disorder, conduct disorder), and/or post-traumatic stress disorder (PTSD).

19.	Student academic performance can be negatively impacted by the:				
Physical symptoms of concussion	1 Strongly Disagree	2 Disagree	3 Neutral	4 Agree	5 Agree Strongly
Psychosocial symptoms of concussion	1 Strongly Disagree	2 Disagree	3 Neutral	4 Agree	5 Agree Strongly
20.	How much training (professional development, college-level coursework) do you have with:				
Identifying the physical symptoms of concussion	1 No Training	2 Some Training	3 Moderate Training	4 Significant Training	5 Extensive Training
Identifying the psychosocial symptoms of concussion	1 No Training	2 Some Training	3 Moderate Training	4 Significant Training	5 Extensive Training
Managing the physical symptoms of concussion	1 No Training	2 Some Training	3 Moderate Training	4 Significant Training	5 Extensive Training
Managing the psychosocial symptoms of concussion	1 No Training	2 Some Training	3 Moderate Training	4 Significant Training	5 Extensive Training
21	I believe my school(s) has effective procedures for				
Identifying students with physical symptoms of concussion	1 Strongly Disagree	2 Disagree	3 Neutral	4 Agree	5 Agree Strongly

Identifying students with psychosocial symptoms of concussion	1 Strongly Disagree	2 Disagree	3 Neutral	4 Agree	5 Agree Strongly
Managing a student's physical symptoms of concussion	1 Strongly Disagree	2 Disagree	3 Neutral	4 Agree	5 Agree Strongly
Managing a student's psychosocial symptoms of concussion	1 Strongly Disagree	2 Disagree	3 Neutral	4 Agree	5 Agree Strongly