Return to School after Sports-Related Concussion

By

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Dissertation

Submitted to the Faculty of the

Graduate School of Vanderbilt University

in partial fulfillment of the requirements

for the degree of

DOCTOR OF PHILOSOPHY

in

Hearing and Speech Sciences

May, 2016

Nashville, Tennessee

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ACKNOWLEDGEMENTS

This work was supported by a microgrant from The Vanderbilt Institute for Clinical and Translational Research (VR#15005). This project was possible due to the support of the Tinney family through the Lindsay Sale-Tinney Scholarship. The scholarship gave me the freedom to dedicate myself to the doctoral program and this dissertation. I am grateful for my dissertation committee members and the unique expertise that each of them brought to the committee. I am indebted to Dr. Stephen Camarata for agreeing to co-chair the committee and for helping me define the scope of this project. I would especially like to thank my mentor and dissertation committee co-chair Dr. Michael de Riesthal for his role in shaping me as a clinician, teacher, and researcher over the past several years. He has been overwhelmingly supportive and encouraging throughout the entire process. I would also like to thank Dr. Mayur Patel for his guidance and for challenging me to expand my understanding and involvement in the field of traumatic brain injury. I would like to thank the parents and children who agreed to participate in this study for being willing to share their personal experiences with concussion, as well Dr. Diamond and the practitioners from the Vanderbilt Sports Concussion Center who do the work on the ground to help these families. I am also appreciative of the survey feedback provided by Paula Denslow of Project Brain and by Vanderbilt's Survey Research Shared Resource. Additionally, I am grateful for the time that Megan White contributed to help schedule the phone calls with the parents and children. Finally, I would like to thank my friends and family who have supported me throughout this process. This would not have been possible without you.

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LIST OF ABBREVIATIONS

CCC= concordance correlation coefficient
CI= confidence interval
CT= computerized tomography
HS= high school
ImPACT= Immediate Postconcussion Assessment and Cognitive Testing
IQR= interquartile range
MRI= Magnetic Resonance Imaging
OR= odds ratio
PCSS= Post Concussion Symptom Scale
SCAT2= Sports Concussion Assessment Tool 2
STEP= School Transition and re-Entry Program
VSCC= Vanderbilt Sports Concussion Center

CHAPTER 1

INTRODUCTION

Definition and epidemiology

Concussion, as defined by the recent consensus statement on concussion in sport is "a complex pathophysiological process affecting the brain, induced by biomechanical forces" (McCrory et al., 2013). A concussion is caused by an impulsive force to the head, either via a blow to the head or the body. The symptoms are usually transient and related primarily to functional disturbances of the brain, rather than to the structural damage that may occur. Therefore, findings on traditional imaging studies (i.e., MRI and CT) are typically absent (McCrory et al., 2013).

In the youth population, sports-related injuries account for a significant portion of concussions. In a five-year national study of emergency department visits, 4 in 1000 children aged 8-13 years old and 6 in 1000 youth aged 14-19 years old presented to the emergency department due to a sports-related concussion, and half of youth who presented to the emergency department with concussion sustained their injury during sports-related activities (Bakhos, Lockhart, Myers, & Linakis, 2010). Additionally, concussions account for 8-15% of high school sports injuries (Gessel, Fields, Collins, Dick, & Comstock, 2007; Meehan, d'Hemecourt, Collins, & Comstock, 2011; Marar, McIlvain, Fields, & Comstock, 2012). Football injuries are the most common cause of sports-related concussions in males, while soccer injuries are the most common cause of sports-related concussions in females (Laker, 2011; Marar et al., 2012). Concussions in sports are caused primarily by contact between players, followed by players hitting the playing surface (Marar et al., 2012).

Previous investigations suggest that although youth athletes tend to underreport concussions (McCrea, Hammeke, Olsen, Leo, & Gukiewicz, 2004; Williamson, 2006), rates of reported concussions are on the rise (Lincoln et al., 2011). This increase may be due to a true increase in concussion accompanying a rise in youth sport participation (National Federation of State High School Associations, 2015), to an increase in awareness of concussion and education campaigns such as the Centers for Disease Control's Heads Up in Youth Sports (Centers for Disease Control and Prevention, n.d.), or to a combination of the two (Lincoln et al., 2011).

Pathophysiology of concussion

A concussion leads to a complex sequence of metabolic changes that may persist for weeks post-injury (Giza & Hovda, 2001). Immediately after a concussion there is a release of excitatory neurotransmitters and a depolarization of neurons, accompanied by an efflux of potassium and an influx of calcium. This is followed by hyperglycolysis, as the brain utilizes more energy to try to return to ionic homeostasis. Neuronal dysfunction can be caused by excessive lactose (a byproduct of glycolysis), the increase in intracellular calcium, and the decrease in intracellular magnesium. Due to decreased cerebral blood flow, the supply of glucose is diminished as the need for energy is increased. The calcium accumulation that occurs can decrease oxidative metabolism and may eventually (though not necessarily) lead to nerve cell death. The period of hyperglycolysis is followed by a depression of glucose metabolism as compared to baseline that may remain for 2-4 weeks after the concussion; however, the relationship between the glucose metabolism depression and clinical symptoms is unclear (Giza & Hovda, 2001).

Symptoms

Acute signs and symptoms of concussion can be divided into four domains: physical, cognitive, emotional, and sleep (Harmon et al., 2013). In high school athletes, the most commonly reported concussion symptoms include headache and dizziness, which both fall in the physical domain (Gessel et al., 2007; Meehan et al., 2011; Marar et al., 2012). Within the cognitive domain, confusion and difficulty with attention or memory are common signs. Emotional signs and symptoms may include irritability and sadness, among others, and signs and symptoms related to sleep may include drowsiness, trouble falling asleep, or a change in quantity of sleep (see Figure 1 for a full list of signs and symptoms). Loss of consciousness occurs only in a minority of cases (McCrea et al., 2003; Guskiewicz et al., 2003; Meehan et al., 2011) and is not a necessary criterion for a diagnosis of concussion (McCrory et al., 2013).

Figure 1. Signs and symptoms of concussion.

Domain	Signs and Symptoms
Physical	Headache, nausea, vomiting, balance problems, dizziness, visual problems, fatigue, sensitivity to light, sensitivity to noise, numbness/tingling, dazed, stunned
Cognitive	Feeling mentally "foggy," feeling slowed down, difficulty concentrating, difficulty remembering, forgetful of recent information and conversations, confused about recent events, answers questions slowly, repeats questions slowly
Emotional	Irritable, sadness, more emotional, nervousness
Sleep	Drowsiness, sleep more than usual, sleep less than usual, difficulty falling asleep

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Concussion recovery

For the majority of youth who sustain a concussion, symptoms resolve within days to weeks after the injury (Collins, Lovell, Iverson, Ide, & Maroon, 2006). However, for approximately 10-15% of youth (estimates vary by the specific population being studied; McCrory et al., 2013) symptoms may persist for weeks to months post-concussion. Children who experience persistent symptoms may receive a diagnosis of post-concussion syndrome; however, the discordant diagnostic criteria outlined in the International Classification of Diseases, 10th Edition and the Diagnostic and Statistical Manual of Mental Disorders, 4th Edition result in significant differences in classification (Barlow, 2016). Additionally, the 5th edition of the Diagnostic and Statistical Manual of Mental Disorders no longer includes post-concussion syndrome as a diagnostic category; rather, it includes Major or Mild Neurocognitive Disorder due to Traumatic Brain Injury (American Psychiatric Association, 2013).

Although the current understanding of what predisposes children to having a prolonged recovery is continuing to evolve, some studies suggest factors such as loss of consciousness (Asplund, McKeag, & Olsen, 2004; McCrea et al., 2013), post-traumatic amnesia (McCrea et al., 2013), greater severity or duration of acute symptoms (Asplund et al., 2004; McCrea et al., 2013; Cancelliere et al., 2014), history of previous concussion(s) (Cancelliere et al., 2014), age (i.e., older youth have more prolonged outcomes as compared to adults or younger children; Field, Collins, Lovell, & Maroon, 2003; Babcock et al., 2013; Cancelliere et al., 2014), and female sex (Babcock et al., 2013; Dougan, 2014a) predict a slower recovery. However, these findings are not consistent across all studies (e.g., Babcock et al., 2013; Lee et al., 2013). As time post-injury increases, non-injury factors are stronger

predictors of symptoms than injury factors (McNally et al., 2013; Barlow, 2016). Thus, some concussion researchers have called for the application of a biopsychosocial model that considers pre-injury child and family factors in addition to injury factors associated with persistent symptoms in youth with concussion, so as to better identify and manage youth who may be at greater risk post-concussion (Yeates, 2010).

School-related issues

The common symptoms (e.g., headache, dizziness) and cognitive deficits (e.g., attention, memory) experienced after concussion have the potential to affect a child's ability to function successfully at school during recovery. For example, headaches can distract a student during school tasks and memory deficits may make standardized testing difficult (Halstead et al., 2013). Several studies have investigated the concerns and perceived needs of children and their parents related to schooling after a concussion. In a qualitative investigation of service needs after mild TBI, Gagnon, Swaine, Champagne, & Lefebvre (2008) found that adolescents whose mild TBI did not require admission to the hospital (i.e., the sample most similar to the sports-related concussion population) were primarily concerned about return to physical activities while parents wanted information about facilitating a successful return to school and had concerns regarding the potential academic impact of concussion. The adolescents in the study by Gagnon and colleagues perceived school personnel as not being informed about brain injury and not providing appropriate accommodations to facilitate return to school. In a series of cross-sectional, clinic-based studies of sports-related concussion, middle and high school students and their parents expressed more concern about the impact of the concussion on academic performance than their elementary school peers (Ransom et al., 2013). Additionally,

students who were still symptomatic at time of evaluation (within 28 days of injury) reported greater concern about the effect of concussion on academic performance as compared to those who had returned to symptom baseline (Ransom, Vaughan et al., 2015). However, both those who had and those who had not returned to symptom baseline expressed greater concern about school performance than their peers who had not been concussed (Sady et al., 2015). Level of concern about academic performance has been shown to be related to symptom severity for both parents and adolescents (though not in younger children; Ransom, Pratson et al., 2014; Ransom, Vaughan et al., 2015). Among those who were symptomatic at evaluation, high school students expressed greater concern than their elementary school and middle school peers, while concern did not differ across grade level for the parents (Ransom, Vaughan et al., 2015).

In recent years researchers have turned their attention to the need to address return-to-school issues during recovery. Kirkwood et al. (2008) outlined clinical management strategies for mild TBI (inclusive of concussion) organized by time post-injury across several domains. In the school domain, the authors suggested that in the acute stage (time of injury to 3 days post-injury), management involves decision-making about timing of return to school and the need for cognitive rest, as well as informing the school of the brain injury so that personnel can monitor the student for symptom exacerbation. In the post-acute stage (4 days to 3 months), management includes a graduated return to school, education of school personnel, and appropriate academic accommodations/modifications. Long-term management (4 months post-injury to full recovery) requires collaborative management of school-based needs by healthcare and

school personnel, as well as attention to non-injury factors that may influence necessary educational interventions.

Similar recommendations were made by Sady, Vaughan, & Gioia (2011), who proposed managing return to school by encouraging the student to work below the threshold at which symptoms return or are exacerbated. They suggest cognitive rest, followed by school-related exertion at home for increasing lengths of time as tolerated, then return to school with modifications (e.g., shortened day, rest breaks) and accommodations (e.g., lighter work load, extended time for assignments) until recovery. The specific timing and accommodations within the return to school plan should be individualized and dictated by a child's tolerance to increases in cognitive effort. Master, Gioia, Leddy, & Grady (2012) presented similar recommendations for a gradual return-to-learning (see Figure 2), but framed it both visually and conceptually in the same manner in which well-accepted return-to-play guidelines are often presented.

Figure 2. Return to learn plan.

Stage	Activity	Objective
No activity	Complete cognitive rest- no school, no homework, no reading, no texting, no video games, no computer work.	Recovery
Gradual reintroduction of cognitive activity	Relax previous restrictions on activities and add back for short periods of time (5-15 minutes at a time).	Gradual controlled increase in subsymptom threshold cognitive activities.
Homework at home before school work at school	Homework in longer increments (20-30 minutes at a time).	Increase cognitive stamina by repetition of short periods of self-paced cognitive activity.
School re-entry	Part day of school after tolerating 1-2 cumulative hours of homework at home.	Re-entry into school with accommodations to permit controlled subsymptom threshold increase in cognitive load.
Gradual reintegration into school	Increase to full day of school.	Accommodations decrease as cognitive stamina improves.
Resumption of full cognitive workload	Introduce testing, catch up with essential work.	Full return to school may commence Return-to-Play protocol.

Note. Recreated with permission of SLACK Incorporated from Master et. al, 2012.

Cognitive rest, or abstinence from mentally taxing activities (e.g., studying, sending text messages), is the first recommendation in each of the above guidelines. Along with physical rest, it has been referred to as "the cornerstone of concussion management" (McCrory et al., 2009). Existing evidence suggests that higher levels of cognitive exertion are associated with longer duration of symptoms (Brown et al., 2014). However, excessive periods of strict cognitive rest can also lead to slower recovery (Thomas, Apps, Hoffmann, McCrea, & Hammeke, 2015). Therefore, for cognitive rest and the subsequent steps in the graduated return to school plan, the goal of the recommendations is to balance restriction of activities to reduce symptom exacerbation with the goal of returning to normal activities to avoid a disruption of participation and to promote recovery (DeMatteo et al., 2015). Despite the growing consensus that a graduated return-to-school is the best approach to concussion management for children, there is very little empirical data to describe the success with which children transition back to school post-concussion and the use of the recommended accommodations/modifications to support that success.

Return to school outcomes

In addition to traditional standardized measures of academic achievement, outcomes related to return to school after concussion include receipt of services, absences, perceived academic performance, and subjective measures of satisfaction.

Receipt of services

A recent study of the impact of an online concussion education and management intervention included the use of concussion logs for all high school fall athletes in the 25 participating schools (Glang et al., 2015). Approximately 78% of athletes who sustained a concussion completed a survey question about school-based accommodations. The authors

reported that, of the students who responded, 56% received at least one school-based accommodation. For students who endorsed the receipt of accommodations, the group that participated in the online concussion education received an average of 2.3 accommodations compared to 1.7 accommodations for the group that did not participate in the online training. The most common accommodations were extended time to complete tasks (78.7%) and reduced workload (46.9%).

A study of 46 children with sports-related concussions found that provider recommendations for school-related accommodations were related to parent and child symptom report and performance on neurocognitive testing; additionally, the recommendation of more accommodations was associated with a reduction of parent and child academic concerns at a follow up appointment for a self-selected subsample of 20 students. The study did not report, however, the number of accommodations that were actually implemented by the children's schools (Vaughan et al., 2014).

Absences

In the general population, excessive absenteeism is related to lower grades and poorer adjustment (Moonie, Sterling, Figgs, & Castro, 2008). A retrospective study of 966 high school students with either concussions (n=494) or lower leg injuries (n=472) found that the average number of student absences increased significantly from 1.57 absent days in the academic quarter prior to injury to 2.29 absent days in the quarter of injury for individuals with concussion. This significant increase was found in the concussion group only. Students with concussion were 1.7 times as likely to have more absences in the quarter of injury as compared to the quarter prior to injury, and nearly twice as likely to have an increase in absences as those with lower leg injuries (Stringer, 2014). Additionally,

absence from school was associated with a decrease in grade point average. In a study of 216 children aged 12-18 with sports-related concussion, 72% of children missed school due to the concussion, with an average of 3 days missed. Missing school was associated with greater number of symptoms at time of injury, parent and child total symptom score at time of evaluation (within 28 days of injury), and the exacerbation of symptoms with exertion (Vaughan et al., 2013).

Academic performance

Ransom and colleagues have reported several clinic-based cross-sectional studies of students who were evaluated within 28 days of injury. In several studies, they found that that middle and high school students experience greater post-concussion school-related problems than younger students, and that these problems were associated with concussion symptoms (Ransom et al., 2013; Ransom, Zayat et al., 2014; Ransom, Sady, McGill et al., 2015). Additionally, the presence of cognitive exertion effects, or the increase in symptoms during neurocognitive testing, poorer pre-injury executive function, and greater decline in executive function were related to greater subjective reports of school-related post-injury problems (Ransom et al., 2013; Ransom, Zayat et al., 2014; Ransom, Sady, Zayat et al., 2015; Sady et al., 2015; Ransom, Vaughan et al., 2015). Students who were still symptomatic at the time of evaluation reported more school problems than those who had returned to symptom baseline. However, those who had returned to symptom baseline reported that they had experienced trouble in at least one class since their concussion. Of symptomatic students, those in high school and middle school (and their parents) reported a greater number of problem classes/subjects than their elementary school peers (Ransom, Vaughan et al., 2015).

In Stringer's (2014) aforementioned retrospective study of 966 high school students with either concussions or lower leg injuries, GPA was found to decline significantly after concussion, but only for younger high school students (i.e., grades 9 and 10 v. grades 11 and 12) who had a severe concussion, as evidenced by greater time lost from sport (Stringer, 2014). However, in a study of 216 children aged 12-18 with sports-related concussion, 31% experienced a drop in grades (per child and/or parent report). Those who reported the drop in grades had higher maternal education, greater parent report of post-concussive symptoms at baseline, the presence of an exertion effect, and a decreased likelihood of having experienced amnesia at the time of injury (Vaughan et al., 2013).

Summary and rationale

Participation in youth sports continues to rise in the United States (The National Federation of State High School Associations, 2015). While there is evidence that participation in sports promotes positive physical and psychological health, there exists the need to consider the impact of injuries that may be sustained by youth during practice and competition (Merkel, 2013). Specifically, the academic responsibilities of school-aged children may be challenging during the period of concussion recovery. Currently, as described above, we know that parents and children are concerned about the impact of concussion on their academic performance, that children experience interfering symptoms and academic difficulties after concussion, and that the recommendation of school-based accommodations is related to a decrease in concern regarding the impact of concussion on academic performance. To date, only one study has reported on receipt of accommodations post-concussion (Glang et al., 2015). While that study found that more than half of students receive some form of classroom accommodations post-concussion, it did not examine the

relationship between the receipt of accommodations, symptom severity, demographic factors, and academic outcomes.

Study Aims

The purpose of the current study is to describe return to school after sports-related concussion, including the frequency with which students are receiving accommodations to support return-to-school, as is commonly recommended in the literature. The first three aims are descriptive in nature and are as follows:

Aim 1: Describe school outcomes (i.e., absences due to concussion and parent/child report of change in academic performance) following concussion.

Aim 2: Describe informal and formal classroom accommodations received after concussion.

Aim 3: Describe parent/child satisfaction with classroom accommodations and the return to school experience.

The final two aims test for significant relationships between the outcomes captured in Aims 1 through 3 and between demographic and injury factors and those same outcomes.

Aim 4: Identify the relationship among selected return to school outcomes. Specifically, we will investigate the relationship amongst receipt of accommodations, absences, academic performance, and parent/child satisfaction.

Our *a priori* hypotheses were as follows: those who received accommodations would report more absences and would be more likely to report a decrease in academic performance after adjusting for severity of symptoms; and parent/child satisfaction with receipt of accommodations and return to school would not be related to other measured outcomes.

Aim 5: Identify demographic and injury factors associated with return to school outcomes.

Our *a priori* hypotheses were as follows: We hypothesized that older children, females, those with greater initial symptom severity, number of previous concussions, and number of school-related problems would be more likely to report greater absences and a negative impact of concussion on academic performance. We hypothesized that older children and those with greater symptom severity and a greater number of reported school problems following concussion would be more likely to receive accommodations. Additionally, in a previous study of secondary students with disabilities, findings show those of lower socioeconomic status face greater barriers to service access than their peers of higher socioeconomic status (Levine, Marder, & Wagner, 2004). Thus, we anticipate that in the proposed study, students of lower socioeconomic status (determined utilizing caregiver/parent education and family income) will be less likely to receive accommodations. We also anticipate that children whose parents were in communication with the school following the concussion would be more likely to receive accommodations. We anticipated that overall, both children and their parents/caregivers would report satisfaction with accommodations, and that satisfaction would not differ by age, sex, concussion history, socioeconomic status, symptom severity, or number of school-related problems.

CHAPTER 2

METHODS

Ethics

All methods were approved by the Vanderbilt University Institutional Review Board prior to the initiation of the study.

Recruitment

Potential participants were patients who attended an appointment at the Vanderbilt Sports Concussion Center between August 2014 and April 2015. The Vanderbilt StarPanel Electronic Medical Record was utilized to determine initial eligibility. Those who met criteria as determined by information available in the medical record were sent a letter (see Appendix A) notifying them of the study and that we would contact them via telephone. After waiting for at least 7 days after mailing to insure time for delivery, initial telephone contact was attempted (see Appendix B for phone script). A second round of mailing was conducted when repeated attempts to contact potential participants via telephone failed (see Appendix C).

Participants

Children aged 13-17 at the time of injury who sustained a sport-related concussion (for a list of sports as operationalized in this study, see Figure 3) and met eligibility criteria (see Figure 4) and their caregiver/parent were invited to participate in the study.

Figure 3. Activities classified as sports.

Archery	Lacrosse
Badminton	Rifle
Baseball/softball	Rowing
Basketball	Rugby
Bowling	Sailing
Cheerleading	Skiing
Cross country	Soccer
Equestrian	Squash
Fencing	Swimming/diving
Field hockey	Tennis
Football	Track and field
Golf	Volleyball
Gymnastics	Water polo
Ice hockey	Wrestling

Notes. This list includes championship and non-championship sports as classified by the National Collegiate Athletic Association in the 2013-2014 academic year (Irick, 2014) and cheerleading.

Figure 4. Eligibility criteria

Inclusion Criteria (Child)	Exclusion Criteria
Age 13-17 at time of injury	Non-English speaking
Diagnosed with sports-related concussion	Majority of school hours spent outside of the regular classroom prior to concussion
Evaluated at the VSCC within 7 days of concussion	Concussion after the 2014-2015 school year
English speaking	Significant psychological or medical event after concussion
Caregiver/parent provides consent	
Inclusion Criteria (Caregiver/parent)	**Exclusion Criteria**
Caregiver/parent of a child who meets eligibility criteria	Non-English speaking

Notes. VSCC=Vanderbilt Sports Concussion Center; If a student sustained multiple concussions during the school year, eligibility was based on latest concussion.

Measures

Independent variables

We gathered information on child and family demographics, the child's academic and medical history, and the child's concussion history, recent concussion, and severity.

Demographics (*Return to School Questionnaire; see Appendix D).*

The Return to School Questionnaire (caregiver and child versions) was developed for this study and is comprised of questions motivated by the existing concussion literature, as described above, and some specific items taken directly from tools developed in other related studies (e.g., Glang et al., 2008, Ransom, Vaughan et al., 2015). We collected demographic information, including age, sex, race, and ethnicity of the child and sex, race, ethnicity, education, and income of the parent/caregiver. Questions regarding demographic characteristics were worded in accordance with the National Institute of Neurological Disorders and Stroke Common Data Elements for Traumatic Brain Injury (Grinnon et al., 2012).

Academic and medical history (*Return to School Questionnaire)*

To be able to describe our sample and understand more specifically the impact of the concussion on return to school, we collected information on pre-morbid medical history, prior support needed in a school setting, and perceived prior academic performance. The question regarding pre-morbid medical history asks caregivers to indicate if their children had any of the premorbid factors identified as concussion modifiers in the most recent consensus statement of the Concussion in Sport Group (McCrory et al., 2013). The question regarding prior support needed in a school setting is taken from the Back to School Survey- Parent Questionnaire Initial-Part 2 (Glang et al.,

2008). The question regarding perceived prior academic performance was previously described and utilized in a study of mental health in adolescents (Richardson, Bergen, Martin, Roeger, & Allison, 2005).

Concussion history and recent concussion event (*Return to School Questionnaire)*

The child's concussion history was collected from both the parent/caregiver and the child. Robbins et al. (2014) found that providing a definition of concussion to current and former athletes yielded estimates of lifetime concussion that were approximately double the estimate when no definition was provided. Therefore, to get a more accurate estimate of concussion history, we utilized the same prompt used by Robbins, which was originally published in a study of executive function in football players (Seichepine et al., 2013). We also gathered information about the context of the concussion event (i.e., sport being played at time of injury, whether the concussion occurred during competition or practice, and whether it was at a school-sanctioned event). Time since concussion was calculated as days from time of concussion to time of parent telephone interview.

Concussion severity

Concussion severity was extracted from the medical record and the Immediate Postconcussion Assessment and Cognitive Testing (ImPACT) database. We utilized symptom severity and presence/absence of loss of consciousness and amnesia.

Symptom severity

Symptom severity was determined using the first recorded assessment (i.e., the 18-question Symptom Evaluation from the Sports Concussion Assessment Tool 2 (SCAT2; McCrory et al., 2009), the 22-question Post Concussion Symptom Scale (PCSS) from the ImPACT test (Lovell et al., 2006), or Vanderbilt's 22-question Concussion: Symptoms

Checklist) in the medical record or the ImPACT database). The SCAT2 and the PCSS from the ImPACT test have both been shown to be reliable assessments of symptoms (Lovell et al, 2006; Guskiewicz et al, 2013). All checklists assess common symptoms following concussion utilizing a 7 point Likert scale (0=symptom absent, 6= severe symptom). If no score was recorded within the first 7 days post-injury, the score was imputed using multiple imputation.

Loss of consciousness and amnesia

We gathered presence or absence of loss of consciousness and amnesia from the medical record. These variables are commonly included as severity indicators and potential modifiers of concussion (McCrory et al., 2013), although their utility in predicting outcome after concussion is not clear (e.g., Collins et al., 2003; Lovell et al., 2003; Lau et al., 2011; Dougan et al., 2014). Loss of consciousness and amnesia have been found to be associated with a decline in grades post-concussion; however, the difference was not in the expected direction- those with loss of consciousness or amnesia were less likely to experience a decline in grades than those without (Vaughan et al., 2013).

Number of school-related problems (*Return to School Questionnaire)*

We gathered the number of school-related problems experienced by the child upon initial return to school following concussion. These include the symptom-interfering effects (i.e., headaches interfering, problems paying attention, feeling too tired) and diminished academic skills (i.e., increased time spent on homework, difficulty understanding material, difficulty studying, difficulty taking class notes) identified in a series of studies by Gioia and colleagues (Ransom, 2015).

Parent-school communication (*Return to School Questionnaire)*

We gathered data on the presence or absence of contact between the parent and school following the child's return to school. This was collected via parent report only.

Dependent Variables

We collected information related to return to school, including number of absences, receipt of school accommodations, subjective change in academic performance, and satisfaction with return to school.

Absences (*Return to School Questionnaire)*

Both caregivers and children were asked to report number of absences due to concussion.

School-based accommodations (*Return to School Questionnaire)*

Both caregivers and children were asked to report the classroom accommodations provided post-concussion. The question format was taken from STEP Parent Questionnaire (Glang et al., nd), and the list of potential accommodations was compiled from clinical forms utilized in the Vanderbilt Sports Concussion Center, the Acute Concussion Evaluation Care Plan: School Version (Gioia & Collins, 2006), and published studies (Richardson et al., 2005; Kirkwood, 2006; Glang et al., 2008; McGrath, 2010; Halstead et al., 2013; Vaughan et al., 2013; Glang et al., 2015; Ransom et al., 2015, Glang et al., nd).

Satisfaction with school-based accommodations (*Return to School Questionnaire)*

Both caregivers and children were asked to report the degree to which they were satisfied with the accommodations received. The question and potential responses were based on a similar question from the STEP Parent Questionnaire (Glang et al., n.d.).

Academic performance (*Return to School Questionnaire)*

Both caregivers and children were asked to indicate whether their post-concussion academic performance was the same, better, or worse than baseline perceived academic performance prior to concussion (operationalized as described above).

Satisfaction with return to school (*Return to School Questionnaire)*

Both caregivers and children were asked to indicate the degree to which they were satisfied with the child's return to school post-concussion. The question and potential responses are based on a similar question from the STEP Parent Questionnaire (Glang et al., n.d.).

Procedure

All potential participants (i.e., those who attended an appointment at the Vanderbilt Sports Concussion Center) were entered into a database in REDCap, a secure, web-based application for electronic capture and management of information (Harris et al., 2009). Medical records were screened to determine if potential participants meet initial eligibility requirements. If they did not meet eligibility requirements, no contact was made and the medical record for that individual was not utilized further. As described above, potential participants received a letter informing them that the principal investigator would attempt to contact them by phone. The principal investigator called the parent/caregiver at least 7 days after sending the letter to insure time for delivery. For patients who could not be reached with the contact information provided through the medical record, an Internet search for current contact information was conducted. Of note, if we were unable to reach the potential participants, we left a message with a call back number, sent another letter by

mail, and made at least eight attempts to contact the potential participant on different days of the week at various times of day before excluding the participant from the study.

Once we made successful phone contact, we first spoke with the caregiver/parent to explain the study, answer questions, make a final eligibility determination, and obtain informed consent. Caregivers/parents who agreed to participate then completed the telephone survey or scheduled a future time to do so. Following this, if caregivers/parents provided consent, we attempted to speak with the child who sustained a concussion and explain the study, answer questions, and obtain the child's assent. If assent was obtained, the child then completed the telephone survey. Surveys required approximately 15 minutes for the caregiver/parent and approximately 10 minutes for the child. Each family received a $15.00 check via mail to compensate them for their time.

After completion of the questionnaires, the remaining information (e.g., symptom severity) was extracted from the medical record and from the ImPACT database. Information extracted from the medical record and the ImPACT concussion database, as well as the log of contact attempts, was stored in the same REDCap database as the survey responses. Once data collection was completed, the database was deidentified and will be maintained indefinitely by the PI.

Analysis

All analyses were conducted in R.

Aim 1: Describe school outcomes (i.e., absences due to concussion and parent/child report of change in academic performance) following concussion.

To address Aim 1 we provide the median and interquartile range of the number of absences as reported by the caregiver/parent and the child. Because we asked participants

to recall past absences, we report the concordance correlation coefficient (CCC; Quinn, Haber, & Pan, 2009) as a measure of agreement on number of absences between parent and child responses to gage the reliability of the responses. Additionally, we report the percentage of students, as reported by the caregiver and student, whose academic performance is the same, better, or worse than before the concussion. We report Cohen's Kappa statistic (κ) as a measure of caregiver-child agreement.

Aim 2: Describe informal and formal classroom accommodations received after concussion.

To address this aim we report the percentage of children who received new accommodations (i.e., accommodations that were not in place prior to the concussion) following concussion, as well as the median and interquartile range of the number of accommodations received. Additionally, we report the percentage of students who received each accommodation, in order to identify the most commonly provided accommodations post-concussion. We report caregiver-child agreement (i.e., κ) for receipt of accommodations.

Aim 3: Describe parent/child satisfaction with classroom accommodations and the return to school experience.

To address this aim we report the percentage of children who fell into each of the four categories of satisfaction (i.e., very dissatisfied, dissatisfied, satisfied, very satisfied) for both classroom accommodations and the return to school experience, as reported by both the caregivers/parents and children. Additionally, we report the caregiver-child agreement (i.e., κ) for report of very satisfied or satisfied versus dissatisfied or very dissatisfied in both of the domains (i.e., classroom accommodations and the return to school experience).

Aim 4: Identify the relationship among selected return to school outcomes. Specifically, we will investigate the relationship amongst receipt of accommodations, absences, academic performance, and parent/child satisfaction.

We report the results of regression with multiple imputation that adjusted for symptom severity to identify the relationship between the outcomes. The Amelia package in R was used to conduct the imputations (Honaker, King, & Blackwell, 2011) and the Zelig package was used to fit the models (Imai, King, & Lau, 2008; Choirat, Honaker, Imai, King & Lau, 2015).

Aim 5: Identify demographic and injury factors associated with return to school outcomes.

We report the models fit by regressing outcomes of interest on demographic and injury variables. Because our sample size was not sufficient to run a single model for each outcome, we fit separate models for each predictor, with the exception of parent income and education, which we combined to look at impact of socioeconomic status on receipt of accommodations and satisfaction.

CHAPTER 3

RESULTS

Description of sample

Clinical records indicated that 495 patients were seen at the Vanderbilt Sports Concussion Center between August 6, 2014 and April 30, 2015. During review of the electronic medical records of those patients, 337 patients were excluded due to failure to meet eligibility requirements (see Figure 5). The remaining 158 patients were eligible for phone call follow up. Five patients were determined to be ineligible during this stage (see Figure 5). This resulted in a final eligible cohort of 153 patients.

Eighty-three parents (54.2%) chose to participate in the study (see Figure 5). Within those families, 78 of the 83 children who had sustained a concussion chose to participate (see Table 1 for demographic information and Table 2 for injury information of the participating families). Wilcoxon Rank-Sum tests and Chi-squared tests were used to test for potential differences between families who participated and families who did not. Participants did not differ from non-participants in age at time of concussion ($W = 2884$, $p = 0.9402$), sex ($X^2 = 0.4451$, $p = 0.5046$), loss of consciousness at time of concussion ($X^2 = 0.7415$, $p = 0.3892$), number of days between concussion and appointment with the concussion center ($W = 3036.5$, $p = 0.6264$), or whether academic accommodation recommendations were provided from the Vanderbilt Sports Concussion Center ($X^2 = 0.0823$, $p = 0.7742$).

Figure 5. Study sample

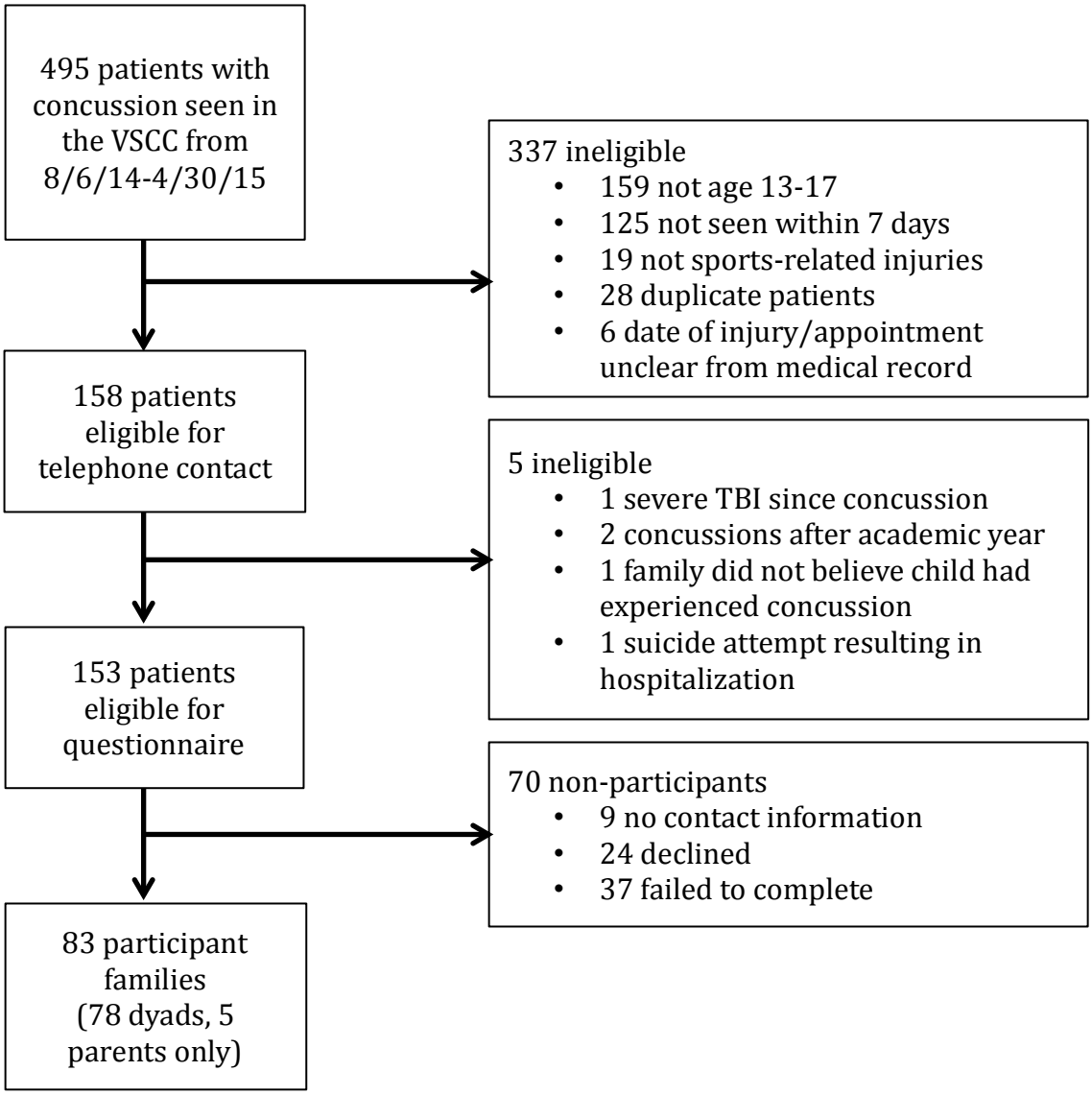

Table 1. Demographic information for participating families (N=83).

	Median	IQR
Age at time of injury (years)	15.72	14.88-16.91
Grade	10	9-11
	%	N
Sex (male/female)	65/35	54/29
Parental education (highest degree earned)		
Less than HS degree	1.2	1
HS degree	4.8	4
Some college, no degree	15.7	13
Associate's degree	9.6	8
Bachelor's degree	47.0	39
Graduate degree	21.7	18
Parental income		
Under $15,000	2.4	2
$15,000-24,999	7.2	6
$25,000-34,999	4.8	4
$35,000-49,999	8.4	7
$50,000-74,999	18.1	15
$75,000-99,999	45.8	38
$100,000 and over	10.8	9

Table 2. Injury information for participating families (N=83).

		Median	IQR
Days from concussion to appointment		3	1-4.5
Days from concussion to parent survey*		276	199.5-321
Symptom score at first assessment**		16.5	4-31.8
Number of previous concussions***		1	1-3
Number of school-related problems****	Parent-report	3	2-5.5
	Child-report	4	2-6
		%	N
Sport played at time of injury	Football	34.9	29
	Soccer	18.1	15
	Basketball	15.7	13
	Ice hockey	7.2	6
	Baseball/softball	6	5
	Cheerleading	4.8	4
	Wrestling	4.8	4
	Lacrosse	4.8	4
	Volleyball	3.6	3
Event	Practice	26.5	22
	Competition	73.5	61
Affiliation with school	School event	80.7	67
	Other event	19.3	16
Loss of consciousness	Present	9.6	8
	Absence	89.2	74
	Unknown	1.2	1
Amnesia	Present	27.7	23
	Absence	37.3	31
	Unknown	34.9	29
Emergency Department visit following concussion	Yes	30.1	25
	No	69.9	58
Written recommendations for academic accommodations by physician	Yes	65.1	54
	No	34.9	29
Return to full sport participation at time of survey	Yes	86.7	72
	No	13.3	11
Parent communication with school	Yes	86.7	72
	No	13.3	11

*Parent surveys were conducted before child surveys. Time from completion of parent survey to completion of child survey ranged from 0-8 days.
**Numbers based on 62 students who had a symptom score recorded within the first 7 days post-injury
***Median and Interquartile Range (IQR) same for parent and child-report of number of previous concussions sustained by child. Parent-child agreement of number of previous concussions following a provided definition was 0.89; average difference between parent and child report was 0.58 concussions.
**** Parent-child agreement of number of school-related problems was 0.61; average difference between parent and child report was 1.46.

Findings

Aim 1. Describe school outcomes (i.e., absences due to concussion and parent/child report of change in academic performance) in the academic year in which the most recent concussion occurred.

The median number of absences due to the concussion was 2 (IQR: 0-3), as reported by both the children and the parents. Parent-child agreement on reported absences was good (CCC = .70); the average difference between parent and child report of number of absences following concussion was one. This suggests good reliability of the data, despite asking families to recall the number of absences in the months following the concussion.

The perception of persistent change in academic performance following concussion was assessed at the time of the phone call survey. Only 7.7% of children (n= 6) reported that their academic performance was worse than before the concussion, while 92.3% of children (n= 72) reported that their academic performance was the same or better than before the concussion at the time of phone call. Similarly, 13.3% of parents (n=11) reported that their child's academic performance was worse than before the concussion, and 86.7% of parents (n= 72) reported their child's academic performance as the same or better than before the concussion at the time of phone call. Parent-child agreement regarding change in academic performance was fair ($\kappa = .31$) in the complete dyads (Landis & Koch 1977). Of note, no children experienced grade retention following the concussion; that is, all children either graduated at the end of the 2014-2015 academic year or progressed to the next grade in the 2015-2016 school year per parent report. Results of bivariate analysis show no relationship between time to survey and absences or change in academic performance.

Aim 2: Describe informal and formal classroom accommodations received after concussion.

When asked to report academic accommodations received after concussion, 26.5% of parents (n=22) and 23.1% of children (n=18) reported that the children were not given any academic accommodations. Caregiver-child agreement on the receipt of any services was moderate ($\kappa = .4$). Of the children who received accommodations per parent report, the number of accommodations provided to children ranged from 1-11, with a median of 3 (IQR 2-5). Of the children who received accommodations per child report, the number of accommodations provided to children ranged from 1-10, with a median of 4 (IQR 2-6). The most commonly provided academic accommodations of the 12 identified by the parent survey were extended time to complete tasks, shortened school days, staggered or postponed tests, and reduced workload. The most commonly provided academic accommodations of the 12 identified by the child survey were extended time to complete tasks, reduced workload, staggered or postponed tests, and time to visit the school nurse. In addition to the accommodations that were specifically queried, one child reported being allowed to retake a test as an accommodation following the concussion. Two parents reported that their children were allowed to wear sunglasses in class, two parents reported that their children were given accommodations to help them avoid busy and noisy hallways, two parents reported that their children were given accommodations to help reduce demands on their reading (i.e., less "board time" for one student and no expectation to read notes for another student). Finally, two parents reported accommodations that helped the child to conduct school work outside of the typical learning environment: one child completed virtual classes and another received home-bound services. See Table 3 for

details regarding receipt of academic accommodations. Results of bivariate analysis show no relationship between time to survey and receipt of accommodations.

Table 3. Accommodations following concussion as reported by children and parents. Parent N=83; Child N=78.

	Parent report		Child report	
Accommodation	%	N	%	N
Reduced workload (e.g., less homework)	32.5	27	30.8	24
Written notes, note-taker, or audio recording	12	10	28.2	22
Extended time to complete tasks (e.g., homework, classwork or tests)	62.6	52	56.4	44
Quiet room for tests or coursework	15.7	13	28.2	22
Staggered or postponed tests	33.7	28	44.9	35
Use of notes during tests	7.2	6	11.5	9
Other test accommodations	7.2	6	3.8	3
Tutoring or extra help (in or out of class) from teacher	20.5	17	29.5	23
Time to visit the school nurse	25.3	21	30.8	24
Shortened classes (e.g., rest breaks during class)	22.9	19	14.1	11
Shortened school days	33.7	28	24.4	19
504 plan or formalized school team meeting	2.4	2	1.3	1

Aim 3: Describe parent/child satisfaction with classroom accommodations and the return to school experience.

When asked about satisfaction with the school's response to accommodating the child's needs following concussion, 81.9% of parents (n=68) and 82.1% of children (n=64) reported they were satisfied or very satisfied (see Table 7). Within the 78 complete dyads, parent-child agreement was moderate ($\kappa = .45$). When asked about their satisfaction with the return to school following concussion, 89.2% of parents (n=74) and 85.9% of children (n=67) reported that they were satisfied or very satisfied with the experience (see Table 4).

Again, parent-child agreement was moderate (κ = .43). Results of bivariate analysis show no relationship between time to survey and any of the satisfaction outcomes.

Table 4. Parent and child satisfaction with accommodations and return to school. Parent N=83; Child N=78.

	Parent report		Child report	
Satisfaction with accommodations	%	N	%	N
Very dissatisfied	4.8	4	3.8	3
Dissatisfied	13.3	11	14.1	11
Satisfied	45.8	38	61.5	48
Very satisfied	36.1	30	20.5	16
Satisfaction with return to school experience				
Very dissatisfied	1.2	1	1.3	1
Dissatisfied	9.6	8	12.8	10
Satisfied	48.2	40	57.7	45
Very satisfied	41.0	34	28.2	22

Aim 4: Identify the relationship among selected return to school outcomes.

From the parent-reported data, as absences increased the likelihood of receiving accommodations increased as well (OR: 1.85, 95%CI: 1.21-2.84). Failure to return to academic performance baseline and symptom severity were not related to receipt of accommodations (see Table 5). It should be noted that there were only 11 children whose parents identified a decline in academic performance. From the child-reported data, neither severity of symptoms, absences, nor return to academic baseline was related to receipt of accommodations (see Table 6).

Table 5. Relationship among parent-reported school outcomes (N=83)

	Satisfaction with accommodations		Satisfaction with return to school		Receipt of accommodations	
	OR	95% CI	OR	95% CI	OR	95% CI
Symptom score	0.99	0.96-1.02	1.01	0.97-1.06	1.12	0.98-1.05
Academic performance	5.76	1.17-28.29	3.49	0.49-24.90	0.61	0.06-.5.95
Absence	1.01	0.96-1.08	1.00	0.93-1.07	1.85	1.21-2.84
Receipt of accommodations	4.48	1.21-16.61	4.92	1.03-23.49	-----	-----

Table 6. Relationship among child-reported school outcomes (N=78)

	Satisfaction with accommodations		Satisfaction with return to school		Receipt of accommodations	
	OR	95% CI	OR	95% CI	OR	95% CI
Symptom score	0.97	0.93-1.01	1.01	0.97-1.06	1.01	0.98-1.05
Academic performance	14.33	1.52-124.92	15.36	1.40-168.94	1.93	0.14-26.00
Absence	1.05	0.76-1.44	0.90	0.65-1.24	1.34	0.96-1.88
Receipt of accommodations	8.97	1.80-44.58	9.00	1.68-48.20	-----	-----

According to the parent-reported data, after adjusting for symptom severity, the likelihood of satisfaction with accommodations was higher for parents of children who received accommodations (OR:4.48, 95%CI: 1.21-16.61) and whose academic performance had returned to baseline (OR:5.76, 95%CI: 1.17-28.29). Additionally, parents of children who received accommodations were more likely to report overall satisfaction with the return to school experience (OR:4.92, 95%CI:1.03-23.49). The pattern was similar in the child-reported data: the likelihood of satisfaction with accommodations was higher for children who received accommodations (OR:8.97, 95%CI: 1.80-44.58) and whose academic performance had returned to baseline (OR:14.33, 95%CI: 1.52-134.93). The same factors were related to child satisfaction with the overall return to school: children who received

accommodations and children whose academic performance had returned to baseline were more likely to report overall satisfaction with the return to school experience (OR:9.00, 95%CI:1.68-48.20 and OR:15.35, 95%CI: 1.40-168.94, respectively; see Table 6).

Aim 5. Identify demographic and injury factors associated with return to school outcomes.

We hypothesized that older children, females, those with greater initial symptom severity, those with a higher number of previous concussions, and those with a greater number of reported school problems following concussion would be more likely to report a negative impact of concussion on academic performance. From the complete-case data, results from parent and child report show that age, sex, and number of previous concussions were not associated with number of absences following concussion. There was a positive relationship between number of reported school problems and number of absences in the child data (β= 0.36, $p<.05$), but not the parent data (β= 0.60, n.s). There was a positive relationship between number of absences and initial symptom severity (parent: β= 0.03, $p<.01$; child: β= 0.05, $p<.01$). An additional day of absence is associated with an increase of approximately 35 points on the symptom severity score according to the parent-reported data, and 21 points on the symptom severity score according to the child-reported data.

Results of the parent-reported data indicate that after adjusting for severity, as the number of school-related problems experienced by the child increased, the likelihood that the parent reported the child had returned to academic baseline decreased (OR:0.64, 95%CI: 0.45-0.91). From the child-reported data, we found that as initial symptom severity and age of the child increased, there was a decreased likelihood of return to academic baseline (OR: 0.94, 95%CI: 0.89-1.00 and OR:0.29, 95%CI: 0.09-0.94, respectively). No

other investigated variables were related to a change in likelihood of return to baseline academic performance.

According to parent report, receipt of accommodations was related to parent communication with the school; that is, there was a higher likelihood of a parent reporting that their child received accommodations if the parent communicated with the school following the child's concussion (OR:10.00, 95%CI:2.17-46.09) or if the physicians had recommended accommodations (OR:3.67, 95%CI:1.28-10.51). Additionally, as the number of school-related problems following concussion that a parent reported increased, the likelihood of a parent reporting that the child received accommodations increased as well (OR:1.50, 95%CI:1.14-1.98). There was no significant relationship between age, symptom severity, or socioeconomic status (as measured by parent education and income) and receipt of accommodations. According to child report, receipt of accommodations was not related to age, symptom severity, number of school-related problems, socioeconomic status (as measured by parent education and income), parent communication with the school following concussion, or physician recommendation for accommodations.

We anticipated that overall, both children and their parents/caregivers would report satisfaction with accommodations and the overall return to school experience, and that satisfaction would not differ by age, sex, concussion history, socioeconomic status, symptom severity, number of school-related problems, or parent contact with school. With the exception of a slight increase in the likelihood of parental satisfaction with their child's receipt of accommodations as parental income increased (OR:1.44, 95%CI 1.02-2.04), there was no significant relationship between any of the investigated variables and either satisfaction outcome in the parent and child data.

CHAPTER 4

DISCUSSION

Interpretation and implications of findings

In this study, we have described aspects of the return to school experience following sports-related concussion. Specifically, we describe absences, return to academic baseline, receipt of accommodations, and satisfaction with the receipt of accommodation and the return to school experience as a whole, from the point of view of both the parent/caregiver and the child.

Students in our sample missed a median of two days of school due to concussion. This is grossly consistent with previous findings that found an increased risk of absences for students following concussion (Stringer, 2014) and an average of 3 days of school missed (Vaughan et al., 2013). In our sample, for every day of absence there was a 1.85 increase in the likelihood of receiving accommodations.

Our findings are consistent with previous findings that show a positive relationship between symptom severity and absences (Vaughan et al., 2013). Additionally, we found that absences were associated with the number of school-related problems experienced by the child, though this relationship was present in the child-reported data only. Of note, the absences in our study included any that the parent or child perceived to be related to the concussion. Therefore, some absences occurred prior to the return to school, and some happened when the child returned to school and was unsuccessful (e.g., due to symptom exacerbation) and missed more days following that initial return.

We found that at a median follow-up time of about 9 months post-concussion, the great majority of children and parents believed that the child had returned to pre-injury

academic performance. No children experienced grade retention following the concussion. The overall long-term success of these students is consistent with recent reports that 80-90% of students experience a resolution of concussion symptoms within a few weeks (McCrory et al., 2013). This is a promising finding for school personnel who may be concerned about the resources necessary to provide accommodations for students. For most students, targeted, short-term accommodations will be sufficient.

We found that as the number of school-related problems following concussion increased (per parent report), the likelihood that the child had returned to academic baseline decreased. Although this would seem to indicate that number of reported school problems could be used to identify students who might be at a greater risk of prolonged difficulties, the pattern did not hold true in the child-reported data. This difference may be related to the fact that agreement between parent and child on return to academic baseline was only fair. An objective measure of academic performance (e.g., grade point average) might help clarify the risk presented by a greater number of school problems following concussion on long term academic performance. From the child-reported data, increased symptom severity and increased age were associated with a decreased likelihood of returning to academic baseline. The relationship between age and decreased likelihood of returning to academic baseline that persisted even after adjusting for severity of symptoms could explain, in part, a previous finding by Ransom, Vaughan et al. (2015) that symptomatic high school students were more concerned about the effect of concussion on academic performance than their symptomatic middle school and elementary school peers. The older students may have a greater reason to be concerned if the concussion is more likely to have a negative long-term effect on academic performance.

There has been a significant push to recommend academic accommodations to students following concussion. In this particular sample, approximately three-quarters of students received at least one academic accommodation that was not related to physical activity (e.g., participation in a physical education class). This is different from the findings of Glang and colleagues (2015) who studied athletes from 25 schools in Oregon (the only other known study to report receipt of specific accommodations following concussion) and found only 56% of the students received accommodations. This percentage included non-academic, school-based accommodations (i.e., exemptions from physical education or weightlifting), so it is likely that the number of students receiving academic-based accommodations was even lower. In the present study, we found from the parent data that students who received written academic accommodations from their healthcare provider were more likely to receive academic accommodations at school. Comparatively, in the Glang study, the sample was school-based versus clinic-based, and approximately one third of the sample was not seen by a healthcare provider for care at all following concussion. Thus, if the finding from our parent data holds true in future studies (i.e., written recommendations from the physician increase the likelihood of receipt of accommodations even after adjusting for severity), this may explain the higher rate of academic accommodations provided in our study as compared to the previous study.

Halstead et al., (2013) highlighted the importance of concussion management teams. They emphasize communication between the family team, the medical team, the school academic team, and the school physical activity team. In our study, we found that those parents/caregivers who spoke with the school following the child's return to school were more likely to report that their students received accommodations. Interpretation of

this should be made cautiously for two reasons. First, the relationship was only present in the parent-reported data, not the child-reported data. Second, the significant correlation does not indicate causation. It is possible that those parents who communicate with the school following their child's concussion may be more likely to advocate for or suggest accommodations. In addition, it is also possible that those parents who communicate with the school are just more aware of the accommodations that are already being provided. Finally, it may be that schools who have protocols in place to manage concussions more successfully are more likely to provide accommodations and communicate with the parent. Regardless, of which interpretation is true, these findings do support the Halstead (2013) recommendation for open communication among the stakeholders in the child's successful return to school following concussion.

With the exception of shortened school days, the academic accommodations that were most commonly provided to the students in the present study (e.g., extra time to complete assignments, reduced coursework) were similar to those identified previously as the most common accommodations (Glang, 2015). This consistency in the types of accommodations recommended across the country, despite the difference in samples (i.e., clinic-based sample in the present study versus school-based sample in the previous study) may be the result of increased efforts to educate parents, physicians, and schools about the need for appropriate accommodations for student athletes following concussion.

Additionally, the agreement between parents and children on receipt of any accommodations was only fair, and the median number of accommodations received, as reported by children, was higher than the number received, as reported by parents. This highlights the importance of obtaining information directly from students, as parents may

not be aware of all the informal interventions provided by the school. Moreover, it underscores the need to include teacher-report and school documentation in future studies.

Satisfaction with receipt of accommodations is a narrow outcome that is likely related to the receipt of accommodations and the outcome of those accommodations. We found that the majority of both parents and children were satisfied with the receipt of accommodations, and that those who were satisfied with the receipt of accommodations were more likely to have received accommodations and at the time of survey had returned to academic baseline. It would be beneficial in a future study to determine if the extent to which accommodations were appropriate (i.e., the specific accommodations received aligned with specific effects of the concussion) has an impact on satisfaction with those accommodations and the ultimate academic outcome.

Satisfaction with return to school is a broader outcome that is likely influenced by the receipt of accommodations and the ultimate academic outcome. This outcome is also influenced by other factors, including, but not limited to, return to sport, interpersonal interactions, support in the academic environment, education of the child regarding the effects of concussion, and timing within the school year. In this study, we found that both parents and children were more likely to report satisfaction with the return to school experience if they received accommodations, and children were more likely to report satisfaction if they had returned to academic baseline. In order to improve satisfaction outcomes in parents and children, it is important for schools to take an individualized approach that can account for potentially contributing factors.

Limitations

There are several limitations that exist in this study. First, the study sample is from a clinical population in which timing of assessment is based on clinical need as opposed to a formal research protocol. We attempted to control for this factor by excluding those who presented to the clinic more than 7 days post-injury to avoid biasing the sample toward those who were likely to be experiencing more persistent symptoms. Several of the studies that have contributed to the literature regarding return to school after concussion have included individuals who presented for assessment up to a month post-injury (e.g., Vaughan et al., 2013; Ransom, Vaughan et al., 2015).

The second limitation is related to the retrospective nature of the study. Because the concussion could have occurred at any point in the past academic year, there was variable follow up (with an interquartile range of approximately 4 months). While follow up at different points in time may influence patient and child report, our bivariate analyses indicated there was no relationship between time to telephone follow up and any of our outcomes.

Third, we did not include the perspective of the school. There was no teacher report and we did not collect any official documentation outside of the medical records. As mentioned above, the rate of agreement between parents and children on accommodations received suggests that an objective measure of accommodations provided by the school may be beneficial. Because many of these accommodations are provided informally, even schools may not keep consistent records of the resources made available to each student. The school records would permit both the parent and child perceptions of academic

performance to be compared to more objective measures such as test scores or grade point average.

Finally, the study was potentially limited by the modest follow-up rate. Although we were able to demonstrate no difference between those who participated and those who did not on demographic and injury variables, it is possible that there are unmeasured differences in the groups that are introducing bias in our findings. Every effort was made to contact participants, but a prospective study in which students and families are enrolled at time of concussion would likely provide a higher participation rate. Because the follow up rate was low, we were not appropriately powered for some of the analyses. This results in large confidence intervals in many of the models and potentially an inability to identify true relationships between variables.

Conclusion

After concussion, most students receive accommodations and most families are satisfied with their experience. However, there continue to be gaps in care, evidenced by failure of some students to receive accommodations, dissatisfaction with accommodations and with return to school following concussion, and breakdown in parent-school communication. Although all 50 states and the District of Columbia currently have concussion legislation (National Conference of State Legislatures, 2014), the focus is overwhelmingly on return to play. Only recently have some states begun to consider return to learn legislation. A statute in Nebraska, for example, requires schools to establish a return to learn protocol:

> "The return to learn protocol shall recognize that students who have sustained a concussion and returned to school may need informal or formal accommodations, modifications of curriculum, and monitoring by medical or academic staff until the student is fully recovered" (Concussion Awareness Act, 2014).

Nebraska's mandate has been in place since the beginning of the 2014-2015 school year. Following notification of a student's concussion, the school assigns a specific member of the concussion management team to communicate with the family, the family completes a brain injury questionnaire, the student and parent are asked to rate the student's concussion symptoms, and a meeting that includes both the student and the parent/caregiver is held to create an individualized plan if the student is symptomatic (Carr & Wieting, 2015). The concussion management teams are thus able to address family concerns, provide systematic and individualized guidance to the student's instructors, and monitor recovery to determine the need for more formal accommodations.

In addition to legislative mandates to manage return to learn in the schools, researchers have begun to tackle the problem of how best to implement such programs and to educate everyone who is involved in the student's return to school. One such effort is a publically-available program called Brain 101: The Concussion Playbook (Brain 101, 2011; available at http://brain101.orcasinc.com/). Brain 101 provides online training for educators, coaches, parents, and athletes and provides information on the process of creating concussion management teams in the schools. An initial study by Glang and colleagues (2015) of the program showed that schools that used Brain 101 were more likely to create concussion management teams, and that those teams were more likely to meet recommended guidelines (i.e., they had a coordinator and met regularly). Additionally, greater knowledge and behavioral intent related to concussion management were present in athletes and parents in schools that utilized Brain 101 versus those who did not.

The students in the present study came from more than 40 different schools, each with its own approach to concussion management. Although these students all experienced receipt of medical care as a function of the eligibility requirements, this will not be the case for all students who identify to the school with a concussion. As state-based mandates and education programs increase in their prevalence, it will be crucial to continue to monitor the effect of concussion on students' return to school experience. This should be done while continuing to take into account child and parent/caregiver perceptions and objective measures gathered from the schools and encouraging communication between care providers and schools to facilitate the best care and maximize child outcomes, both in the short term and long term following concussion.

Finally, this study found that for a small percentage of students (7.7% per child report and 13.3 % per parent report), a concussion can have long-term academic effects. In order to better prevent and manage these injuries and the negative repercussions, large-scale research is necessary to help identify those who fall into this high-risk category. For these students, formalized school accommodations may be necessary to address ongoing needs.

Appendix A. Recruitment letter

To the parent/caregiver of _____,

Hello. You are receiving this letter because your child sustained a concussion and was treated at the Vanderbilt Sports Concussion Center. A member of our team has identified you and your child as potential participants in an ongoing research project for youth with concussion.

The goal of our study is to better understand how a child's schooling is impacted after a sports-related concussion. Participation will require about 15 minutes each for you and your child, and upon completion of the telephone survey you will be sent a $15.00 check.

To be eligible for this study, your child must:

- Be 13-17 years of age
- Be enrolled in public school at the time of concussion
- Be English-speaking
- Have been seen in the Vanderbilt Sports Concussion Center within 7 days of concussion

Laura Wilson, a speech-language pathologist and member of our research team, will be contacting you via telephone within the next two weeks to determine if you are interested in participation, answer any questions you may have, and determine if you are eligible to participate.

If you and your child wish to participate in the study, you will be asked to answer questions over the phone to determine if you are eligible. If eligible, you and your child will both be asked to complete telephone questionnaires that ask about your child's concussion, schooling, and demographics.

If you have any questions before receiving the phone call, please feel free to contact Laura:

Phone: (615) 746-7575
Email: laura.d.wilson@vanderbilt.edu

Thank you very much for your time.

Sincerely,

Members of the Vanderbilt Sports Concussion Research Team
Vanderbilt University

Appendix B. Phone script

Hello. May I speak to the parent of [child's name], please? My name is Laura Wilson. I am calling from the Vanderbilt Sports Concussion Center. We are studying how a child's schooling is impacted by a sports-related concussion. You are being asked to participate because your child sustained a concussion in the past school year.

To participate in this study, I will ask you questions to determine if you are eligible. If you are eligible and choose to participate, you and your child will both be asked to complete telephone questionnaires that ask about your family, your child's concussion, and his/her schooling. Participation will require about 15 minutes each for you and your child and your family will receive a $15.00 gift card upon completion of the surveys.

Are you willing to answer some questions and to allow your child to answer some questions for this research?

If no: Thank you for your time.
If yes:

Before I begin, do you have any questions about the purpose of the study or what you would be asked to do if you participate?

If yes, Laura will answer questions in a manner that is consistent with the information provided in the IRB application.

If no, Laura will continue with the following questions:

Your child attended an appointment at the Vanderbilt Sports Concussion Center on [date]. Was he/she enrolled in public school at the time of that concussion?

At the time of the concussion, did your child spend the majority of school hours outside of the regular classroom (that is, in a special education classroom)?

Are both you and your child comfortable communicating in English?

If the parent/caregiver responses no to the first question or yes to the second or third question, then the family does not meet eligibility requirements for the study. No further questions will be asked and the parent/caregiver will be informed that he/she is not eligible for participation and will be thanked for his/her time.

Based on your responses, it appears that you and your child are eligible to participate in the study. I will now ask you the study questions. If you are uncomfortable answering a question you may decide to skip it. You can also choose to end the questionnaire at any time.

ADMINISTER THE CAREGIVER/PARENT QUESTIONNAIRE

Upon completion:
That was the last question I have for you. Now I would like to speak with [child's name]. He/she will be answering the same kinds of questions. He/she can choose not to participate, can skip questions, and can end questions at any time if he/she wishes. May I speak with him/her now?

If no, ask for a time to call back.
If yes:

(To parent/caregiver:) Thank you. If you have any questions, please feel free to call me on the number that was given in the letter mailed to you, or you can call your Vanderbilt Sports Concussion Center physician.

(To student:) Hello. My name is Laura Wilson. I am calling from the Vanderbilt Sports Concussion Center. We are studying how schooling is impacted by a sports-related concussion. You are being asked to participate because you sustained a sports-related concussion in the last school year.

To participate in this study, I will ask you questions about your concussion, schooling, and demographics. It will take about 10 minutes. Do you have any questions about the purpose of the study or what you would be asked to do?

If yes, Laura will answer questions in a manner that is consistent with the information provided in the IRB application.

If no, Laura will continue with the following question:

Are you willing to answer some questions for this research?

If no: Thank you. Have a good day.
If yes:
Thank you. If you are uncomfortable answering a question you may decide to skip it. You can also choose to end the questionnaire at any time. We will start now.

ADMINISTER STUDENT QUESTIONNAIRE.

Thank you for your time. If you have any questions, please feel free to call me on the number that was given in the letter mailed to your house, or you can call your Vanderbilt Sports Concussion Center physician.

Appendix C. Follow-up recruitment letter

To the parent/caregiver of _____,

Hello. You are receiving this letter because your child sustained a concussion and was treated at the Vanderbilt Sports Concussion Center. A member of our team has identified you and your child as potential participants in an ongoing research project for youth with concussion.

The goal of our study is to better understand how a child's schooling is impacted after a sports-related concussion. Participation will require about 15 minutes each for you and your child, and upon completion of the telephone survey you will be sent a $15.00 check.

To be eligible for this study, your child must:

- Be 13-17 years of age at the time of concussion
- Be enrolled in school at the time of concussion
- Be English-speaking
- Have been seen in the Vanderbilt Sports Concussion Center within 7 days of concussion

We have been unable to contact your family via telephone. If you are interested in participating, please email us at laura.d.wilson@vanderbilt.edu or call us at (615) 746-7575. Laura Wilson, a speech-language pathologist and member of our research team, will answer or return the emails and calls. If you call outside of our business hours, please leave a message with your name, number, and best time to call. We are able to schedule evening or weekend call times if that works best for your family.

If you and your child wish to participate in the study, you will be asked to answer questions over the phone to determine if you are eligible. If eligible, you and your child will both be asked to complete telephone questionnaires that ask about your child's concussion, schooling, and demographics.

Thank you very much for your time.

Sincerely,

Members of the Vanderbilt Sports Concussion Research Team
Vanderbilt University

Caregiver telephone questionnaire

Please complete the survey below.

Thank you!

What is your (caregiver's) name? _____

Are you the primary caregiver for [child_name]?
- ◯ Yes
- ◯ No

What is your relationship with [child_name]?
- ◯ Mother
- ◯ Father
- ◯ Step-mother
- ◯ Step-father
- ◯ Grandmother
- ◯ Grandfather
- ◯ Other
- ◯ Not reported

Other relationship _____

What grade will he/she be in Fall 2015?
- ◯ 6
- ◯ 7
- ◯ 8
- ◯ 9
- ◯ 10
- ◯ 11
- ◯ 12

Now I am going to ask you some questions about the (most recent) concussion [child_name] sustained during the 2014-2015 school year.

What grade was he/she in at the time of your concussion?
- ◯ 6
- ◯ 7
- ◯ 8
- ◯ 9
- ◯ 10
- ◯ 11
- ◯ 12

What school was [child_name] attending at the time of his/her concussion? _____

What sport was he/she playing when he/she sustained his/her concussion?
- ◯ Football
- ◯ Soccer
- ◯ Cheer/spirit
- ◯ Volleyball
- ◯ Lacrosse
- ◯ Hockey
- ◯ Other

Please describe the other sport [child_name] was playing when he/she sustained his/her concussion. _____

Did his/her concussion occur during competition or practice?
- ◯ Competition
- ◯ Practice

Was the [competition_practice] a school event?
- ◯ Yes
- ◯ No

Did [child_name] go to the Emergency Department after his/her concussion?
- ◯ Yes
- ◯ No

Now I am going to ask you some questions about [child_name]'s recovery and school experience.

Has [child's name] returned to full sport since his/her concussion?
- ◯ Yes
- ◯ No

If not, why?
- ◯ Dropped sport
- ◯ Unresolved/still out
- ◯ Sport season ended
- ◯ Unknown
- ◯ Other

Other reason for not returning to sport _____

Some people have the misconception that concussions only happen when you black out after a hit to the head or when the symptoms last for a while. But, in reality, a concussion has occurred anytime you have had a blow to the head that caused you to have symptoms for any amount of time. These include: blurred or double vision, seeing stars, sensitivity to light or noise, headache, dizziness or balance problems, nausea, vomiting, trouble sleeping, fatigue, confusion, difficulty remembering, difficulty concentrating, or loss of consciousness. Whenever anyone gets a ding or their bell rung, that too is a concussion.□□□Based on this definition, how many total concussions has [child's name] had in his/her life, including the most recent one? _____

Does [child_name] have a history (prior to the most recent concussion) of any of the following? (Please check all that apply)
- ☐ Migraine
- ☐ Depression or other mental health disorders,
- ☐ Attention deficit hyperactivity disorder (ADHD)
- ☐ Learning disabilities (LD)
- ☐ Sleep disorders
- ☐ Other neurological disorders
- ☐ Not reported

Other neurological disorder _____

Before the injury, did [child_name] need support in any of the following areas?
- ☐ Academic
- ☐ Speech/language communication
- ☐ Social/behavioral
- ☐ Physical/motor
- ☐ Vision/hearing
- ☐ Medical

Please rate [child_name]'s overall academic performance prior to his/her (most recent) concussion.
- ◯ Failing
- ◯ Below average
- ◯ Average
- ◯ Above average

(Richardson 2005)

How does his/her overall academic performance compare now?
- ◯ Same now as before concussion
- ◯ Worse now than before the concussion
- ◯ Better now than before the concussion

Other school problems _____

What kinds of school problems did [child_name] have AFTER his/her injury?

- ☐ Can't pay attention in class
- ☐ Difficulty taking notes
- ☐ Difficulty understanding material
- ☐ Homework takes longer
- ☐ Difficulty studying for tests/quizzes
- ☐ Headaches
- ☐ Too tired
- ☐ Other

(Check all that apply- new problems or problems that have gotten worse since injury)

Is he/she still experiencing that problem/any of those problems?

- ◯ Yes
- ◯ No

Which problems?

- ☐ Can't pay attention in class
- ☐ Difficulty taking notes
- ☐ Difficulty understanding material
- ☐ Homework takes longer
- ☐ Difficulty studying for tests/quizzes
- ☐ Headaches
- ☐ Too tired
- ☐ Other

Other persistent problem

_____

Did [child_name] miss any days of school due to the concussion he sustained on [concussion_date]?

- ◯ Yes
- ◯ No

How many days of school did he/she miss due to the concussion?

_____

Did [child_name]'s school provide any of the following classroom accommodations to meet your child's needs?

- ☐ Reduced workload (e.g., less homework)
- ☐ Written notes, note-taker, or audio recording
- ☐ Extended time to complete tasks (e.g., homework, classwork or tests)
- ☐ Quiet room for tests or coursework
- ☐ Staggered or postponed tests
- ☐ Use of notes during tests
- ☐ Other test accommodations
- ☐ Excuse from PE/gym class
- ☐ Tutoring or extra help (in or out of class) from teacher
- ☐ Time to visit the school nurse
- ☐ Shortened classes (e.g., rest breaks during class)
- ☐ Shortened school days
- ☐ 504 plan or formalized school team meeting
- ☐ Other accommodations
- ☐ No accommodations were provided

Other accommodations

_____

How well did the accommodation(s) (or lack thereof) meet his/her needs?

- ◯ Very dissatisfied
- ◯ Dissatisfied
- ◯ Satisfied
- ◯ Very satisfied

When your child returned to school after his/her concussion, which of the following people were aware of his/her concussion? (Select all that apply.)

- ☐ Classroom teacher(s)
- ☐ School psychologist
- ☐ School counselor
- ☐ Special education teacher
- ☐ Principal
- ☐ Coach
- ☐ Athletic trainer
- ☐ Speech language pathologist
- ☐ Social worker
- ☐ School nurse
- ☐ School physician
- ☐ PE teacher

Was there any communication between your health care provider and the school regarding your child's concussion?

- ◯ Yes
- ◯ No

Who from the school spoke with your health care provider?

- ☐ Classroom teacher(s)
- ☐ School psychologist
- ☐ School counselor
- ☐ Special education teacher
- ☐ Principal
- ☐ Coach
- ☐ Athletic trainer
- ☐ Speech language pathologist
- ☐ Social worker
- ☐ School nurse
- ☐ School physician
- ☐ PE teacher
- ☐ Other

Other communicator _____

Was there communication between you and the school regarding [child_name]'s return to school after concussion?

- ◯ Yes
- ◯ No

Who from the school spoke with you?

- ☐ Classroom teacher(s)
- ☐ School psychologist
- ☐ School counselor
- ☐ Special education teacher
- ☐ Principal
- ☐ Coach
- ☐ Athletic trainer
- ☐ Speech language pathologist
- ☐ Social worker
- ☐ School nurse
- ☐ School physician
- ☐ PE teacher
- ☐ Other

Other communicator _____

Has there been someone at the school who has been particularly helpful when you've had questions or concerns? (check all that apply)

- ☐ Classroom teacher(s)
- ☐ School psychologist
- ☐ School counselor
- ☐ Special education teacher
- ☐ Principal
- ☐ Coach
- ☐ Athletic trainer
- ☐ Speech language pathologist
- ☐ Social worker
- ☐ School nurse
- ☐ School physician
- ☐ PE teacher
- ☐ Other

Other helpful person _____

Project BRAIN is an organization that supports the needs of students who have a concussion and their families. Were you aware of this organization?

◯ Yes
◯ No

Have you spoken to anyone with Project BRAIN regarding [child_name]'s (most recent) concussion?

◯ Yes
◯ No

What services were provided?

☐ Family education
☐ Communication with school
☐ Referral to service coordinator
☐ Referral to other community resources
☐ Other

Describe other services provided by Project BRAIN.

_____

Overall, how satisfied were you with [child_name]'s return to school following concussion?

◯ Very dissatisfied
◯ Dissatisfied
◯ Satisfied
◯ Very satisfied

Now I am going to ask you some demographic questions.

What is your race? Choose all that apply.

☐ American Indian or Alaska Native
☐ Asian
☐ Black or African-American
☐ Native Hawaiian or Other Pacific Islander
☐ White
☐ Unknown
☐ Not Reported;

What ethnicity do you most closely identify with?

◯ Hispanic or Latino
◯ Not Hispanic or Latino
◯ Unknown
◯ Not reported

What is the highest grade or level of school you (or the primary caregiver) has completed or the highest you/he/she has received?

◯ Never attended/Kindergarten only
◯ 1st Grade
◯ 2nd Grade
◯ 3rd Grade
◯ 4th Grade
◯ 5th Grade
◯ 6th Grade
◯ 7th Grade
◯ 8th Grade
◯ 9th Grade
◯ 10th Grade
◯ 11th Grade
◯ 12th Grade, no diploma
◯ High school graduate
◯ GED or equivalent
◯ Some college, no degree
◯ Associate degree: occupational, technical, or vocational program
◯ Associate degree: academic program
◯ Bachelor's degree (e.g., BA, AB, BS, BBA)
◯ Master's degree (e.g., MA, MS, MEng, MEd, MBA)
◯ Professional school degree (e.g., MD, DDS, DVM, JD)
◯ Doctoral degree (e.g., PhD, EdD)
◯ Unknown

What is the range, in U.S. dollars, of the annual pre-tax, pre-deduction total income, of your household?

- ◯ Under $15,000
- ◯ $15,000 to $24,999
- ◯ $25,000 to $34,999
- ◯ $35,000 to $49,999
- ◯ $50,000 to $74,999
- ◯ $75,000 to $99,999
- ◯ $100,000 and over
- ◯ Refused
- ◯ Unknown

How many people, including you and [child_name], are supported by the household gross annual income reported?

_____

Child telephone questionnaire

Please complete the survey below.

Thank you!

FIrst I am going to ask you some questions about your concussion and school experience.

Some people have the misconception that concussions only happen when you black out after a hit to the head or when the symptoms last for a while. But, in reality, a concussion has occurred anytime you have had a blow to the head that caused you to have symptoms for any amount of time. These include: blurred or double vision, seeing stars, sensitivity to light or noise, headache, dizziness or balance problems, nausea, vomiting, trouble sleeping, fatigue, confusion, difficulty remembering, difficulty concentrating, or loss of consciousness. Whenever anyone gets a ding or their bell rung, that too is a concussion.□□□□Based on this definition, how many total concussions have you had in your life, including your most recent one?

_____

Please rate your overall academic performance prior to your (most recent) concussion.

◯ Failing
◯ Below average
◯ Average
◯ Above average
(Richardson 2005)

How does your overall academic performance compare now?

◯ Same now as before concussion
◯ Worse now than before the concussion
◯ Better now than before the concussion

What kinds of school problems did you have AFTER your injury?

☐ Can't pay attention in class
☐ Difficulty taking notes
☐ Difficulty understanding material
☐ Homework takes longer
☐ Difficulty studying for tests/quizzes
☐ Headaches
☐ Too tired
☐ Other
(Check all that apply- new problems or problems that have gotten worse since injury)

Other school problems

_____

Are you still experiencing that problem/any of those problems?

◯ Yes
◯ No

Which problems?

☐ Can't pay attention in class
☐ Difficulty taking notes
☐ Difficulty understanding material
☐ Homework takes longer
☐ Difficulty studying for tests/quizzes
☐ Headaches
☐ Too tired
☐ Other

Other persistent problem

_____

Did you miss any days of school due to the concussion you sustained on [concussion_date]?
- ◯ Yes
- ◯ No

How many days of school did you miss due to the concussion?
_____

Did your school provide any of the following classroom accommodations to meet your needs?
- ☐ Reduced workload (e.g., less homework)
- ☐ Written notes, note-taker, or audio recording
- ☐ Extended time to complete tasks (e.g., homework, classwork or tests)
- ☐ Quiet room for tests or coursework
- ☐ Staggered or postponed tests
- ☐ Use of notes during tests
- ☐ Other test accommodations
- ☐ Excuse from PE/gym class
- ☐ Tutoring or extra help (in or out of class) from teacher
- ☐ Time to visit the school nurse
- ☐ Shortened classes (e.g., rest breaks during class)
- ☐ Shortened school days
- ☐ 504 plan or formalized school team meeting
- ☐ Other accommodations
- ☐ No accommodations provided

Other accommodations
_____

How well did the accommodation(s) (or lack thereof) meet your needs?
- ◯ Very dissatisfied
- ◯ Dissatisfied
- ◯ Satisfied
- ◯ Very satisfied

When you returned to school after your concussion, which of the following people were aware of your concussion? (Select all that apply.)
- ☐ Classroom teacher(s)
- ☐ School psychologist
- ☐ School counselor
- ☐ Special education teacher
- ☐ Principal
- ☐ Coach
- ☐ Athletic trainer
- ☐ Speech language pathologist
- ☐ Social worker
- ☐ School nurse
- ☐ School physician
- ☐ PE teacher

Has there been someone at the school who has been particularly helpful when you've had questions or concerns? (check all that apply)
- ☐ Classroom teacher(s)
- ☐ School psychologist
- ☐ School counselor
- ☐ Special education teacher
- ☐ Principal
- ☐ Coach
- ☐ Athletic trainer
- ☐ Speech language pathologist
- ☐ Social worker
- ☐ School nurse
- ☐ School physician
- ☐ PE teacher
- ☐ Other

Other helpful person
_____

Overall, how satisfied were you with your return to school following concussion?
- ◯ Very dissatisfied
- ◯ Dissatisfied
- ◯ Satisfied
- ◯ Very satisfied

Now I am going to ask you some demographic questions.

What is your race? Choose all that apply.

- ☐ American Indian or Alaska Native
- ☐ Asian
- ☐ Black or African-American
- ☐ Native Hawaiian or Other Pacific Islander
- ☐ White
- ☐ Unknown
- ☐ Not Reported;

What ethnicity do you most closely identify with?

- ◯ Hispanic or Latino
- ◯ Not Hispanic or Latino
- ◯ Unknown
- ◯ Not reported

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