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Examining Concussion Awareness, Perceptions, and Management Practices in Georgia High School Sports: An Application of the Diffusion of Innovations Theory in Sports Injury Prevention

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ABSTRACT

Examining Concussion Awareness, Perceptions, and Management Practices in Georgia High School Sports: An Application of the Diffusion of Innovations Theory in Sports Injury Prevention

By Tamara R. Espinoza

Background: Traumatic brain injury (TBI) affects 1.7 million Americans each year. Sport related TBI accounts for nearly 20% of all head injuries in the United States. Sate concussion legislation has been universally adopted to address the growing need for improved education and concussion management in youth sports. It is unknown what effect legislative efforts have had on concussion awareness and management practices within high school athletic arenas.
Objective: The objective of this research was to assess knowledge, attitudes, and adoption behaviors among high school sport stakeholders in Georgia.
Methods: A pilot tested electronic survey was disseminated to high schools within the Georgia High School Association (GHSA) to coaches, student athletes, and parents of student athletes who actively participated in high school sports during the 2012-2013 season. Survey constructs focused on: a) knowledge, awareness, and perceptions of concussions; b) knowledge, attitudes and perceptions of established concussion guidelines; and c) coaches' adoption of the GHSA polices.
Results: 355 participants completed the online survey. Among respondents, 50% were coaches, 43% were parents and 7% were student athletes. Nearly all (94%) respondents accurately identified a concussion as a TBI and more than 90% of coaches accurately identified signs and symptoms of concussions. Most participants perceived concussions as serious (93%), and believed structured concussion policies were important for protecting youth health (88%). Similarly, 75% of respondents were aware of the GHSA guidelines and most surveyed coaches reported the GHSA guidelines were similar (85%) and compatible (86%) with current schools' policies on concussion injuries. Yet, only up to 85% of surveyed coaches accurately identified appropriate management actions for a potentially concussed athlete, and over 7% of parents who witnessed a concussion in the previous year, reported coaches did not follow standard removal and return to play guidelines for high school athletes.
Impact: This data suggests that while most Georgia high school sports have high degree of knowledge and awareness of concussion injuries, and generally a positive perception of GHSA concussion policies, specific gaps in knowledge and policy adoption exists that warrant further attention by public health practitioners and policy makers alike.

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CHAPTER 1: INTRODUCTION

Traumatic brain injury (TBI) remains a significant medical and public health concern. Over 1.7 million Americans suffer from some form of significant traumatic brain injury each year in the U.S.[1] These injuries result in over 235,000 hospital admissions and are the root cause of over 50,000 deaths annually.[2] In 2010, it was estimated that total direct and indirect costs of these injuries exceed $76 billion per year, including costs related to loss of productivity, lost wages, and other non-medical expenditures.[3]

Nearly 80% of head injuries sustained in the U.S. are defined as mild traumatic brain injury (mTBI) or concussions. Sports-related concussion injuries are the third most common causes of mTBI, accounting for over 200,000 emergency department visits annually.[4] Males and youth aged 5-18 years have the highest rate of ED visits for sports-related TBI.[5] Between 2005 and 2008, visits to Georgia emergency departments for concussions remained within the range of 1700-2500 for teens between the ages of 13-19 years of age. American football has the highest reported prevalence of concussive injuries, with approximately 5.6% of high school football players sustaining a concussion per season.[6] While most concussions resolve quickly, high school athletes tend to require a more prolonged and graduated recovery period compared to collegiate and professional athletes.[7] Additionally, investigators have shown a history of prior concussions is an independent risk factor for incurring a repeat concussion, and athletes with a history of multiple concussions are slower to recover than athletes without such history.[8]

In light of the recent and growing evidence of long term cognitive, functional and psychological effects of repeated concussions, efforts to improve community awareness

of TBI and standardize preclinical concussion management efforts has lead to the development of state legislation for concussion in young athletes. The Zackery Lystedt Law (Washington House Bill 1824) was the first legislation aimed at improving concussion awareness, recognition, and management in youth sports. Subsequently, over the last five years, all 50 states and the District of Columbia effectively passed some variation of youth sports concussion laws. However, it is unknown what effect, if any, these legislative efforts have had on concussion knowledge and management practices within the recreational and high school athletic arenas. Moreover, limited funding for implementation of the laws and lack of formal monitoring and enforcement mechanisms has led many community stakeholders to question overall feasibility and compliance, labeling the mandate an "unworkable law." (Gowen et al. Presented during the *Implementation of State Youth Concussion Laws: Perspectives from the Frontlines* webinar. 2012)

To address these concerns, further research is needed to assess the efficacy of current legislation in improving awareness, mitigating injury, and preventing long-term morbidity due to sports- and recreation-related concussion. Additionally, evaluation of state-specific concussion by-laws and strategies for policy implementation is critical to inform future guidelines and policy efforts for traumatic brain injury. Applying the Diffusion of Innovations theory[9], this proposal seeks to evaluate knowledge and attitudes towards concussion injuries and as well as motivation (or lack thereof) to adopt standardized concussion management policies for youth sports among Georgia High School stakeholders.

Theoretical Framework For Concussion Legislation Evaluation: An Overview

The Diffusion of Innovations (DOI) theory focuses on stages and processes of change to provide a framework for the implementation and adoption of novel ideas within target populations. More specifically, Rogers defines diffusion as "*the process through which an innovation is communicated through certain channels over time among the members of a social system*."[9] According to the theory, dissemination and uptake of an idea is predicated upon the complex interplay between the innovation (or intervention), characteristics of the target population (or decision making units), and the ecological context in which the innovation is deployed (Figure 1). Innovations that are: viewed positively, accepted as warranted and beneficial for the general public health, perceived to be easy to use and align with societal norms, offer an advantage over current practices, and can be tried and tested by potential end-users, are more likely to be adopted.

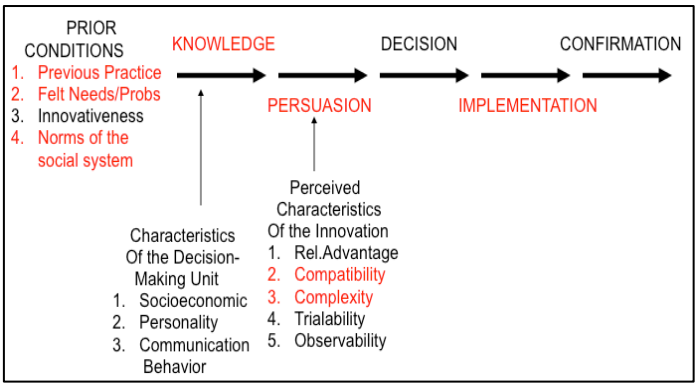

Figure 1. Theory of Diffusion of Innovations
Constructs highlighted in red are areas of focus in the current study

Not surprisingly, DOI has been used in many preventative and intervention-based public health efforts, covering a wide range of health behavior outcomes. However very few investigators have applied DOI to brain injury research or evaluation of injury prevention strategies for youth sports. To date, the author is aware of only two other published studies in which DOI was applied to concussion research – the first studying

helmet use among ski and snowboarding populations[10], and the second evaluating the Center for Disease Control and Prevention's "Heads Up" concussion initiative.[11,12] Given the heightened attention placed on mTBI and concussion injuries within the last decade, and the currently evolving paradigm shift to standardized, mandated concussion assessment guidelines, the application of DOI is particularly relevant to study the adoption of specific recognized consensus guidelines directing concussion assessment and management in youth sports.

The primary aim of this proposal is to develop and validate a survey instrument to study the *adoption of* and *attitudes towards* the Georgia High School Association's (GHSA) policy on youth concussion management among players, parents, and coaches actively involved in Georgia high school athletic programs. The GHSA policy outlines three ***strongly recommended*** principles for youth concussion injury management: 1) Athletes must be removed from game or practice play for all confirmed or suspected concussions; 2) Any athlete diagnosed with a concussion should be cleared by an appropriate heath care professional (HCP) prior to returning to athletic activities. Furthermore, a graduated return to play (RTP) protocol should be a part of the medical clearance; and 3) It is strongly recommended that coaches participate in a free, online course on concussion management prepared by the National Federation of High School Sports (NFHS). For the purposes of this study, the three proposed concussion policies above – removal from play, graduated return-to-play by a licensed medical professional, and coaches' education – will define "*The Innovation*" within the DOI paradigm. This proposal will address the following questions:

1. What is the knowledge and awareness of concussion injuries among Georgia high school players, parents and coaches.
2. What are the attitudes and beliefs towards concussion injuries among high school players, parents, and coaches in Georgia?
3. What are the knowledge, attitudes and beliefs towards proposed concussion policies among high school players, parents, and coaches in Georgia?
4. How well have proposed concussion policies been adopted among high school players, parents, and coaches in Georgia?

CHAPTER 2: BACKGROUND

Brain injury has become an increasingly recognized leading public health problem. Sports and recreation-related concussion injuries are the third leading contributor to the prevalence of mild traumatic brain injury (mTBI) in the U.S. More concerning, each year, nearly half a million U.S. emergency department (ED) visits for TBI are made by children aged 0 – 14 years.[13] Considering the growing evidence for potential long-term neurocognitive and psychological sequelae after chronic, repeated concussions[14,15], efforts to correctly identify brain injured individuals and prevent or limit future concussions are paramount.

Significant progress has been made over the last 10 years to increase awareness and improve available tools for the identification and management of concussion injuries. Nonetheless, the translation of academic discovery into practical "field-ready" implementation has been a gradual, laborious process. Moreover, the identification of potentially injured participants is severely hindered by widespread under-reporting of

symptoms in athletes at all levels of play. Findings about concussion reporting by high school football players indicate that only 47.3% report their injury, often due to not thinking the injury was serious enough (66.4%), concern about being withdrawn from competition (41%) or lack of awareness of concussion symptoms (36.1%).[7] Limited data exists assessing parent opinions or actions regarding concussion injuries. However, recent reports found that parents are not seeking medical advice about their teen, including guidance on concussion risk, symptoms, and preventative efforts, until *after* the first concussion.[16] Steps to improve the impact of current public health messaging and assess continued gaps in knowledge transfer to target audiences are critical to improve concussion injury awareness and prevention.

Early Outreach Efforts

To aid in knowledge dissemination, increase overall public awareness, and lower the incidence of sports-related concussion injury, in 2005 the Centers for Disease Control (CDC) developed the *Heads Up* Concussion campaign - a comprehensive concussion awareness and management initiative ("toolkit") designed to assist high school coaches (later editions focused on parents and players/students and finally medical providers) in their head injury prevention, identification, and management practices. The initiative provided much needed education on concussion symptoms and risk factors, and additionally stressed the importance of immediate removal from play after suspected concussive injury, followed by a graduated RTP protocol once an athlete was cleared by a medical provider. The toolkits were disseminated to high school coaches across the country and could also be ordered through the CDC website.

Following dissemination of the toolkit, a summative evaluation of the *Heads Up* initiative concluded the resources positively affected high school coaches' knowledge, attitudes and behaviors towards concussion.[11] A second study evaluating coaches perceptions' of the toolkit found that most coaches reported an improved ability to identify athletes with suspected concussion (77%) and many indicated they learned new information from the toolkit (50%). Most strikingly, nearly 70% of the coaches interviewed stated **they did not have access to any other concussion materials prior to receiving the *Heads Up* toolkit from the CDC**.[17] Thus, the CDC *Heads Up* campaign was a pivotal public health initiative for concussion injuries, providing the first nationally distributed, and in many cases the only evidence-based resource for concussion awareness and education, particularly relevant for removal and return to play management decisions in youth sports.

Gaps in Knowledge Transfer and Adoption of Recommended Guidelines Persist

Within three months of the program, the CDC estimated it had distributed approximately 20,000 toolkits and reached an audience of 6 million through its targeted media campaign.[11] However, a recent study released January 2013, revealed disparities in knowledge and adoption of guideline recommendations still exist among family physicians, those who perhaps would be expected to have a higher overall awareness of evidence-based policy recommendations for concussion management. Lebrun et al.[18] found that while most U.S. primary care physicians used clinical examination for concussion assessment (93.8%), far fewer used multidisciplinary concussion screening tools or balance testing (26.7%) – both of which are endorsed by most authorizing bodies within the medical and sports communities as well as the 2008 Zurich Consensus policy

on concussions.[19] Additionally, the authors found nearly 84% of practitioners prescribed *physical* rest after a concussive injury, however significantly fewer recommended *cognitive* rest (47.5%). Notably, only 64% of U.S. physicians relied on recognized guidelines for return-to-play management decisions.[18]

While the *Heads Up* campaign has been instrumental in creating awareness and dialogue surrounding concussion injuries, barriers to implementation and adoption of recommended concussion guidelines persist behind silos of clinical practice, and likely are even more prominent in communities with fewer resources and limited access to information. Further, education-only initiatives are limited to those with access to the information, and motivation to learn and comply with recommendations. In light of the growing demand for improved concussion resources and heighted attention focused on injury reduction, legislation was created to standardize the process for identifying and clearing potentially concussed athletes in high school and recreational leagues, with the overall goal of reducing brain injury in young athletes.

Concussion Legislation

In 2009, Washington became the first state to pass concussion legislation directing the management of brain injuries for youth and high school athletes. The mandate, entitled The Zackery Lysted law, was named after the middle school football player who sustained severe and permanent brain injury after returning to play during a game in which he sustained an unrecognized concussion. Since then, concussion legislation has been universally enacted nationwide. While the exact policy by-laws vary by state[20], all legislative policies contain the following three core principles:

1. Coaches (*Note: Many states also include provisions for player and parent/guardian education as well*) must be educated on concussion recognition, injury sequelae, treatment, and return to play guidelines.
2. After sustaining a confirmed or suspected concussion, athletes must be immediately removed from play and cannot return to play that same day
3. Athletes must be evaluated and cleared for play by a licensed provider trained in concussion management. Decisions regarding return-to-play (RTP) should follow an individualized and graduated protocol. Athletes should not be cleared for play until they are symptom free at rest and with exertion.

Georgia passed the Return to Play Act (House Bill 284) in 2013, directing concussion management in youth and recreational sports. Prior to the passage of this legislation, all Georgia high school athletic programs were under the purview of the Georgia High School Association's by-laws concerning concussion injuries. The GHSA is a voluntary organization of over 400 public and private high schools. The GHSA sets and maintains standards of eligibility of play for both students and schools, and provides registration, training, and evaluation of officials in all competitive events.

The GHSA policy on concussion head injuries aligns with the core principles of concussion legislation passed in other states. However, prior to passage of the Return to Play Act, the GHSA concussion policy recommendations were only ***strongly encouraged*** at the state level. Decisions regarding monitoring, enforcement, and consequences for non-compliance were left to the individual schools. Not surprisingly, little is known about concussion knowledge, attitudes, and practice behaviors of coaches, players, and parents

in the Georgia high schools. Additionally, it is unclear how well the GHSA core principles (*The Innovation)* – education, removal from play, and return to play - have been adopted and implemented within Georgia athletic communities *prior* to a concussion mandate.

To fill this gap, this study surveyed Georgia high school stakeholders to study the impact of the GHSA concussion policies (and recent legislation) on community knowledge, attitudes, and adoption behaviors of recommended management guidelines.

CHAPTER 3: METHODS

Survey Development and Validation

Survey Measures

The Diffusion of Innovations theory was used to develop and validate a survey tool to assess concussion knowledge, attitudes, and adoption behaviors among high school concussion stakeholders. Content validity of survey measures was assessed through expert panel review and comparison with current published survey instruments.[11,21] Three separate but similar surveys were created, one for each population of interest (athlete, parent/guardian, coach). Survey questions include open-ended, multiple choice, Likert scale, and case based questions to assess the following DOI constructs (Appendix A):

Prior Conditions

- Perceptions and attitudes towards mTBI risk among high school players, parents and coaches
- Previous practices for concussion assessment and return to play management
- Attitudes towards enforced concussion management policies and legislation

Knowledge

- Knowledge of signs and symptoms of concussion
- Knowledge of current concussion management policies for high school athletics

Persuasion

- Perceptions and motivation to comply with established concussion policies relevant to Georgia High School athletics
- Compatibility and complexity of concussion policies

Implementation

- Self-reported management practices for removal from play and return to play after suspected concussion
- Current sources of concussion messaging/education among players, parents, and coaches

Pilot Survey Validation

Face validity of the pilot surveys was assessed through pilot testing of student athletes, parents/guardians of student athletes, and team coaches from a single high school within the Atlanta metropolitan area. Snowball sampling was utilized to recruit a sample of 13 participants (n=4 student athletes, 5 parents/guardians of student athletes, and 4 high school coaches) for pilot survey development. Subjects completed a pen-paper version of the pilot survey followed immediately by a focus group interview. Focus group questions focused on item clarity, content comprehension, overall comprehensiveness of the survey, and other feedback relevant to satisfy face validity analysis of the survey constructs. Focus group transcripts were analyzed following Kreuger's framework for

thematic analysis[22] for final survey modifications. Focus group participants were compensated $35 for their time.

Survey Dissemination

The final study survey was disseminated to Georgia high schools over a 6-week period from November through December 2013. Although survey dissemination occurred after the passage of Georgia's Return to Play Act, statewide implementation of the bill did not occur until after data collection for this study was complete. Thus, investigators chose to reference the GHSA policies for concussion injuries when evaluating knowledge, attitudes, and adoption of "the innovation", rather than referencing the newly enacted, and likely less recognized concussion bill. However, to assess baseline awareness of state legislation, participants were asked the following question, " Does your state have laws regarding concussion in youth sports?"

Participant Recruitment

Potential participants were identified via established channels though the Georgia High School Association's listserv. This network of Georgia high schools provides a sampling frame of 443 public and private schools within the state.

Study Participants

Inclusion and exclusion criteria were identical for the survey validation pilot group and final survey implementation. Student athletes aged 16 years or older, actively involved in one or more Georgia high school sport(s) during the 2012 -2013 season were eligible for study participation. Parents/guardians of student athletes with similar qualifications or coaches of a high school sports were also eligible. Exclusion criteria

included minors less than 16 years of age, non-Georgia residents, or individuals without English fluency.

Survey Implementation

Surveys were administered and collected anonymously through the *Emory Feedback Server,* a HIPPA compliant, survey design and data collection software program. Prior to survey dissemination, a recruitment flier and relevant information was sent to schools participating in the GHSA using established school points-of-contact, and disseminated via school websites, departmental or group emails, distribution of fliers, and/or word of mouth. Following the announcement, the study survey was posted through the same web resources. *A follow-up reminder was sent 2-3 weeks after survey dissemination to remind participants of study procedures*. Participants were also given the option to complete a pen/paper version of the survey if preferred.

The survey took approximately 30 minutes to complete. Participants were able to view and save survey responses for submission at a later time if they choose. Survey participants were compensated $10 for their participation.

Study Outcomes

Formative research outcomes from the pilot survey were incorporated into the final study survey. Thematic analysis revealed focus group discussion centered on clarity of instructions and questions being asked, however content and comprehensiveness was felt to be appropriate. Thus, items were refined based on pilot feedback, but final survey constructs were not modified from those described above. Additionally, demographic information – including categorical status (player, parent/guardian or coach), personal concussion history, gender, age (for student athletes only) – school concussion rates (self-

reported), campus resources, and sources of concussion information, were collected for descriptive analysis and to inform future outreach efforts.

Data Analysis

Quantitative data analysis was performed using IBM SPSS Statistics software, version 21.0. We applied univariate, statistics for primary study outcomes for each population cohort. We used descriptive analysis to assess trends in self-reported management practices in among Georgia high school stakeholders. Finally appropriate, differences between and within selected cohorts are also described.

CHAPTER 4: RESULTS

Demographics

A total of 355 Georgia residents participated in this survey, representing 87 schools and 49 counties in Georgia (Appendix B). Participants included high school coaches (n=178, 50%), parents/guardians of high school student-athletes (n=151, 43%), and student athletes (n=24, 7%). A slight majority of participants were male (n=181, 52%). Mean age for athletes was 16.6 years (sd 0.72). Age was not collected for parents or coaches. Among the coach participants, the majority (n=157, 88%) reported being a varsity coach as their primary role in high school athletics. Similarly, 88% (n=21) of athletes self-identified as varsity high school athletes, and 75% (n=115) of parents reported having a child in varsity high school sports.

Most participants reported having athletic trainers available during games (n=289, 81%) but fewer reported having athletic trainers available during practices (n=236, 67%). Of the coaches surveyed, 86% (n=153) reported having access to a healthcare provider trained in concussion injury for medical evaluation (clearance) and return to play

decisions. However, only 45% (n=79) of parents and student athletes reported that their medical provider was trained in concussion injury, while the remainder of participants (n=91, 51%) were unsure if their provider had any concussion training.

For the purpose of this study, *season years* was defined as the number of high school sport seasons per year in which a respondent is an active participant. Thus, an athlete that participates in one sport each high school year for three years would have a 3-season year experience in high school athletics. Alternatively, an athlete that participates in 2 sport seasons (e.g. football and baseball) each high school year for three years would have a 6-season year experience in high school athletics. Among surveyed participants, high school athletic experience as measured in season years was highly variable, with a range of 1 to 81 season years reported (mean 10.27 season years, sd=12.18). Athletes and parents of student-athletes reported a mean of 4.09 (sd=2.25) and 4.35 (sd=3.17) season years respectively in high school sports (Note: parent's reported on their child's participation in high school athletics). Coaches were more variable in their experience, reporting a mean of 15.98 season years (sd=15.68).

Athletes

During the previous high school year, 5 (21%) of athletes reported they sustained 1 concussion injury, one (4%) reported having two concussive injuries, and the remainder denied having any concussion injuries. Of those that reported concussions, the most common sports for mTBI were: soccer (n=4, 17%), cheerleading (n=3, 13%), and lacrosse (n=2, 8%). The majority of athletes surveyed indicated they had never sustained a concussive injury in their lifetime (n=15, 63%), while 8 (33%), had 1 concussion over their lifetime. Notably, one athlete reported a lifetime history of 4-5 concussions.

Objective 1: Describe awareness, knowledge and attitudes towards concussion injuries among Georgia high school players, parents and coaches

A. Knowledge and Awareness

Respondents were given several multiple-choice questions describing various signs, symptoms, and causes of concussion injuries to evaluate baseline knowledge of mTBI. Table 1 compares the overall accuracy of each cohort for each knowledge question presented. Collectively, nearly all respondents (94%) accurately identified a concussion as a TBI, and 94% reported concussions could occur without a loss of consciousness. Five (21%) athletes, 64 (36%) coaches, and 40 (26%) parents correctly answered all four questions representing the cause of concussion. However, 40% of those surveyed incorrectly reported a "ding" or "getting your bell rung" was not a concussion. Additionally, 5% of participants believed concussion injuries were associated with cardiovascular disease.

Table 1. Concussion Knowledge and Awareness Among High School Stakeholders

	Athletes	Parents/Guardians	Coaches
	N (%) correct		
A concussion is a type of traumatic brain injury or TBI	20 (83%)	139 (91%)	171 (96%)
All concussions are serious	22 (92%)	142 (93%)	174 (98%)
Concussions always occur with a loss of consciousness (*results listed indicate subject correctly disagreed with this statement)*	20 (83%)	144 (94%)	168 (94%)
Concussions are associated with heart attacks and heart abnormalities (*results listed indicate subject correctly disagreed with this statement)*	11 (46%)	95 (62%)	103 (58%)
For high school athletes, all concussion symptoms resolve within one week (*results listed indicate subject correctly disagreed with this statement)*	21 (88%)	141 (92%)	177 (99%)
CAUSE: Concussions can occur from a blow to the body that causes the head to move rapidly back and forth	**18 (75%)**	**132 (86%)**	**164 (92%)**
CAUSE: A "ding" or getting your bell rung is a concussion	**5 (21%)**	**50 (32%)**	**85 (48%)**

CAUSE: Concussion can occur in any sport or recreational activity	24 (100%)	147 (96%)	175 (98%)
CAUSE: Concussions only occur after direct impact to the head (*results listed indicate subject correctly disagreed with this statement)*	**16 (67%)**	**116 (76%)**	**146 (82%)**

Most surveyed coaches accurately identified signs or symptoms associated with a concussion in which an athlete should be removed from play, including being dazed (93%), forgetting instructions (92%), being unsure of the game, score, or opponent (97%), amnesia before or after the event (95% and 98% respectively), loss of consciousness (98%), headache (93%), vomiting (97%), concentration difficulties (98%), or balance problems (98%).

B. Attitudes towards concussion injuries

Nearly all respondents (n=328, 93%) felt concussions were serious, with only 1 (4.2%) athlete, 10 (6.5%) parents, and 11 (6.2%) coaches who indicated concussions were "not at all serious".

Among student-athletes, most felt *other* student-athletes (n=21, 88%) and their coach (n=24, 100%) perceived concussions as either very serious or somewhat serious. Among coaches, most believe student-athletes (n=163, 92%) and parents (n=164, 93%) perceive concussions as serious. Most parents felt coaches perceived concussions as serious (n=139, 92%) but fewer believed student athletes perceived held the same perception (n= 117, 76%).

To determine if parent personal history of mTBI had an impact on perceived seriousness of concussion, data regarding personal concussion history was dichotomized into "yes" and "no", where "no" included those without a self-reported confirmed history of concussion. Perceived concussion seriousness was dichotomized into "serious" (combining "very serious" and "somewhat serious"), and "not at all serious". Those who

answered “unsure” were not included for analysis. Parents with a history of mTBI did not a perceive concussions as serious (n=21, 96%) significantly more than those who did not have a history of mTBI (n=119, 93%) (Fisher’s Exact Test = 0.186; df=1; P= 0.55).

The impact of having a child injured with a concussion on parents’ perceptions of the seriousness of concussions was also assessed by dichotomizing a child’s lifetime history of concussion into “never” or “1 or greater” times. We found parents with a child who had never sustained a concussion were not more likely to report concussions as serious (n=81, 91%) than parents who had a child with at least one lifetime history of concussion (n=59, 97%). A child’s concussion history did not significantly impact parents’ perceptions of concussions as serious injuries. (Fisher’s Exact Test = 1.90; df=1; P=0.15).

Objective 2: Describe knowledge, attitudes and perceptions towards concussion policies for high school athletics

Overall the entire cohort showed a moderate to high level of awareness of the Georgia High School Association’s policy for addressing sports-related concussions. Seventy-five percent of those surveyed reported the GHSA had a sports-related concussion policy, and accurately identified the three by-laws of the policy: coaches should receive concussion education prior to coaching student-athletes (92%), athletes with a concussion must be symptom-free both at rest and after exertion before they can return to sports activities (81%); and an athlete with suspected concussion should be immediately pulled from practice and game play (91%). However, a sub-analysis of the individual cohorts surveyed found only 50% of athletes (n=12) and 59% of parents (n=90) where aware of the GHSA policy. Most coaches (n=163, 92%) did know of the

GHSA policies. Additionally, a number of participants erroneously reported that the GHSA policy mandated "*A licensed athletic trainer or physician should be on the sideline during game play or competition for all sports at high risk for head injury or concussion*" (76%).

Only 88 (25%) participants had knowledge of Georgia's state law for youth concussion (4 (17%) athletes, 28 (18%) parents, and 56 (32%) of coaches). The majority of respondents (n=254, 72%) were unsure if such legislation was available, while only 3% (n=11) of the surveyed cohort reported Georgia did NOT have a state law for youth concussion. Most respondents felt concussion legislation was very important (n=244, 69%) or somewhat important (n=68, 19.2%) for protecting the health of young athletes. Only 3.7% (n=13) of those surveyed felt concussion laws were "not at all" important.

To assess how well schools' current concussion policies compared to the GHSA guidelines for youth concussion, coaches were queried on perceived characteristics of the GHSA concussion by-laws. The majority of respondents (coaches only) indicated their schools' policies were similar to the GHSA policies (n=132, 85%), while 7.1% (n=11) reported their schools' policies were *more* comprehensive than the GHSA guidelines. None of the coaches surveyed reported their schools' policies were *less* comprehensive than the GHSA. Most coaches felt the GHSA guidelines were very compatible with the their current concussion management system (n=151, 86%), yet 25 (14%) coaches indicated most items of the GHSA are compatible with their current concussion management system but there are still items that have been difficult to implement. None of the participating coaches reported that the GHSA policies were "very difficult" or "unable to be implemented".

Objective 3: Describe coaches' adoption of GHSA concussion guidelines in high school sports

A. Coaches Participation in Concussion Education and Training Activities

Participation in educational and training activities for concussion was highly variable among coaches. Forty-seven (26%) coaches received concussion education information one time, 70 (39%) coaches reported receiving concussion education materials 2-5 times, and 57 (32%) reported receiving concussion education more than 5 times. Similarly, when queried on their participation in concussion training courses, responses ranged from participation once (n=67, 38%), 2-5 times (n=69, 39%), and more than 5 times (n=32, 18%).

Notably, 2.2% (n=4) of coaches reported they had never received concussion education materials while 5.6% (n=10) had never taken training courses for concussion assessment and management.

B. Removal from Play for Suspected Concussion and Graduation RTP after HCP evaluation and clearance

The majority of participants (n=303, 85%) reported having school policies in place for addressing sports-related concussion, while 46 (13%) were unsure, and 4 respondents (1.1%) reported their school did not have a sports-concussion policy. Most reported their school's policy was easy to access (n=255, 72%), was monitored and enforced (n=246, 70%), required athlete removal from play for suspected concussion (n=285, 80%), and provided guidance as to who can provide medical clearance after a concussion (n=279, 79%).

To assess self-reported exposure to concussion injuries over the previous athletic season, participants were asked to select responses to a witnessed head injury or describe how often specific behaviors were encountered. Coaches were asked to describe their own responses while athletes and parents were asked to comment on the behaviors of their coach.

During the 2012-2013 season, 95 (53%) coaches reported witnessing a concussion in their primary sport. Of these, only 1 coach reported allowing an athlete to return to play on the same day of injury. The majority removed the athlete from play (n=77, 89%), referred the athlete to a healthcare provider (n=80, 90%), and allowed the athlete to return to practice/game play only after clearance from an appropriate HCP (n=75, 86%). One coach reported on one occurrence allowing an athlete to return to play without getting a formal medical evaluation because the player was no longer symptomatic. Additionally 2 (1.1%) coaches reported one occurrence in which an athlete was allowed to return to play without getting a formal medical evaluation because the *player's parent(s)* reported the athlete no longer had concussion symptoms.

Eighty-one (53%) parents reported witnessing an mTBI in their child's sport(s) during the previous season. Of those who witnessed a concussion, most reported the coach followed recommended concussion management guidelines, including removing the injured athlete from play (n=68, 86%), having the athlete evaluated by an appropriate HCP (n=57, 72%), and only allowing an injured athlete to return to play after evaluation by an HCP (n=54, 68%). Most parents also reported the coach informed the athletes' parents about a known or suspected concussion (n=58, 73%). However, 7.6% (n=6) of

parent respondents reported the coach allowed an athlete to resume playing during the same practice or game after a witnessed head injury.

Among student-athletes, 8 (33%) reported being removed from play during a practice or game due to a suspected concussion. Within this cohort, 7 (87.5%) were removed only once, while one athlete reported being removed greater than 5 times during the 2012-2013 season for suspected concussion. All of the athletes survey reported that, even when asymptomatic, their coach did not allow them to return to practice/play without getting a formal medical exam after a confirmed or suspected concussion.

To evaluate coaches' knowledge and adoption of the GHSA concussion assessment and management policies, coaches (only) were presented with case scenarios in which they were instructed to assume the head coach role in a described sport, and asked to indicate their behavioral action in response to a sports-related concussion.

In the first case, a varsity football athlete sustained a symptomatic concussion that resolved within 10 minutes of rest on the sideline. Coaches were asked to select the best appropriate course of action. In this scenario, 61% (n=108) of coaches correctly reported they would keep the player benched for the remainder of the game. Others stated they would call the athlete's parents and send him to the local E.R. (n=36, 20%); reassess the player after and additional 10 more minutes and allow him to return to the game if he continued to be asymptomatic (n=21, 12%); or reassess the player after performing sprint exercises on the sidelines and allow him to return to the game if he remained asymptomatic (n=11, 6.2%). A minority of respondents reported they would allow the athlete to return to the game immediately (n=2, 1.1%).

In the second case, a varsity girl's basketball athlete sustained a possible concussion with associated headache during a game but does not get a medical evaluation. Two days later she is requesting to participate in practice and is asymptomatic. Most coaches (n=151, 85%) correctly reported they would refer the athlete and her parents to an appropriate HCP for evaluation. Fewer coaches selected incorrect distractor items such as: allowing the athlete to return to practice for non-contact drills only (n=21, 12.%); performing a sideline assessment and allowing the player to return to play if she remained asymptomatic at rest (n=5, 3%); or allowing her to return to play immediately (n=1, 0.6%).

CHAPTER 5: DISCUSSION

In our current milieu of social media, streaming Internet content, and near instantaneous dissemination of information via electronic messaging, the examination of public opinions on sports-related concussion poses a significant challenge. Combined with heightened attention towards concussion injuries in popular professional sporting leagues, and an increased responsibility placed on all of those caring for potentially injured athletes, the evaluation of TBI legislation is confounded by various messaging content and information sources available to the public. Nonetheless, this study provides a critical first step in the objective evaluation of important head injury prevention initiative in Georgia, and provides baseline information for future concussion legislation evaluation and reform.

Overall, the results from this survey demonstrate a high collective knowledge and awareness of sports-related concussions among Georgia high school stakeholders. These results are similar to those found by Shenouda et al.[21], who evaluated the impact of

concussion legislation in Washington state on knowledge and awareness among youth soccer association members. In the Washington study, 96% of respondents were aware concussion was a type of TBI, and 93% agreed concussion could occur without a loss of consciousness, as compared to 94% and 94% with identical responses in the present study respectively. Comparatively, Shenouda et al. reported 10% of respondents incorrectly associated concussion injuries with heart attacks, while in the present study only 5% of incorrectly agreed with this statement.

When the cohorts were assessed individually, coaches continued to demonstrate a high degree of knowledge on concussion injuries, however parents and student athletes were less able to discriminate causes of concussions. Specifically, fewer parents and athletes were aware concussions could occur from an impact to the body (rather than the head) or that impacts that caused a rapid deceleration of the head (without direct impact) could cause concussions.

Notably, in our study, only 40% of respondents (21% athletes, 32% parents, and 48% of coaches) correctly reported that a "ding" or "getting your bell rung" was a concussion. Thus, despite significant messaging campaigns and concussion initiatives, non-medical sports jargon such as a "ding" continues to be used in athletic communities to describe "lesser" head impacts that cause symptoms but are <u>not</u> perceived to be potential head injuries. We believe this to be a critical gap in knowledge translation and highlights important areas for intervention. While we report perceived seriousness of *concussion injuries* is high, recognizing a head injury as a ding (rather than a concussion) may have serious impact on how a head injury is managed, and potentially places at

athlete at risk for repeat injury. Further educational efforts are warranted in this area to improve the overall knowledge and safety in youth sports.

Additionally, we found parents' personal previous exposure to concussions – whether through personal history of concussion or having a child who had sustained a concussion – did not impacts parents' perception of concussions as serious. This is likely due to a ceiling effect, as nearly all parents surveyed (n= 140, 93%) felt concussions were serious. This seems to argue against earlier research which found parents did not seek medical advice about their teen, including guidance on concussion risk, symptoms, and preventative efforts, until *after* their first concussion.[16] One possible explanation may be an overall increase in dissemination of concussion-related messaging in lay media and sports environments, thereby improving concussion awareness in the general population irrespective of previous concussion experience.

Finally, we found most survey respondents were aware of the GHSA policies for concussion management in youth sports and reported their schools' protocols were similar to (and in a small subset, even more comprehensive) than these established guidelines. Although only 25% of respondents were aware of Georgia's concussion legislation, data collection for this study was completed prior to mandatory implementation of the law. A repeat assessment after the law has been fully implemented will be valuable in assessing adoption of these newly mandated protocols.

In general, adoption of the GHSA core principles was adequate, although a significant subset of the respondents reported concussion management behaviors that directly conflict with established concussion guidelines. For example, we found most coaches self-reported removal from play for a suspected concussion and RTP only after

clearance from a HCP. However, of those who had witnessed a concussion, some coaches and nearly 8% of parents continue to report observing actions that allowed an athlete to remain in the competition (practice or game) despite a suspected injury. Additionally, when presented with case scenarios requiring the correct identification of concussion symptoms and knowledge and implementation of recommended management guidelines, up to 40% of coaches selected an inaccurate course of action after a concussion.

Thus, when adoption is measured through constructs of knowledge and awareness, adoption remains high. Yet when adoption is measured through implementation, we found adoption to be low to moderate among Georgia high school coaches. In following the DOI framework, among Georgia high school stakeholders we report a high degree of policy awareness and largely positive perceptions and attitudes towards established concussion guidelines, yet the processes to translate positive knowledge and attitudes (persuasion) to decision and implementation of the intervention have not been as widely adopted. Continued public health outreach is warranted in this effort to improve overall management of SRC in youth and high school sports.

This study had several limitations. First, while we collected over 350 survey responses, only one-third of Georgia counties (n=149) and less than 25% of high schools participating in the GHSA (n= 443) are represented in our study sample. Although we utilized a structured, and previously trialed network of high schools through the GHSA listserv, the dissemination of the survey at each particular institution was dependent on that schools' point-of-contact, and thus was high variable. Further, while the geographic distribution of our sample is acceptably diverse, the south/central portion of Georgia was not at all represented in our study. Second, selection bias may have influenced our data

outcomes, as it is possible those motivated to participate in an online concussion survey may have greater knowledge of concussions and related health policies, regard concussion injuries as more serious, or have greater access to concussion messaging than those who did not participate in our study. Third, the authors acknowledge the study is limited by the reliance on self-reported data through our survey methodology. However, until more standardized and comprehensive surveillance options are available to study youth concussions, the anonymous electronic survey provides a feasible means to collect meaningful outcome data from a diverse target population. Finally, threats to external validity exist due to limitations in geographic representation of the central Georgia, and our sample population being skewed by significant access to concussion resources (e.g. on-site athletic trainers and referring health care providers). Additionally, cohorts participating in athletic events outside of the high school environment (e.g. recreation leagues, middle schools, or other club sports) were not represented in our sample.

Despite these limitations, to our knowledge this the first study to describe the current status of knowledge, awareness and perceptions of concussions in Georgia youth sports, and provide a baseline examination of current policy adoption behaviors in the state. Ultimately, this study offers a platform to compare and evaluate concussion legislation from a state and national perspective, and inform ongoing dialogue in TBI, and sports injury prevention.

In the future, we anticipate repeating this survey after community outreach and implementation of the Georgia Return to Play Act has been completed. Through this mechanism, we hope to evaluate changes in knowledge, attitudes and adoption behaviors in Georgia pre- and post-legislation. To our knowledge, no other study or state legislation

for concussion has been evaluated in this manner. Additionally, future work will focus on extending our data collection methods to other sports populations such as middle schools, and recreation leagues, as well as cohorts outside of Georgia to further evaluate the impact of concussion legislation.

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APPENDIX A: STUDY SURVEY MEASURES

(Survey Questions / DOI Construct)

Q1. What is the knowledge and awareness of concussion injuries among high school players, parents and coaches?	
• Mark your strength of agreement with the following statements about concussion	Knowledge
• Indicate your strength of agreement about the causes of concussion	Knowledge
• After a player is hit, which of the following signs and symptoms are sufficient reasons to keep an athlete out of play the day of injury	Knowledge
Q2. What are the attitudes and beliefs towards concussion injuries among high school players, parents, and coaches?	
• How serious is the issue of concussion in high school sports	Felt Needs
• How seriously do you think your athletes (or your athletes parents, coaches) view the issue of concussion	Felt Needs; Social Norms
• My role as a _____ includes educating athletes about sports-related concussion	Felt Needs
Q3. What are the knowledge, attitudes and beliefs towards proposed concussion policies among high school players, parents, and coaches?	
• Does your state have laws regarding concussion in youth sports?	Knowledge; Awareness; Previous practice
• How does your school's policy compare with your state's laws for sports-related concussion?	Compatibility; Relative Advantage
• How important do you feel legislation and laws are for protecting the health of young athletes?	Felt Needs
• How well does your state concussion laws fit into your current concussion and head injury management system?	Compatibility
• What are some barriers you have seen or experienced with using a formal concussion policy at your school?	Compatibility; Complexity
Q4. How well have proposed concussion policies been adopted among high school players, parents and coaches?	
• Does your school have a formal policy for concussion?	Knowledge; Awareness; Previous practice
• During the 2013-2014 playing season, did you witness any sports-related concussions? If so, how did you respond?	Implementation; Management trends
• Please tell use about any firsthand experiences you have had with head injuries since July 2013	Implementation; Management trends
• Case Scenarios (for coaches only) – removal from play and return to play cases	Implementation; Management trends

APPENDIX B: GEORIA COUNTIES REPRESENTED IN THE STUDY POPULATION