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Concussion Knowledge and Understanding in GHSA Guardians

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CONCUSSION KNOWLEDGE AND UNDERSTANDING IN GHSA GUARDIANS

by

CHLOE SALWAY

(Under the Direction of Tamerah N. Hunt)

ABSTRACT

Context: Concussions are a serious injury that could result in both short and long-term consequences, particularly if not recognized and managed appropriately. Concussion education has been implemented, mostly as a result of Concussion legislation. Coach and athlete concussion education has been evaluated in the literature, however the literature is scarce on parental concussion education.

Purpose: To assess concussion knowledge and understanding in guardians of Georgia High School Association (GHSA) student-athletes that completed the GHSA concussion awareness form, in comparison to those that received additional concussion education.

Methods: This study utilized a prospective cross-sectional descriptive research design. Participants were GHSA guardians (n=102) that were recruited during athletic events throughout the Fall 2016 athletic season. Participants completed a 34 item paper-based survey. The survey included demographic questions, concussion knowledge questions, and scenario questions to assess concussion understanding. Participants were divided into groups based upon level of concussion education they had received. Independent-t tests were calculated to evaluate differences in concussion knowledge, understanding, and overall score. A Pearson correlation

examined the correlation between knowledge and understanding score. All statistical analyses were conducted using SPSS 23.0. Significance levels were set *a priori* at $p \leq 0.05$.

Results: There was a response rate of 82%, with a sampling rate of 35%. Overall, the group that only completed the form had a mean knowledge score of 75% and mean understanding score of 82%, while the group that completed additional concussion education had a mean score of 79% for knowledge, and 84% for understanding. No statistically significant differences were found between groups on knowledge ($t_{(100)}=1.742$, $p=.085$), understanding ($t_{(100)}=.833$, $p=.407$), and total scores ($t_{(100)}=1.878$, $p=.063$). The Pearson correlation revealed a non-significant weak correlation between concussion knowledge and understanding ($r = .03$; $p = 0.76$).

Conclusions: Guardians of high school student-athletes displayed a moderate knowledge and understanding of concussion. Knowledge transfer techniques, such as the Knowledge to Action framework, as well as learning strategies that are geared towards adult learners may benefit this population. A multifaceted approach to concussion education should be utilized in order to most effectively reach every guardian in order to meet their educational needs.

INDEX WORDS: Concussion, Education, Knowledge, Understanding, Guardians

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CHAPTER 1

INTRODUCTION

Concussion is defined as a complex pathophysiological process affecting the brain, induced by biomechanical forces.¹ The term concussion is synonymous with mild-traumatic brain injury (mTBI) throughout the literature, as it is a subset of traumatic brain injury (TBI). Approximately 1.6-3.8 million sports-related traumatic brain injuries occur each year.² Concussive injury is caused by an impulsive force transmitted to the head from a direct blow to the neck, face or anywhere on the body. Following a concussive injury, there is an onset of signs and symptoms such as headache and dizziness, sensitivity to light and noise, neurocognitive deficits, and balance problems that may present within minutes or hours of injury.¹ Timely recognition of signs and symptoms is important to ensure the athlete's safety and well-being. It is also important that upon recognition of symptoms, the athlete is taken through the proper concussion management protocol.¹

Concussive injuries have increasingly garnered attention in recent years, especially in the athletic population. In 2009, the Lystedt Law of Washington State was enacted, and included three core elements: (1) annual guardian and athlete education (2) the immediate mandatory removal from play of athletes suspected of having a concussion, and (3) clearance by an appropriate health professional before an athlete that has sustained a concussion may return to play.³ Since then, all 50 states and the District of Columbia have enacted laws related to youth concussion.⁴ In general, legislation does not specify the type of education that guardians or athletes should receive. However, some laws have used the Center for Disease Control's educational materials as a guide.³ Forty-six states and the District of Columbia require

concussion information sheets to be distributed to the athletes, of which 44 states require guardian signatures.⁴

The Return to Play Act of 2013 is the current concussion legislation in the state of Georgia.⁵ This law requires each local board of education, administration of a nonpublic school, and governing body of a charter school to implement a concussion management and return to play policy. Within that policy, they must provide an information sheet to legal guardians, which details the nature and risks of concussions. The concussion policies also provide stipulations that a youth athlete that exhibits concussion-related symptoms “must be removed from participation immediately and evaluated by a health care provider”.⁵ In the state of Georgia, a health care provider is defined as “a licensed physician or licensed personnel under the supervision of a physician, or a certified athletic trainer that has received training in concussion evaluation and management.” Once diagnosed, an athlete must not return to play until they have received clearance by the health care provider. The law also suggests the use of one or more concussion education courses, including one that is available in an online format.⁵ It is very important that each athletic association abide by this law and implement these requirements for the safety of the athletes.

The Georgia High School Association (GHSA) is the governing body over high school athletics in the state of Georgia and is a member of the National Federation of State High School Associations (NFHS). Prior to participation in sport, GHSA requires guardians and athletes to read and sign a concussion awareness form. This is the only educational requirement mandated by Georgia state legislation and the GHSA. The form provides background information of concussion, common signs and symptoms related to concussion, and the GHSA concussion policy. The GHSA concussion policy follows the guidelines given by the consensus statement, the National Federation of State High School Associations, and Georgia’s Return to Play Act of 2013.^{1,5} This includes the immediate removal of an athlete that exhibits any signs, symptoms, or

behaviors consistent with concussion and the requirement that they shall not return to play for at least 24 hours. GHSA also requires medical clearance from an appropriate health care provider and completion of a graduated return to play protocol. GHSA mandates that every coach in every sport participates in a free online concussion education program every two years, however it is not required for guardians or athletes.

In general, there is a large focus on coach and athlete concussion education while little research focuses on guardian education.⁶ Concussion education in the guardian population is very important and should not be overlooked, as guardians are the primary caretakers of the high school athletes. Although the majority of legislation requires guardian education, the extent and effectiveness of guardian education being received should be investigated. If a guardian is educated on concussion, they may recognize if their child is suffering from post-concussive symptoms and seek appropriate concussion treatment.⁷ Mannings et al. found a relationship between the guardian's ability to correctly identify statements related to concussion and correct identification of concussion-related symptoms.⁷ In another study, it was found that no guardians were able to correctly identify all of the symptoms that were associated with concussions.⁸ Lin et al. found that in general their participants scored well on their indexes, however, there were various subgroups in particular that would benefit from additional concussion education.⁶

In order to make concussion education for guardians as effective as possible, theories surrounding adult learning and knowledge transfer should be considered. The 4th Consensus Statement on Concussion in Sport and Provvidenza et al. suggest that knowledge transfer (KT) has a critical role in concussion education, as it may provide a beneficial framework through assessing knowledge gaps and identifying educational strategies which concussion education should be implemented.^{1,9} KT can be defined as “the exchange, synthesis, and ethically-sound application of knowledge within a complex system of interactions among researchers and users to accelerate the capture of benefits of research through improved health, more effective services and products, and a strengthened health care system.”⁹ Knowledge is “the fact or condition of

knowing something with familiarity gained through experience or association” while understanding can be defined as “the power of comprehending and the ability to make experience intelligible through the application of concepts.”^{10,11} It is important to understand the definitions, because KT is a process that encompasses everything from the creation of knowledge, the dissemination of knowledge, the application of this knowledge into practice, and the evaluation of the application of the knowledge through a defined series of steps that are listed below. This process is how the KT theory connects the creation of knowledge to eventual understanding and application of the material by the target audience. Provvidenza et al. suggest that there is a clear link between concussion and KT, in that there is a clear target audience that can benefit from individualized learning strategies, and there are several concussion education tools that exist in various formats.⁹ Therefore, the use of KT may help to create a positive relationship between knowledge and understanding, or application of concussion knowledge. It is necessary to ensure that the target population is learning in a way that matches their learning styles. Further, the educational tools should be assessed to ensure that they are effective in accordance to their learning styles.¹² This would be done by following the steps within a framework, such as the Knowledge to Action (KTA) framework.

The Knowledge to Action (KTA) framework has been suggested to be the most effective framework in concussion education.⁹ KTA reinforces collaboration between knowledge creators and those that will utilize the knowledge. Within the KTA framework, the knowledge is research-based and refined to meet the needs of the knowledge users. The action cycle within the KTA framework consists of six steps. These steps are 1) identifying the knowledge need that is relevant to the stakeholders, 2) adapting the knowledge in a contextual manner as to facilitate acceptance, 3) assessment of adaptation, barriers, facilitators, potential users, and the knowledge setting. From there, step 4 includes identifying, tailoring, and implementing interventions. Step 5 involves monitoring knowledge use and the overall impact of the knowledge use. Finally, step 6 involves creating a plan to sustain the knowledge over a longer period of time should also be implemented. Effective KT strategies vary in respect to target audience and should be adjusted

accordingly. While performing the assessment of potential users, the target audience should be assessed in order to fulfill the educational needs of that population. In order to ensure efficacy of concussion education in the adult population, the most effective educational considerations for adult learners should also be considered.⁹

Adult learning theories can also help us understand the most effective educational strategies for the adult population. Current theories of adult learning emphasize many points that should be considered when creating an effective learning environment for adults. Adult learning theories and principles suggest that education within the adult population should consist of: (1) Content that is relevant and useful to the learner's real life, (2) connection to experience and previous knowledge that the learner may have, (3) providing the learners the ability to actively participate and reflect about what they have learned, (4) the material should be focused on the needs of the audience, and (5) the teacher should become a facilitator of knowledge.¹³ Guardians serve as the primary caretakers of their children, therefore knowledge of concussion is both relevant and useful information that can be directly applied to situations involving their children, especially if their children participate in sport.

Adult learning theories support the idea that concussion education may be more effective if it ties in previous experiences the guardian may have had playing or coaching sports. Educational initiatives are found to be more successful if the adult learner is able to relate the material to previous experience, which may help them to understand how the information provided is relevant and useful.¹³ Additionally, educational resources would be more beneficial if they use interactive and active learning strategies. Active learning strategies enable involvement of the learners beyond just listening which result in higher levels of engagement. The focus becomes developing the skills and exploring values and attitudes, rather than plainly transmitting information.¹³ These suggestions within adult learning theories can be implemented in the various web-based resources and interactive programs available for concussion education.

There are various concussion education tools available that are aimed at increasing guardian concussion knowledge. Common concussion education tools include the CDC's Heads Up initiative for guardians, Sports Legacy Institute Community Educators (SLICE), ThinkFirst, Brain 101, and Borrow Brainbook.¹⁴ The materials from these programs are available in various formats including interactive web-based resources and videos. It is important to understand the use and effectiveness of each format.

Printed materials and didactic lectures are ineffective standalone methods for concussion-related education in an adult population.¹⁵ A study by Grimshaw et al. found that that printed materials proved to be ineffective for physicians.¹⁵ Sullivan et al. found that a didactic lecture was ineffective for the retention of concussion knowledge and understanding of concepts in a group of physical therapy students.¹⁶

The use of technology-based resources has been encouraged for the adult learner population.¹⁷ It has been suggested that online strategies for health-related knowledge translation can link the researchers, or creators of knowledge, to the consumers of knowledge in a more timely and relevant manner.¹⁸ A multifaceted approach is encouraged to facilitate effective knowledge transfer of concussion education across all populations.^{9,19} Based on these facts, the effectiveness of the GHSA concussion awareness form should be assessed by evaluating the concussion knowledge and understanding of guardians of GHSA student-athletes.

According to existing research and suggestions concerning Knowledge Transfer theory and the Adult Learning theory, the current requirement for concussion education for GHSA guardians may not be adequate and should be assessed. Although legislation has incorporated the requirement of annual guardian education, it is apparent that guardian knowledge of concussion is lacking. The current study will help to further understand the amount of concussion knowledge and understanding that guardians exhibit in comparison to the amount and types of concussion education they have received. Therefore, the purpose of this study is to evaluate the knowledge and understanding of concussion in guardians of high school students that have completed the

GHSA concussion awareness form, and those that have received additional concussion education.

CHAPTER 2

METHODS

The primary purpose of this study was to assess concussion-related knowledge and understanding in guardians of Georgia High School Association (GHSA) student-athletes in comparison to the amount of concussion education they have received. Guardians are required to complete the concussion awareness form annually prior to their child's participation in GHSA sanctioned athletics.

STUDY DESIGN

To fulfill the purpose of this study, a prospective cross-sectional descriptive research design was used.

PARTICIPANTS

Participants included guardians of high school student-athletes within five high schools in southeast Georgia. These schools were selected as a sample of convenience for their participation in one sports medicine provider outreach program and involvement in various competitions. Participants were recruited from schools of various sizes (1A-6A) and demographics (culture and socioeconomic status).

The predicted total population of guardians was 375, assuming the average number of guardians of Fall athletes was 75 across the 5 high schools targeted for this study. The ideal number of participants was 113, for a response rate of 30%. A response rate between 30-40% is ideal for survey research within the field of athletic training.²⁰ Inclusion criteria included: completion of the GHSA concussion awareness form and legal guardianship of a student participating in a GHSA sponsored athletic team in the Fall athletic season. Exclusion

criteria included: English as a second language and failure to complete the entire survey.

Participants were divided into two groups based upon level of concussion education. The first group included participants that have only received concussion education from the GHSA concussion awareness form. The second group included participants that have completed the form and received additional concussion education such as a computer-based training module, a presentation from a healthcare provider, information from a Doctor, media, or an online search, or have been exposed to concussion information due to previous experience with concussive injuries.

RESPONDENT DEMOGRAPHICS

All of the respondents (102/102) identified as the legal guardian to a GHSA student-athlete. All of the respondents (102/102) also stated that English was their primary language. The majority (70.6%) of the respondents self-identified as female (72/102), and 68.6% of the respondents identified as the mother of the student-athlete. Twenty-nine percent (30/102) of the respondents identified as the father of the student-athlete, and 2% (2/102) identified as a grandmother. Most of the respondents were aged 35-50 (66.9%; 83/102). Only four respondents were aged 26-34 and 14 were over 50 years old. Eight-two percent of the respondents self-identified as Caucasian, while 12.7% identified as African American. Ninety-eight percent of the sample self-identified as non-Hispanic. The majority of the participants in this study stated their annual household income was above \$75,000, while only seven participants stated that their annual household income was below \$30,000. The majority of the survey participants also had advanced degrees, while only 13 participants had only completed their high school degree or GED (See Table 1 for more details).

PROCEDURES

Following IRB approval and administrative approval from the school district, the researcher attended either preseason informational guardian meetings for the high schools targeted in the study or competitions where the guardians may attend throughout the Fall 2016 season. The participants were given scripted information about the study, and were provided with a survey and consent form. When recruiting at parent meetings, the researcher made a scripted announcement and those that wished to participate were given the survey and consent form as well as the instructions necessary in order to complete the survey. The survey was given in a paper-format. If the guardian that attended the preseason meeting or sporting event was not the same guardian that completed the awareness form for their respective student-athlete, they were provided a copy of the GHSA concussion awareness form to review.

INSTRUMENTATION

Survey questions were formed based on surveys used in similar studies.^{6,7,21,22} The survey contained questions relating to demographics including: guardianship, gender, age, race, ethnicity, annual income, education level, and size of the child's school. Concussion education level was determined by whether they have received additional formal concussion education. The type, format and reason they received additional education was also asked. Previous concussion experience was accounted for by asking the guardian if they or their child has ever had a previously diagnosed concussion.

The additional survey questions were split into two sections: knowledge and understanding. This was done in order to assess knowledge and understanding independently. In order to assess the knowledge transfer of concussion education in the survey participants, it was important to assess whether the knowledge transfer techniques were adequate in transforming knowledge into understanding.

The knowledge and understanding questions were based on concussion background and management. The knowledge portion of the survey asked questions based on the information provided on the GHSA concussion awareness form. The knowledge section consists of nine questions including yes/no questions and a section of 26 signs and symptoms associated with concussion. Each correct response was counted as one point, and the “check all that apply” provided one point for each correct answer. Therefore, the knowledge section consisted of a total of 40 possible points, while the understanding section had a total of 8 possible points. The total possible score for the entire survey was 48 points. The survey contained 34 questions total, and took between 10 and 20 minutes to complete.

PILOT DATA

The Concussion Knowledge and Understanding Survey for guardians was pilot-tested in a sample of adults that were not targeted for the study. Of 19 surveys that were completed, 14 were deemed valid. The five surveys that were excluded from the pilot study were due to incomplete responses. It should be noted that the sample population was comprised of recreational department leaders and coaches, therefore all but one participant had completed additional concussion education. Pilot data was analyzed prior to the beginning of the study period and changes were made to the survey as needed. Due to the limited number of participants without additional concussion education, statistical analyses could not be conducted. However, this pilot test was appropriate in respect to content validity. These changes included grammatical corrections and word changes to enhance readability.

DATA ANALYSIS

Demographics were analyzed using descriptive statistics including frequencies and percentages. Participants were divided into two groups according to the amount of concussion education received. The independent variable was the amount of concussion education received: (1) completed only the GHSA concussion awareness form, and (2) completed the concussion

awareness form as well as additional concussion education. The dependent variables were knowledge, understanding and total scores of the participants. Research commonly examines total knowledge scores, however for this study, we chose to analyze understanding and knowledge score separately in order to obtain a better understanding off the differences between factual knowledge versus application of knowledge.

The scores were calculated by the total points correct. However, total score was also analyzed in an effort to remain consistent with previous similar studies, of which none have separated knowledge and understanding explicitly. In order to help us draw conclusions from the results, it was important to be able to qualify each score. For the purpose of qualifying the scores, we adopted cut-off values that were used in previous research.²³ In order to better understand the implications of our findings, the cut-off values in respect to knowledge and understanding are as follows with <60% indicating poor knowledge or understanding, 60-80% indicating moderate knowledge or understanding, and >80% indicating good knowledge or understanding.²³ All statistical analysis was conducted using SPSS 23.0 (IBM, Chicago, Illinois).

STATISTICAL ANALYSIS

All data was examined for violation of assumptions including but not limited to: distribution, equal variances, and independence among the sample. These assumptions were

tested via inspection of skewness/kurtosis and Levene's test to analyze variance. Levene's test was not violated for any of the tests, so the degrees of freedom were not adjusted. The mean knowledge score, mean understanding score, and mean total score of each group were compared using independent t-tests. A Pearson correlation was conducted to identify a potential relationship between knowledge and understanding. Prior to running the independent-t tests and Pearson correlation, the data was converted to z-scores in order to account for the difference in points available between the knowledge and understanding sections. The significance level was set *a priori* at $p < 0.05$. Cohen's d was calculated by hand to evaluate effect size.

CHAPTER 3

RESULTS

SURVEY RESPONSE

The estimated total sample was 450 guardians. A total of 160 surveys were handed out, with 132 surveys returned (response rate = 82%, sampling rate = 35%). Of the 132 surveys that were completed, 106 were considered valid according to the inclusion and exclusion criteria, as 26 were deemed invalid due to incomplete responses.

Following initial statistical analysis including the Kolmogorov-Smirnov and Shapiro-Wilk tests for normality, four surveys were found to be outliers and were excluded from the study ($p=0.87$ for knowledge score; $p=.00$ for understanding score; $p=.05$ for total score). Therefore, a total of 102 surveys were included in the final statistical analysis. Skewness and kurtosis were assessed. Skewness and kurtosis for total knowledge score was -0.33 and -1.58 , respectively. Skewness and kurtosis for total understanding score was -1.18 and -1.24 , respectively. The skewness and kurtosis for total correct was -0.54 and -1.39 , respectively. All of the skewness and kurtosis values revealed that the data is normal with a slightly negative skew.

CONCUSSION EDUCATION BACKGROUND

Fifty-four respondents stated that they had only received concussion education from the GHSA Concussion Awareness form. Forty-eight respondents stated they had received additional concussion education (Table 1). The most common source of additional concussion education was information from the coach (37.5%) and information provided by a physician (35.4%). Twenty-three percent of the participants received concussion education from the media and an online search. Only 4.2% of participants completed computer-based concussion education (Figure 2). Seventy-three percent of participants reported that neither they nor their child had sustained a concussion, while 25.5% of the respondents previously sustained a concussion.

Fifty-nine percent of the respondents had reviewed the GHSA concussion awareness form within one month from completing the survey, while 22.8% selected “other” and 9.9% had reviewed the form within 30 minutes of completing the survey (Table 1).

COMPARISON OF KNOWLEDGE SCORES BY GROUP

Levene’s test for equality of variances was not violated for each independent t test, therefore equal variances were assumed. An independent t-test revealed no statistically significant difference in mean knowledge score between those that have only received the concussion awareness form and those that have received the form and completed additional concussion education, $t(100) = 1.742$, $p = .085$. The mean knowledge score for the respondents that had additional concussion education was 31.52, while the mean knowledge score for the respondents that had no additional concussion education was 30.04.

Independent samples t-test revealed no significant differences between groups, $t(100) = .833$, $p = .407$, with a mean understanding score for those that had additional concussion education recorded as 6.77, while the mean understanding score for those that had no additional concussion education was 6.61 (Table 2).

An independent t-test also revealed no statistically significant difference in total score, $t(100) = 1.878$, $p = .063$. The mean total score for the group that had additional concussion education was 38.29, while the mean total score for the group that had no additional concussion education was 36.65 (Table 2).

Finally, a Pearson correlation revealed a non-significant, weak correlation between total knowledge score and total understanding score, $r = .03$; $p = 0.76$. Cohen’s d test for effect size revealed small effect sizes of 0.37 for total knowledge score, 0.02 for total understanding score, and 0.04 for total score (Figure 3).

Seventy-five participants (74%) stated no personal or child history of concussion, while twenty-six participants or child had a previous history of concussion. An independent t-test revealed that there was not a significant difference in knowledge $t(100)=-.97$, $p=.358$, understanding $t(100)=1.459$, $p=.150$ or total score $t(100)=1.195$, $p=.237$ between those that had a previous history of concussion.

While examining responses to individual questions, some interesting findings were discovered. For example, 83.3% of the group that had additional concussion education 96.2% of those without additional education thought that continuing to play before a concussion heals could result in death. All of the participants agreed that if an athlete exhibits any sign or symptom of a concussion, they should not be allowed to return to play and should seek medical attention from an appropriate healthcare provider; however, not all participants answered this way when given any of the scenario-based questions on this concept.

Additionally, 64.6% of those that received additional concussion education and 62.3% of those who had not, recognized a Certified Athletic Trainer as an appropriate healthcare provider. Further, 14.6% of those who completed additional concussion education and 11% of those who had not, recognized a coach as an appropriate healthcare provider.

All of the participants (100%) were able to identify a headache and difficulty remembering as a sign or symptom of concussion. All of the participants that had additional concussion education were able to identify dizziness as a symptom of concussion, while 98.1% of those that did not have additional concussion education were able to recognize dizziness as a symptom. The majority of participants were also able to correctly identify balance problems (96%), irritability (80%), feeling unsteady (92%), nausea (92%), vomiting (90%), difficulty sleeping (74%), sensitivity to light (94%), sensitivity to noise (89%), confusion (95%), being mentally foggy (92%), change in behavior (81%) and having difficulty concentrating (95%) as

signs or symptoms consistent with a concussion. However, a majority of participants incorrectly identified a nose-bleed (76%), abnormal sense of taste (72%) and thirst (72%) as signs and symptoms consistent with a concussion.

CHAPTER 4 DISCUSSION

CONCUSSION KNOWLEDGE AND UNDERSTANDING

The purpose of this study was to assess concussion-related knowledge and understanding in guardians of Georgia High School Association (GHSA) student-athletes that only complete the GHSA Concussion Awareness form compared to those with additional concussion education. The present study found that 52.9% (54/102) participants completed the GHSA Concussion Awareness form, but had not completed any additional concussion education. This is similar to a study by Chrisman et al. that found only 16.2% of the guardians that participated in their study completed concussion education via two or more modalities, while 57.9% were only exposed to the mandatory concussion awareness form.⁸

KNOWLEDGE SCORES

We found that the mean knowledge score was similar, but slightly better, than the finding of Lin et al. who found an average of 73.6% correct on their Concussion Knowledge Index.⁶ These findings are also consistent with Merz et al., who found that participants who reported completion of additional concussion education did not have greater concussion knowledge.²⁴ In comparison to the cut-off values that were adopted from a previous study, the average knowledge scores found in the present study are moderate.²³ The fact that both groups performed moderately on the knowledge portion, which included symptomology, is inconsistent with Gourley et al.'s study that found that guardians were unable to correctly identify all signs and symptoms related to a concussion.²²

While trying to understand underlying reasoning for the scores, we evaluated the amount of time that had passed between the participant completing the form and completing the survey. The majority of the sample completed the concussion awareness form within one month of taking the survey. Interestingly, among those that signed the form within the previous month,

mean total score was 37.55. Those that had received the concussion awareness form within the previous hour had the lowest mean score (30.00), however this only accounted for two participants. Additionally, three participants had received the concussion awareness form within the last week, and had the highest mean score of 39. While interesting to observe, due to the low numbers in each time frame, conclusions cannot be drawn.

UNDERSTANDING SCORES

Examination of guardian knowledge and understanding within the concussion literature has been scarce. We found the mean understanding score for the group that had additional concussion education was 6.77/8 (84.6%) while the mean understanding score for the group that did not have additional concussion education was a 6.61/8 (82.6%), both groups performed better on the understanding section of the survey, with those that had and had not received additional concussion education scoring 84.6% and 82.6%, respectively. We did not find significant differences between those with and without additional concussion education on knowledge and understanding measures. Merz et al. did not evaluate concussion understanding however, they reported those that completed additional concussion education did not perform significantly better on a concussion knowledge survey.²⁴

The Pearson correlation revealed a very weak and non-significant correlation between the knowledge and understanding sections. This indicates that the knowledge score and understanding score do not have a significant relationship, and the way that a participant scored on one section did not necessarily relate to how they scored on the other section. Interestingly, when the participants were asked if an athlete that is displaying signs or symptoms of a concussion should be removed from play, every participant agreed that they should. However, when given a scenario-based question about this concept, not all of the participants answered that the athlete should be removed from play.

These findings from the Pearson Correlation differ from our hypothesis that participants that score higher on the knowledge section would perform better on the understanding section,

and those that score lower on the knowledge section would perform worse on the understanding section. However, the Adult Learning theory may explain this, as it states that if learners are able to connect the material to their own personal experiences, they may be able to understand the material better.¹³ This may explain why the participants performed better on the understanding portion, and worse on the knowledge portion, thus making the Pearson correlation insignificant. Provvidenza et al. as well as the Consensus Statement on Concussion in Sport suggest that knowledge transfer theories may help bridge the gap between knowledge and understanding through the use of the KTA framework.^{1,9}

Knowledge transfer theories show the process of turning knowledge into understanding through the KTA framework, which sets specific steps to ensure that the creation of knowledge, the dissemination of knowledge, and the use of the knowledge, is all done as effectively as possible.⁹ While it is unknown if the KT theory was used in the creation of the concussion awareness forms, the theory should still be considered in the continual dissemination of concussion information. The concussion awareness form should be based off of relevant concussion education research, and should be tailored to the guardians and their specific needs and provide concussion information that is relevant to their lives. If those creating the educational tools would follow the KTA framework, all of these needs would be met. The KTA framework encourages the dissemination of knowledge that is research based, and the collaboration between researchers and learners in order to refine and tailor the information for the target audience. Through this framework, concussion education would be evolving constantly, in order to ensure an adequate level of effectiveness. It is also important to consider the format of the concussion education and how it can help the user learn the information.⁹

KT suggests the use of a multifaceted approach in order to meet the needs of various learning styles within a population through the use of multiple platforms and resources that are beneficial for multiple learners with various learning styles. As mentioned previously, there are many concussion education tools that exist in a variety of formats. These formats include web-based resources, videos, handouts, and presentations.¹⁴ While the present study did not evaluate

the immediate effects of a web-based interaction, Kroshus et al. found that educational videos provided a greater understanding of concussion.²⁵ Glang et al. also found that schools that utilized a web-based resource found a significant changes in knowledge application and behavioral intention following the educational intervention.²⁶ Adult learning and KT theories also encourage the use of technology in education and find that it is important to modify the educational tool to be relevant and match the needs of the learner.^{18,27}

The present study revealed that, in general, the participants scored higher on the understanding section than they did on the knowledge section. This could be due to the lack of difficulty, or possibly the nature of the scenario questions. The media and internet have a large influence over education and when used appropriately, can have a positive effect on concussion knowledge.^{28,29} This supports the thought that a participant could have seen a story in the media that could have specifically related to the scenario questions, or had first-hand experience with a similar situation, which may have helped them to answer the questions correctly.

REASON FOR ADDITIONAL CONCUSSION EDUCATION

The present study revealed that parents received additional concussion education for various reasons. The most common reason that a participant completed additional concussion education was to fulfill a requirement in order for their child to be able to participate in sport, while the second most common reason was that they simply wanted to know more information about concussions. This finding is encouraging and makes it even more important that guardians have access to appropriate concussion education materials, as they are showing a desire for further concussion education. It appears that this supports concussion legislation requiring guardians to complete some form of concussion education prior to their child's participation in sport.⁵ Although the minimum requirement set by concussion legislation in the state of Georgia is to read and sign the concussion awareness form, any requirement greater than that may be set by the individual school district.⁴ While the State of Georgia does not set any requirements on the format or amount of concussion education received, they do encourage the use of a web-based resource in addition to a concussion awareness form.⁵

SOURCES OF CONCUSSION EDUCATION

There are many concussion education resources available, and some that are already being used and mandated in the coaching population. It may be beneficial to guardians to have access to these educational tools in order to increase their concussion knowledge. Knowledge Transfer suggests the use of a multifaceted approach, in order to match various learning styles and increase the effectiveness concussion education.⁹ As the adult learning theories and knowledge transfer techniques suggest, educational resources should be relevant to learners' needs.^{9,18,27} These suggestions are important to consider because each learner has a unique learning style and may respond differently to education that is provided in various formats. Traditional hand-outs and didactic lectures have been ineffective as a standalone method of concussion-related education in physician and physical therapists populations.¹⁵ Mrazik et al. reported that successful educational efforts are those that have ensured that materials are user-friendly, interactive, and utilize multiple modalities and formats to present information.³⁰ This is consistent with the adult learning and knowledge transfer theories where the suggestion of a web-based or online resource is more effective to facilitate knowledge transfer and a cost-effective solution to this population, because it is easy to access and utilizes active learning strategies.^{9,18} The effect of media on concussion education and awareness is also important and should be considered, as it has the ability to positively influence knowledge and performance.^{28,29} Many people have access to media throughout their daily lives, and can influence their personal experience with concussion.

One such personal experience would be the effect of previous history of concussion to the guardian or their child as a source of concussion education. Previous history of a concussion did not reveal a significant difference in concussion knowledge or understanding, however those that had a previous concussion scored higher than those that had not in knowledge, understanding, and the total score. On average, those who had a previous history of concussion scored 31.38 on the knowledge portion, 6.89 on the understanding portion, and 38.27 on the total

score, while those without previous history of concussion had a mean score of 30.60 on the knowledge portion, 6.63 on the understanding portion, and 37.23 on the total score. The findings of the present study are contrary to the findings of Lin et al., who reported a significant difference in those that had previous history of concussion on their concussion knowledge index.⁶ Further, O'Donoghue et al. found coaches who had a personal history of concussion performed significantly better on a concussion recognition index.³¹ However, our findings are consistent with Merz et al. who found that previous concussion experience did not have an effect on concussion knowledge and understanding.²⁴

The most common format that additional concussion information is received was provided by a coach. While coaches are providing information about concussions, it is alarming due to the fact that they are not healthcare professionals. In one study, the majority of coaches agreed that they are not experts on concussion. Further, O'Donoghue et al. found that coaches displayed a moderate knowledge level of concussion (84%) on their measure.³¹ While, generally higher than participants from the current study, this does not mean that coaches should be the only party distributing concussion education. This is contrary to Mannings et al.'s finding that 45% of their sample received concussion education materials from their pediatrician's office, while about 17% of their sample received concussion education materials from coaches (Table 1).⁷ Sarmiento et al. found that the Heads Up initiative created favorable changes in knowledge, attitude, and practices surrounding concussion management.³² There are many concussion education resources that could be implemented such as Borrow Brainbook, ThinkFirst, SLICE, and Brain 101 that would all satisfy the suggestions of KT.¹⁴ The importance of concussion knowledge and understanding in this population should not be overlooked due to the influence that they have in the well-being of high school student-athletes.

The format and types of additional concussion education the participants claimed to have completed should be considered. There are different formats that have been suggested for various

populations. For the adult learner, the use of technology has been suggested to be effective.¹⁷ If those that had additional concussion education would have completed formalized concussion education, there may have been a more significant difference between those that had additional concussion education and those that had not. Further research with a larger and more robust sample should be completed to determine the effects of concussion education on concussion knowledge and understanding.

LIMITATIONS

Our study is not without limitations. The study utilized a sample of convenience from five high schools in rural southeast Georgia. As we relied on the state mandated form, we can only make interpretations regarding the Georgia High School guardians. This study, cannot be generalized beyond the state of Georgia.

We also believed that the GHSA concussion awareness form would be the primary source of concussion education, however it seems as though there are various additional concussion education tools being utilized. A limitation to this study is that we were not able to control for the type of concussion education. More formalized concussion education may be necessary to make a difference between the knowledge and facts of concussion and what the guardians are able to utilize as their children participate in sport.

CONCLUSION

While there was no significant difference between those that only received the form and those with additional concussion education, we found that the current concussion education form in the state of Georgia provides information for guardians to understand and identify the signs and symptoms of concussion, as well as general concussion facts and information about return to play and management. While this form appears to provide appropriate knowledge, utilizing KT and adult learning theory may enhance educational interventions for guardians by incorporating a multimedia format that would match the needs of the adult learner and possibly have a deeper impact on a greater number of people.

Concussion education has been described as the “cornerstone” of concussion prevention. However, the appropriate concussion education methodology may have been overlooked. The results of this study were encouraging in comparison to other studies, as the participants in our study demonstrated moderate concussion knowledge and understanding.^{6,22} Our results support the use of a form for concussion education however, knowledge transfer and the adult learning theory support the use of multiple platforms. It would be beneficial to provide multiple platforms in which guardians could access and engage in concussion education. Additional research should be conducted to examine the effectiveness of concussion education, retention of knowledge and understanding and potential confounders to educational reform.

APPENDIX A

Research Questions

- 1) Does knowledge level reflect the amount of concussion education the participant has been exposed to?
- 2) Does the level of understanding of concussion information reflect the amount of concussion education the participant has been exposed to?
- 3) What is the correlation between knowledge and understanding of concussion information in guardians of GHSA student-athletes?

Hypotheses

- 1) H_0 : The mean knowledge score will not be higher in the group of participants that received additional concussion education than in the group that has only completed the GHSA concussion awareness form.
 H_A : The mean knowledge score will be higher in the group of participants that received additional concussion education than in the group that has only completed the GHSA concussion awareness form.
- 2) H_0 : The group that has received additional concussion education will not have a higher average understanding score than the group that has only completed the GHSA concussion awareness form.
 H_A : The group that has received additional concussion education will have a higher average understanding score than the group that has only completed the GHSA concussion awareness form.

3) H_0 : There will not be a strong, positive correlation between knowledge and understanding of concussion in guardians of GHSA student-athletes.

H_A : There will be a strong, positive correlation between knowledge and understanding of concussion in guardians of GHSA student-athletes.

Limitations

A low response rate and relatively small sample was expected for this type of survey research. Although data will be collected from high schools across various counties, all of the high schools are in the Southeast Georgia region. These factors may limit the generalizability of this study to a larger population. The sample population was a sample of convenience, so bias may have been introduced into the study in this respect. The target sample was limited to the guardians that attend the pre-season meetings and athletic competitions, and was limited to only guardians of student-athletes that participate in sports that compete during the Fall 2016 athletic season.

Delimitations

The study was limited to the participants that complete the entire survey, unless their only non-response was in regards to general demographic information that did not pertain to any inclusion/exclusion criteria. The high schools targeted for this study are across multiple counties, and vary in size of student population. This should have provided the researchers variation in rural and urban demographics as well as variation in socioeconomic status.

Assumptions

This study was completed under the assumption that all participants answered the survey questions honestly, accurately, and to the best of their ability. The study was also completed under the assumption that the sample population is be generalizable to the target population.

Definitions

- 1) Concussion- A complex pathophysiological process affecting the brain, induced by biomechanical forces. ¹
- 2) Knowledge- The fact or condition of knowing something with familiarity gained through experience or association¹⁰
- 3) Understanding- the power of comprehending; the power to make experience intelligible by applying concepts and categories¹¹

APPENDIX B

REVIEW OF LITERATURE

I. BACKGROUND

Concussion

Concussion is defined as a complex pathophysiological process affecting the brain, induced by biomechanical forces.¹ The term concussion is synonymous with mild-traumatic brain injury (mTBI) throughout the literature, as it is a subset of traumatic brain injury (TBI). Concussive injuries have increasingly garnered attention in recent years, especially in the athletic population.

A concussion occurs as a result of an impulsive force transmitted to the head from a direct blow to the neck, face, or body.¹ Forces that cause rapid acceleration and deceleration of the brain are likely to result in concussive injury. A concussive injury may result in a variety of signs and symptoms that may or may not involve a loss of consciousness. The onset of symptoms reflects a functional disturbance, rather than a structural disturbance. Therefore, a concussive injury cannot be seen through standard structural neuroimaging techniques.¹ Signs and symptoms may include headache, dizziness, emotional symptoms, behavioral changes, cognitive impairment, sleep disturbances, feeling pressure in the head, neck pain, blurred vision, balance problems, sensitivity to light and noise, feeling slowed down, not feeling “right”, difficulty concentrating or remembering, fatigue or low energy, confusion, and loss of consciousness.¹ Any combination of the symptoms may be present following a concussive injury, and may arise within minutes or several hours after injury. The three most commonly reported symptoms include headache, dizziness, and confusion.² Guskiewicz et al. found that of the athletes that sustained a concussion, 86% reported experiencing a headache, 67% reported experiencing dizziness, and 59% reported experiencing confusion.² Individuals with a history of undiagnosed concussion had a significantly higher likelihood of loss of consciousness (31% vs. 22%, $p=0.038$) and significantly greater severity of symptoms (33 vs. 25, $p<0.004$) with

recurrent concussion.³

History of concussion may increase an individual's risk of sustaining another concussive injury. Athletes that have sustained a concussive injury in one season are three times more likely to sustain another concussive injury within that same season.² Athletes that have a history of concussion are 3.0-5.8 times more likely to sustain a concussion when compared to individuals that have no history of concussion.^{2,4} A more robust concussion history is also associated with a longer time to symptom resolution. Guskiewicz et al. also found that 14.6% of participants that had a history of one concussion had a symptom recovery longer than one week, while 30% of those that had three or more previous concussions took longer than a week for their symptoms to subside.⁴ Individuals with a history of undiagnosed concussion had a significantly higher likelihood of loss of consciousness (31% vs. 22%, $p=0.038$) and significantly greater severity of symptoms (33 vs. 25, $p<0.004$) with recurrent concussion.³

II. EPIDEMIOLOGY

Approximately 1.6-3.8 million sports-related traumatic brain injuries occur each year.⁵ This estimation is based on the Center for Disease Control and Prevention's finding that 300,000 sports related concussions that result in a loss of consciousness occur every year.⁶ It has been found that concussions resulting in a loss of consciousness only accounted for 8%⁷ and 19.2%⁸ of sports-related traumatic brain injury.⁵ Therefore, the estimation accounts for concussions in which no medical care is sought, as well as those that did not result in a loss of consciousness.

Characteristics of concussion rates vary by participation level, gender, sport, age and concussion history.

The average incidence rate of concussion is between 2% and 9% across various epidemiological studies.^{9,10} Gessel et al. reported that concussions accounted for 8.9% of total injuries and an injury rate of 0.23 per 1,000 athlete-exposures (A-Es) across 9 different high school sports.¹⁰ Marar et al. found a similar concussion injury rate of 2.5 per 10,000 A-Es across 20 different high school sports.¹¹ Both studies reported a higher concussion injury rate during competitions in comparison to practices. The injury rate for practices is .11 (per 1,000 A-Es) while the injury rate for competition is between 0.53 (per 1,000 A-Es) and 6.4 (per 10,000 A-Es).^{10,11}

It is important to understand the incidence and rates associated with different sports and genders. Football accounts for the majority of concussions (47.1%), followed by girls' soccer (8.2%), boys' wrestling (5.8%) and girls' basketball (5.5%). Football players usually account for a large proportion of athletes, which may be one reason why football represents a large percentage of concussions. In gender comparable sports, females had higher concussion rates than their male counterparts.^{10,11} In 2003, Covassin et al. found that females sustained more concussions during games than males (9.5 % vs. 6.4%, respectively).¹² Girls may have a higher incidence of initial and recurrent concussion due to anatomical differences in the head and neck.¹²

III. Management and Treatment

Concussion diagnosis may be challenging, as every concussion is unique and should be treated as such.¹ Any athlete that is suspected of sustaining a concussion should be immediately

removed from sport participation and assessed using a variety of measures.¹ These measures should include a clinical assessment, neuropsychological testing, cognitive testing, a balance assessment, and symptomology. An athlete should be monitored daily following a concussion diagnosis. The currently accepted guideline for treatment of concussion is complete physical and cognitive rest. In most cases (80-90%), concussions will resolve within 7-10 days. However, various factors may influence the length of recovery. Children and adolescents typically take longer to recover than adults.¹

The 4th Consensus Statement on Concussion in Sport details proper guidelines for return to play protocols.¹³ Baseline testing of various assessments aids the return-to-play process as it helps to ensure that athletes are back to their normal level of function in various aspects. An athlete should not start the return-to-play progression until they are symptom free, have returned to baseline values or above on concussion assessments, and have a normal clinical examination. Once the athlete meets these requirements, they are able to begin a 6-day stepwise progression of activity. The athlete will progress through the various levels of activity, with a 24-hour rest period between the stages. If the athlete becomes symptomatic at any point during the return-to-play progression, they are required to stop activity immediately. The progression will start again no sooner than 24 hours later, and begin with the previously asymptomatic level.¹

The first stage of the progression involves no activity. Physical activity begins during the second stage, with light aerobic exercise that does not exceed 70% of maximum heart rate. There should be no resistance training during the first and second stage. During the third stage, the athlete may begin sport-specific exercise that does not involve any activities in which the head may receive an impact. The athlete will then progress to more complex non-contact training drills during the fourth stage to incorporate coordination and cognitive load. Following medical

clearance, the athlete may return to full contact practice to restore confidence and assess functional skills. The athlete may return to full participation in competition once they have reached the sixth stage.¹³

Returning to play prematurely puts the athlete at risk for serious consequences. If a second injury occurs while still symptomatic from a prior concussion, the athlete is at risk for Second Impact Syndrome.¹⁴ Second Impact Syndrome most commonly occurs in athletes between the ages of 14 and 16. Although it can occur in any sport, it has most commonly been seen in football, hockey and boxing.¹⁵ An athlete that suffers Second Impact Syndrome may appear stunned, and gradually become more dazed. Typically, the athlete will collapse and fall into a semi-comatose state with rapidly dilating pupils and loss of eye movement. Within 2-5 minutes, the brain stem can become compromised resulting in coma and respiratory failure.¹⁶ Concussion education is a crucial aspect in the prevention of Second Impact Syndrome. The ability to recognize symptoms and seek appropriate medical care and concussion management helps to prevent Second Impact Syndrome.¹⁶ The majority of concussion legislation mandates that a return to play protocol that follows the guidelines detailed above must be implemented in an effort to prevent catastrophic injuries and ensure a safe return to activity.

IV. LEGISLATION

History of legislation

Across the board, concussion legislation aims to raise awareness among students, guardians, athletes, and coaches, while attempting to prevent the short-term and long-term effects associated with concussion. In 2009, the Lystedt Law of Washington State was voted into

law, requiring school districts and state interscholastic activity boards to develop concussion guidelines and educational programs. This law has since been adapted nationally.¹⁷

The Lystedt law was organized around 3 core elements including annual guardian and athlete education, the immediate mandatory removal from play of athletes suspected of having a concussion, and clearance by a designated health professional before an athlete that sustained a concussion may return to play.¹⁸ Part of the educational elements requires guardians to sign a concussion injury information sheet annually before their child is allowed to compete in any school organized sport. Although the exact contents of concussion legislation vary across the nation, they all follow the basic framework of the Lystedt law.¹⁷

All 50 states and the District of Columbia have enacted laws related to youth concussion.¹⁷ 46 States and the District of Columbia have enacted concussion laws that require concussion information sheets to be distributed to athletes. Of those, 44 require guardian signatures and 40 require child signatures. 33 of the states require that the information sheet be signed annually, and 7 states require the forms to be completed before participation.¹⁷ In all 50 states and the District of Columbia, the concussion laws apply to high school athletes between the ages of 14 and 18. All of the states' laws apply to scholastic athletic leagues.¹⁷ In 20 of the states, the laws apply to non-school youth/adolescent sports leagues. Georgia, Ohio and Illinois require recreational facilities that are hosting organized youth athletic events to provide concussion information to the athlete's guardian or guardian. 48 states provided information regarding signs or symptoms of concussion, while 44 provided information about the short-term consequences of concussion.¹⁷ Of the laws that require concussion information to be distributed, few have specified the type of education that guardians or athletes should receive, however some laws have used the CDC's concussion education materials as a guide.¹⁸

Effectiveness of Concussion Legislation

While studying the effectiveness of the Lystedt Law in Washington state, Shenouda et al. found that there are still gaps in knowledge and practice regarding concussion even though at least 75% of participants were able to answer questions correctly about the Lystedt Law and its provisions.¹⁹ In general, guardian knowledge of concussion symptoms and legislative guidelines on medical clearance for return to play was good. However, this study was done only in guardians of youth soccer athletes and they were not able to account for the amount of concussion education they received prior to the implementation of the legislation.¹⁹ Chrisman et al. found that in Washington state, following the passage of the Lystedt law, high school football and soccer coaches were receiving adequate concussion education, however guardian and athlete education was limited.²⁰ Athletes were required to complete the Lystedt law form, but only 1/3rd of coaches required that they receive additional education.²⁰ Another study found that even when guardians indicated that they had discussed concussion awareness with their child on a consent form, 46% of the athletes reported that they did not actually discuss concussion awareness with their guardian.²¹ As of the Fall of 2014, all but four states had laws that required concussion information to be provided directly to the athletes about concussion.¹⁷

Twenty states require coaches to be trained in youth concussion awareness and recognition. As of 2012, of the states that require coach education, only five explicitly require a prospective evaluation of the efficacy of the education or information that is received. There is not a national consensus on the type of education the coaches should receive. In the majority of states, coaches are subject to the educational requirements of their membership associations or athletic governing bodies. Often times, the educational requirements that mandated by the

athletic associations are more rigorous than the state-mandated requirements and often implement more than one educational tool.¹⁸

Georgia Legislation

The “Return to Play Act of 2013” is the current concussion legislation in the state of Georgia.²² This law requires each local board of education, administration of a nonpublic school, and governing body of a charter school to implement a concussion management and return to play policy. Within that policy, they must provide an information sheet to guardians or legal guardians that details the nature and risks of concussions. The concussion policies must also state that a youth athlete that starts to exhibit concussion-related symptoms must be removed from participation and evaluated by a health care provider.²²

In the state of Georgia, a health care provider is defined as a licensed physician or licensed personnel under the supervision of a physician, or certified athletic trainer that has received training in concussion evaluation and management. If a health care provider finds that an athlete has sustained a concussion, the athlete should not return to play until they receive clearance by a health care provider to begin a graduated return to play protocol. This law also suggests that the Department of Public Health shall endorse one or more concussion education courses, such as the CDC’s online courses, to inform Georgia citizens about the nature and risks of concussions in youth athletics. At least one of the concussion education courses endorsed should be available in an online format.²²

GHSAs Requirements

The Georgia High School Association (GHSAs) is the athletic association that oversees public high school athletics in the state of Georgia and is a member of the National Federation of

State High School Associations (NFSHA). GHSA follows the consensus guidelines for management and treatment of concussion.¹ GHSA requires that any athlete who exhibits signs, symptoms or behaviors consistent with concussion to be removed from contest and to delay return to play until clearance by an appropriate health-care professional. GHSA asks that officials, coaches and school administrators be aware and observe athletes for signs and symptoms of concussion.²³

Each school participating in GHSA athletics is responsible for carrying out these guidelines and ensuring the athletes safety. In accordance with Georgia's Return to Play Act of 2013, an awareness form should also be provided to athletes and guardians prior to participation and it should be returned to the school with athlete and guardian signature. The guardian and athlete should also retain a copy of the awareness form at home for reference. The awareness form details concussion background information, the common signs and symptoms of concussion, and the GHSA concussion policy. Although the concussion legislation in the state of Georgia encourages the endorsement of an online resource for concussion education, GHSA does not require guardians to complete additional online training.²³

V. EDUCATION

Concussion Education

Appropriate medical management of concussion requires timely recognition and accurate diagnosis. In order to ensure appropriate care, all of the individuals involved in athletics should be adequately educated on signs, symptoms, screening methods, diagnosis, and appropriate management of concussion. Athletes, guardians, coaches, and medical personnel are among the individuals that should be educated on the various aspects of concussion. Although every state

has legislation that mandates concussion education, there is no uniform educational program to disseminate concussion information to high school athletes, guardians or coaches.²⁴ Each state has the jurisdiction to mandate concussion education program or establish a minimum standard for the concussion education each school district must provide to its athletes, guardians, and school officials.²⁴ Concussion education initiatives should focus on improving attitudes and beliefs about concussion among athletes, coaches and guardians to promote better reporting behaviors among young athletes.²⁵

Concussion Education Tools

Existing education programs include Heads Up: Concussion in Youth Sports, ThinkFirst, Sports Legacy Institute Community Educators (SLICE), Brain 101: The Concussion Playbook, and Barrow Brainbook.²⁴ The CDC's Heads Up initiative provides information and teaching tools for coaches, guardians, and health educators. It includes information on how to prevent, recognize and respond to concussion. The Heads Up toolkits can be tailored for specific audiences. The Heads Up toolkit has been found to be effective in a physician population, who claimed they were less likely to allow an athlete to return to play on the same day as concussive injury.²⁴ Coaches also had success with the toolkit and were more knowledgeable about identifying concussions in athletes.²⁴

GHSA coaches are required to complete an online course on concussion management titled "Concussion in Sport" that is prepared by the NFHS in conjunction with the CDC. The purpose of this course is to education coaches, officials, guardians and students on the importance of proper concussion recognition and management sin high school sports. The course highlights the impact of concussion on athletes, signs and symptoms, proper management steps, state requirements, return to play guidelines, and suggestions to help prevent concussions. This

course has been found to be effective in improving knowledge or concussion and the ability to reach large audiences.²⁴

The ThinkFirst program provides classroom presentations on concussion. The educator uses? models of the brain and the skull with slides and handouts to define concussion, talk about signs and symptoms of concussion, second-impact syndrome, and various restrictions athletes may go through in order to heal from concussion. Data on the effectiveness of this education program is not yet available.²⁴

The Sports Legacy Institute Community Educators (SLICE) provides presentations to student athletes that are interactive and include discussion, videos, and audience demonstrations. Significantly more participants passed a concussion quiz after the presentation compared to before the presentation (34% vs 80%, $p < .001$).²⁶

Brain 101: The Concussion Playbook is a web-based school-wide concussion management program that contains modules for guardians, coaches, teachers, and players. The program educates on signs and symptoms of concussions as well as safe practices for return to play. Each module is geared toward the role that person has. Families that had been exposed to the program had significantly higher rates of concussion knowledge and application of knowledge.²⁷ Athletes and guardians that participated in Brain 101 did significantly better on concussion-related knowledge and knowledge application than those that did not. Athletes that received concussions that attended schools that use Brain 101 received more varied academic accommodations than those at schools without Brain 101.²⁸

The Barrow Brainbook was launched as the most comprehensive educational effort in the state of Arizona. The program has two phases, with the first being concussion education. More

than 150,000 high school athletes received concussion education via an online module. The second phase of the Brainbook is educating guardians, coaches and teachers who are involved with student-athletes. Data on the effectiveness of this education tool is not yet available.²⁴

Education Techniques

Many educational techniques can be considered when trying to ensure effective knowledge and understanding. Didactic lectures are traditional face-to-face information sessions. Although this is an effective way to address multiple people at one time, this may not be the most effective way to address the target audience. For knowledge transfer to be effective, Providenza et al. suggest that concussion education should go beyond traditional didactic lectures and handouts.²⁹ Online concussion courses have proven to be effective in the coaching population as well as athlete population.²⁴ In the adult learner population, the use of technology-based learning has been encouraged.³⁰

A multifaceted approach that encompasses multiple educational techniques is beneficial for the athletic population, since individual athletes have strengths and weaknesses in various areas.³¹ The media and internet are prominent in education and have the ability to affect knowledge and change performance.³² The media draws awareness to important issues and may affect proper concussion management. Printed materials and didactic lectures have been found to be an ineffective standalone method for concussion-related education in a physician population.³³ Educational resources that are available across multiple platforms are beneficial to the adult learner.

Knowledge Transfer

For concussion education to be effective, it should be based on a theoretical framework. The most recent consensus statement on concussion in sport suggests that the concept of knowledge transfer is important to consider in concussion education.¹ Knowledge transfer (KT)

has been defined as “the exchange, synthesis, and ethically-sound application of knowledge within a complex system of interactions among researchers and users to accelerate the capture of benefits of research through improved health, more effective services and products, and a strengthened healthcare system.”²⁹ Knowledge transfer encompasses all of the steps involved in helping the creation of new knowledge reach its beneficial outcome in society. KT includes knowledge dissemination, communication, knowledge utilization, implementation research, and the development of consensus guidelines. This theory is utilized to bridge the gap between knowledge and understanding. KT is an interactive process that requires communication and ongoing collaborations among stakeholders.²⁹

The stakeholders involved in concussion education include researchers, policy makers, health care providers, the general public, patients, the private sector, various forms of media, and those who help to shape the views of the public.²⁹ There are multiple resources in which concussion knowledge can be transferred that should be considered in order to find the most effective concussion KT strategy.²⁹ Effective knowledge transfer strategies vary in respect to the target audience. Possible mediums for KT include web-based resources, printed education materials, didactic lectures, social media, television and news resources.²⁹

Knowledge transfer can address gaps in concussion knowledge by identifying and developing effective education strategies and using the outcomes to facilitate decision-making. This follows the Knowledge to Action (KTA) framework, which reinforces the collaboration between knowledge creators and those that will utilize the knowledge.²⁹ The first steps in the

action cycle include identifying the knowledge that is relevant for the stakeholders and adapting the knowledge in the most effective way in order to increase acceptance and overcome potential barriers. Therefore, the barriers, facilitators, and potential users must be assessed. Interventions must then be identified and properly tailored to the target audience. Following the intervention, knowledge use should be monitored and evaluated to determine the impact of the knowledge acquired. Upon evaluation, a plan to sustain knowledge over time should be implemented.²⁹

Adult Learning

In 1968, Malcom Knowles presented the concept of andragogy, which is defined as the art and science of helping adults learn. Andragogy is based on 5 principles that describe the adult learner as: someone who (1) has an independent self-concept and can direct his or her own learning, (2) has accumulated life experiences, (3) has learning needs closely related to changing social roles, (4) is problem-centered and interested in immediate application of knowledge, and (5) is motivated to learn by internal factors.³⁴ Current theories of adult learning emphasize many points that should be considered when creating an effective learning environment for adults. The content should be relevant and useful to the learner's real life. There should be a connection to experience and previous knowledge that the learner may have. It is beneficial to give the learners the opportunity to actively participate and reflect about what they have learned. The teaching of content should be focused on the needs of the audience and the teacher should become a facilitator of knowledge.³⁵

There are five stages to the learning process proposed by Taylor and Hamdy.³⁶ The process starts with dissonance, which occurs when the learner's existing knowledge is challenged and found to be incomplete. Dissonance is followed by refinement, in which the learner seeks out possible explanations or solutions to a problem. While the learner seeks out possible explanations, they are able to form new concepts through tools like research, discussion, and reflection. The next stage involves organization, where the learner develops or restructures ideas to make sense of the new information. Once the learner has organized the new information, they are able to articulate new knowledge and

provide feedback. The final stage is consolidation, in which new reflection occurs about what was learned.³⁵

VI. CONCUSSION KNOWLEDGE IN ADULT LEARNERS

Coach Knowledge

As mentioned previously, there has been more focus in educating the coaching population. The results of coach education can provide important insights into education the guardian population, as coaches can also be considered adult learners. Chrisman et al. found that 74.4% of the coaches in their study were required to complete concussion education before they were able to coach.²⁰ 91% of coaches were required to fulfill the concussion education requirements annually. In one study, coaches scored 84% on knowledge of sport concussion. The coaches also scored a 79% and 92% on management and recognition, respectively. Male coaches scored significantly higher than female coaches ($p < .01$). Coaches with prior concussion history also scored significantly higher on the recognition section ($p < .04$). Coaches who attended a concussion workshop scored significantly higher on the management section ($p = .02$).³⁷ Mrazik et al. found that 66% of coaches in their sample felt that they had limited knowledge of concussion.³⁸ Magazines and newspapers were the most frequently used source of concussion education, however the majority of coaches felt that this source was not effective.³⁹

Guardian Knowledge and Understanding

Knowledge can be defined as the fact or condition on knowing something with familiarity gained through experience or association.⁴⁰ Concussion knowledge includes being able to recognize the signs and symptoms commonly associated with concussion and having a general understanding of concussion. There has been great effort in ensuring the proper concussion education among athletes and coaches, however there is less focus on guardian education.⁴¹ As previously stated, the extent and implementation of guardian education varies across the board. Chrisman et al. surveyed guardians regarding the implementation of concussion legislation and found that the majority of coaches received concussion-related education via two or more modalities, while only 34.7% of athletes did the same.²⁰ More alarming,

is the finding that only 16.2% of guardians had received concussion-related education via two or more modalities, and 57.9% were only exposed to the mandatory concussion awareness form.²⁰ Since the majority of guardians are only exposed to the mandatory concussion awareness form, it is important to evaluate the effectiveness of this educational method. Mannings et al. found that only 28.7% of guardians that participated in their study had ever received any concussion-related education material, and 53.2% reported having a discussion that defined concussion.⁴² 57.7% of the guardians included in the study reported having a discussion about symptoms associated with a concussion. However, none of the guardians in the study were able to correctly identify all of the symptoms listed that were correctly related or not related to concussion.⁴²

Lin et al. examined guardian knowledge of sports-related concussion in which they saw an average of 18.4 points out of 25 possible points on the Concussion Knowledge Index.⁴¹ Gourley et al. found that less than 70% of guardians in their study were able to correctly answer that an athlete should not return to play after a hit to the head.⁴³ On average, guardians had a correct response score of 9.19+/-3.07 out of 16 on symptom recognition questions. These results show a knowledge deficit regarding guardian's ability to recognize concussion symptoms. Previous sport experience does not affect the concussion knowledge level. However, if the guardian claimed to have a history of concussion, their concussion knowledge was significantly greater than those that had not.⁴¹ Guardians that have received medical training scored significantly better on concussion recognition than those that had not.⁴³ Lin et al. also were able to show that guardians with low income and low education levels in particular, may benefit from additional concussion-related education.⁴¹

Understanding can be defined as the power of comprehending and the ability to make experience intelligible through the application of concepts.⁴⁴ Having the knowledge of the facts of concussion is important, however understanding the facts and being able to apply the concepts is also important. Guardians need to be able to make appropriate decisions about their child's healthcare if they ever experience a concussion. Merz et al. studied the knowledge and understanding of TBI, and found that their overall accuracy rate for their survey was 61%.⁴⁵ revealed that misconceptions regarding TBI, specifically post-concussive syndrome and chronic traumatic encephalopathy, were prevalent.

The lack of concussion knowledge and understanding in the guardian population could potentially lead to concussions going undiagnosed or mismanaged.

VII. CONCLUSION

Sport-related concussion is a common injury among athletic populations regardless of gender, age, or level of participation. Timely recognition and proper management of concussive injuries are very important aspects of ensuring the safety and well-being of an athlete.

Legislation has passed that requires schools to implement concussion education programs and for guardians to sign forms that detail concussive injuries and concussion protocols. As the primary caretaker of their child, it is important that guardians understand the risks involved with concussion so that their child receives proper care following a concussive injury. Knowledge transfer strategies should be implemented in concussion education resources for guardians. This includes accounting for the characteristics of adult learners. Although there is not much literature on the best way to increase the effectiveness of knowledge transfer in the guardian population, from what we know about adult learners, we can gather that a handout or didactic lecture should not be the only format of education. It is possible that a multifaceted approach would be more beneficial in order to increase the effectiveness of concussion educational techniques and increase concussion knowledge and understanding in the guardian population.

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APPENDIX C

IRB DOCUMENTS
Research Compliance Combined Cover Page
 Georgia Southern University

Application for Research Approval

Investigator Information:		
Name of Principal Investigator: Chloe Christina Salway	Phone: 765-586-7276	For Office Use Only: Date Received: _____ Protocol ID
Email: cs09946@georgiasouthern.edu (Note: Georgia Southern email addresses will be used for correspondance.)	<input type="checkbox"/> Faculty <input type="checkbox"/> Doctoral <input type="checkbox"/> Specialist <input checked="" type="checkbox"/> Masters <input type="checkbox"/> Undergraduate <input type="checkbox"/> Other:	
Department Name and PO Box: School of Health and Kinesiology P.O. Box 8026		
Name(s) of Co-Investigators: Dr. Tamerah Hunt (Chair) Dr. Jody Langdon Dr. Steven Patterson	Phone: 912-478-8620 912-478-5378 912-478-8014	
Email addresses: thunt@georgiasouthern.edu jlangdon@georgiasouthern.edu spatterson@georgiasouthern.edu	<input checked="" type="checkbox"/> Faculty; Doctoral; Specialist; Masters Undergraduate <i>(If multiple: identify by initial letter behind name. E.g., F for faculty)</i>	
Department Name and PO Box: School of Health and Kinesiology P.O. Box 8026		
Personnel and/or Institutions Outside of Georgia Southern University involved in this research (Attach training certification): N/A		
Project Information: (Note: funded project titles must match grant title)		
Title: Concussion Knowledge and Understanding in GHSA Guardians		
Brief (less than 50 words) Project Summary: The Georgia High School Association (GHSA) requires that guardians of high school student-athletes complete a concussion awareness form annually prior to their child's participation in sport. The current study will assess knowledge and understanding of concussion of guardians/guardians based on the extent and type of concussion education they have received.		
Compliance Information:		

<i>Please indicate which of the following will be used in your research: (application may be submitted simultaneously)</i>	
<input checked="" type="checkbox"/> Human Subjects (Complete <i>Section A: Human Subjects</i> below) <input type="checkbox"/> Care and Use of Vertebrate Animals (Complete <i>Section B: Care and Use of Vertebrate Animals</i> below) <input type="checkbox"/> Biohazards (Complete <i>Section C: Biohazards</i> below)	
<input type="checkbox"/> Do you or any investigator on this project have a financial interest in the subjects, study outcome or project sponsor. (A disclosed conflict of interest will not preclude approval. An undisclosed conflict of interest will result in disciplinary action.).	
Project Start Date: 05/15/2016 End Date: 05/14/2017 (no more than 1 year) Anticipated renewals <input type="checkbox"/> year 2 <input type="checkbox"/> year 3	Check one: <input checked="" type="checkbox"/> New submission <input type="checkbox"/> Resubmission #
Funding Source: <input type="checkbox"/> Federal <input type="checkbox"/> State <input type="checkbox"/> Private <input type="checkbox"/> Internal GSU <input checked="" type="checkbox"/> Self-funded/non- funded	
Funding Agency: <input checked="" type="checkbox"/> Not Applicable	

Section A: Human Subjects Not Applicable	
Number of Subjects (Maximum): 750	Date of IRB education completion: 02/09/2016 (attach copy of completion certificate)
<i>Purpose of Research: (Check all that apply)</i> <input checked="" type="checkbox"/> Publication/use in thesis/dissertation <input checked="" type="checkbox"/> Publication (journal, book, etc.) <input checked="" type="checkbox"/> Poster/presentation to a scientific audience <input type="checkbox"/> Completion of a class project <input type="checkbox"/> Presentation to GSU audience only <input type="checkbox"/> Presentation in outside of GSU <input type="checkbox"/> Results will not be published <input type="checkbox"/> Other	<i>Please indicate if the following are included in the study (Check all that apply):</i> <input type="checkbox"/> Human Subjects Incentives <input checked="" type="checkbox"/> Informed Consent Document <input type="checkbox"/> Greater than minimal risk <input type="checkbox"/> Research Involving Minors <input type="checkbox"/> Deception <input checked="" type="checkbox"/> Generalizable knowledge (results are intended to be published) <input checked="" type="checkbox"/> Survey Research <input type="checkbox"/> At Risk Populations (prisoners, children, pregnant women, etc) <input type="checkbox"/> Video or Audio Tapes <input type="checkbox"/> Medical Procedures, including exercise, administering drugs/dietary supplements, and other procedures

Section B: Care and Use of Vertebrate Animals <input checked="" type="checkbox"/> Not Applicable	
<i>Purpose of use/care of animals:</i>	<i>Please indicate if the following are included in the study:</i>

<input type="checkbox"/> Research <input type="checkbox"/> Teaching <input type="checkbox"/> Demo only <input type="checkbox"/> Student participation in faculty work <input type="checkbox"/> Class Project <input type="checkbox"/> Exhibition <input type="checkbox"/> Display	<input type="checkbox"/> Physical intervention with vertebrate animals <input type="checkbox"/> Housing of vertebrate animals <input type="checkbox"/> Euthanasia of vertebrate animals <input type="checkbox"/> Use of sedation, analgesia, or anesthesia <input type="checkbox"/> Surgery <input type="checkbox"/> Farm animals for biomedical research (e.g., diseases, organs, etc.) <input type="checkbox"/> Farm animals for agricultural research (e.g., food/fiber production, etc.) <input type="checkbox"/> Observation of vertebrate animals in their natural setting
-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------	-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------

Section C: Biological Research		<input checked="" type="checkbox"/> Not Applicable	<input type="checkbox"/> Submitted Separately
<i>Biosafety Level:</i>	<i>Please indicate if the following are included in the study:</i>		
<input type="checkbox"/> Exempt <input type="checkbox"/> BSL 1 <input type="checkbox"/> BSL 2 <input type="checkbox"/> BSL 3	<input type="checkbox"/> Use of rDNA <input type="checkbox"/> Non native/invasive plant species <input type="checkbox"/> Last EHS lab safety inspection date: <u> Attach Report </u>	<input type="checkbox"/> Last IBC biosafety lab inspection date: <u> Attach Report </u>	

Signature of Applicant(s): (PI, CoPI)		Date: 04/22/2016
X		
If student project please complete research advisor's information below (note that advisor signature must be received before application will be reviewed.):		
Research Advisor's Name: Dr. Tamerah Hunt, Ph.D., ATC	Advisor's E-mail: thunt@georgiasouthern.edu	
Advisor's Phone: 912-478-8620	Advisor's Department: School of Health and Kinesiology P.O. Box: 8026	
If student project - Signature of faculty member who is responsible for the student conducting research. If faculty project – Signature of department head or chair.		
By signing this cover page I acknowledge that I have reviewed and approved this protocol for scientific merit, rational and significance. I further acknowledge that I approve the ethical basis for the study.		
Signature of Committee Chair/Research Advisor (if student) Department Chair(if faculty): Date: 04/22/2016		
X		

Please submit this protocol to IRB@georgiasouthern.edu in a single email; scanned signatures are accepted. Original signature pages may follow by mail or fax. Applications may also be submitted via mail to the Georgia Southern University Office of Research Integrity, P.O. Box 8005 or via fax to 912-478-0719.

The application should contain all required documents specific to the committee to which you are applying. Questions or comments can be directed to (912)478-5465 or IRB@georgiasouthern.edu.

IRB Narrative

PERSONELL

Chloe Salway, ATC, LAT- Graduate Student/Principal Investigator

Dr. Tamerah Hunt, Ph.D., ATC- Georgia Southern University Faculty Member/ Co-Investigator (CHAIR) who is experienced with survey and concussion research.

Dr. Jody Langdon, Ph.D.- Georgia Southern University Faculty Member/ Co-Investigator who is experienced with survey research and statistics.

Dr. Steven Patterson Ed.D., ATC- Georgia Southern University Faculty Member/ Co-Investigator who is experienced with survey research.

PURPOSE

The purpose of this study is to assess concussion knowledge and understanding in guardians/guardians of Georgia High School Association (GHSA) student-athletes that have completed the GHSA concussion awareness form in comparison to those that have received additional concussion education.

Research Questions:

- 4) Does knowledge level reflect the amount of concussion education the participant has been exposed to?
- 5) Does the level of understanding of concussion information reflect the amount of concussion education the participant has been exposed to?
- 6) What is the correlation between knowledge and understanding of concussion information in guardians of GHSA student-athletes?

Hypotheses:

- 4) H_A: The mean knowledge score will not be higher in the group of participants that received additional concussion education than in the group that has only completed the GHSA concussion awareness form.
H₀: The mean knowledge score will be higher in the group of participants that received additional concussion education than in the group that has only completed the GHSA concussion awareness form.
- 5) H_A: The group that has received additional concussion education will not have a higher average understanding score than the group that has only completed the GHSA concussion awareness form.
H₀: The group that has received additional concussion education will have a higher average understanding score than the group that has only completed the GHSA concussion awareness form.
- 6) H_A: There will not be a strong, positive correlation between knowledge and understanding of concussion in guardians of GHSA student-athletes.
H₀: There will be a strong, positive correlation between knowledge and understanding of concussion in guardians of GHSA student-athletes.

There is no direct benefit to the participants of this study. However, the results from this study may provide an indirect benefit to the participants, as well as the target population and society. The results of this study will help to understand the knowledge and understanding gained from the GHSA concussion awareness form, as well as the effect of additional concussion education resources. The results may also help to improve concussion education requirements and initiatives. Effective concussion education is an important aspect of ensuring the safety and well-being of athletes.

LITERATURE REVIEW

Concussive injuries have increasingly garnered attention in recent years, especially in the athletic population. A concussion is defined as a complex pathophysiological process affecting the brain, induced by biomechanical forces.⁷ The term concussion is synonymous with mild-traumatic brain injury (mTBI) throughout the literature, as it is a subset of traumatic brain injury (TBI). Approximately 1.6-3.8 million sports-related traumatic brain injuries occur each year.² Concussions are caused by an impulsive force transmitted to the head by a direct blow to the body. Concussive injuries result in an onset of signs, symptoms, and neurocognitive deficits. Timely recognition and proper management of concussions is important to ensure the safety and well-being of athletes. Failure to do so may result in long-term consequences, and possibly death.⁷

The Lystedt Law of Washington State was enacted in 2009, as the first of its kind. The Lystedt Law addresses guidelines for the management and prevention of youth concussion. Since then, all 50 states and the District of Columbia have enacted legislation modeled around the three core elements of the Lystedt Law.⁵ The three core elements include: (1) annual guardian and athlete education, (2) the immediate mandatory removal from play of athletes suspected of having a concussion, and (3) clearance by an appropriate healthcare professional before an athlete has sustained a concussion may return to play.⁴ Although much of the youth concussion legislation requires guardian and athlete education, the type of concussion education to be received is not specified. 46 states and the District of Columbia require that concussion information sheets be distributed to athletes, of which 44 require guardian signatures.⁵

The youth concussion law in the state of Georgia is titled “The Return to Play Act of 2013.” This law requires each local board of education, administration of a nonpublic school, and governing body of a charter school to implement a concussion management and return to play policy. Within that policy, they must provide an information sheet to guardians or legal guardians that details the nature and risks of concussions.⁶ The Georgia High School Association (GHSA) is the governing body over high school athletic in the state of Georgia and is a member of the National federation of State High School Associations (NFSHA). GHSA requires that guardians and athletes read and sign a concussion awareness form prior to participation in sport. Completion of the form is the only concussion education requirement that the guardians and athlete must fulfill. The form details background information of concussion, the common signs and symptoms of concussion, and the GHSA concussion policy.

In general, there is a large focus on coach and athlete concussion education, while the focus on guardian education is scarce.⁸ Concussion education for the guardian population is very important, as the guardians are typically the primary care-takers of the athletes. Although the majority of legislation requires guardian education, the extent and effectiveness of the concussion education being received should be investigated. Concussion education and

awareness are key aspects in being able to recognize a concussive injury in their child.⁹ Chrisman et al. found that only 16.2% of guardians received concussion-related education via two or more modalities, while 57.9% of guardians had only been exposed to a mandatory concussion awareness form.¹⁰ In contrast, 91% of coaches received concussion-related education via two or more modalities.¹⁰ Additionally, Mannings et al. found that only 28.7% of guardians that participated in their study had ever received any concussion-related education material, while 53.2% reported having a discussion that defined concussion.⁹ There are various concussion education programs that may be effective in increasing guardian knowledge of concussion. These programs include the CDC's Heads Up Initiative for Guardians, SLICE, ThinkFirst, Brain 101, and Borrow Brainbook.¹⁶

In order to make concussion education for guardians as effective as possible, theories surrounding adult learning and knowledge transfer should be considered. The 4th Consensus Statement on Concussion in Sport and Provvidenza et al. suggest that knowledge transfer (KT) has a critical role in concussion education.^{7,12} KT can be defined as "the exchange, synthesis, and ethically-sound application of knowledge within a complex system of interactions among researchers and users to accelerate the capture of benefits of research through improved health, more effective services and products, and a strengthened health care system."¹² Effective KT strategies vary in respect to target audience and should be adjusted accordingly. The target audience should be assessed in order to fulfill the educational needs of that population. The target audience in this study are adults, so the most effective educational resources for adult learners should be considered. The Knowledge to Action (KTA) framework has been suggested to be the most effective framework in concussion education. KTA reinforces collaboration between knowledge creators and those that will utilize the knowledge.¹²

Adult learning theories can also help to understand the most effective educational strategies for the adult population. Current theories of adult learning emphasize many points that should be considered when creating an effective learning environment for adults. Education within the adult population should consist of: (1) Content that is relevant and useful to the learner's real life, (2) connection to experience and previous knowledge that the learner may have, (3) providing the learners the ability to actively participate and reflect about what they have learned, (4) the material should be focused on the needs of the audience, and (5) the teacher should become a facilitator of knowledge. For guardians in regards to concussion education, the content is relevant and useful to their real life.¹⁵ As mentioned previously, they are the primary care-takers of their children and this information is relevant and necessary. Concussion education may be more effective if it ties in previous experiences the guardian may have had playing or coaching sports. The adult guardian population would also benefit from an interactive method of concussion education, possibly an interactive discussion or web-based resource. A multifaceted approach is encouraged to facilitate effective knowledge transfer of concussion education across all populations.^{12,21} Printed materials and didactic lectures have been found to be an ineffective standalone method for concussion-related education in some populations. The use of technology-based resources has been encouraged for the adult learner population.¹⁷ Therefore, the effectiveness of the GHSA concussion awareness form should be assessed by evaluating the concussion knowledge of guardians of GHSA student-athletes.¹⁹

These theories show that a concussion awareness form should not be the only form of concussion education the guardians should receive. Although legislation has incorporated the requirement of annual guardian education, it is apparent that guardian knowledge of concussion

is lacking. This study will help to further evaluate the concussion knowledge and understanding of guardians in respect to the type and amount of concussion education they have received. The purpose of this study is to evaluate the knowledge and understanding of concussion in guardians of high school students that have completed the GHSA concussion awareness form, as well as those that have received additional concussion education.

OUTCOME

The findings of this study will include knowledge and understanding of concussion in guardians of Georgia High School Association (GHSA) student-athletes that have received varying concussion education. These findings will help to evaluate the effectiveness of the GHSA concussion awareness form, based on the knowledge and understanding of concussion of the guardians that completed the form. The results of this study could potentially influence future concussion education requirements. There will be no direct benefit to the participants of this study. Guardians of athletes would benefit indirectly from the results of this study as the results will encourage the use of the most effective concussion education strategy. The results of this study will also help those that are charged with promoting concussion education understand factors that influence knowledge and understanding of concussion. The results of this study hope to support knowledge transfer and adult learning theories that encourage the use of a multifaceted approach when attempting to effectively educate an adult population on concussion.

SUBJECTS

The current study will survey legal guardians of high school student-athletes that will be competing in GHSA sanctioned athletics in the Fall 2016 athletic season. Participants will be recruited from six high schools of varying size (1A-5A) and demographics (cultural and socioeconomic status). The predicted total population of guardians is 450, assuming the average number of guardians of Fall 2016 athletes is 75 across the six high schools targeted for this study. The ideal number of participants is 135, for a response rate of 30%. A response rate of 30-40% is acceptable for survey research within the field of athletic training. Participants will meet inclusion criteria if they have completed the GHSA concussion awareness form, have a valid e-mail address, are the guardian of a student participating in a GHSA sponsored athletic team in the Fall 2016 athletic season. Participants will be excluded from the study if English is not their primary language. Participants will be divided into two groups based on the amount of concussion education they have received. One group will include participants that have only received concussion education from the GHSA concussion awareness form. The other group will include participants that have completed the form and received additional concussion education, including those who have been exposed to concussion information due to previous experience with concussive injuries.

RECRUITMENT AND INCENTIVES

There will be no reward or incentives for participation. Participation in this study is voluntary. Participants will be primarily recruited during pre-season guardian meetings or athletic events at six different high schools. The researcher will make an announcement describing the study and will follow a script to ask guardians to participate in the study. The script will read as follows:

“Hello, my name is Chloe Salway and I am currently pursuing my Master’s of Kinesiology with a concentration in Athletic Training. I am conducting a thesis project as a requirement of my studies. The purpose of this study is to assess concussion knowledge and understanding in guardians of GHSA student-athletes in comparison to the amount of concussion education they have completed. Your participation is very important in helping to understand the effectiveness of current concussion educational practices. The findings from this study could help to improve concussion education efforts. You will receive no direct benefit for participating in this study. Participation in this study involves completing a survey that will take between 10 and 20 minutes to complete. If you wish to participate in this study, please complete a consent form before starting the survey. You will be given a copy of the consent form for your record. iPads will be passed around with an electronic copy of the survey that can be completed. The same survey may also be completed in paper form. If you complete in on paper, please turn in to the drop box. The survey includes questions regarding demographics, knowledge, and understanding of concussion. Participation is completely voluntary and you may stop taking the survey at any time for any reason. Once you receive the survey, please answer all questions honestly and to the best of your ability. Please answer all questions. Responses are anonymous and confidential. If you have any questions, do not hesitate to ask.”

An alternative method of recruitment may be used if the researcher is unable to attend a guardian meeting at a school, or the school does not hold pre-season guardian meeting. In these instances, the researcher will send a recruitment flyer to the guardians that will be distributed to the student-athletes following practices, or included in pre-season packets that the guardians are required to complete prior to the athletic season. The recruitment flyer will give a brief overview of the study, as well as ask the guardian to provide their e-mail address. A paper copy of the consent form will be attached with the initial recruitment flyer and returned to the researcher with the completed flyers. The researcher will then collect all returned forms from the respective schools and send a recruitment e-mail to each potential participant. The e-mail will include a brief overview of the study and a link to the web-based survey. A consent form will be attached to the e-mail for the participant’s record. The e-mail recruitment script will read as follows:

“Hello, my name is Chloe Salway and I am currently pursuing a Master’s of Kinesiology with a concentration in Athletic Training. I am conducting a thesis project as a requirement of my studies. You are receiving this e-mail because you indicated that you would be willing to participate in my study. The purpose of this study is to assess concussion knowledge and understanding in guardians of GHSA student-athletes in comparison to the amount of concussion education they have completed. The findings from this study could help to improve concussion education efforts. Your participation is very important in helping to understand the effectiveness of current concussion educational practices. Participation in this study involves completing a survey that will take between 10 and 20 minutes to complete. You will receive no direct benefit or incentive for participating in this study. If you still wish to participate in this study, please click the link below and complete the survey. Participation is completely voluntary and you may exit the survey at any time, for any reason. Once you have completed the survey, you will no longer be able to access it via the link provided to you. Responses are completely anonymous. Please keep the attached consent form for your records. If you have any questions, please do not hesitate to contact me. My contact information is listed below. Thank you for your time.”

RESEARCH PROCEDURES AND TIMELINE

Following administrative approval, the researcher will attend standard preseason informational guardian meetings or any athletic event for the 6 high schools targeted in the study. The researcher is expecting to collect data from June 1, 2016 to September 30, 2016. If the guardian that attends the preseason meeting or athletic event is not the same guardian that completed the awareness form for their respective student-athlete, they will be provided a copy of the GHSA concussion awareness form to review. The researcher will provide a brief scripted overview of the study and give instructions needed to complete the survey. Participants will complete the survey on iPads and paper copies will be provided as a back-up. If paper surveys are used, the participant will place them in a drop-box once they have completed the survey in order to ensure anonymity. Consent forms in paper format will be distributed and read by the participants prior to them completing the survey. The consent form includes a passive consent statement, in which that participant consents to participating in this research by completing the survey. They will be given a consent form for their record as well. If the alternative method of recruitment is used, the consent form will be completed by the participant when they fill out the initial recruitment flyer and return it to the researcher. They will again be provided a consent form to keep for their record in the follow-up email.

A web-based survey will be created using Qualtrics Survey Software. The anonymous setting will be used on Qualtrics and the consent form will be provided prior to the start of the survey. The consent form will be the same as for the paper surveys, stating that the participant consents to participating in this research by completing the survey. No surveys have been validated for the purposes of this study, therefore the survey created for this study is based on multiple surveys that have been used in previous studies throughout the literature. The survey will undergo pilot testing in a smaller sample of 5-10 guardians that are not involved in the target population. Differences between the web-based and paper surveys will be analyzed during pilot testing to ensure uniformity across the two formats. Pilot data will be analyzed prior to the beginning of the study period and changes will be made to the survey as needed. Survey questions will be modified from previously utilized surveys. The survey will contain questions relating to demographics including: guardianship, gender, age, race, ethnicity, annual income, education level, and size of the child's school. Concussion education level will be determined by whether they have received additional formal concussion education. The type, format and reason they received additional education will also be asked. We will account for previous concussion experience by asking the guardian if they or their child has ever had a previously diagnosed concussion.

The knowledge portion of the survey will ask questions based on the information provided on the GHSA concussion awareness form. The knowledge section consists of nine questions including yes/no questions and a section on the signs and symptoms associated with concussion. The understanding section consists of eight scenario questions. The knowledge section will be scored by calculating the percent of total correct responses. The symptomology question will be scored based on the percent of correctly identified signs and symptoms the participant identified as concussion-related or not. The survey contains 34 questions total, and should take between 10 and 20 minutes to complete.

DATA ANALYSIS

Participants will be divided into two groups according to the amount of concussion education they have received. The two groups will be divided between participants that have

only completed the GHSA Concussion Awareness form, and participants that have completed the form and received additional formal concussion education. The independent variable is the amount of concussion education the participant has received: (1) has only completed the GHSA concussion awareness form, and (2) has completed the concussion awareness form as well as additional concussion education. The dependent variables will be the knowledge and understanding scores of the participants. Independent t-tests will be used to evaluate the effect of amount of concussion education on knowledge and understanding. A Pearson correlation will be done to evaluate the correlation between knowledge and understanding. Demographics will also be analyzed using descriptive statistics. All data will be exported from Qualtrics and all statistical analysis will be conducted using SPSS 23.0 (IBM, Chicago, Illinois). If paper surveys are used, data from those will also be imported into SPSS.

The assumptions for this analysis is that there is a normal distribution, equal variances of the population, and that there is independence in the sample. We will use Levene's test to analyze variance. If Levene's test is violated, we will adjust degrees of freedom. The mean knowledge score and mean understanding score of each group will be compared using independent t-tests. A Pearson correlation will be done to identify any correlation between knowledge and understanding. The significance level will be set *a priori* at $p < 0.05$. Eta squared will be calculated by hand to evaluate effect size. Participant responses will be anonymous and data collected will be kept on a password-protected computer and a locked filing cabinet.

Special Conditions:

Risk:

This study involves minimal risk. Participation in the survey is voluntary and the participant may choose to discontinue participation at any point. Survey responses are anonymous and confidential. The survey questions pose minimal risk. Risk is no greater than risk associated with daily life experiences.

Research involving minors.

This study does not involve minors.

Deception.

This study does not involve deception.

Medical procedures.

This study does not involve medical procedures.

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Cover page checklist.

The participants will complete an informed consent document prior to participation in the study. They will also be given a copy of the informed consent document for their record. The survey is anonymous and confidential. The survey involves minimal risk. The results of this study may be generalizable to our target population and may have an effect on future concussion education efforts.

Opportunity to Participate in Research Study

Greetings,

My name is Chloe Salway, and I am currently pursuing my Master's of Kinesiology with a concentration in Athletic Training. I am conducting a thesis project as a requirement of my studies. The purpose of this study is to assess concussion knowledge and understanding in guardians of GHSA student-athletes in comparison to the amount of concussion education they have completed. Your participation is very important in helping to understand the effectiveness of current concussion educational practices. The findings from this study could help to improve concussion education efforts. You will receive no direct benefit for participating in this study. Participation in this study involves completing a survey that will take between 10 and 20 minutes to complete.

If you wish to participate in this study, please complete a consent form and provide your e-mail address. An e-mail will be sent to you with a link to an online survey. Please return this form and the completed consent form. Further information regarding the specifics of this study are provided in the attached consent form.

Your participation in this study is greatly appreciated and is very important in furthering the efforts of concussion education. E-mail address:

Concussion Survey for Guardians

1. Are you the legal guardian responsible for signing the GHSA Student/Guardian Concussion Awareness form?
 - a. Yes
 - b. No
2. When did you read the GHSA Student/Guardian Concussion Awareness form? Within the last...
 - a. 30 minutes
 - b. Hour
 - c. Day
 - d. Week
 - e. Month
 - f. Other: _____
3. What type of guardian/relation are you to your student-athlete?
 - a. Mother
 - b. Father
 - c. Sibling
 - d. Grandmother
 - e. Grandfather
 - f. Aunt
 - g. Uncle
 - h. Other: _____
4. What is your gender?
 - a. Male
 - b. Female
5. What is your age?
 - a. 18-25
 - b. 26-34
 - c. 35-50
 - d. Over 50
6. What is your race?
 - a. Hispanic or Latino
 - b. Caucasian
 - c. African American
 - d. Asian or Pacific Islander
 - e. Alaskan Native/Native American
 - f. Other
7. What is your ethnicity?
 - a. Hispanic
 - b. Non-hispanic
8. Is English your primary language?
 - a. Yes
 - b. No
9. What is the highest level of education you have completed?
 - a. High School Diploma/GED
 - b. Some College
 - c. Associate's Degree
 - d. Bachelor's Degree
 - e. Master's Degree
 - f. Doctorate
 - g. None of the above
10. What is your annual household income?
 - a. Less than \$30,000
 - b. \$30,000-\$49,000
 - c. \$50,000-\$74,900
 - d. \$75,000-\$100,000
 - e. More than \$100,000
11. How many years has your child/children participated in organized coached sports associated with GHSA? (If more than one child, add number of years together). For example, if you have one senior and one freshman, it would be 5 years).
12. Select the size of your child(s) school.
 - a. 1A
 - b. 2A
 - c. 3A
 - d. 4A

- a. Yes b. No c. Unsure
- 25. An appropriate health care provider includes: (Circle all that apply)**
- a. Certified Athletic Trainer
 - b. Coach
 - c. Doctor (MD/DO)
 - d. Physician's assistant
 - e. Nurse practitioner
 - f. Athletic Director

26. For each of the following symptoms, please check YES if you think it is a symptom of a concussion. Please check NO if you do not think it is a symptom of concussion. Please check UNSURE if you don't know.

Symptom	Yes	No	Unsure
Headache			
Dizziness			
Balance Problems			
Irritability			
Feeling Unsteady			
Fatigue/low energy			
Weight Gain			
Nausea			
Nose Bleed			
Abnormal sense of taste			
Vomiting			
Thirst			
Difficulty Sleeping			
Sensitivity to light			
Sensitivity to noise			
Confusion			
Hunger			
Hives			
Difficulty Remembering			
Burst of energy			
Abnormal sense of smell			
Mentally foggy			
Difficulty concentrating			
Hair loss			
Change in behavior			
Loss of consciousness			

27. A football player receives a direct blow to the side of his head from another player and falls to the ground. As he gets up, he experiences mild dizziness and has a headache. He continues to play and does not report his symptoms to the coach or athletic trainer. Should the player have continued to play football in this situation?

- a. Yes b. No c. Unsure

28. While playing in a game, Player Q and Player X collide with each other and each suffers a concussion. Player Q has never had a concussion in the past. Player X has



COLLEGE OF HEALTH AND HUMAN SCIENCES

DEPARTMENT OF HEALTH AND KINESIOLOGY

INFORMED CONSENT TO ACT AS A SUBJECT IN AN EXPERIMENTAL STUDY

1. Greetings, my name is Chloe Salway and I am a Master's student pursuing a degree in Health and Kinesiology with a Concentration in Athletic Training at Georgia Southern University. I am doing this research as requirement of my studies, as well as to further understand the effect that current concussion education practices may have. The title of my study is: "Concussion Knowledge and Understanding in Georgia High School Association (GHSA) Guardians"
2. The purpose of this study is to assess concussion knowledge and understanding in guardians/guardians of GHSA student athletes that have completed the GHSA concussion awareness form in comparison to those that have received additional concussion education.
3. Participation in this research will include the completion of a survey that will assess concussion knowledge and understanding, as well as demographics. The survey may be completed in a web-based or paper format. Please return this form to the researcher before beginning the survey. You will be given a copy of this form to keep for your record. The survey should take between 10 and 20 minutes to complete. Please answer questions honestly and to the best of your ability. Feel free to ask any questions that may arise at any point.
4. This survey involves minimal risk. Responses are anonymous, so there is no risk in providing confidential information. You will not be at risk for physical or psychological harm. You may experience discomfort in responding to personal questions during the demographics section. However, this information is anonymous and confidential.
5. Benefits:

- a. There are no direct benefits to you as a participant. There may be indirect benefits to the guardian population and society regarding the results of this research.
 - b. A potential benefit of this study to society is the ability to understand the knowledge and understanding gained from the GHSA concussion awareness form. The results of this study may positively influence concussion education requirements in the future.
6. The survey should take between 10 and 20 minutes to complete and contains 34 questions.
7. Surveys will be anonymous and confidential. The researcher will store electronic surveys on a password protected computer, and paper surveys in a locked filing folder. Deidentified or coded data from this study may be placed in a publically available repository for study validation and further research. You will not be identified by name in the data set or any reports using information obtained from this study, and your confidentiality as a participant in this study will remain secure. Subsequent uses of records and data will be subject to standard data use policies which protect the anonymity of individuals and institutions.
8. You have the right to ask questions and have those questions answered. If you have questions about this study, please contact the researcher or the researcher's faculty advisor, whose contact information is located at the end of the informed consent. For questions concerning your rights as a research participant, contact Georgia Southern University Office of Research Services and Sponsored Programs at 912-478-5465.
9. You will not receive any form of compensation for participation in this study. There will be no incentives for your participation.
10. Participation in this study is completely voluntary. You do not have to participate if you do not want to. If you start the survey, you can stop at any time and you do not have to answer every question.
11. You will not be penalized if you choose not to participate in this study. You may decide at any time to discontinue participation. If you do so, there will be no penalty or retribution.
12. You must be 18 years of age or older to consent to participate in this research study. If you consent to participate in this research study and to the terms above, please sign your name and indicate the date below

You will be given a copy of this consent form to keep for your records. This project has been reviewed and approved by the GSU Institutional Review Board under tracking number H16413.

By completing the survey, I acknowledge that I have read the above information and consent to participating in this research study.

Title of Project: Concussion Knowledge and Understanding in GHSA Guardians

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APPENDIX D

Survey Instrument
Concussion Survey for Guardians

- 1. Are you the legal guardian responsible for signing the GHSA Student/Guardian Concussion Awareness form?**
 - a. Yes
 - b. No
- 2. When did you read the GHSA Student/Guardian Concussion Awareness form? Within the last...**
 - a. 30 minutes
 - b. Hour
 - c. Day
 - d. Week
 - e. Month
 - f. Other: _____
- 3. What type of guardian/relation are you to your student-athlete?**
 - a. Mother
 - b. Father
 - c. Sibling
 - d. Grandmother
 - e. Grandfather
 - f. Aunt
 - g. Uncle
 - h. Other: _____
- 4. What is your gender?**
 - a. Male
 - b. Female
- 5. What is your age?**
 - a. 18-25
 - b. 26-34
 - c. 35-50
 - d. Over 50
- 6. What is your race?**
 - a. Hispanic or Latino
 - b. Caucasian
 - c. African American
 - d. Asian or Pacific Islander
 - e. Alaskan Native/Native American
 - f. Other
- 7. What is your ethnicity?**
 - a. Hispanic
 - b. Non-hispanic
- 8. Is English your primary language?**
 - a. Yes
 - b. No
- 9. What is the highest level of education you have completed?**
 - a. High School Diploma/GED
 - b. Some College
 - c. Associate's Degree
 - d. Bachelor's Degree
 - e. Master's Degree
 - f. Doctorate
 - g. None of the above
- 10. What is your annual household income?**
 - a. Less than \$30,000
 - b. \$30,000-\$49,000
 - c. \$50,000-\$74,900
 - d. \$75,000-\$100,000

- e. More than \$100,000
- 11. How many years has your child/children participated in organized coached sports associated with GHSA? (If more than one child, add number of years together). For example, if you have one senior and one freshman, it would be 5 years).**

12. Select the size of your child(s) school.

- | | |
|-------|-----------|
| a. 1A | d. 4A |
| b. 2A | e. 5A |
| c. 3A | f. Unsure |

13. Have you or any of your children ever been diagnosed with a concussion by a health care professional?

- | | | |
|--------|-------|-----------|
| a. Yes | b. No | c. Unsure |
|--------|-------|-----------|

14. Have you ever received concussion-related education in addition to the GHSA Concussion Awareness form?

- | | |
|--------|-------|
| a. Yes | b. No |
|--------|-------|

15. In what format did you receive additional concussion education?

- | | |
|---------------------------------------------------------------------|-------------------------------------------|
| a. Computer based training module | e. Media- (ex. Newspapers, magazines, TV) |
| b. Presentation from Athletic Trainer or other health care provider | f. Online search |
| c. Information from Doctor | g. Other: OPEN ENDED |
| d. Information provided by coach | h. Unsure |
| | i. Does not apply |

16. Why did you receive additional concussion-related education?

- | | |
|-----------------------------------------------------|---------------------------------------------------------------|
| a. Required to be able to coach | d. Wanted to receive additional information about concussions |
| b. Required so my child could participate in sports | e. Other: OPEN ENDED |
| c. Requirement of my job | f. Does not apply |

For the following questions, please circle “yes”, “no”, or “unsure” accordingly.

17. A concussion can only occur from a blow to the head.

- | | | |
|--------|-------|-----------|
| a. Yes | b. No | c. Unsure |
|--------|-------|-----------|

18. A concussion has only occurred if the athlete “blacks out”.

- | | | |
|--------|-------|-----------|
| a. Yes | b. No | c. Unsure |
|--------|-------|-----------|

19. A concussion changes the way a student’s brain normally works.

- | | | |
|--------|-------|-----------|
| a. Yes | b. No | c. Unsure |
|--------|-------|-----------|

32. He should be evaluated by medical personnel to determine if he had a concussion.

d. Yes

e. No

f. Unsure

33. He should have a symptom-free week beginning on the first day without symptoms and follow a return to play exercise protocol that gradually increases in difficulty.

d. Yes

e. No

f. Unsure

34. If during this week he experiences any of those symptoms again, he should complete that week of rest and then return to play for a total of 7 days off.

d. Yes

e. No

f. Unsure

APPENDIX E

TABLES

Variable	Frequency	% of Sample (N=102)
Gender		
Male	30	29.4
Female	72	70.6
Age		
	4	N=101
26-34	83	4
35-50	14	82.2
Over 50		13.9
Relation		
Mother	70	68.6
Father	30	29.4
Grandmother	2	2
Race		
Hispanic or Latino	2	2
Caucasian	84	82.4
African American	13	12.7
Other	3	2.9
Ethnicity		N=99
Hispanic	2	2
Non-	97	98
Hispanic		

Level of Education		
High School Diploma/GED	13	12.7
Some College	17	16.7
Associate's Degree	22	21.6
Bachelor's Degree	28	27.5
Master's Degree	19	18.6
Doctorate	2	2
None of the above	1	1
Annual Household Income		N=101
Less than \$30,000	7	6.9
\$30,000-\$49,000	13	12.9
\$50,000-\$74,900	15	14.9
\$75,000-\$100,000	31	30.7
More than \$100,000	35	34.7
Size of Child's School		
2A	1	1
3A	28	27.5
4A	17	16.7
5A	41	40.2
6A	3	2.9
Unsure	12	11.8
Years of Child Participation		
1	21	20.6
2	24	23.5
3	12	11.8
4	11	10.8
5	8	7.8
6	8	7.8
7	6	5.9
8	6	5.9
10	4	3.9
12	2	2.0

Timing of Concussion Awareness Form

30 minutes	10	9.9
1 Hour	2	2.0
1 Day	3	3.0
1 Week	3	3.0
1 Month	60	59.4
Other	23	22.8

Self or Child Previous Concussion		
Yes	25	25.5
No	75	73.5
Unsure	1	1
Additional Concussion Education		
Yes	48	47.1
No	54	52.9

Table 1: Participant Demographic Information

Note: Data included in this table was extracted from questions 2-14 of the demographics section of the Concussion Survey for Guardians

Variable	Group Mean	P-value	SD
Total Knowledge Score	31.52	0.085	0.197
Additional Education Form Only	30.04		
Total Understanding Score		.407	0.20
Additional Education Form Only	6.77		
	6.61		
Total Correct		0.063	0.196
Additional Education Form Only	38.29		
	36.65		

Table 2: Knowledge, Understanding, and Total Score Independent-T test results

FIGURES

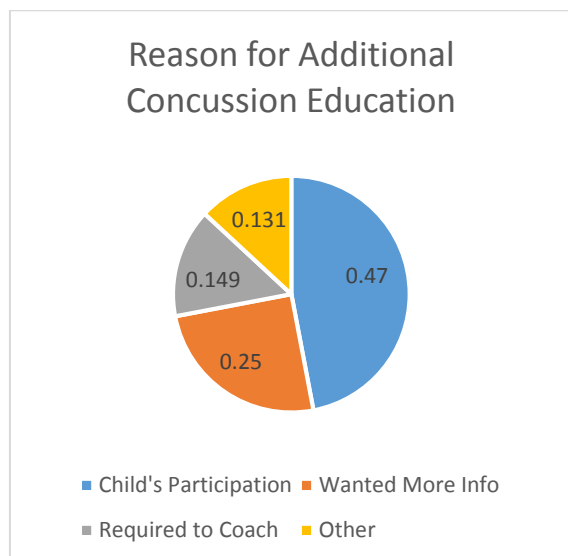


Figure 1: Reason Participants Completed Additional Concussion Education

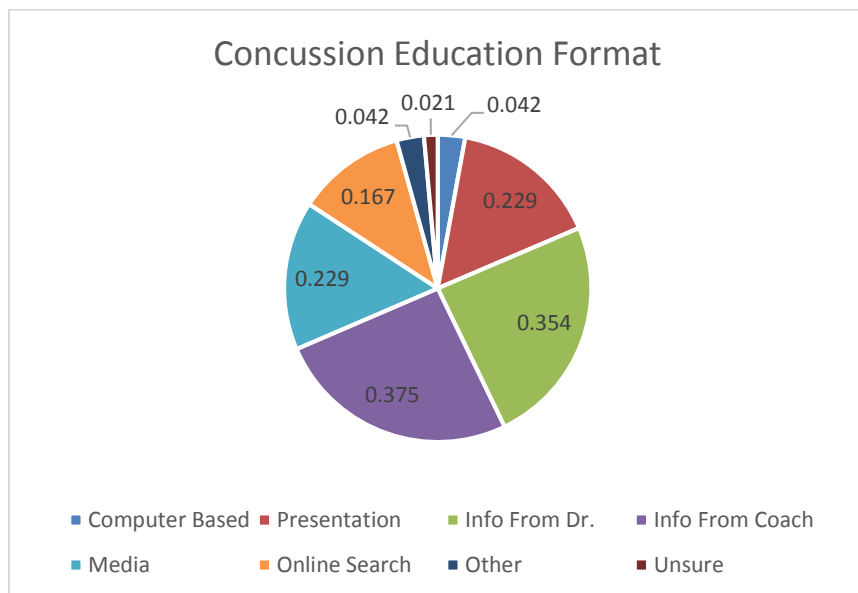


Figure 2: Format Participants Received Additional Concussion Education

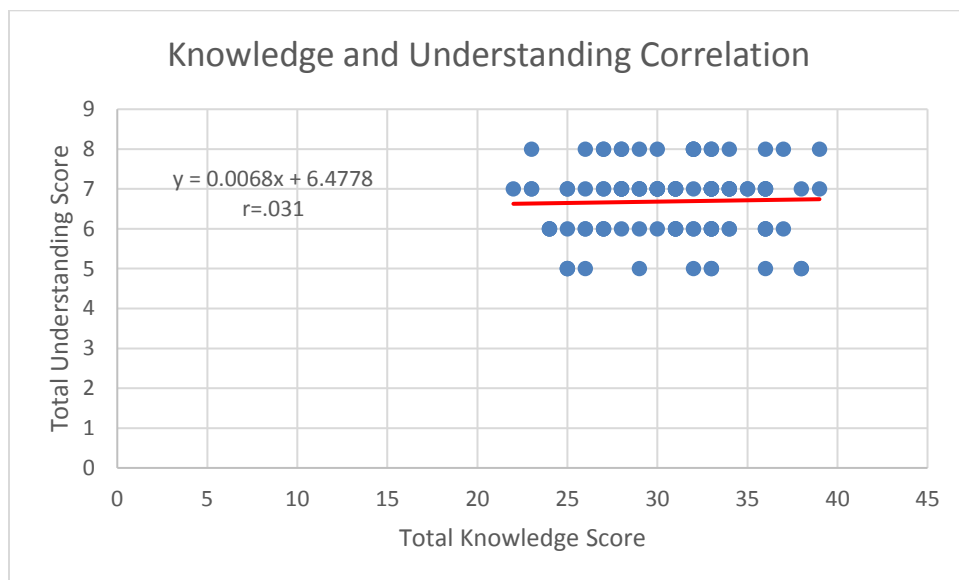


Figure 3: Pearson Correlation for Total Knowledge and Understanding Score

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