CONCUSSION KNOWLEDGE AMONG YOUTH PARENTS IN THE COMMONWEALTH OF PENNSYLVANIA: A SURVEY BASED ON THE SAFETY ON YOUTH SPORTS ACT

A THESIS

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THESIS APPROVAL

Graduate Athletic Training Education

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INTRODUCTION

Sport-related concussion can occur in any sport and has been shown in high school athletics to account for 8.9% of all athletic injuries. It is estimated that 1.6 to 3.8 million concussions occur each year and approximately 50% of those go unreported.[1-4] It has been shown adolescent athletes are more likely to sustain a concussion so the responsibility of recognizing signs and symptoms falls on the parents and coaches. Therefore, it is important for parents and coaches of youth athletes be educated on the signs and symptoms of a concussion, the best post-injury treatment plans, and the proper medical professional clearance before returning to play.

A concussion can be defined as a brain injury involving complex pathophysiological processes induced by biomechanical forces affecting the brain.[5] Biomechanical forces may be caused by a blow to the head, face, neck, or blow to the body resulting in shear forces on the brain. Concussion sign and symptom domains are: symptoms, physical signs, behavioral changes, cognitive impairment, and sleep disturbance, which are summarized in the Consensus Statement of the 4th International Conference on Concussion

in Sport held in Zurich, November 2012.[5] Components of these domains could include headache, feeling in a fog, nausea or vomiting, dizziness, loss of consciousness, anterograde or retrograde amnesia, irritability, sadness, anxiousness, slowed reaction time and difficulty concentrating.[5]

Understanding the neurophysiology of concussions helps with explaining to parents or coaches treatment and management options and can also make them easier to comprehend. Concussions can be thought of as a two-part injury, the first being the initial blow to the head and or body, the second being the inflammatory process, which accompanies any physical injury. The delayed inflammatory process following the initial injury could possibly explain why some signs and symptoms are not immediately present and go unrecognized.[6] Along with suffering from neurophysiological signs and symptoms, another possible component often overlooked is the neuropsychological component. The injured athlete may experience a number of different long-term and/or psychological issues including depression, anxiety, psychosocial problems, physical, and cognitive disturbances, and chronic traumatic encephalopathy.[7]

One of the more serious and possibly fatal consequences of concussions is second impact syndrome. The

name was coined from a description written by two researches, Saunders and Harbaugh[8,9], in 1984 on a 19-year-old college football player who suffered a head injury. Second Impact Syndrome occurs when a concussed athlete returns to activity and receives a second blow to the head or body before the original injury has healed. The result is rapid brain swelling, severe onset of brain trauma symptoms and in most cases, death. Second Impact Syndrome reinforces the importance of concussion knowledge among parents of youth athletes so that life altering or life threatening situations can be minimized.

Reasoning behind why so many concussions go unreported every year could be due to parents, coaches, and athletes not having enough knowledge and awareness of the signs and symptoms of concussions. A survey study examined the underreporting of concussion incidence in high school football players and displayed only 47% actually reported concussion symptoms to their parent or medical professional. They were asked to state their reasoning for not reporting their symptoms: 66% did not think the injury was significant and 36% did not realize the symptoms they had were from a concussion.[10] Providing more education for parents, coaches, and athletes is the first step in

overcoming the underreporting issue, which in turn will help with proper management to prevent recurrent injuries.

In May of 2009 the Lystedt Law was passed in Washington State which requires youth parents, coaches and athletes be educated on the signs and symptoms of concussions.[11] The law also mandates immediate removal from the playing field if a concussion is suspected and requires written clearance from a trained medical professional before returning to play. Shenouda et al[11] administered a survey study to parents, coaches, and officials of youth soccer organizations in Washington State in order to examine the effectiveness of the Lystedt Law. The results suggested that 96% knew concussions were a form of TBI, 93% were aware that loss of consciousness does not have to take place, 98% identified neurological symptoms as concussion indicators, and 85% were actually aware of the Lystedt Law.[11] The information found in the study revealed benefits of youth concussion legislation and showed the importance of parents knowledge on the injury.

The state of Pennsylvania passed the Safety in Youth Sports Act in 2011 also known as the Pennsylvania Senate Bill 200/Act 101.[12] This bill focuses on interscholastic athletics and mandates coaches complete an annual concussion education course. Immediate removal from

participation is required for someone displaying signs and symptoms of a concussion and before return to play the athlete must have written clearance by a licensed physician and be completely symptom free.[12] In addition, the Safety in Youth Sports Act requires that athletes and their parents annually review and sign the Understanding of Risk of Concussion and Traumatic Brain Injury form (Appendix C1). Also known as the Concussion Information Sheet, this form is included in the Pennsylvania Interscholastic Athletic Association (PIAA) Comprehensive Initial Pre-Participation Physical Evaluation packet (CIPPE).

There has not been any evidence-based research published on the Safety in Youth Sports Act or the Concussion Information Sheet to date. It is important for both to be evaluated because they could be the only educational tools utilized by the parent and athlete. In order to protect young athletes' brains from injury and possible long-term consequences, it is imperative to make sure every aspect of this newly passed legislation provides the correct resources and guidance to parents, youth athletes, and coaches.

METHODS

The primary purpose of this study was to assess the concussion knowledge gained from the Concussion Information Sheet by parents whose youth are involved in athletics in the Pennsylvania Interscholastic Athletic Association (PIAA). A survey was distributed in order to evaluate the parents' knowledge following review of the Concussion Information Sheet. The Concussion Information Sheet is part of the Pennsylvania Senate Bill 200 Act 101, effective in 2012, which states that students participating in interscholastic athletics and the students' parent(s) are required to sign and return acknowledgment of receipt and review of the Concussion Information Sheet for each year of participation.[12]

Research Design

This study utilized a descriptive research design aimed at analyzing data collected from the developed survey. Following approval by the Institutional Review Board (Appendix C2) at California University of Pennsylvania, an electronic survey formatted on SurveyMonkey.com was administered to participants in order

to evaluate their current knowledge of the Concussion Information Sheet. The independent variables were: completed education level by the parent, size of the student athlete's school, if the school employs a certified athletic trainer, concussion history of the parent, and concussion history of the student athlete. The dependent variable of this study was the parents' knowledge score of the Concussion Information Sheet. The survey used to measure the dependent variable was administered online through Surveymonkey.com.

Participants

Participants included in the survey were parents/guardians of youth athletes competing in the PIAA. Currently, there are 1,422 schools and over 350,000 student athletes competing under the PIAA jurisdiction.[13] There were 507 surveys sent out to Pennsylvania State Athletic Directors Association (PSADA) members and there was a total of 143 participants who completed the survey. It was assumed that all the athletic directors in the PSADA have all current emails for the parents associated with their school. Parents of all student athletes from sports within the athletic association were analyzed with the exclusion

criteria of: not having a child in interscholastic athletics associated with the PIAA, the parent/guardian being less than 18 years of age, and/or not completing the survey questions associated with the Concussion Information Sheet.

Preliminary Research

A preliminary survey was developed before Institutional Review Board (IRB) submission in order to determine the quality and effectiveness of the survey. The preliminary survey was distributed to faculty members in the athletic training department at California University of Pennsylvania. Included were the Graduate Athletic Training Education Program Director, the Head Athletic Trainer, and two full-time Athletic Training faculty members. They were provided with a copy of the Concussion Information Sheet along with the preliminary survey and were instructed to evaluate the survey's construct and content validity, focusing on their relation to the information sheet. Any instruction and recommendations were considered and a final survey was developed.

Instrumentation

At the beginning of every school year, each athlete must turn in the completed PIAA CIPPE before the athletic season begins. Section 3 of the CIPPE is the Understanding of Risk of Concussion and Traumatic Brain Injury form, also known as the Concussion Information Sheet. The one page document includes information such as defining a concussion, the signs and symptoms associated with a concussion, and action to be taken when an individual feels they or someone else has suffered a concussion.

In order to evaluate the knowledge level of parents in relation to the Concussion Information Sheet, the researcher distributed a survey (Appendix C3) to parents of youth involved in the PIAA. The first page of the survey was the cover letter explaining the details of the study and information on informed consent and confidentiality. The material in the survey covered seven demographic questions, 12 additional information questions, and 15 questions directly focused on the Concussion Information Sheet (34 total). The demographic section (1-7) included age, race/ethnicity, gender, parents' occupation and highest level of education. In the additional information section (8-19), questions included; how many of their

children compete in the PIAA, size of the child's school, and parent/child history of concussion. Also in this section there were three questions which focused directly on the effectiveness of the Concussion Information Sheet and Safety in Youth Sports Act (10-12). The final section of the survey focused strictly on the information sheet itself and included True/False, Yes/No/Don't Know, and multiple choice questions (20-34). Question 25 was a sign and symptom identification question with 22 possible answers where the parent selected whether or not each symptom related to a concussion. Questions 20-34 were scored for a total of 36 possible points. Correct responses were awarded one point, incorrect/don't know/somewhat responses were awarded zero points. An example of the survey format and questions can be found in Appendix C3 along with the Concussion Information Sheet in Appendix C1.

Procedures

The study was approved by the Institutional Review Board at California University of Pennsylvania (Appendix C2). Prior to data collection, an original survey was distributed to California University of Pennsylvania athletic trainers to determine content and context

validity. The panel of experts were contacted via email with instructions to complete a validity questionnaire directed towards the survey (Appendix C4). The PIAA agreed to distribute the SurveyMonkey link and the cover letter to all of the athletic directors in the Pennsylvania State Athletic Directors Association (PSADA). The cover letter (Appendix C5) was strictly for the athletic directors and included a brief summary of the study and instructions to distribute the SurveyMonkey link to the parents of athletes in their school. Once the Executive Director of the PIAA distributed the information to the athletic directors, the survey was available on Surveymonkey.com for two weeks. After seven days of the survey being available, a follow-up email was sent to the Executive Director requesting a reminder email be sent to the athletic directors to encourage their parents to complete the survey. At the end of the two week period the survey was closed and data collection began.

Hypotheses

The following hypotheses were based on previous concussion survey related research and the researcher's intuition based on a review of the literature.

1. There will be a difference in knowledge scores of parents based on completed education level of the parent.
2. There will be a difference in knowledge scores of parents based on the size of the student athletes' school.
3. There will be a difference in knowledge scores of parents based on whether a school employs a certified athletic trainer.
4. There will be a difference in knowledge scores of parents if the parent has a history of concussion.
5. There will be a difference in knowledge scores of parents if their student athlete has a history of concussion.

Data Analysis

Results of the survey were collected via SurveyMonkey.com and transferred into SPSS for data analysis. Comparative data analysis were used to determine if data supports the hypotheses. Specifically, a one-way factorial ANOVA was utilized in order to analyze the independent variables and their effect on the dependent variable. Level of significance was set at $p \leq .05$.

Descriptive statistics were conducted on items 10-12 to determine if the Concussion Information Sheet and Safety in Youth Sports Act was useful and effective. For items 20-34, an overall score was calculated with 36 total possible points and was the dependent variable in the ANOVA test. One point was awarded for correct responses and zero points were awarded for incorrect/don't know/somewhat responses.

RESULTS

The purpose of this research was to assess parents' knowledge of the Concussion Information Sheet that has been implemented as part of the Safety in Youth Sports Act. Various demographic items were used as independent variables and each participant received an overall knowledge score, which was the dependent variable. The following section contains the data collected through the study and is divided into three subsections: Demographic Data, Hypothesis Testing, and Additional Findings.

Demographic Data

A total of 192 surveys were completed and returned. The PIAA executive director sent the survey information to 507 PSADA members. Without knowing how many surveys were distributed to parents, a rate of return was not determined. Only 143 surveys were included in the study following removal of incomplete submissions and submissions failing to meet the inclusion criteria. There were 92 female (65.7%) and 48 male (34.3%) participants that completed the survey. Age range varied with 16.1% aged 31-

40 (N=23); 62.9% aged 41-50 (N=90); 18.2% aged 51-60 (N=26); and 2.8% 61 and older (N=4). Participant responses revealed 43.2% being a part of organized coached sports for ten or more years.

Parents were asked to indicate their highest level of education completed. Table 1 displays data for highest level of education completed.

Table 1. Highest Education Level Completed by Parent

	N	Percent
Graduated from HS	16	11.3
Completed 1-3 years of College	29	20.4
Graduated from College	44	31.0
Completed some Graduate School	17	12.0
Graduated from Graduate School	36	25.4
Total	142	100.0

It was hypothesized that the size of the student athlete's school will have an impact on the parents' knowledge score. 46% (N=64) of parents indicated their student athlete belongs to a AA school. Data is displayed in Table 2.

Table 2. Size of Student Athletes' School

	N	Percent
A	21	15.1
AA	64	46.0
AAA	36	25.9
AAAA	3	2.2
Don't Know	15	10.8
Total	139	100.0

Participants were asked to indicate whether or not their son or daughter's school employs a certified athletic trainer. It was hypothesized that having an athletic trainer in a secondary school system will have an impact on the parents' knowledge of concussion. Table 3 displays 93% of participants (N=132) stated "yes", their student athlete's school employs a certified athletic trainer; 1.4% of participants stated "no" (N=2), and 5.6% of participants (N=8) did not know if their school employed a certified athletic trainer.

Table 3. Certified Athletic Trainer

	N	Percent
Don't Know	8	5.6
Yes	132	93.0
No	2	1.4
Total	142	100.0

Table 4 provides the distribution of parents that have been diagnosed with a concussion. It was a hypothesis that parents that have been diagnosed with a concussion will show a difference in knowledge scores compared to parents who have not been diagnosed.

Table 4. Parent Diagnosed with Concussion

	N	**Percent**
Don't Know	3	2.1
Yes	34	23.8
No	106	74.1
Total	143	100.0

It was also asked of the parents to indicate whether or not their student athlete has ever been diagnosed with a concussion. Similar to the previous table, it was hypothesized that if the student athlete has been diagnosed with a concussion, then the parents' knowledge score will be affected; data is displayed in Table 5.

Table 5. Student Athlete Diagnosed with Concussion

	N	**Valid Percent**
Don't Know	1	.7
Yes	52	36.4
No	90	62.9
Total	143	100.0

Hypothesis Testing

The following list contains the hypotheses that were tested in this study. All hypotheses were tested with a level of significance set at $P \leq 0.05$. A one-way factorial ANOVA was calculated for the effect of the independent variables on the dependent variable. Each of the hypotheses were tested separately as their own independent variable.

Hypothesis 1: There will be a difference in knowledge scores of parents based on completed education level of the parent. The one-way ANOVA on education level and knowledge score of the parent was not significant ($F(6,135) = 1.614$, $p > 0.05$). The data suggests that education level completed by parents of youth athletes does not influence parents' knowledge as it relates to the Concussion Information Sheet. The distribution of data is represented in Table 6.

Table 6. Education Level Completed & Raw Score

Completed Education	Raw Score Mean	N	Std. Deviation
Graduated from HS	25.44	16	6.271
1 yr of College	26.78	9	2.167
2 yrs of College	22.93	14	11.228
3 yrs of College	26.17	6	2.483
Graduated from College	26.89	44	5.195
Some Grad School	29.41	17	3.624
Completed Grad School	26.50	36	5.906
Total	26.50	142	6.095

Hypothesis 2: There will be a difference in knowledge scores of parents based on the size of the student athlete's school. Table 7 displays the distribution of data between size of school and the parents' raw score. The one-way ANOVA on this hypothesis was not significant ($F(5,133) = .675$, $p > 0.05$). School size is not a factor in parent knowledge as it relates to the Concussion Information Sheet.

Table 7. Size of Student Athletes' School & Raw Score

School Size	Raw Score Mean	N	Std. Deviation
Don't Know	25.79	14	6.796
A	27.90	21	2.827
AA	26.23	64	5.580
AAA	26.39	36	6.813
AAAA	31.67	3	4.163
Other	26.0	1	
Total	26.60	139	5.719

Hypothesis 3: There will be a difference in knowledge scores of parents based on whether a school has a certified athletic trainer or not. Table 8 displays the distribution of data between a school having a Certified Athletic Trainer and the parents' raw score. Table 9 displays the one-way ANOVA that was calculated as significant ($F(2,139) = 3.212$, $p < 0.05$). Although data suggests significance, it should be noted that 132 participants answered "yes", two answered "no", and eight answered "don't know". As a result of this distribution, a Post Hoc Tukey statistic was run to show where the significance is among the distribution. Table 10 shows these findings.

Table 8. Certified Athletic Trainer & Raw Score

ATC at School	Raw Score Mean	N	Std. Deviation
Don't Know	25.50	8	3.665
Yes	26.69	132	5.989
No	15.50	2	14.849
Total	26.46	142	6.112

Table 9. One-way ANOVA of ATC on Raw Score

DV-Raw Score	Type III Sum of Squares	Df	Mean Square	F	Sig.
Corrected Model	270.330[a]	2	135.165	3.212	.043
Intercept	4455.821	1	4455.821	105.89	.000
ATC	270.330	2	135.165	3.212	.043
Error	5848.909	139	42.078		
Total	73708.000	142			
Corrected Total	6119.239	141			

a. R Squared = .044 (Adjusted R Squared = .030)

Table 10. Post Hoc Tukey of ATC on Raw Score

(I) ATC	(J) ATC	Mean Difference	Std. Error	Sig.
DK	Yes	-2.091	2.362	.650
	No	9.000	5.128	.189
Yes	DK	2.091	2.362	.650
	No	11.091	4.621	.046
No	DK	-9.000	5.128	.189
	Yes	-11.091	4.621	.046

Hypothesis 4: There will be a difference in knowledge scores of parents if the parent has a history of concussions. Table 11 displays the distribution of parents' history of concussion and their raw score. The ANOVA test was not significant ($F(2,140) = 1.884$, $p > 0.05$). The data

suggests that parent concussion diagnosis does not impact knowledge scores.

Table 11. Parent Concussion History & Raw Score

Parent Dx History*	Raw Score Mean	N	Std. Deviation
Don't Know	17.0	3	15.716
Yes	25.88	34	7.503
No	26.92	106	4.990
Total	26.46	143	6.091

* Dx - Diagnosis

Hypothesis 5: There will be a difference in knowledge scores of parents if their student athlete has a history of concussions. Table 12 shows the distribution of student athletes who sustained concussions and the parents' raw score. The ANOVA test was not significant ($F(2,140) = 1.142$, $p > 0.05$) and it appears knowledge scores are not impacted by student athlete diagnosis history as it relates to the Concussion Information Sheet.

Table 12. Student Athlete Concussion History & Raw Score

Student Athlete Dx History	Raw Score Mean	N	Std. Deviation
Don't Know	20.0	1	-
Yes	27.85	52	3.415
No	25.73	90	7.098
Total	26.46	143	6.091

Additional Findings

A number of descriptive findings were calculated that relate directly to the responses associated with the effectiveness of the Safety in Youth Sports Act and the Concussion Information Sheet. The parents' average knowledge score of the Concussion Information Sheet was 26±6 out of 36 possible points (74%). Out of 143 surveys, 50 parents scored 29 points or higher, which means 35% of parents scored higher than 80% on the Concussion Information Sheet questions.

Question 10 of the survey asked, "Were you aware of the recently passed Safety in Youth Sports Act and what it mandates"? A total of 141 responses were included; 43.3% of parents said "yes" (N=61), 28.4% said "no" (N=40), 24.1% said "somewhat" (N=34), and 4.3% said "don't know" (N=6). This data is shown in Table 13.

Table 13. Awareness of Safety in Youth Sports Act

	N	Valid Percent
Don't Know	6	4.3
Somewhat	34	24.1
Yes	61	43.3
No	40	28.4
Total	141	100.0

Question 11 asked the parents to indicate if they learned something new following review of the PIAA Understanding of Risk of Concussion and Traumatic Brain Injury form? A distribution of 141 responses are as follows; 44.7% of parents said "yes" (N=63) they did learn something new, 44.7% said "no" (N=63), and 10.6% said "don't know" (N=15). This data is shown in Table 14.

Table 14. Learned Something New

	N	Valid Percent
Don't Know	15	10.6
Yes	63	44.7
No	63	44.7
Total	141	100.0

Question 12 of the survey stated "Following review of the PIAA Understanding of Risk of Concussion and Traumatic Brain Injury Form, do you feel better about recognizing the signs and symptoms associated with concussions and the proper management steps"? There were a total of 141

responses that displayed 68.1% answered "yes" (N=96), 19.9% answered "no" (N=28), and 12.1% answered "don't know" (N=17). This data is shown in Table 15.

Table 15. Feel Better About Recognition

	N	Valid Percent
Don't Know	17	12.1
Yes	96	68.1
No	28	19.9
Total	141	100.0

A total of 22 symptoms were included in the signs and symptom identification section of the survey. Table 16 shows 13 signs or symptoms associated with concussions and were directly from the Concussion Information Sheet, and nine not associated with concussions or are traditionally related to other physical injuries. The most common symptoms that were identified correctly were headache, dizziness, nausea, vomiting, and confusion. 100% of participants identified these as correct responses.

Three of the most commonly identified symptoms that are not associated with a concussion but parents identified them to be associated were seizure, weakness of neck musculature, and black eye. Respectively, only 6.8%, 9.1%, and 28% of parents identified these symptoms to not be associated with concussions.

Table 16. Sign & Symptom Identification

Symptom	Yes (N)	No (N)	Don't Know (N)	Identified Correct Responses (%)
Nosebleed*	55	36	39	27.7
Coughing*	32	66	33	50.4
Headache	134	0	0	100.0
Chest Pain*	15	79	35	61.2
Double Vision	134	0	1	99.3
Memory Loss	133	0	1	99.3
Black Eye*	62	37	33	28.0
Pressure in Head	126	1	5	95.5
Clear nasal leakage*	45	41	45	31.3
Dizziness	134	0	0	100.0
Nausea	134	0	0	100.0
Vomiting	134	0	0	100.0
Weak neck musculature*	89	12	31	9.1
Difficulty paying attention	134	0	1	99.3
Confusion	135	0	0	100.0
Extreme thirst*	33	48	50	36.6
Light sensitivity	131	1	3	97.0
Noise sensitivity	121	3	10	90.3
Shivering*	33	40	57	30.8
Mentally foggy	132	0	2	98.5
Balance problems	133	0	2	98.5
Seizure*	104	9	19	6.8

* Signs/Symptoms that are not associated with the Concussion Information Sheet

There were two questions related to helmets and equipment specifically preventing concussions. Question 32 stated, “Helmets prevent concussions”, and revealed 46.7% of parents (N=64) stated this as “true”, 48.9% of parents (N=67) stated “false”, and 4.4% (N=6) stated “don’t know”. Question 34 specifically stated, “Properly fitted equipment prevents athletes from sustaining concussions” and revealed 20.4% of parents (N=28) identified this as a “true” statement, 74.5% of parents (N=102) stated this as “false”, and 5.1% (N=7) stated “don’t know”.

DISCUSSION

The literature suggests that parents, athletes, and coaches could all benefit from more education on the topic of concussions.[4] Gourley et al concluded in their survey based study that additional education could be beneficial to parents and youth athletes.[4] Lack of knowledge about concussion has been implicated as the main reason for athletes not reporting concussions.[14]

The purpose of this research was to assess parents' knowledge of the information given on the PIAA Understanding of Risk of Concussion and Traumatic Brain Injury form. It is important to evaluate this Concussion Information Sheet since it could be the only tool the parent utilizes to learn about the injury. This chapter is divided into three subsections: Discussion of Results, Conclusions, and Recommendations.

Discussion of Results

The current study found one significant hypothesis, schools that have a certified athletic trainer on staff, displayed higher knowledge scores by the parents. Although this one-way ANOVA revealed athletic trainers have an impact on knowledge scores, the distribution of responses (132 yes; 2 no; 8 don't know) for this specific question should be considered before conclusions are made. In order to make a proper conclusion about this hypothesis, more schools without athletic trainers should be surveyed in order to compare the knowledge scores. The four remaining independent variables (completed education level, size of school, parent concussion history, and student athlete concussion history) showed no significance and suggest that they do not affect the Concussion Information Sheet knowledge scores.

Question 13 of the survey asked parents if they feel concussion education and awareness has improved as a whole. 84.5% of parents (N=120) stated "yes" they do feel education and awareness has improved, 14.1% stated "no" (N=20), and 1.4% stated "don't know" (N=2). It is unknown if the improvement of concussion education and awareness is a direct result of the Safety in Youth Sports Act.

Questions pertaining directly to the effectiveness of the Concussion Information Sheet and the Safety in Youth Sports Act revealed a number of findings. There were 43.3% of parents who were aware of the legislation and 68% of parents stated they felt better about recognizing concussions. The question referring to learning something new following review of the Concussion Information Sheet revealed the same percentage for "yes" and "no" answers (44.7%). The distributions of these findings are in tables 13-15.

The signs and symptoms portion of the survey revealed positive findings for the number of correct symptoms identified. The more traditionally recognized symptoms, possibly due to media exposure, were all identified correctly by all of the parents (headache, dizziness, nausea, vomiting, and confusion). The three incorrect symptoms that were identified the most by parents as symptoms of a concussion were; seizure, weakness of neck musculature, and black eye. Although some youth athletes may experience these symptoms following a blow to the head, neck, or face, they are typically not directly associated with a concussion but could identify a more serious medical emergency.

Reasoning behind the high number of participants answering true to question 32 (Helmets prevent concussions: True; 46.7%, False; 48.9%) is unknown but this finding could provide recommendations for future educational tools. The last question of the survey stated, "Properly fitted equipment prevents athletes from sustaining concussions". Although the majority of parents selected the correct response (False; 74.5%), 20.4% of the parents still believe properly fitted equipment will prevent a concussion from occurring.

Conclusions

Evaluating youth concussion legislation is important to help determine if what the law is mandating is doing what it intends to do. The Safety in Youth Sports Act requires educational training for coaches, written clearance by a physician, signing of the PIAA Concussion Information Sheet, and also immediate removal from play if a concussion is suspected. Previous studies[4,15-17] revealed recognition of signs and symptoms, management, and proper return to play are all important aspects of awareness and concussion knowledge. In some cases, signs and symptoms can arise hours after a blow to the head or body; therefore, it

is imperative medical professionals and youth sport organizations educate the parents of young athletes so they are able to recognize concussions after the fact.

The findings of this survey based study revealed completed education, size of a student athlete's school, personal history of concussion, and student athlete's history of concussion does not affect a parent's knowledge of the Concussion Information Sheet. If a student athlete's school had a certified athletic trainer, it appears the parent's knowledge score was higher and could reinforce the importance of athletic trainers in the secondary school.

There were several additional findings that could open the doors for future research and provide educators with information on specific misunderstood aspects of concussions. There has not been any research to support helmets completely preventing concussions or the use of properly fitted equipment and its impact on concussion prevention. The findings of this survey revealed a high number of parents who believe helmets and properly fitted equipment prevent concussions from occurring. Reasoning behind this is unknown and could identify a major disconnect in the Concussion Information Sheet. It is speculated that there is a misunderstanding taking place from the wording of the Concussion Information Sheet in the

properly fitted equipment section. It is unknown if these misunderstandings are direct results from the Concussion Information Sheet, but they do offer possible insight into future research.

Out of the 22 symptoms parents were instructed to identify, there were three prevalent symptoms that were selected as correct, when really they were incorrect. Seizure, weakness of neck musculature, and black eye were identified by parents as being symptoms associated with a concussion. Reasoning behind these incorrect responses could be due to the fact that parent's concussion experience may have involved these symptoms, so they directly associate them with the injury. Seizures and weakness of neck musculature may very well accompany a concussion, but typically if these are taking place they resemble a more serious brain or spinal cord injury. Being hit in the eye socket with an object such as a ball will usually result in swelling and ecchymosis (discoloration) around the area, typically referred to as a "black eye". If the force of the object is great enough, it is possible a concussion may be sustained.

Providing evidence for the effectiveness of the Safety in Youth Sports Act and the Concussion Information Sheet was given in questions 10-12 of the survey. This data

(Tables 13-15) helps make conclusions on the level of awareness and effectiveness of the legislation. There was a high number of parents who were not aware or only knew some of what the legislation mandates. Several positive findings were shown in whether or not they learned something new, and if the parent felt better about recognizing concussions. These three questions provide insight for future improvements to the Concussion Information Sheet but also show the importance of the Safety in Youth Sports Act and the information provided to parents.

The Concussion Information Sheet knowledge score displayed an average of 26±6 out of 36 possible points (74%). Although some participants did not complete all of the questions included in the score, this percentage shows a high number of parents that may not be retaining the information provided to them. Only 50 parents (35%) scored higher than 80% on the Concussion Information Sheet questions. This statistic identifies the need for future improvements to the Concussion Information Sheet so that parents are fully aware and knowledgeable of the injury.

Recommendations

This study yields findings that could be beneficial for future research on the Safety in Youth Sports Act and also, provides useful information that administrators for the Pennsylvania Interscholastic Athletic Association could use for improving future concussion educational tools. From the results of the questions concerning equipment preventing concussions it is obvious there is a misunderstanding about the amount of protection a helmet provides.

A section in the Concussion Information Sheet titled, "How can students prevent concussions", provides information on properly fitted equipment and its protection when it is used correctly. Although the section does not mention that helmets prevent concussions, the statement "for equipment to properly protect a student, it must be:" could possibly be misleading causing perceptions that equipment prevents injury. Although equipment may help reduce injury, it cannot fully protect a student athlete from suffering a concussion. Restructuring the equipment section of the PIAA Concussion Information Sheet could correct any misunderstood or misleading information.

Considering a total of 52.5% of parents were not aware or had somewhat of an idea about the Safety in Youth Sports Act identifies there is still a lack of awareness on the recently passed legislation. This lack of awareness could be due to the fact that the law is still very recent (2012), information is not being effectively disseminated to parents, and/or parents of youth athletes are just unaware there is legislation in place to regulate education and management of the injury.

Data in this research suggests that schools that employ a certified athletic trainer have a greater impact on parents' knowledge of the Concussion Information Sheet. With that said, a larger sample size of parents with schools without athletic trainers should be surveyed in order to draw more concrete conclusions on the effect.

Due to an average of 74% on the Concussion Information Sheet questions, it would be useful to have the parents of the PIAA complete a follow-up survey in the coming years. If the knowledge scores were to improve, that information would show a higher level of effectiveness of the Safety in Youth Sports Act.

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APPENDICES

Appendix A

Review of Literature

Literature Review

Concussion in sport has been a recurring topic over the past decade in recreational, elite and professional sports. It is estimated 1.6 to 3.8 million concussions occur each year in the United States and approximately 50% of those go unreported.[1-3] There has been a lot of new research examining different helmets in contact sports along with rule changes directed at protecting the athlete from possible head injury.

Along with new rules and equipment for safety concerns, there are several nationally recognized organizations that assist in providing information for parents and coaches about concussions and what to do when one occurs. Several of the articles in this literature review highlight some of these organizations, including; Center for Disease Control, American College of Sports Medicine, National Athletic Trainers' Association, American Academy of Neurology and American Medical Society for Sports Medicine. Also included are several nationally and internationally recognized journals; International Journal of Athletic Therapy and Training, British Journal of Sports Medicine, International Journal of Sports Physical Therapy,

Journal of Family Practice, Journal of School nursing and the Clinical Journal of Sports Medicine.

The purpose of this literature review is to first examine what parents need to know about concussions so they are properly prepared to care for their child without assistance from a medical professional. This includes recognizing signs and symptoms, understanding post-concussion treatment, and return to play protocols. This literature review will also discuss the presence of concussions in specific sports, the education and awareness of concussions among parents and coaches, and also newly formed laws enacted to protect young athletes from future injury.

Concussion Background

Signs and Symptoms

Concussion is a brain injury and a complex pathophysiological process affecting the brain, induced by biomechanical forces.[1,4] These biomechanical forces can be caused by a blow to the head, face, neck, or somewhere else on the body that distributes a force to the head. A change in the rotational velocity and angular acceleration of the brain is the result, which causes the brain injury.[21] The

signs and symptoms following a concussion can be at the onset, or several minutes to hours after the injury. Most commonly, athletes report a headache as a post concussive symptom along with dizziness 23% of the time in a post concussive assessment.[5-11] The most common types of these post-traumatic headaches are tension headaches, migraine headaches, combined migraine and tension headaches, and cognitive fatigue headaches.[5,12-14]

Several other symptoms are summarized in the Consensus Statement of the 4th International Conference on Concussion in Sport held in Zurich, November 2012 by McCrory, et al. These were classified into clinical domains: Symptoms (headache, feeling in a fog, dizziness, lability), physical signs (loss of consciousness, amnesia), behavioral changes (irritability), cognitive impairment (slowed reaction time), and sleep disturbance (insomnia). Symptoms included in the article by Lear and Hoang[15] Sport Concussion: A return-to-play guide, was adapted from the Sport Concussion Assessment Tool (SCAT2). These symptoms are as follows: headache, pressure in head, neck pain, nausea or vomiting, dizziness, blurred vision, balance problems, sensitivity to light and/or noise, feeling slowed down, feeling like "in a fog", "don't feel right", difficulty concentrating, difficulty remembering, fatigue, confusion, drowsiness,

trouble falling asleep, irritability, sadness, and nervousness or anxiety.[15] In the assessment of a concussion, any of these symptoms or combination of these symptoms may or may not be present and may arise minutes to several hours after the initial injury.

Neurophysiology and Neuropsychology

In the following sections, other aspects of concussions will be discussed along with management and return to play protocols. When managing concussions it is helpful to understand the physiology of brain function that is causing the symptoms to occur. An animal model depicting a concussion or mTBI has been developed and is termed the Lateral Fluid Percussion brain injury model.[3] This produces injury to the brain using a device to drive fluid against the intact dura of an exposed brain surface, which in turn creates a small brain contusion and a small amount of surrounding hemorrhage. A concussion injury can be looked at as a two part process, the first being the initial injury to the brain, secondly the inflammatory process that accompanies any physical injury. This initial injury creates ion disruption within the cell walls, which in turn results in cellular death. As severely injured cells die, they release cytokines that stimulates the inflammatory

process. The secondary injury is a result of these cytokines being released and may explain why some concussion symptoms do not arise until minutes or hours after injury. Knowledge of concussion symptoms and the neurophysiologic process is critical for the proper recognition of potentially life-threatening traumatic brain injuries.[16]

There are some signs and symptoms of concussions not always visible and may not appear to be a factor in the treatment of an individual. Along with the neurophysiological component there is the neuropsychological component, which plays a big role in recovery time and management. The concussed athlete may experience a variety of psychological symptoms including long-term effects such as depression, anxiety, psychosocial problems, physical and cognitive disturbances, and chronic traumatic encephalopathy.[17] Certified Athletic Trainers play a crucial role in this regard because they spend time with the athletes on a daily basis. Athletes who have adverse emotional responses to concussion symptoms may experience a prolonged recovery that is associated with muscle tension, anxiety, changes in heart rate, and sleep disturbances.

Second Impact Syndrome and Recurrent Concussions

Athletes who experience multiple brain injuries in a short period of time (hours, days, weeks) may suffer catastrophic or fatal reactions related to Second Impact Syndrome.[18,45] Second Impact Syndrome occurs when a concussed athlete returns to sport and receives a second blow (may or may not be as significant as the initial concussion) before the original symptoms are resolved. The result is rapid and profound brain swelling and can lead to severe and rapid onset of symptoms, which in some cases can result in death.[18,45,46] Saunders and Harbaugh coined the term second impact syndrome in there 1984 description of a 19 year old college football player who suffered a head injury with brief loss of consciousness, returned to play, reported a headache, and on the 4th day collapsed, became unresponsive, and died.[19,20] Second Impact Syndrome solidifies the reasons to recognize, properly manage, and treat concussed athletes so they do not suffer from the possibly fatal consequences of returning to competition to soon.

The importance of obtaining a detailed concussion history before the start of athletic competition cannot be stressed enough. Concussion or TBI has been identified as a risk factor for chronic depression and a potential risk factor for the occurrence of Alzheimer's disease and

Parkinson's syndrome.[21-23] Recently this topic has come up in the National Football League with retired players such as Junior Seau and others who suffered from multiple concussions over their NFL careers. A survey of over 2500 retired professional American football players found an 11.1% prevalence of clinical depression and, more notably, an increased incidence of depression with increasing number of concussions.[21,24]

Concussions in Adolescents

Knowing the signs and symptoms of a concussion and the possible repercussions of mismanaging them is just the first step in concussion awareness and treatment. The following section examines literature focused on adolescent concussions in sport and how to properly treat and safely return them to play.

Management and Treatment

There is no gold standard for the diagnosis of concussion or TBI but there are several resources medical professionals can use.[25] The study done by Yang et al, examined hospitalizations for sport related concussions in children aged 5 to 18 years old from 2000 to 2004. Out of

755 sport related concussions, 143 received principle procedures (MRI, CT Scans) with 59.4% being CT scans and 10.5% being an MRI of the brain and brain stem.[26] Brain imaging should only be ordered in the presence of progressive neurologic decline and or high-risk of injury mechanism that could have caused a skull fracture or intracranial bleed.[27-29]

One of the widely used concussion assessment tools is the Sport Concussion Assessment Tool (SCAT2), which can be used in the clinical and on the field settings to evaluate and manage a concussion by a Certified Athletic Trainer or other medical professional. This tool has shown unreliable results in adolescents and therefore a pre-season baseline assessment with comparative measures post-concussion should also be used in the assessment and management of concussions.[27]

Concussion management in the adolescent athlete should be considered more conservative and focus on an individual treatment plan. Adolescent brains are still maturing during this early stage of life and therefore will take longer than adult brains to heal from injury. It is important to maintain symptom free status while gradually preceding through a return-to-play protocol. Physical and cognitive rest is required for the brain to heal, which can be

difficult for adolescent athletes. Cognitive rest involves refraining from using all media devices including phones, computers, video games, and TVs as well as being absent from school activities such as homework.[27,30] Physical rest involves avoiding exercise of sports whether they are recreational, organized, practice or competition. It is also important to obtain day-to-day evaluations to ensure recovery is taking place at an acceptable pace and to note the increase or decrease of symptoms.

Return-to-Play

One of the most difficult aspects of managing a concussion is determining when to allow the athlete to return to competition. As previously stated, adolescent athletes take longer to recover and should be managed conservatively with returning to play. Child athletes should remain symptom free before starting a medically supervised stepwise exertion protocol.[31] A recent study from 2012 examined 100 adolescent and 100 young adult athletes who suffered a sport related concussion by using the neurocognitive Immediate Post-Concussion assessment and Cognitive Testing battery (ImPact).[32] The study suggested 13-16 year old athletes take longer to return to their

neurocognitive and symptom baselines than 18-22 year old athletes.[32]

Once an athlete is symptom free at rest they may begin a return-to-play protocol supervised by a medical professional. As previously stated, it is also important to obtain day to day symptoms during the protocol period. The most accepted protocol for return to play is a six step sequence outlined in the Consensus statement on concussion in sport: the 4th International Conference on Concussion in Sport held in Zurich, November 2012.[4] The stepwise progression is as follows: no activity, light aerobic activity (walking), sport specific activity, non-contact training drills, full-contact practice, return to game. The athlete should take 24 hours to proceed through each step and must remain symptom free before moving onto the next step.[31] If symptoms reoccur after exertion the athlete should follow up with their supervising medical professional to determine when to move on to the next step.

Concussions in Several Contact Sports

Football

Football is a high contact physical sport and presents medical professionals with a large variety of different

injuries. High school football players are the single largest cohort of athletes playing tackle football, and account for the majority of sport related concussion.[33] Over the past decade, football organizations at all levels have been adjusting rules of the game in order to protect their athletes. State laws have also been enacted to maintain proper management and return to play of concussed individuals. 44 states and Washington D.C. have passed youth sport TBI laws since 2009 and the majority of these laws focus on increasing coach's and parents' ability to identify and manage TBIs and reduce the immediate risk of multiple TBIs.[43] One of the laws discussed in further paragraphs is the Youth Sports Safety Act passed in Pennsylvania in 2011.

An 11-year study performed from 1997 to 2008 examined the incidence of concussion in 12 high school sports for boys and girls. The data revealed a total of 2651 concussions and an incidence rate of .24 concussions per 1000 athletic exposures.[34] Football accounted for 53.1% of all concussions and had an incidence rate of .60 concussions per 1000 athletic exposures. Over the 11 years there was a concussion rate increase of 4.2 fold, a 15.5% increase for all sports.[34] This rate of increase could possibly be due to actual increased occurrence or an

increase of awareness, which has in turn made detection and management more evident. An article published by the Journal of School Health made several recommendations on the topic of concussions in football.[33] Johnson recommended eliminating tackling from school football for youth under the age of 16 years old. It was also recommended shortening the competitive season, limiting on-field time during games, and adopting "hit counts" similar to pitch counts in little league baseball.[33]

Lacrosse

Lacrosse is another sport that has a significant amount of concussions at all levels but is not publicized as much as football. The 11-year high school study mentioned above also included the incidence of concussions in boy's and girl's lacrosse. The total number of concussions in lacrosse was 358 with a .50 rate per 1000 athletic exposures.[34] The total for boys was 244 concussions with a .30 rate per 1000 athletic exposures and girls was 114 with a .20 rate per 1000 athletic exposures. Boys had a 17% mean annual increase and girls had a 14% mean annual increase during the 11 year study. This statistical evidence shows a significant amount of concussions in

lacrosse and also displays noteworthy mean annual increases in both boys and girls.

A study performed in 2002 published by the Journal of Athletic Training examined the effects of repetitive impact forces on lacrosse helmets and set out to increase awareness of helmet safety standards.[35] The study took two traditional helmets and two contemporary helmets and measured the Gadd Severity Index (GSI) after repetitive drops on a rubber modular elastomer programmer. The findings of the study indicated all the helmets had decreased capacity to dissipate forces after repetitive blows due to increased GSI scores.[35]

Soccer

Along with lacrosse, soccer has a noticeable number of concussions in both boys and girls. One of the 12 sports of the study mentioned above examining incidence rates of concussions in high school athletics was boys and girls soccer.[34] Girls' soccer had the most concussions of the girls' sports (195) and the second highest incidence rate of all 12 sports (.35). The study also revealed in similar boys and girls sports (baseball/softball, basketball, soccer), girls had roughly twice the concussion risk of boys.[34]

A study published in 2006 by the British Journal of Sports Medicine examined the effect of protective headgear on head injuries and concussions in adolescent soccer.[36] The headgear used in the study was described as "head gear with no chin strap and protection around the front, sides, and back of head".[36] There were 278 completed surveys with 216 athletes who did not wear headgear and 52 athletes who did wear headgear. The results of the study showed 26.9% of athletes who wore headgear suffered a concussion and 52.8% of athletes who did not wear headgear suffered a concussion.[36] Analysis of the data displayed in this adolescent population, female athletes and athletes who did not wear headgear were more likely to suffer a concussion, which supports previous research indicating female athletes are more susceptible to concussions in soccer.[36-38]

Unlike football and lacrosse, little can be done to prevent concussions occurring in soccer, regardless of the level of competition. Rule changes have effected all three of these sports over the past several years and usually only occur when there is a clear-cut mechanism implicated in a particular sport.[30] An example of this in soccer is where studies have shown upper limb to head contact in heading accounted for approximately 50% of concussions.[36] As stated in previous paragraphs, a concussion is a

traumatically induced disturbance of brain function caused by biomechanical forces on the head, neck, or body. This disturbance of brain function is due to linear and/or rotational forces transmitted to the brain.[1] When these forces occur the brain moves within the skull which causes cellular and metabolic changes creating the disturbance in brain function. There is currently no evidence-based equipment that can prevent concussions or the movement of the brain inside the skull. The only way to fully prevent concussions or TBIs is to eliminate the biomechanical forces that occur to the brain, which can be a difficult task in some cases.

Education and Awareness

Concussion Knowledge Surveys

There have been several studies performed over the past 5 years dealing with the knowledge of concussion awareness on high school athletes, parents, and coaches. A survey study by Esquivel et al wanted to examine if there are differences in concussion management and awareness among boys' football, boys' ice hockey, and boys' and girls' soccer.[39] The survey was intended to be completed by athletic directors, athletic trainers, and coaches. A total

of 235 responses were received and showed concussion awareness education was given to football players 97% of the time, hockey players 65% of the time, boys soccer 57% of the time, and girls soccer 47% of the time.[39] The survey also asked if the school had a written policy in place to manage concussions and the results showed 50% of athletic directors, 53% of ATCs, and 62% of coaches said yes.[39] Esquivel et al concluded concussion awareness is promoted well in football, but should be expanded in soccer and hockey.

Assessing the knowledge of parents, athletes, and coaches on concussions is an important piece to consider when examining concussion management and return to play. The assessment can identify weak areas in education and assist in improving the concussion education programs. Gourley et al investigated the knowledge of youth athletes and their parents regarding concussion and their ability to recognize it and properly treat it.[40] A survey was administered to athletes and their parents and consisted of 73 athletes (aged 10-14) and 100 parents. Results displayed no differences among athletes and parents on correct responses in the symptom recognition portion of the survey, with mean scores of 9.19 and 9.23 (of 16).[40] The only area where differences were noted was the second scenario

question where 22% of athletes and 43% of parents correctly responded to "an athlete should not return to play if he or she was awake with no loss of memory, asymptomatic at rest, and only had a headache with activity".[40] It was also noted parents with previous medical training (CPR, First Aid) scored significantly better on the symptom recognition portion of the survey.

Two other studies focused strictly on coaches' knowledge of concussions including recognition, management, and prevention and also evaluated the use of the Center for Disease Control's "Heads Up: Concussion in Youth Sports" initiative. The first was conducted by O'Donoghue et al and involved a cross-sectional survey of 126 high school coaches.[41] The three sections of the survey were recognition, management, and prevention with eight possible points and 24 total points.[41] Mean scores consisted of recognition, 7.39; management, 6.33; and prevention, 6.53 with a total of 20.27.[41] Coaches overall concussion knowledge was 84%, the highest being the recognition section with 92% and the lowest being the management section with 79%.[41]

Covassin et al examined the usefulness of the CDCs "Heads Up: Concussion in Youth Sport" initiative by surveying 340 youth sport coaches.[42] The CDC "Heads Up"

material can be obtained online for free and involves a fact sheet for coaches, parents, and athletes, a clipboard information sheet, a magnet and a poster. The results of the survey found 77% of coaches reported being better able to identify athletes who may have a concussion, along with 50% stating they learned something new about concussions after reviewing the material.[42] Coaches reported the fact sheet for coaches (65.7%) and the magnet (63.8%) were the most useful materials of the CDCs "Heads Up: Concussion in Youth Sports".[42]

Legislative Research

A recent study published in 2013 was performed by Harvey H. who investigated state laws involving youth sport TBIs and also included a data set of the current laws.[43] Since the beginning of 2009, forty-four U.S. states and Washington DC, passed legislation designed to reduce the overall impact of TBIs. The scope of these laws include 24-hour mandatory removal from play, requiring assessment from a medical professional before return to play, and coach training in concussion management and recognition.[43] Instead of focusing on primary prevention, the majority of the laws passed focus on parent and coach awareness and their ability to recognize symptoms of a concussion.

Another survey-based study examining the effectiveness of the Lystedt Law in Washington State was performed by Shenouda et al. The Lystedt Law was signed in May 2009 and requires coaches, parents, and youth athletes to be educated about concussions and sign a "concussion injury information sheet".[44] Shenouda et al wanted to determine if adults associated with youth soccer programs in Washington State were properly educated on recognition, management, and prevention following the Lystedt Law. A total of 391 adults responded to the survey and the results displayed 96% knew concussions were a TBI, 93% identified concussions to be serious, and 85% were aware of the newly formed Lystedt Law.[44] Shenouda et al concluded the data suggests knowledge of concussions to be high with Washington State adult associates of youth soccer leagues but some gaps regarding prevention may still be present.

The Safety in Youth Sports Act also known as the Pennsylvania Senate Bill 200 Act 101 was passed in 2011 and applies to all interscholastic athletics. This legislation requires immediate removal from play if an athlete is exhibiting signs or symptoms of a concussion, and also states that the athlete must be cleared by a licensed medical professional before returning play. Coaches must complete an annual concussion education course before the

season of their respective sport begins. A student participating in an athletic activity and the student's parent or guardian shall each school year, sign and return to the school acknowledgement of receipt and review of the Understanding of Risk of Concussion and Traumatic Brain Injury form.[47] Also, known as the Concussion Information Sheet, it covers what a concussion is, the signs and symptoms of a concussion, what athletes should do if they suspect a concussion, and how athletes can prevent themselves from further injury following a concussion.

The Safety in Youth Sports Act has not been followed up on since its passing in 2011. Research on the effectiveness of the Concussion Information Sheet on parents' and athletes' knowledge of concussion is lacking. A disconnect is present within this newly founded law because there are no measures to determine the level of knowledge parents obtain from signing the Concussion Information Sheet. The Safety in Youth Sports Act requires coaches to complete a concussion education course such as the Center for Disease Control's "Heads Up" Concussion in Youth Sports training for coaches. With this specific course, coaches must obtain an 80% or higher on the final quiz in order to obtain their certificate of completion. In regards to the parents' knowledge following review/signing

of the Concussion Information Sheet, there is currently no threshold they must meet prior to their child competing in athletics. It has been shown in previous studies[40,48-50] that recognition of concussion signs and symptoms, concussion management, and return-to-play guidelines are all important aspects of concussion awareness and knowledge. This study will examine the Concussion Information Sheet to help determine whether the Safety in Youth Sports Act is doing what it intended to do.

Conclusion

Concussions in sport have been increasing over the years which could be due to better medical coverage and public awareness or the incidence rates are just increasing themselves. The importance of parent and coach education on concussions is stressed in the literature and supports the need for mandated legislative laws. This literature review covered a number of different topics to stress the importance and seriousness of concussions. Regardless of the severity, all concussions need to be taken seriously and parents and coaches need to be able to accurately recognize, manage, and return a concussed athlete as safely as possible. Future research could consider more evidence

based work on adolescent athletes and the reliability and validity for concussion assessment tools specific to this age group.

Appendix B

The Problem

Statement of the Problem

The problem associated with this study is that the recently passed Safety in Youth Sports Act does not include any follow-up measures to test whether it is effective or not. The focus of this study examines the Concussion Information Sheet which must be signed by the athlete and parent/guardian prior to every athletic year. Over the past decade there has been increased discussion concerning concussion awareness, prevention, and management at all levels of athletics. It is important to focus on adolescent athletes and their parents because once the concussed athlete leaves the medical professionals care, if any was available, it will be the parent's responsibility to recognize various signs, symptoms and to determine whether further medical intervention is required.

Definition of Terms

1. Concussion – Type of traumatic brain injury involving complex pathophysiological processes induced by biomechanical forces affecting the brain.[1,4]
2. Content Validity – Depends on the extent to which an empirical measurement reflects a specific domain of content.[51]

3. Construct Validity – Depends on the extent to which a particular measure relates to other measures consistent with theoretically derived hypotheses concerning the concepts that are being measured.[51]

Basic Assumptions

The following are basic assumptions of this study:

1. The participants will be honest when they complete the demographics portion of the survey.
2. The participants will complete the survey to the best of their ability.
3. The athletic directors who are members of the Pennsylvania State Athletic Directors Association will distribute the survey link appropriately to their schools' parents.
4. The intended recipient will complete the survey.

Limitations of the Study

The following are possible limitations of the study:

1. Not being able to distribute cover letter and survey link directly to parents in the PIAA.

2. The above limitation caused the inability to have an accurate rate of return; therefore, it was unknown how many surveys were sent to the parents.
3. Some participants may not have computer or online access.
4. Unaware if athletic directors at schools have access to all of the parent's current emails.
5. Limited amount of time for the survey window to be open to the parents.

Statement of Significance

The findings of this study are significant because it is important for health organizations and medical professionals to make sure they are educating parents of youth athletes about the seriousness of sport related concussion. Regardless of what sport is being played the athlete's parents should be able to recognize a concussion and know when to seek further medical attention. Since it has been demonstrated by several studies that adolescent brains are more susceptible to concussions,[1,2] it is important the athlete's parents are prepared to care for and manage them correctly.

This study examines the effectiveness of the Concussion Information Sheet put in place by the

Pennsylvania Senate Bill 200 Act 101, which requires the parents and their athletes to review and sign the information sheet before every school year. Gathering this information will tell us whether or not more effort needs to go out for educating and spreading awareness about sport related concussions and also help determine the effectiveness of the recently passed legislation. If there are certain domains of concussions (symptoms, treatment, and return-to-play) that have a trend of being misunderstood, medical professionals will be able to better understand what information is being relayed correctly and which needs to be revised. It is important to make sure all youth parents are fully knowledgeable and can identify, manage, and treat sport related concussions when not in the presents of a medical professional.

Appendix C

Additional Methods

Appendix C1

Understanding of Risk of Concussion and Traumatic Brain Injury

SECTION 3: UNDERSTANDING OF RISK OF CONCUSSION AND TRAUMATIC BRAIN INJURY

What is a concussion?
A concussion is a brain injury that:

- Is caused by a bump, blow, or jolt to the head or body.
- Can change the way a student's brain normally works.
- Can occur during Practices and/or Contests in any sport.
- Can happen even if a student has not lost consciousness.
- Can be serious even if a student has just been "dinged" or "had their bell rung."

All concussions are serious. A concussion can affect a student's ability to do schoolwork and other activities (such as playing video games, working on a computer, studying, driving, or exercising). Most students with a concussion get better, but it is important to give the concussed student's brain time to heal.

What *are* the symptoms of a concussion?
Concussions cannot be seen; however, in a potentially concussed student, ***one or more*** of the symptoms listed below may become apparent and/or that the student "doesn't feel right" soon after, a few days after, or even weeks after the injury.

- Headache or "pressure" in head
- Nausea or vomiting
- Balance problems or dizziness
- Double or blurry vision
- Bothered by light or noise
- Feeling sluggish, hazy, foggy, or groggy
- Difficulty paying attention
- Memory problems
- Confusion

What should students do if they believe that they or someone else may have a concussion?

- **Students feeling any of the symptoms set forth above should immediately tell their Coach and their parents.** Also, if they notice any teammate evidencing such symptoms, they should immediately tell their Coach.
- **The student should be evaluated.** A licensed physician of medicine or osteopathic medicine (MD or DO), sufficiently familiar with current concussion management, should examine the student, determine whether the student has a concussion, and determine when the student is cleared to return to participate in interscholastic athletics.
- **Concussed students should give themselves time to get better.** If a student has sustained a concussion, the student's brain needs time to heal. While a concussed student's brain is still healing, that student is much more likely to have another concussion. Repeat concussions can increase the time it takes for an already concussed student to recover and may cause more damage to that student's brain. Such damage can have long term consequences. It is important that a concussed student rest and not return to play until the student receives permission from an MD or DO, sufficiently familiar with current concussion management, that the student is symptom-free.

How can students prevent a concussion? Every sport is different, but there are steps students can take to protect themselves:

- Use the proper sports equipment, including personal protective equipment. For equipment to properly protect a student, it must be:
  - The right equipment for the sport, position, or activity;
  - Worn correctly and the correct size and fit; and
  - Used every time the student Practices and/or competes.
- Follow the Coach's rules for safety and the rules of the sport.
- Practice good sportsmanship at all times.

If a student believes they may have a concussion: Don't hide it. Report it. Take time to recover.

I hereby acknowledge that I am familiar with the nature and risk of concussion and traumatic brain injury while participating in interscholastic athletics, including the risks associated with continuing to compete after a concussion or traumatic brain injury.

Student's Signature _____ Date ___/___/___

I hereby acknowledge that I am familiar with the nature and risk of concussion and traumatic brain injury while participating in interscholastic athletics, including the risks associated with continuing to compete after a concussion or traumatic brain injury.

Parent's/Guardian's Signature _____ Date ___/___/___

Revised: July 26, 2012

Appendix C2

Institutional Review Board

IRB proposal approval as amended #13-033

Instreviewboard
Sent: Friday, March 14, 2014 3:44 PM
To: OBR1699 - O'BRIEN, TREVOR
Cc: Meyer, Michael; Skwarecki, Robert

Institutional Review Board
California University of Pennsylvania
Morgan Hall, Room 310
250 University Avenue
California, PA 15419
instreviewboard@calu.edu
Robert Skwarecki, Ph.D., CCC-SLP, Chair

Dear Trevor O'Brien:

Please consider this email as official notification that your proposal titled "Concussion Knowledge Among Youth Parents in the Commonwealth of Pennsylvania: A survey based on the Safety in Youth Sports Act" (Proposal #13-033) has been approved by the California University of Pennsylvania Institutional Review Board as amended.

The effective date of the approval is 3/14/2014 and the expiration date is 3/13/2015. These dates must appear on the consent form .

Please note that Federal Policy requires that you notify the IRB promptly regarding any of the following:
(1) Any additions or changes in procedures you might wish for your study (additions or changes must be approved by the IRB before they are implemented)
(2) Any events that affect the safety or well-being of subjects
(3) Any modifications of your study or other responses that are necessitated by any events reported in (2).
(4) To continue your research beyond the approval expiration date of 3/13/2015 you must file additional information to be considered for continuing review. Please contact instreviewboard@calu.edu

Please notify the Board when data collection is complete.

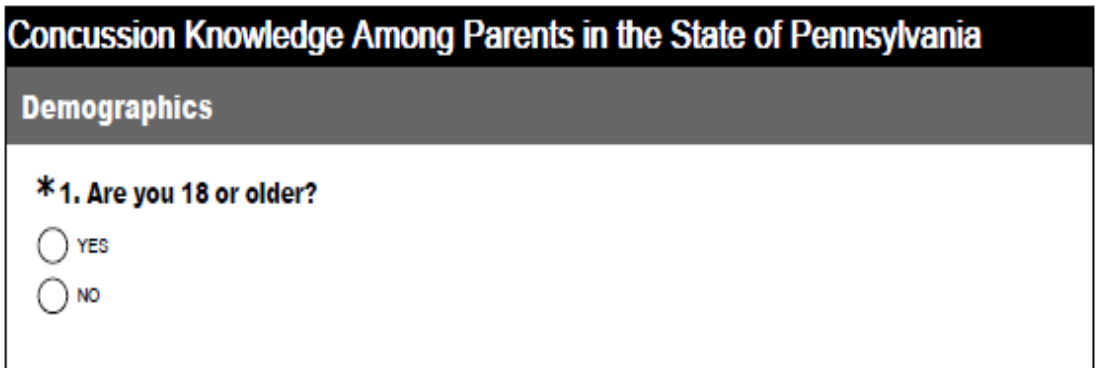
Regards,
Robert Skwarecki, Ph.D., CCC-SLP
Chair, Institutional Review Board

Appendix C3

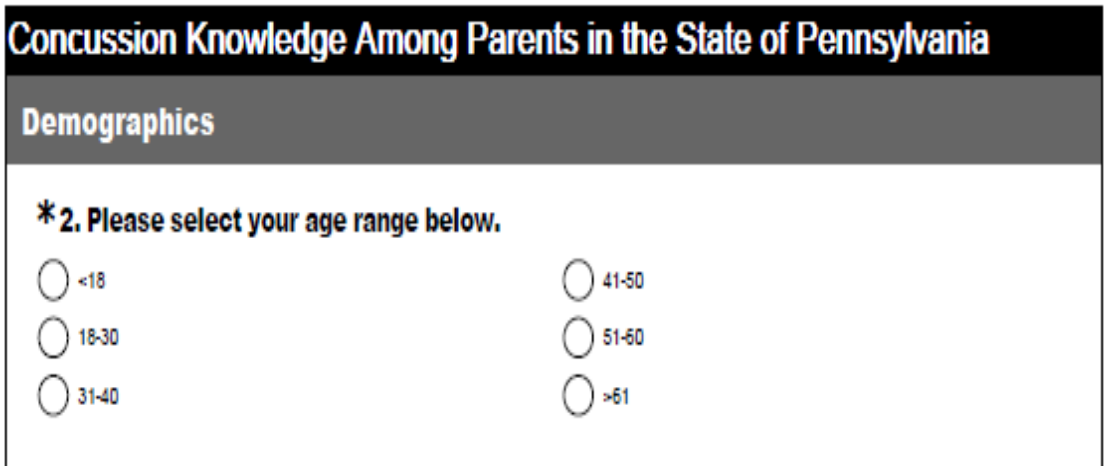
Concussion Information Sheet Survey

Concussion Information Sheet Survey

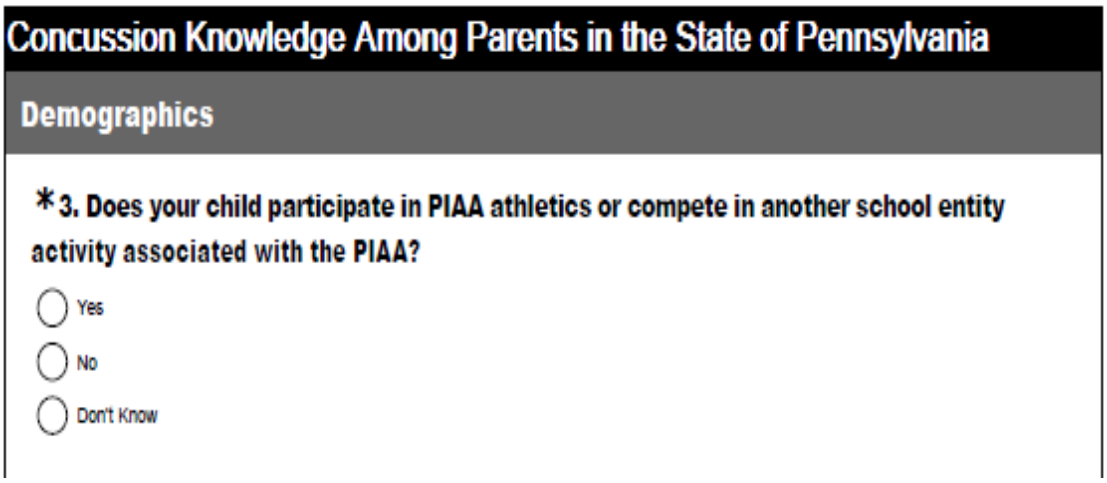
(SurveyMonkey format)



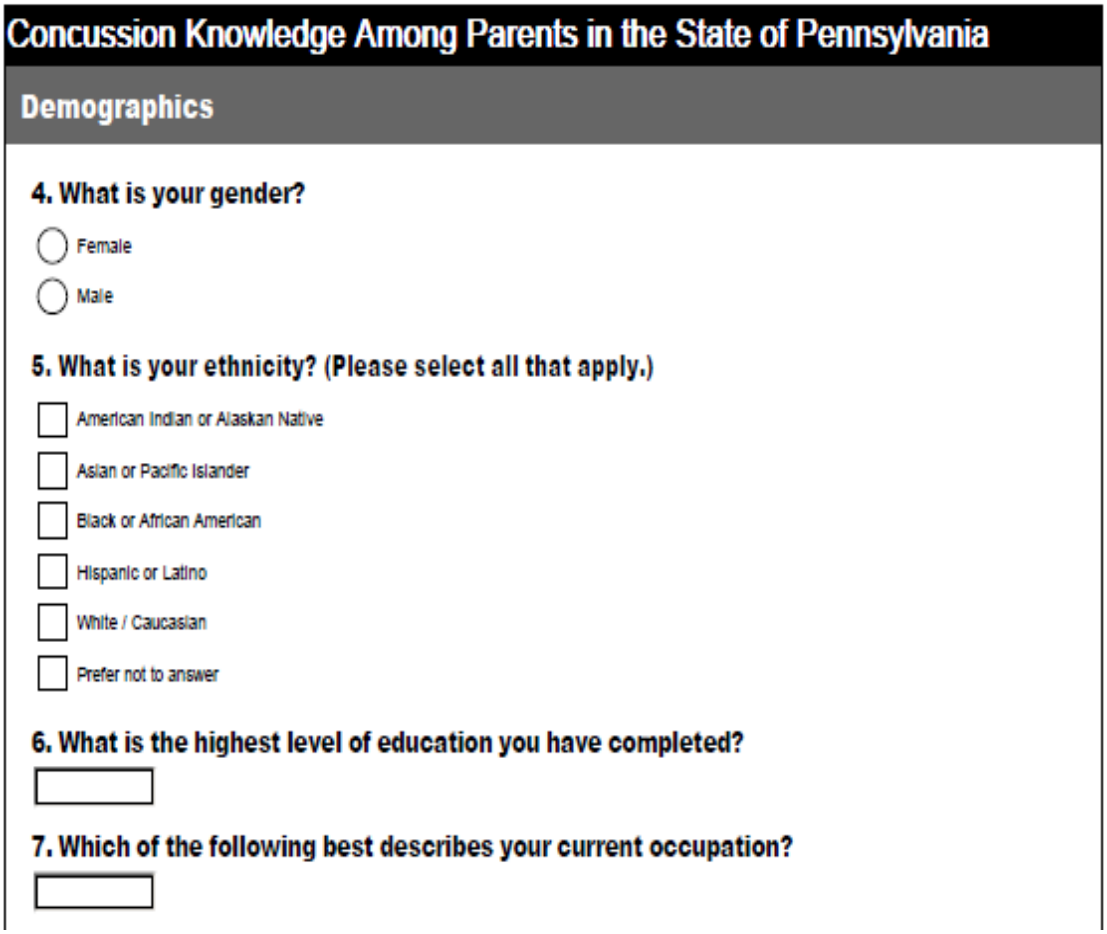
* Required to answer, disqualification if younger than 18



* Required to answer, disqualified if younger than 18



* Required to answer, disqualified if child does not participate in PIAA athletics



Concussion Knowledge Among Parents in the State of Pennsylvania

Demographics

4. What is your gender?

- Female
- Male

5. What is your ethnicity? (Please select all that apply.)

- American Indian or Alaskan Native
- Asian or Pacific Islander
- Black or African American
- Hispanic or Latino
- White / Caucasian
- Prefer not to answer

6. What is the highest level of education you have completed?

7. Which of the following best describes your current occupation?

* Question 6 (drop-down menu): displays education levels grade school through graduate school

* Question 7 (drop-down menu): displays a list a various occupation categories

Concussion Knowledge Among Parents in the State of Pennsylvania

Additional Information

8. Did you review and sign the PIAA Understanding of Risk of Concussion and Traumatic Brain Injury Form?

- ◯ Yes
- ◯ No
- ◯ Don't Know

9. Did your child review and sign the PIAA Understanding of Risk of Concussion and Traumatic Brain Injury Form?

- ◯ Yes
- ◯ No
- ◯ Don't Know

10. Before this survey, were you aware of the recently passed Safety in Youth Sports Act and what it mandates?

- ◯ Yes
- ◯ No
- ◯ Somewhat
- ◯ Don't Know

11. Did you learn something new following review of the PIAA Understanding of Risk of Concussion and Traumatic Brain Injury form?

- ◯ Yes
- ◯ No
- ◯ Don't Know

12. Following review of the PIAA Understanding of Risk of Concussion and Traumatic Brain Injury form, do you feel better about recognizing the signs and symptoms associated with concussions and the proper management steps?

- ◯ Yes
- ◯ No
- ◯ Don't Know

Concussion Knowledge Among Parents in the State of Pennsylvania

13. In general, do you feel concussion education and awareness has improved as a whole?

- ◯ Yes
- ◯ No
- ◯ Don't Know

Additional Information

14. For how many years have your children participated in organized coached sports associated with the PIAA? (If more than one child, add number of years together) For example, if you have two senior student athletes, select 8yrs. If you have one senior and one freshmen, select 5yrs.

[ ]

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

- ◯ A
- ◯ AA
- ◯ AAA
- ◯ AAAA
- ◯ Other
- ◯ Don't Know

16. Does your child's school have an employed Certified Athletic Trainer?

- ◯ Yes
- ◯ No
- ◯ Don't Know

17. Have any of your children ever been diagnosed with a concussion?

- ◯ Yes
- ◯ No
- ◯ Don't Know

18. Have YOU ever been diagnosed with a concussion?

- ◯ Yes
- ◯ No
- ◯ Don't Know

19. How many years did/have YOU participated in organized coached sports?

[ ]

* Questions 14 and 19 were drop-down menus with number selections for age and years

Concussion Knowledge Among Parents in the State of Pennsylvania

Concussion Information Sheet Questions

Please answer the following questions to the best of your knowledge

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

- ◯ True
- ◯ False
- ◯ Don't Know

21. A concussion does not have to involve loss of consciousness.

- ◯ True
- ◯ False
- ◯ Don't Know

22. A concussion changes the way a student's brain normally works.

- ◯ True
- ◯ False
- ◯ Don't Know

23. Following a concussion, a student's ability to do school work and other mental tasks will not be effected.

- ◯ True
- ◯ False
- ◯ Don't Know

24. Concussions can occur during practices and games involving any sport.

- ◯ True
- ◯ False
- ◯ Don't Know

Concussion Knowledge Among Parents in the State of Pennsylvania

Concussion Signs & Symptoms

Please identify signs and symptoms of a concussion

25. Identify the possible signs and symptoms of a concussion from the list below by selecting (Yes/No/Don't Know).

Nosebleed	
Coughing up blood	
Headache	
Chest pain	
Double or blurry vision	
Memory problems	
Black eye	
Pressure in head	
Clear nasal leakage	
Dizziness	
Nausea	
Vomiting	
Weakness of neck musculature	
Difficulty paying attention	
Confusion	
Extreme thirst	
Light sensitivity	
Noise sensitivity	
Shivering	
Feeling sluggish or foggy	
Balance problems	
Seizure	

* Each sign and symptom had its own drop-down menu with Yes/No/Don’t Know selections

Concussion Knowledge Among Parents in the State of Pennsylvania

Concussion Information Sheet Questions

Please answer the following questions to the best of your knowledge

26. Athletes feeling any signs/symptoms of a concussion should:

- ◯ Tell their coach only
- ◯ Tell their parent only
- ◯ Tell their coach and parent
- ◯ Tell no one
- ◯ Don't Know

27. Following a concussion, athletes must have written clearance by ____ before returning to play:

- ◯ Coach
- ◯ Parent/Guardian
- ◯ Licensed physician with concussion education
- ◯ Certified Athletic Trainer
- ◯ Don't Know

28. Recovering from a current concussion, athletes are:

- ◯ More susceptible for another concussion
- ◯ Less susceptible for another concussion
- ◯ No greater or lesser risk for suffering another concussion
- ◯ Don't Know

29. Repeat concussions can:

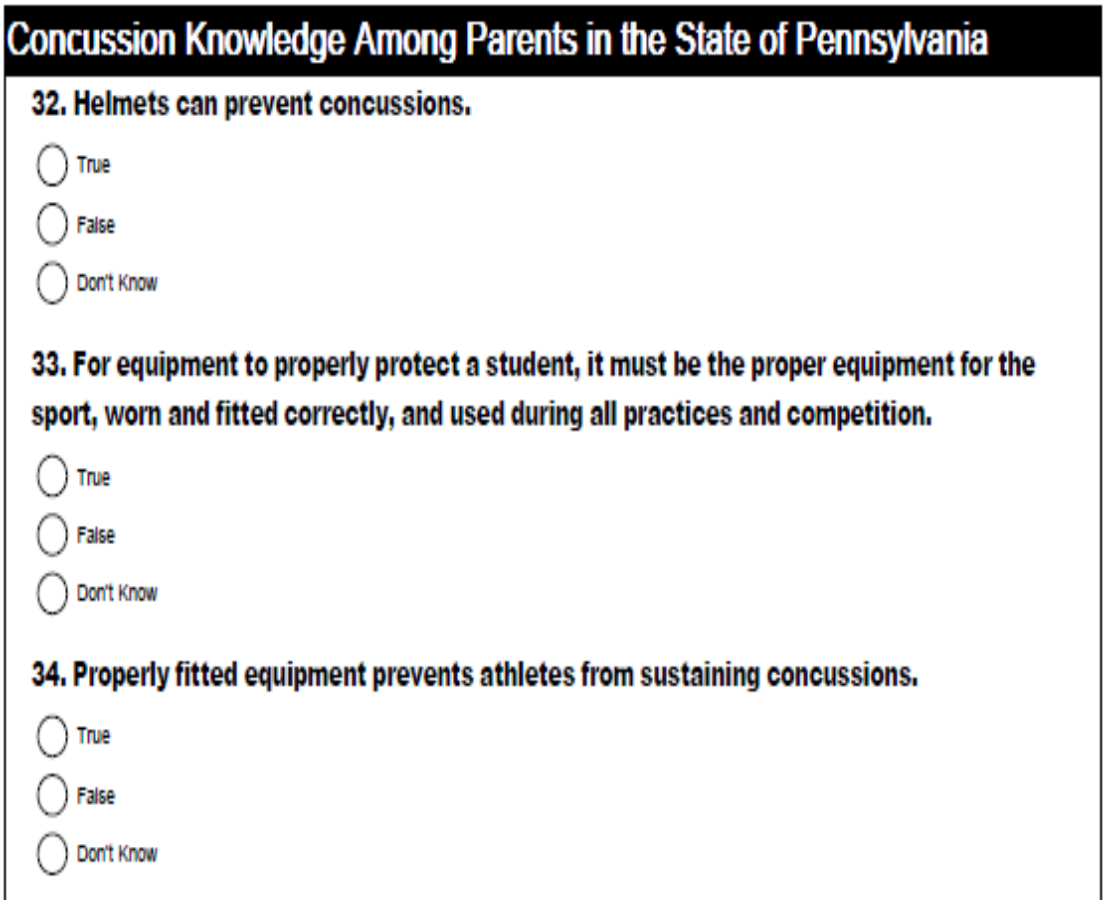
- ◯ Decrease recovery time
- ◯ Increase recovery time
- ◯ Will not increase chances of anything
- ◯ Don't Know

30. Repeat concussions can potentially cause long term brain damage:

- ◯ True
- ◯ False
- ◯ Don't Know

31. Following a concussion, the athlete may safely return to full participation if signs and symptoms are minimal.

- ◯ True
- ◯ False
- ◯ Don't Know



Concussion Knowledge Among Parents in the State of Pennsylvania

32. Helmets can prevent concussions.

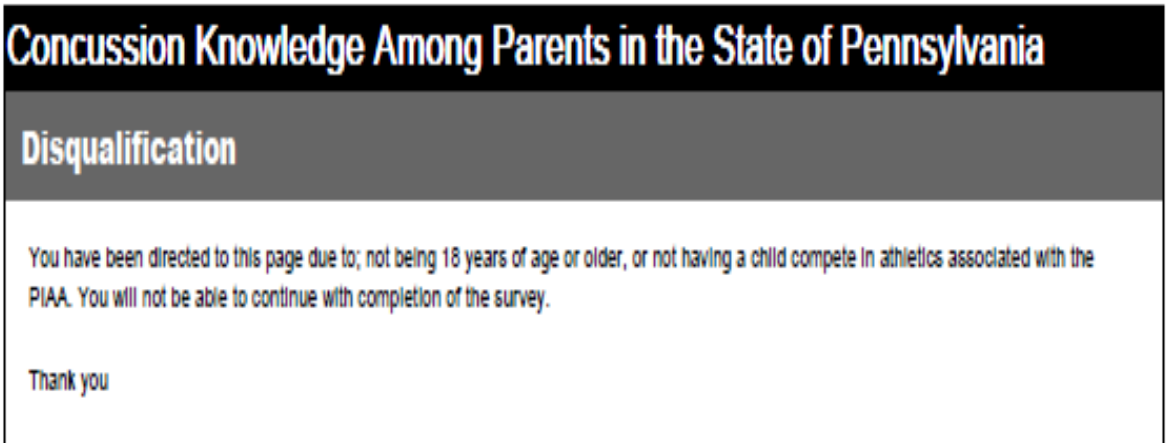
- ◯ True
- ◯ False
- ◯ Don't Know

33. For equipment to properly protect a student, it must be the proper equipment for the sport, worn and fitted correctly, and used during all practices and competition.

- ◯ True
- ◯ False
- ◯ Don't Know

34. Properly fitted equipment prevents athletes from sustaining concussions.

- ◯ True
- ◯ False
- ◯ Don't Know



Concussion Knowledge Among Parents in the State of Pennsylvania

Disqualification

You have been directed to this page due to; not being 18 years of age or older, or not having a child compete in athletics associated with the PIAA. You will not be able to continue with completion of the survey.

Thank you

* If participants were disqualified they were sent to this page

Appendix C4

Validity Questionnaire for Panel of Experts

Validity Questionnaire

(Questions answered by panel of experts)

1. Does the survey show adequate construct validity in relation to the concussion information sheet?

2. Does the survey show adequate content validity in relation to the concussion information sheet?

3. Are there questions too broad or misleading (from a parents' perspective)?

4. Are there any grammatical or phrasing issues?

5. Any other comments?

Appendix C5

Cover Letter to Athletic Directors & Parents

Date: 3/17/14

Dear Athletic Director:

My name is Trevor O'Brien and I am currently a student in the Graduate Athletic Training Education Program at California University of Pennsylvania. I am performing a survey-based research study to evaluate the effectiveness of the concussion information sheet included in the PIAA Comprehensive Initial Pre-Participation packet. The Safety in Youth Sports Act, effective in 2012, requires all parents and athletes to review and sign the concussion information sheet prior to each school year. I want to determine the knowledge level of parents by having them complete a survey, which directly reflects the material on the concussion information sheet. Gathering this information is significant because it will help determine whether or not the concussion information sheet is doing what it intends to do and also determine the effectiveness of the Safety in Youth Sports Act.

The survey will be completed on SurveyMonkey.com and the link to access the survey is attached on the same email this cover letter was attached to. You are being asked to distribute the survey link to all parents of student athletes associated within your school district. You do not need to complete the survey yourself, it is strictly for parents of student athletes. I do ask that you distribute the survey at your earliest convenience as it will only be available to the parents for two weeks following you receiving this letter. Your participation is voluntary and you do have the right to choose not to distribute the survey. Your participation or non-participation will have no benefit or penalty.

All survey responses are anonymous and will be kept confidential. Completed surveys will not have any

information that will allow you or the parents to be identified. Electronic data will be stored in password-protected files on California University of Pennsylvania's servers. Minimal risk is posed by participating and distributing the survey to the parents in your school district. I ask that you please consider the possible benefits of participating and collecting this data because it will directly reflect how much information parents retain every year from the concussion information sheet. If you have any questions regarding this project, please feel free to contact the primary researcher, Trevor O'Brien, LAT, ATC at obr4699@calu.edu. You may also contact the thesis chair supervising the research, Dr. Michael Meyer, LAT, ATC at meyer_m@calu.edu.
Lastly, I will share the results of this research with the PIAA and any school requesting the results.

Thank you for taking the time to take part in this research. I greatly appreciate your time, thought, and effort you have put into your participation.

Sincerely,

Trevor O'Brien, LAT, ATC
Primary Researcher
California University of Pennsylvania
Graduate Athletic Training Education Program
250 University Ave
California, PA 15419
Obr4699@calu.edu

Dear parent or guardian:

My name is Trevor O'Brien and I am currently a student in the Graduate Athletic Training Education Program at California University of Pennsylvania. I am performing a survey-based research study to evaluate the effectiveness of the concussion information sheet included in the PIAA Comprehensive Initial Pre-Participation packet. The Safety in Youth Sports Act, effective in 2012, requires all parents and athletes to review and sign the concussion information sheet prior to each school year. I want to determine the knowledge level of parents by having them complete a survey which directly reflects the material on the concussion information sheet. Gathering this information is significant because it will help determine whether or not the concussion information sheet is doing what it intends to do and also determine the effectiveness of the Safety in Youth Sports Act.

You are being asked to participate because you have a son(s) or daughter(s) participating in athletics under the PIAA. However, your participation is voluntary and you do have the right to decline participating in this survey. You also have the right to discontinue participating at any time during the survey completion process, at which time your data will be discarded. Your participation or non-participation will have no benefit or penalty. This study was approved by the California University of Pennsylvania Institutional Review Board. The effective date of the approval is 03/14/2014 and expiration date is 03/14/2015.

All survey responses are anonymous and will be kept confidential; by completing this survey, you are providing informed consent to use the data collected upon return of the survey. Completed surveys will not have any information that identifies you, your child, or associated school

district. Electronic data will be stored in password-protected files on California University of Pennsylvania's servers. Minimal risk is posed by participating as a subject in this study. I ask that you please take this survey at your earliest convenience as it will take approximately 10 minutes to complete. I also ask you consider the benefits of gathering this data as it will identify strengths and weaknesses of the recently passed legislation focused on protecting your son(s) or daughter(s) from head injury. If you have any questions regarding this project, please feel free to contact the primary researcher, Trevor O'Brien, LAT, ATC at obr4699@calu.edu. You may also contact the thesis chair supervising the research, Dr. Michael Meyer, LAT, ATC at meyer_m@calu.edu.

Thank you for taking the time to take part in this research. I greatly appreciate your time, thought, and effort you have put into completion of the survey.

Sincerely,

Trevor O'Brien, LAT, ATC
Primary Researcher
California University of Pennsylvania
Graduate Athletic Training Education Program
250 University Ave
California, PA 15419
Obr4699@calu.edu

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ABSTRACT

Concussion Knowledge among Youth Parents in the Commonwealth of Pennsylvania: A survey based on the Safety in Youth Sports Act

O'Brien TB, Meyer M, West T, Bishop V: The School of Graduate Studies and Research, California University of Pennsylvania; California, PA.

Context: In July of 2012, the Commonwealth of Pennsylvania deemed the Safety in Youth Sports Act effective concussion legislation. The law establishes standards for interscholastic athletics; immediate removal from play for anyone suspected of having a concussion, written clearance by a licensed medical professional before returning to play, concussion training courses for coaches prior to every season, and signing of a concussion information sheet by the parent and student athlete prior to every school year. **Objective:** This study examines the knowledge of the Concussion Information Sheet by parents who are associated with the Pennsylvania Interscholastic Athletic Association (PIAA). **Design:** This is a descriptive research design utilizing a survey which directly reflects the information on the PIAA Concussion Information Sheet. **Participants:** The survey was sent to parents/guardians who have student athletes competing in athletic events associated with the PIAA. **Interventions:** An original survey was developed on SurveyMonkey.com and sent via email to the parents. **Main Outcome Measures:** After surveys were submitted, each parent received an overall knowledge score that was used to test the hypotheses and to draw further descriptive conclusions on the data. **Results:** A total of 143 surveys were included in the study (92 females, 48 males). The average knowledge score by the parents was 26 out of 36 (74%). Schools that employ a Certified Athletic Trainer will have an impact on knowledge scores came back as significance. 43.3% of parents stated they were aware of the recently passed legislation. 44.7% of parents revealed they learned something new following review of the information sheet. 68.1% of parents felt better about concussion recognition following review of the information sheet. 46.7% of parents stated that helmets prevent concussions and 20.4% stated properly fitted equipment will prevent concussions. **Conclusion:** Medical professionals and youth sport organizations need to make sure they are providing proper educational tools for parents regarding concussions in

youth sports. Currently, there is no evidence to suggest various demographic information effects knowledge of the Concussion Information Sheet. Further research needs to look more into the perceptions of parents on equipment and concussions, along with improving awareness and knowledge of the Safety in Youth Sports Act and what is mandated under the legislation.