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Public Knowledge of Concussion in Youth Sports - A Local Study

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Abstract: ***This paper attempts to determine how much people really know about the serious issue of concussions in sports, especially in young adults. A survey questionnaire consisting of six questions was distributed amongst 100 random people in three different organizations in the States of Delaware and Pennsylvania in the United States. The results of the survey instrument were compared with the established statistical data regarding concussions in general and amongst young adults in particular. Results indicate that for the most part the general population is unaware of the seriousness of the issue of concussions in youth. More education, research and outreach by governments at all levels, the academia and the private sector are needed to address this issue and help curtail its occurrence now and in the future.***

Keywords: Concussions, Adults, Survey, Amongst, People, Research, Education

1. Introduction

Sports-related concussions have reached an epidemic level in the United States. There are an estimated 3.8 million sports-related concussions that occur every year, leading the Center for Disease Control (CDC) to draw the line on the fact that sports concussions are a serious threat. High school athletes sustain an estimated 300, 000 concussions annually (Vanlandingham 2017). When left untreated, concussions can result in long-term brain damage and may even lead to one's death. Despite many efforts to inform the students and parents of this serious problem, many are either unaware, or believe the risks are insignificant. In this article, through a comprehensive search of literature, reliable data on the rate of concussion in several different high school sports was collected. A survey questionnaire was designed to ask one hundred random people about their knowledge and understanding of concussion in the sports. The questionnaire was distributed amongst interested participants in three different organizations – senior students in Kennett High School, engineers and planners in the New Castle County government and graduate students at the University of Delaware. The two data sets were statistically compared and analyzed. The analysis and the results are documented in the sections below.

2. What is Concussion?

A concussion is a type of traumatic brain injury that occurs when a head impact shakes the brain inside the skull. Concussions can cause serious and sometimes permanent damage. In some cases, dangerous and fatal swelling and bleeding can occur inside the brain. The more forceful the blow to the head, the greater the chance of serious injury. Repeated concussions and head trauma without proper healing time between each head injury have been shown to cause long-term harm, and death (What is a Concussion 2015).The brain is a soft organ surrounded by spinal fluid that acts like a cushion during normal movement. If the head or body receives a hit, the brain may crash into the skull and sustain injury. Delicate neural pathways in the brain can become damaged, causing neurological disturbances. There are three different types of concussions: Grade 1 or mild, grade 2 or moderate and grade 3 or severe. In grade 1, symptoms last for fifteen minutes or less and there is no loss of consciousness. In grade 2, there is no loss of consciousness, but symptoms last for more than fifteen minutes. In grade three, the person loses consciousness, sometimes just for a few seconds (Concussion Traumatic Brain Injury 2017).

A concussion can be caused by major blow to the head, a fall, or a head-to-head collision with another person. Common causes of concussions include bike accidents, car accidents, and fights. Concussions can also occur while participating in sports such as soccer, football, skiing, boxing, hockey and more. Concussions are not the easiest to figure out, and it can be hard to know whether someone has been diagnosed with a concussion. While some people may pass out after sustaining a concussion, most do not. Almost 90 percent of diagnosed concussions do not involve a loss of consciousness. Mental symptoms of a concussion include difficulty remembering, confusion, inability to concentrate, inability to think clearly, mental fogginess, inability to remember new information, trouble paying attention, and loss of focus. Sleep symptoms of a concussion include oversleeping, unable to fall sleep or sleeping less than usual. Physical symptoms of concussion include dizziness, issues with balancing, nausea and/or vomiting, sensitivity to any noise or sound, sensitivity to light, blurred vision, headache, low energy level, unequal pupils and seeing flashing lights. Emotional symptoms of a concussion include easily angered or upset, feeling nervous or anxious, feelings of sadness, crying more than usual, lack of interest in usual activities, and depression (Signs of a Concussion 2015). Altogether, the causes and effects of concussions are not only subtle and inconsistent, but they can have truly harmful impacts on a human being for an extended period of time depending on the grade of concussion.

3. Sports-Related Concussions in School Age Players

Head injuries are on the rise for athletes at all levels of play, and in all areas of sports. Reports show that the number of children reporting to emergency medical care for sports concussions sustained while playing competitive athletics has doubled in the past few years. Boys football, boys hockey and soccer account for the largest occurrence of sports concussions. This is due to different measures that are lacking in the game and various rules of the game that lead people to be dealing with concussions. Concussions are usually mild and often heal without problem. However, some head injuries can cause serious and permanent damage. Most dramatically, cumulative sports concussions are shown to increase the likelihood of catastrophic head injury leading to permanent neurologic disability by an astounding 39 percent. Sometimes a head injury can be worse that it looks. Even if there is no bleeding or visible bump, a head impact c an cause dangerous swelling and bleeding inside the brain. Close to 90 percent of concussions that are diagnosed do not involve a loss of consciousness, the ones that do are mostly the Grade III are the rarest but still occur throughout the United States. So, it is important that appropriate concussion evaluation and tests are performed at the first signs of impact that are noticed (Effects of a concussion 2015).

3.1 Chronic Traumatic Encephalopathy (CTE)

Bennet Ifeakandu Omalu is a Nigerian-American physician, forensic pathologist, and neuropathologist who was the first to discover and publish findings of chronic traumatic encephalopathy (CTE) in American football players while working at the Allegheny County Coroner's Office in Pittsburgh. He later became the chief medical examiner for San Joaquin County, California, and is a professor at the University of California, Davis, Department of Medical Pathology and Laboratory Medicine (Bennett Omalu 2018).

Together with partners in the Department of Pathology at the University of Pittsburgh, Omalu distributed his discoveries in the diary Neurosurgery in 2005 out of a paper titled "Chronic Traumatic Encephalopathy in a National Football League Player." In it, Omalu called for further investigation of the malady.

Omalu has likewise found CTE in the cerebrums of military veterans, distributing the principal recorded case in a November 2011 article. Omalu discovered proof of CTE in a 27-year-old Iraq War veteran who experienced Post Traumatic Stress Disorder (PTSD) and later ended it all. Omalu's paper joins PTSD to the CTE range of sicknesses and calls for further examination.

3.2 Latest Research

A single season playing football may be everything necessary to change a youthful competitor's cerebrum. Those are the fundamental discoveries of research displayed in Chicago at the yearly gathering of the Radiological Society of North America. Analysts utilized unique MRI strategies to see nerve packages in the brain in an investigation of the cerebrums of 26 youthful male football players, normal age 12, after one season. Twenty-six progressively youthful boys who didn't play football likewise got MRI checks in the meantime to be utilized as a control group. In the youth who played football, the analysts found that nerve strands in their corpus callosum, the band that interfaces the two parts of cerebrum, changed over the season, says lead researcher Jeongchul Kim, an exploration scientist in the Radiology Informatics and Imaging Laboratory at Wake Forest School of Medicine in Winston-Salem, North Carolina (Youth Football Changes Nerve Fibers 2018).

The article also stated that Dr. Kim described the researchers discovered some nerve groups developed longer and different packs ended up shorter, or contracted, after the players' underlying MRI examines toward the start of the season. He says they saw no adjustments in the integrity of the groups. The team says these outcomes propose that repeated hits to the head could prompt changes in the state of the corpus callosum, which is basic to incorporating motor, sensory and cognitive capacities between the right and left hemisphere of the cerebrum.

Dr. Gerard Gioia, a pediatric neuropsychologist at Children's National Health Center, who was also portrayed in the article says these most recent discoveries are just a piece of the bit of the riddle they're endeavoring to understand. There are still many questions to be answered such as: “Should my child play football? Should my child play soccer? Should my child play ice hockey?” For the present, he says, they have a great deal of unanswered inquiries (Youth Football Changes Nerve Fibers 2018).

4. What is being done to Tackle the Problem of Sports-Related Concussions in Young Adults?

4.1 The Lystedt Law

Extreme awareness of concussions is changing the culture of youth sports. In the State of Washington, the Lystedt law has been implemented and is one that requires youthful competitors associated with having suffered a concussion to get medical clearance before coming back to activity. A 14-year-old first year recruit football player at Duvall's Cedarcrest High School was overwhelmed by a powerful hit on the football field. His name was Zachary Lystedt, was carried to a medical plaza to adjacent Seattle, determined to have a serious concussion and discharged the following day as explained by writer Michael Popke in 2009.The law did what it is was originally intended to do, which is prevent brain injuries, says Richard Adler, founding principal at Seattle-based law firm Adler Giersch P.S., who as president of the Brain Injury Association of Washington assisted draft Washington's Zackery Lystedt Law. "The kid in Cedarcrest had a concussion, they took him out, and they didn't put him back in until he could be cleared properly” (Popke 2009). The Lystedt Law (which

collectively passed both the Washington House and Senate) has impacted comparative enactment in different states and began endeavors to set up government directions in regard to concussion management. The law additionally orders that school districts work with the Washington Interscholastic Activities Association to teach mentors, players and guardians about the nature and danger of concussions and stipulates that youth competitors and their parents sign a data sheet about concussions and head wounds before each season (Popke 2009).

4.2 Ten Point Plan to Save Football

Christopher John Nowinski is an American author, co-founder and executive director of the Concussion Legacy Foundation who has developed different research ideas about sports-related concussions. However, in 2015 when the CTE discovery was announced, he wanted to take quick actions and had broad plans (Popke 2016). As one of 16 people who affirmed at a U.S. House Judiciary Committee hearing in late October on football-related brain wounds and how the National Football League has taken care of the issue, he introduced a general "10 Point Plan to Save Football." In it, he proposed ways to a more secure diversion that can and ought to be utilized to diminish mind injury at all dimensions of play including re-evaluating practices, tackling and blocking techniques, rules and rules enforcement, and the role of referees; mandating brain trauma and concussion education for coaches, certified athletic trainers, parents and athletes; and developing better methods of concussion detection, diagnosis and management (Popke 2016). This plan has been utilized in many colleges and universities across the United States.

4.3 Specific Solutions

The wellbeing courses, handling facilities, $300 protective caps and full-contact practice adjustments were only a few of numerous estimates taken by Marshall High School football staff in the State of Virginia to decrease head wounds. Concussions dropped from 33 in 2013 to 31 in 2014 (Goldwein 2016). Other sources and athletic trainers are taking different approaches. For instance, the Fairfax county in the State of Virginia has become a poster county for youth concussion safety (Goldwein 2016). In May, FCPS (Fairfax Country Public Schools) published a news release boasting significant declines in football concussions (43 percent) and injuries (24 percent) since 2013-14. The reason for this drop is due to their education and training advancements. Concussion safety and proper precautions are topics discussed in the classroom and in the locker rooms, which has translated to better numbers on the field. The biggest precaution that is taken in account is the proper way to tackle and different blocking techniques. In the point of view of this school district, the more colleges and different leagues adhere to these pre-game techniques and standards, the more they will get used to it and the concern for concussions will have a great drop. Ultimately, that is something that people have strived for and it can very well become a reality in the near future.

4.4 Michigan High School Athletic Association

The MHSAA (Michigan High School Athletic Association) has completed a yearlong database of head injury reports from its schools, mandated in 2015-16 for the first time as part of an objective to sort out and reduce the incidence of those types of injuries in athletics. The MHSAA got information from nearly 99 percent of its secondary schools after the finish of the fall, winter and spring seasons, and kept on following every injury report until late spring. Now, there are certain reasons and clarifications that were made by John E. Roberts, executive director of the MHSAA. He stated: “We know that school sports are safer than they’ve ever been, thanks to advances in equipment, increased and more complete coaches’ education, and rules designed to bring higher levels of safety to both practices and competition. This study will allow us for the first time to set a baseline by which we can determine year-to-year progress as we work to reduce the incidence of head injuries in school sports, while providing questions we will seek to answer with assistance from our research partners” (Kimmberley 2016). This is a gradual approach to the problem as the school first wants to gather data, analyze it, and take the proper steps to improve.

The results were eventually gathered up and they encountered that during 2015-16, 4, 452 brain injuries occurred.“Total participation in MHSAA sports for 2015-16 was 284, 227 – with students counted once for each sport he or she played and only 1.6 percent of participants experienced a head injury. Boys experienced 3, 003 – or 67 percent – of those injuries, although boys participation in sports, especially contact sports, also was higher than girls” (Kimberley 2016).Also, the MHSAA was one of the first school districts to embrace a return-to-play protocol that keeps an athlete left out of their activities for at least the next day after a suspected concussion and permits that athlete to return to play once he or she has been cleared 100% for activity by a doctor (M.D. or D.O.), physician’s assistant or nurse practitioner.

MHSAA has released their statistics following the 2016 school year and Ben Orner (2018), an author, has described and elaborated on all of them starting with the number of concussions suffered by student athletes at Michigan high schools being dropped nearly 10 percent the previous year (MHSAA).MHSAA member schools saw a 9.6% decrease in the number of official concussions last school year. Schools saw a total of 3, 580 head injuries, which is a relatively lower number than years before. Last year’s data is the third since the MHSAA began requiring high schools to track concussions in the 2015-16 school year. Since then, reported concussions have dropped 19.6%.Sixty-five percent of concussions came during competition, and boys experienced the most concussions (66 percent). However, females again reported significantly more concussions than males playing the same or similar sports, according to the release. Contact sports had the most head injuries, with ice hockey and football taking the first and second spots.

4.5 New Concussion Research Centers and Clinics

Across the United States, there have been numerous institutions opening up specifically designed to prevent and/or decrease the occurrence of concussions. They hire specialists known for head repair and prevention of any severity of concussions. Two such academic centers are described below:

4.5.1 University of Delaware

STAR Health at the University of Delaware and Christiana Care Health System have partnered to create the STAR Health Concussion Clinic. The clinic, which provides concussion treatment and management services for anyone 13 years of age and older, promotes a safe return to sport, work and play. This is especially important for the youth athletes in the community (Tom Kaminski2018). Housed in STAR Health's Nurse Managed Primary Care Center, the Concussion Clinic offers comprehensive physical therapy and speech-language pathology services as part of an interdisciplinary approach to concussion treatment and management ("New Concussion Clinic" 2018).

The partnership allows community athletes access to the same level of care as UD Athletes, which is based on the latest research, including work at UD. Powered by UD nurse practitioners and Christiana Care sports medicine physicians, the clinic features easy accessibility to qualified medical professional for initial and follow-up visits. STAR Health also boasts referrals to certified athletic trainers to support youth and interscholastic athletes. As the management of concussions (especially those that are sport-related) evolves, it is critical for all members of the health care delivery team to stay up-to-date on the latest in research and care. As a collaborative effort, the clinic will combine expertise and provide an opportunity for clinicians, researchers and students to work together and offer high-quality health care services.

4.5.2 Stanford University

Launched in 2014 with funding by the U.S. Department of Defense, and subcontracted to the Brain Trauma Foundation, the center brings together brain injury experts from the Brain Trauma Foundation, Stanford University, Oregon health centers, and other developed medical institutions on the west coast. The Brain trauma Foundation's aim is to develop an evidence-based classification for the spectrum of traumatic brain injury, including concussion, and to model post-injury trajectories and outcomes (Advancing the science between brain health and science injury 2014).

The organization has goals of researching what is the best solution for the issues revolving around concussions and assess different ways a person can seek the best treatment for themselves. Its core objectives and ideologies represented by the Stanford University Brain and Concussion Center (2014) are:

A. To establish evidence for concussion subtypes, describing their prevalence in head injured patients, and informing how each subtype recovers. Goals of this work are to lead to targeted management strategies to effect better care.

B. To maximize the utility of scientific efforts to-date that address the epidemic of concussion and brain trauma, for the purpose of deriving a clinically useful classification system, and evidence-based guidelines for diagnosis, prognosis, treatment, and outcomes.

C. To create a consortium among the neurotrauma community that will inspire a commitment to the principles of evidence-based medicine in the design and conduct of brain trauma research.

D. To continue updating the Brain Trauma Foundation traumatic brain injury guidelines.

4.6 New Helmets

The recently developed and tested new helmet known as the Vicis has been on the news lately as the first helmet truly designed to combat against concussions. This helmet has been reviewed by many organizations such as the NFL, and college football institutions (Virginia Tech, Purdue, etc.). The company began by gathering science and engineering majors, and employees to work on a new technology that can be of convenient size to fit in football helmets and can be 100% effective when working against the possibility of a concussion. Bruce Y. Lee of Forbes Magazine and Ahiza Garcia of CNN have written about the specific technologies that go into the design of this helmet and what has been done by the organization to expand and spread their helmets. Ahiza Garcia (2017) has stated that this season, about 70 NFL players are wearing a new helmet that's a radical departure from previous iterations -- and, the league believes, safer. Specifically, it is scientifically designed to weaken and soften a blow to the head by an opposing person. The scientists, neurosurgeons and engineers who designed the helmet make clear that it won't prevent concussions - No helmet will. Houston Texans linebacker Brian Cushing, who wears the Vicis helmet, suffered a concussion during his team's first game of the season.

But the NFL and the NFL Players Association spent the last few years testing dozens of helmet concepts that could help protect players. Out of all the designs, the Vicis ranked highest in safety.

There are a few patterns and designs that lead the helmet to function in a very interesting way. Garcia begins by stating how it works by offering four layers of protection. An outer layer compresses to absorb shock and then rebounds, the way a tennis ball deforms when it hits a solid surface and then returns to shape. Below that is a layer of polymer columns that move in different directions to absorb shock and reduce force. A hard-inner shell helps prevent skull fractures and brain bleeds. And a layer of memory foam provides comfort (Garcia 2017). All other helmets which are used in sports are consisted of a single sheet of foam cushioning inside a hard-plastic shell. There have been many other helmets tested by the NFL and

NCAA but they all consist of the basic layers of cushioning and nothing scientifically proven to combat against concussions and diffuse the chances after a collision.

5. Sports-Related Concussion Statistics

The comprehensive survey of literature conducted for this project contained numerous sources with statistical data related to concussions. The ones chosen and summarized below are mainly from Theye and Mueller (2014), Vanlandingham (2017), what is a concussion (2019) and Collins and Mucha (2013). These data sources were selected because they seemed most reliable, were comprehensive and were easier for comparative analysis with the results of our own survey.

5.1 Overall in Athletics:

- High school athletes are more vulnerable to concussions than older athletes and may take longer to recover.
- More than 5% of high school athletes are concussed each year while participating in collision sports.
- 300, 000 concussions are diagnosed annually in high school level athletics.
- Concussion rates in high school sports have increased 16% annually from 1997-1998 to 2007-2008.
- 15% of injuries reported to Certified Athletic Trainers for high school sports teams are concussions.
- 4 to 5 million concussions occur annually, with rising numbers among middle school athletes.
- 90% of most diagnosed concussions do not involve a loss of consciousness.
- 39% -- the amount by which cumulative concussions are shown to increase catastrophic head injury leading to permanent neurologic disability.
- 47% of all reported sports concussions occur during high school football.
- 33% of high school athletes who have sports concussion report two or more in the same year.
- 47% of all reported sports concussions occur during high school football.
- “33% of all sports concussions happen at practice.
- Between 1.7 and 3 million sports- and recreation-related concussions happen each year. Around 300, 000 are football-related.
- 5 of 10 concussions go unreported or undetected.
- 2 in 10 high-school athletes who play contact sports — including soccer and lacrosse — will suffer a concussion this year.
- Girls' soccer sees the second-most concussions of all high school sports. Girls’ basketball sees the third most.
- The UPMC Sports Medicine Concussion Program sees more than 17, 000 patients each year:
  - 30 percent are from outside the state of Pennsylvania.
  - About 70 percent are high school-aged.

5.2 Concussions Per Sport (Per 100, 000 players):

The statistics shown below have all been retrieved from the respective writers at Headcase (2017):

- Football: 64 -76.8
- Ice hockey: 54
- Soccer: 19 - 19.2
- Wrestling: 22 - 23.9
- Basketball: 18.6 - 21
- Softball: 16 - 16.3
- Field hockey: 22 - 24.9
- Cheerleading: 11.5 - 14
- Volleyball: 6 - 8.6
- Baseball: Between 4.6 - 5
- Gymnastics: 7

The information and numbers shown above are compared to the results of the survey questionnaire the author conducted for this project.

6. The Survey

A general survey questionnaire consisting of 6 questions was distributed amongst senior high school students at Kennett High School, Pennsylvania; the planners and engineers in the New Castle County government in Delaware; and graduate students at the University of Delaware. Approximately 100 surveys were handed out randomly. A total of 100 respondents answered the questions, with a response rate of 100%. The intent of this investigation was to gather insights on how much knowledge random folks really have on the topic of concussion in sports and its recent booming in the last several years. Having an idea of what a concussion means to a school and how they can be prevented can sometimes be a difficult subject to comprehend. A great deal of external factors applies, such as: the strength of padding players wears, or how hard someone makes contact with their head. Internal factors as well apply, such as: students deciding whether they should really play a certain sport, what apparel is most suitable to prevent an injury, psychological reasons, and many others that are private and confidential may not be easily identifiable. The survey questionnaire was designed to analyze the understanding of how common and tragic concussions can be, and how serious the American agencies and media have been reaching out to the public expressing this serious issue that needs a solution in the near future. Bar Charts, and frequency tables are displayed as well as minimum values, maximum values, count (number of respondents per question), measures of central tendency, and measures of spread are provided for each question. Also, this survey was done to get a picture on how knowledgeable people really are about concussions, and their understanding will be compared to the real statistics and values that have been recorded all over the United States about concussion risks in specific sports and annual rate of concussions.

7. Results & Analysis

Question 1: “Gender?”

This question on the survey was asked to get an overall picture of the distribution of people responding to the survey and to prevent any bias from this survey. Again, this survey was taken completely randomly from students

in the high school that the author currently attends, Kennett High School, students among the University of Delaware, and engineers and planners among the New Castle County Government Building. Every taker of the survey responded to this question and the result of the gender of respondents came out to be 36 Female, and 64 Male.

Question 2: "Do you know how serious head injuries are in high school sports in the U.S?"

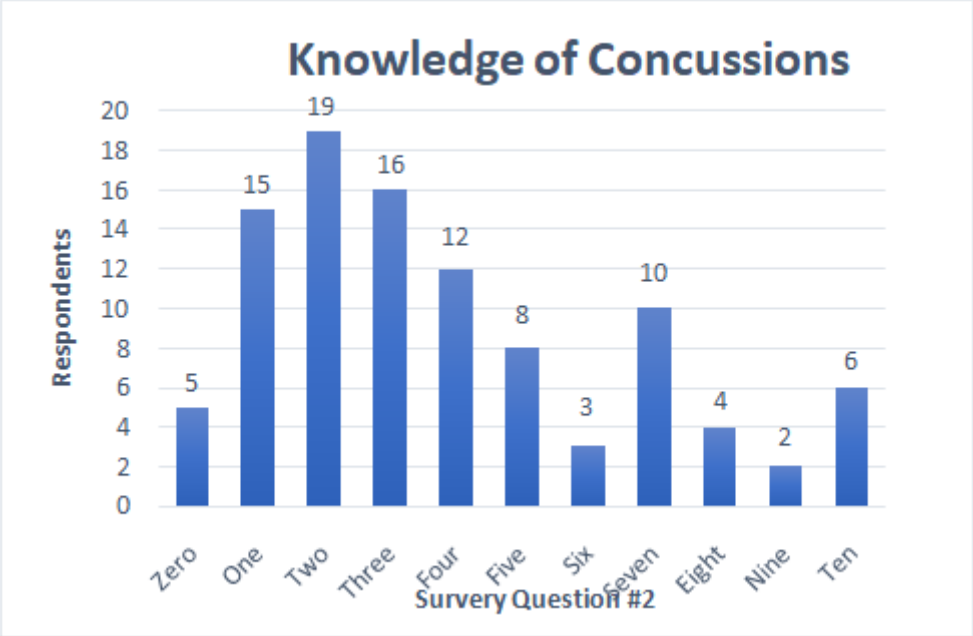


Figure 1: "Do you know how serious head injuries are in high school sports in the U.S?"

This question was asked to get a prerequisite knowledge of how much people know about concussions. The question had numbers from a scale of zero to ten (zero being no knowledge, and ten being most amount of knowledge) and there was a 100% response rate. This question specifically asked for knowledge of concussions in high school sports, not overall concussion rates in every level. After reviewing the data received at the end of the survey, the mode of the knowledge of concussions was 2, the mean (average) was 3.87, the median was 3, the standard deviation was 2.74, and the variance was 7.50. These statistics demonstrate that most people are not very knowledgeable about concussions in high school sports.

Question 3: "If you are aware, what has been your source of information?"

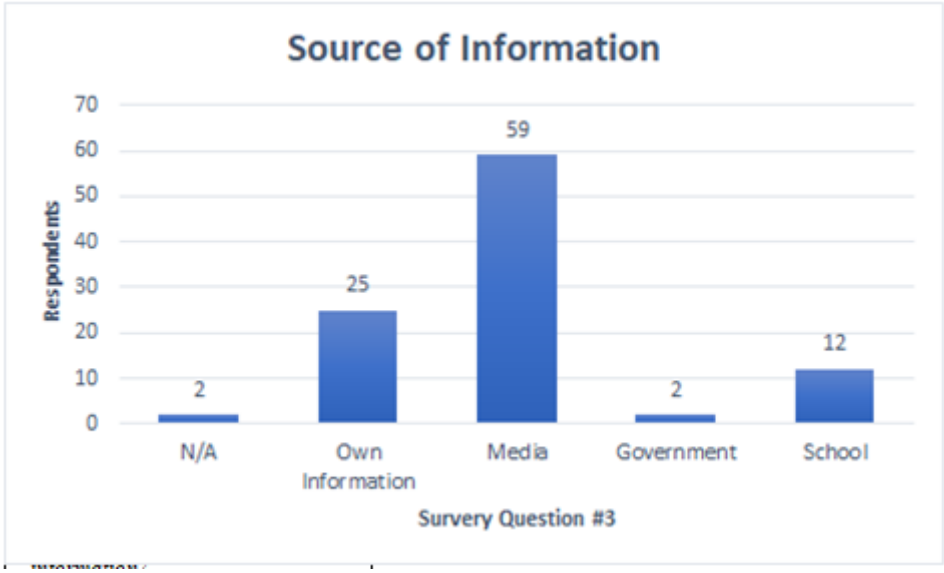


Figure 2: "If you are aware, what has been your source of information?"

This question was designed for every respondent to answer and not to be a follow up to Question 2. It did have a 100% response rate. The question has five choices and those choices were N/A (never heard about concussions anywhere), my own information, media (internet, social media, broadcasting), government, and schools (classroom or friend being diagnosed with a concussion). This question is for concussions in general and not in any

certain level of school or in any certain institution. After reviewing the data received at the end of the survey, the mode was 59, the mean (average) was 20, the median was 12, the standard deviation is 23.75, the variance is 564.5. The graph clearly demonstrates that most people get their knowledge about the epidemics of concussions from the media as more than half of the respondents chose that.

Question 4: "How many total sports-related concussions do you believe happen annually in the U.S?"

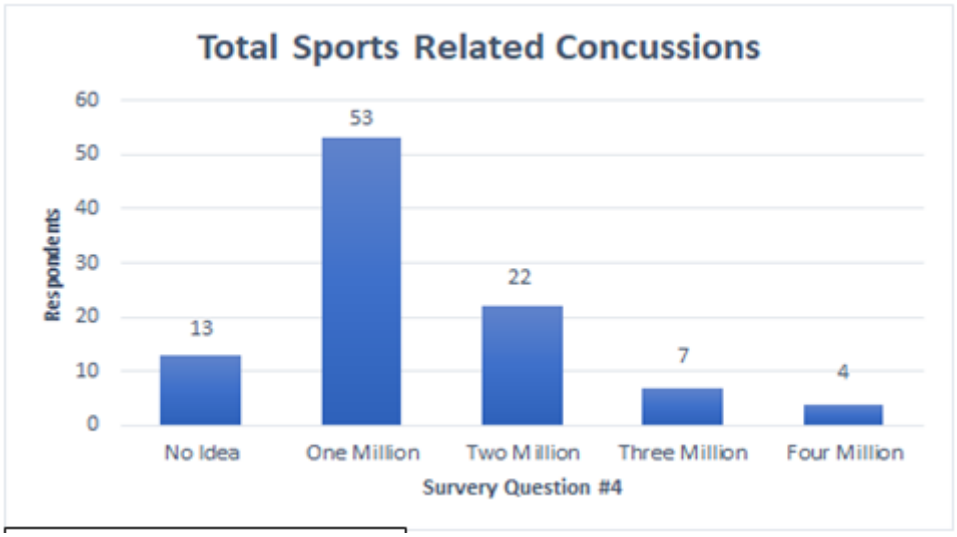


Figure 3: "How many total sports-related concussions do you believe happen annually in the U.S?

This question was taken as a comparison from what people estimate are the total sports related concussions in the United States to the real, collected statistical data of this question provided in the next section of the paper. The response rate was also 100%. This question had five choices, starting with no idea, about one million, about two million, about three million, and about four million, all being the number of sports-related concussions people think occur in the Untied States. After reviewing the data received at the conclusion of the survey, the mode was 1, 000, 000, the mean was 1, 570, 954, the median was 1, 000, 000, the standard deviation is 840, 000, and the variance is 5.927 x 10^{17}. These statistics demonstrate that the majority of the respondents believe that one million sports-related concussions occur annually in the United States.

Question 5: "How many high school sports-related concussions do you believe happen in the U.S every year?"

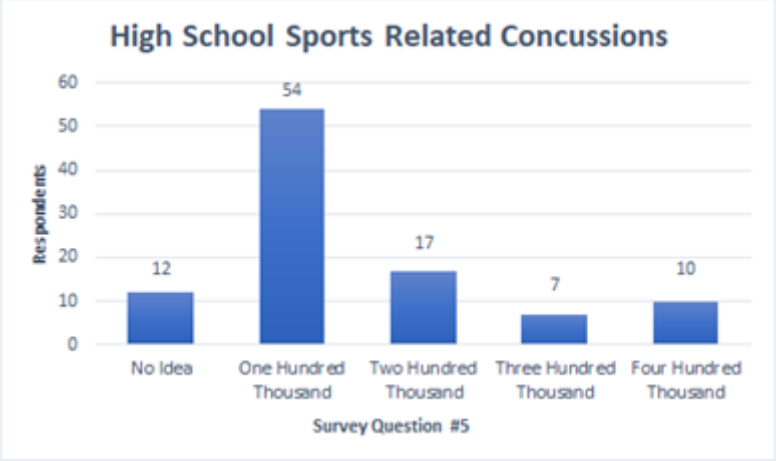
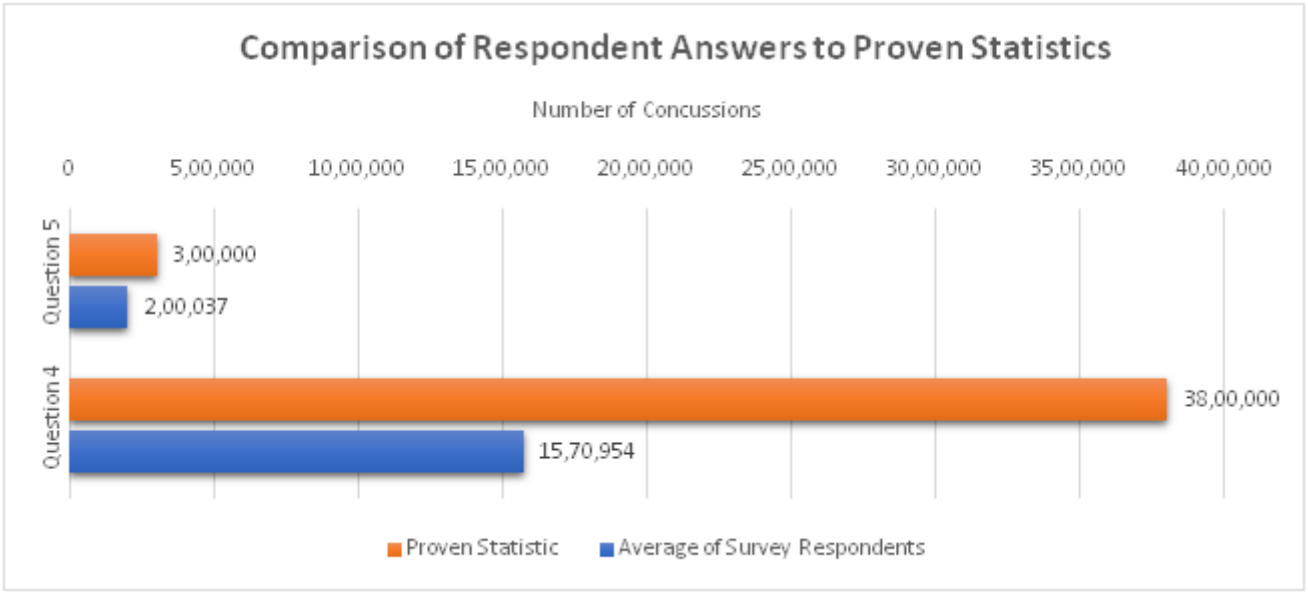


Figure 4: "How many high school sports-related concussions do you believe happen in the U.S every year?"

This question was also asked as a comparison from what people estimate are the total sports related concussions in the United States high schools to the real, proven statistics of this question provided in the next section of the paper. Note, this question is just relating to concussions occuring in high schools. The response rate was also 100% for this question. There were five choices, starting with, no idea, about a hundred thousand, about two hundred thousand, about three hundred thousand, and about four hundred thousand, all being the number of sports-related concussions people think occur in United States high schools. After reviewing the data received at the end of the survey, the mode is100, 000, the mean is 200, 037, the median is100, 000, the standard deviation is 176, 000, and the variance is 3.09 x 10^{10}. These statistics clearly demonstrate that the majority of the respondents believe that there are only about one hundred thousand sports-related concussions in U.S high schools every year.

8. Comparisons to Established Statistics

The chart below demonstrates the comparison between what people thought and reacted to the questions presented to them compared to real statistics and answers from those questions to really show if the American public is aware of the issue of concussions or not.



The above is a graph comparing the average number of concussions said to be in Question 4, which states, "How many total sports-related concussions do you believe happen annually in the U.S?", and Question 5, which states ""How many high school sports-related concussions do you believe happen in the U.S every year?". After reviewing the data, it is clearly represented that people do not have a complete and full understanding of the issue of concussions. The number of total concussions that are sports related in high schools are more than double of what people initally thought, with the proven statistic sitting at 3, 800, 000 concussions per year. Sports related concussions only in high school sports are far more than people ever thought of in the survey as that number sits at 300, 000 concussions per year in the high school level.

8.1 Results of the Final Question and Comparisons

Question 6:"Please rate from 1 to 5 the following high school sports, based on which you think has the most occurrence of concussion (1 having the highest occurrence, 5 having the lowest occurrence)

This question is the final question and every respondent was given five sports, which included: soccer, American football, basketball, ice hockey, and baseball. They were asked to rate each one on a scale of what they thought had the greatest number of concussions occurring in them to the least amount of concussions occurring in them.
Here are the counts between all five sports corresponding to their degree of concussions that people marked:

I. Soccer Survey: This was the first sport on the list and based on the survey, most people believed soccer is prone to concussions for the most part. 55% of people thought of soccer being the highest or the second highest sport with the most concussion occurrences. As provided by (Headcase 2017), per 100, 000 players, the concussion rate of soccer is 19-19.2, just below American football and ice hockey. This is a significant number and compared to the other four sports tested on our list, soccer is scientifically and statically proven to be one of the sports with the most concussions. So, with just 17% of the respondents saying concussions in soccer are at the lower end, it is safe to say that the majority of our respondents accurately depicted soccer as one of the sports with the most concussion occurrences.

Soccer	
Occurrence Level	**Amount of people**
1	**19**
2	**36**
3	**28**
4	**10**
5	**7**

II. American Football Survey: This was the second sport on the list and based on the survey, 64% of the respondents believed football is the sport with the highest number of concussions and 84% believed to be in the top two. As provided by (Headcase 2017), per 100, 000 players, the concussion rate of American football is 64-76.8. This is a remarkable number and football has been proven to be the sport with the most concussions occurring in it. So, our respondents were correct in believing that the number of concussions in American football as being one of the highest out of the all sports on the list.

American Football	
Occurrence Level	Amount of people
1	64
2	20
3	12
4	3
5	1

III. **Basketball Survey:** This was the third sport on the list and based on the survey, more than half of people placed it at number four and 75% placed basketball at either four or five. According to (Headcase 2017), the rate of concussions in basketball per 100, 000 players is 18.6-21. This number is similar to the rate of concussions in soccer and after comparing the respondents' answers with proven facts, it is safe to say that people underestimated the number of concussions occurring in basketball. Only 8% of people placed basketball in the top two values and it has been proven that basketball is mostly in the middle of the pact out of all sports involving concussions, not at the bottom. So, our respondents were off the mark when it came to the sport of basketball.

Basketball	
Occurrence Level	Amount of people
1	0
2	8
3	17
4	55
5	20

IV. **Ice Hockey Survey:** This was the fourth sport on the list and based on the survey, there was an even spread. With 50% of respondents placing ice hockey in the top two positions, and 50% of respondents placing it in the 3-4 slots, it is shown that half of people believe ice hockey to be a concussion-prone sport while others think that it is more in the middle of the all sports as far as occurrences of concussions. According to (Headcase 2017), the concussion rate for ice hockey per 100, 000 players is at 54. This is a high number as it is just below American football in the ranks that were shown in the data. Overall, ice hockey's prime spot on the list would be at number two which 33% of people placed it as. This is a solid number of people but not enough to say that the majority predicted ice hockey to be one of the sports with the most concussions occurring in it.

Ice Hockey	
Occurrence Level	Amount of people
1	17
2	33
3	36
4	14
5	0

V. **Baseball Survey:** This was the fifth and final sport on the list and based on the survey, the list looks extremely skewed and most of the respondents leaned on concussion occurrence in baseball as very limited. According to (Headcase 2017), the rate of concussions in baseball per 100, 000 players is 4.6-5. From all high school sports, this puts baseball at the lowest part of the pact. The respondents were correct on this prediction as 90% of people stated concussions either occur very rarely or don't occur. Only 3% of people placed baseball in the top two slots so that was an accurate sight to see when comparing.

Baseball	
Occurrence Level	Amount of people
1	0
2	3
3	7
4	18
5	72

9. Summary, Conclusions & Recommendations

This research project provides an analysis of the association between the people's knowledge of concussions compared with the currently available statistics. An overview of concussions that have had a profound impact on human development is reported.

Following this examination, the project discusses the connection between the onset people's point of view with the statistics provided by various sources. For instance, the Headcase article has listed that around 3, 000, 000 sports related concussions occur every single year in the United States which demonstrates that concussions are in fact a major health issue and need to be addressed.

Subsequently, another question was asked regarding the number of high school sports related concussions in the U.S every year and that stood at around 300, 000 (also provided by Headcase). Not only does this interrupt the development of a student's brain, it also damages their nervous and circulatory systems.

Results from the survey report that people's understanding was not up to par with the collected statistics and that demonstrates a loophole somewhere in either our ability to comprehend the challenges of concussions, or news outlets have not been reporting them to the level they should.

Moreover, the results of a survey questionnaire administered around the University of Delaware campus, Kennett High school, and peers at the New Castle Government building are provided. Statistical data, frequency tables, and bar charts are completed for all relevant questions. Analysis of the results is provided, which convey respondent preferences and sentiments towards the issue of concussions. Another set of results show the level of concussion per 100, 000 players that occurs in each sport including soccer, American football, basketball, ice hockey, and baseball. Based on the frequency tables, the data shows that people varied in their accuracy of projections to the statistic. Most people identified American football as having the most concussions but very few people figured ice hockey was one of the higher-level sports that have concussions occurring among the players.

Since concussion occurring in all sports, especially among the young adults is an important medical issue and happens frequently, the media, the government, the medical institutions and the schools themselves need to do more to educate the students, their parents, and the population at large. Better education, prevention and research will hopefully result in lower number of young lives being affected by concussions.

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Author Profile

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