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Does Knowledge Of Concussion Symptoms Influence An Athlete's Self-Report Of A History Of Concussion Across Gender And Age?

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DOES KNOWLEDGE OF CONCUSSION SYMPTOMS INFLUENCE AN ATHLETE'S SELF-REPORT OF A HISTORY OF CONCUSSION ACROSS GENDER AND AGE?

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by

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Abstract

Background: The incidence of sport-related concussion is debatable. While the Centers for Disease Control and Prevention report an extrapolated incidence of 1.6 to 3.2 million recreational/sports-related traumatic brain injuries a year, the suspicion is that the incidence is much higher (CDC, 2014). An important consideration in determining the incidence involves whether an athlete's knowledge of what a concussion is influences their self-report of prior concussions.

Purpose: The purpose of this study is to replicate and extend Pfirman (2015) in determining whether providing information about concussion will increase the self-report of a history of concussion. Furthermore, this study investigates whether there is a difference in self-reporting between males and females and between age groups (18 and over; 17 and under).

Study Design: Group design comparing a Pre-Test Information Group and a Post-Test Information Group matched for gender and age.

Methods: Before taking the ImPACT test the athletes (participants) will be randomly separated into two groups, the Pre-Test Information Group and the Post-Test Information group. The Pre-Test Information Group will be read a script describing symptoms associated with a concussion prior to taking the ImPACT test, while the Post-Test Information Group will not receive concussion information until after the ImPACT test. Both groups will complete a questionnaire following ImPACT testing that asks: "Based on your experience here today, do you think you have ever had a concussion? What is your age? What grade are you in school? Are you male or female?"

Results: A Chi Square analysis yielded that there was no statistically significant difference

between the Pre-Test Information Group and the Post-Test Information Group (p=0.160). An additional Chi Square analysis found that age of the athletes was not a factor (p=0.160), and there was no difference in gender (p=0.160)

Table of Contents

List of Tables

Lists of Figures

Chapter 1: Introduction

The purpose of this study is to promote public awareness of the seriousness of sports-related concussions. Salvatore and Fjordbak (2011) state that a concussion is a brain injury initiated by a bump, blow, or jolt to the head that changes the way the brain functions at the level of the neurons. According to Centers for Disease Control and Prevention (CDC) (2014), concussions affect more than 1.7 million people in the United States annually and often can be difficult to diagnose. Further more, the purpose of this study is also to replicate and extend Pfirman (2015) in determining whether providing information about concussion will increase the self-report of a history of concussion. Additionally, this study investigates whether there is a difference in self-reporting between males and females and between age groups (18 and over; 17 and under).

1.1 Statement of the Problem

Covassin, Elbin, and Sarmiento (2012) mentioned that roughly 45 million American children partake in organized sports annually. Youth athletes between the ages of 5 and 18 years account for 65% of all sports- and recreation-related traumatic brain injuries (including concussions) treated in U.S. emergency departments annually." The short and long-term ramifications that concussions have on the brain are found to be an intriguing, yet a vital topic that is unquestionably a beneficial subject for further exploration.

1.2 Research Questions

If athletes are given information about what a concussion is before taking an ImPACT baseline test, will they be more likely to report having concussion versus athletes who do not receive this information prior to taking the test? Will males have a statistically significant higher self-report rate of a history of concussion versus females? Will those 18 and over have a statistically significant higher self-report rate of a history of concussion versus those who are 17 and under?

1.3 Assumptions

It is assumed that the athletes given information about concussions prior to taking an ImPACT baseline test will report higher rates of concussion than the athletes who received the same information after they take the test. The males will report a statistically significant higher rate of concussion than the females. Those 18 and over will report a statistically significant higher rate of concussion versus those who are 17 and under.

1.4 Significance of Study

This study will help promote public awareness of the seriousness of sport-related concussions. The symptoms of a concussion, how concussions should be managed, and their lasting effects are imperative for health care providers, families, and communities to understand, so that the injury is properly managed. This study will also teach the large quantity of athlete's we see in our clinic to readily recognize symptoms related to concussion, so they may report it to their coaches and trainers. Doing so will help prevent further harm and allow athletes to be put on the appropriate healing protocol.

Chapter 2: Background/Literature Review

2.1 Key Influences on Concussion Reporting

According to Snedden (2013), it is imperative to provide a clear understanding of concussion. A concussion can generate long-term recovery and permanent sequelae in a developing brain. Concussions may cause long-lasting consequences on cognitive, social, psychologic, and sleep areas. Furthermore, allowing a concussed athlete to return to their sport early may position them at danger of second-impact syndrome. Cantu (1998) reports that second-impact syndrome occurs when a person endures a first brain injury and then experiences a second brain injury before the symptoms related to the first injury have resolved. Regardless of severity, the second concussion may cause devastating consequences ranging from severe neurological dysfunction to death. Although it has been mentioned that it is imperative to provide coaches, parents, and athletes with knowledge of what a concussion is. This had been a difficult task, because there is no agreed-upon term for a concussion. With this being stated, the following definition of concussion is provided by Snedden (2013): Concussion is described as a multifaceted, pathophysiologic process from the effects of a traumatic bump, blow, or jolt to the head, or to the body with an intensity shifted to the head initiating concurrent rotational acceleration of the brain. Consequences occur as a rapid onset of temporary alterations in one or all of the cognitive, physical, behavioral, and sleep domains. Commonly, the symptoms are temporary, subsiding spontaneously. The manifestation of concussion does not necessitate the loss of consciousness or amnesia. Moreover, with the use of brain imaging, it is found that concussion is of structural abnormality. The signs/symptoms associated with concussion differ amongst persons and involve personalized care for evaluation, management, and follow-up.

Based on McCrory (2013), several symptoms may be associated with concussion and may present as follows: the migraine domain may include headaches, dizziness, visual problems, sensitivity to noise/light, nausea/vomiting, balance problems, and numbness/tingling. Under the cognitive domain, one might experience fatigue, fogginess, drowsiness, cognitive slowing, and difficulty concentrating/remembering. Symptoms associated with the sleep domain may involve difficulty sleeping, sleeping less, or sleeping more. Lastly, symptoms that fall under the neuropsychiatric domain include feeling more emotional, sadness, nervousness, and irritability.

The incidence of sports-related concussion is debatable. While Centers for Disease Control and Prevention (CDC) (2014) reports an extrapolated incidence of 1.6 to 3.2 million recreational/sports-related traumatic brain injuries a year, the suspicion is that the incidence is much higher. The exclusion of athletes who do not visit the ER underestimates the incidence rate of concussions. Puga (2011) reported that the incidence of sports-related concussion admitted to the emergency departments in El Paso hospitals was statistically smaller than the incidence reported by athletic trainers in the El Paso high schools. When a comparison of concussions reported by athletic trainers versus admissions to the ER for athletes was observed, it was seen that 55% of the cases of concussions reported by athletic trainers were not reported in the ER. A majority of the athletes were managed and evaluated by the athletic trainer and a physician. Evaluation of a concussion consists of immediate sideline attention relying on athletic trainers to diagnose a concussion and more often than not, these cases are not seen in the ER. The 55% who were not hospitalized are an example of the concussed athletes not accounted for in the national datasets.

A cursory inspection of the incidence of concussion reported by El Paso high school athletes during baseline testing suggests an incidence of approximately 25%. Carroll, et al.,

(2004) reporting for the WHO Collaborating Centre Task Force on Mild Traumatic Brain Injury, stated that 25% of mild TBIs are seen in children 5-14 years of age. While Guskiewicz, et al., (2000) reported approximately 5% of high school and collegiate athletes experience a concussion each season. Given this difference in reported incidence, an important consideration in determining the incidence involves whether the number of concussions is determined by self-report by the athlete, sideline diagnosis, or admission to an emergency department. When NFL athletes were asked in face-to-face interviews, they reported a concussion history of approximately 15%, but when asked to report the incidence anonymously, 75% of them reported a history of concussion (Guskiewicz et al., 2000). A second consideration is the following: does an athlete's knowledge about concussion, influence their self-reports of a history of concussion. According to Puga (2011) absence of information about a concussion was the most common factor for not reporting a concussion to anyone. Puga proceeded to report McCrea et al. (2004), whose researchers provided an operational definition of concussion to athletes in their study, and in return found these athletes then readily recognized and admitted to having experienced a concussion.

Covassin, Elbin, and Sarmiento (2012) found that numerous coaches from around the country, even those in states with a concussion in sports law in place, still obtain limited knowledge on the prevention, recognition, and management of sports-related concussions. Athletes frequently look to their coaches for guidance on and off the sports field, and if coaches themselves are not knowledgeable about concussions, then their athletes are at a loss as well. A group of coaches in their study were given materials that explained concussions. Once the coaches read the materials, they made efforts to educate others, specifically their athletes, parents, and other coaches about brain injury.

McCrea, Hammeke, Olsen, Leo, and Guskiewicz (2004), report that their results indicated that high school football players usually do not report a probable concussion because they did not think their concussion was significantly serious, which was unexpected based on past stereotypes. It has long been thought that football players were hesitant to report a concussion based exclusively on competitive factors—their motivation not to be withheld from competition. Based on the survey results, McCrea et al. suggest that a lack of knowledge related to the risks and potential consequences of concussion, play an equal or greater role in high school football players not reporting a probable concussion. When provided with a definition of concussion and a description of injury signs and symptoms, these players more readily recognized and admitted to sustaining a concussion over the course of the football season. Weber and Edwards (2010) also stated that terminology has been known to effect self-report rates in athletes. Greater self-reports in sports were observed when informal terms (i.e. bell rung, dinged) or a symptom-based method was used compared to direct injury history questions. This implies that the question "have you ever sustained a concussion?" could generate different self-report rates than the question "have you ever sustained an mTBI?" The significance of terminology should not be underestimated. Researchers have implied that sports brain injury terminology varies in knowledge and understanding which can effect injury-related expectations, as well as recovery and outcome, as shown by symptom self-reports or neuropsychological tests (Weber & Edwards, 2010).

2.2 Additional Influences

Another potential influence on athletes self-report of concussion may be the attitude of their coaches. De Lench (2013) purports that a developing body of evidence indicates that the main barrier to honest reporting of concussion symptoms is not a lack of concussion knowledge. Rather, De Lench suggests that the attitude of coaches towards reporting and athletes believing the coach will punish them if they report concussion symptoms are more significant factors. The athlete may also feel that they will be perceived as weak by their coach, teammates, and/or parents. If this culture is going to change, it is necessary to construct an atmosphere that promotes athletes to report their concussion symptoms and those of their teammates. Athletes should be encouraged to report honest concussion symptoms, not just during games or practices, but also in the hours and days after play. Using a buddy system where teammates look for and report signs of concussion in each other should be recommended as well.

2.3 Testing

The athletes assessed at the University of Texas at El Paso (UTEP) Concussion Management Clinic (CMC) are administered the Immediate Post-Concussion Assessment and Cognitive Test (ImPACT). Lovell (2015) renders this computer-administered test as the most-widely used and most scientifically validated computerized concussion assessment tool. According to ImPACT (2015), "The ImPACT Concussion Management Model promotes the highest level of care and a safe return to play for athletes of all ages, from younger children (ages 10 and up) to collegiate and professional athletes."

There are 4 parts that make up the ImPACT test in the following order: demographic profile and health history questionnaire, current concussion symptoms and conditions, baseline

and post-injury neurocognitive tests, and graphic display of ImPACT test scores. The demographic profile and health history questionnaire asks the athlete to enter simple demographic and descriptive information concerning areas, such as height, weight, sport, position, concussion history, history of learning disabilities, and further principal explanatory information. The current concussion symptoms and conditions section question the athlete about their latest concussion date, hours slept the night before taking the test, and present medications.

2.4 Pilot Study

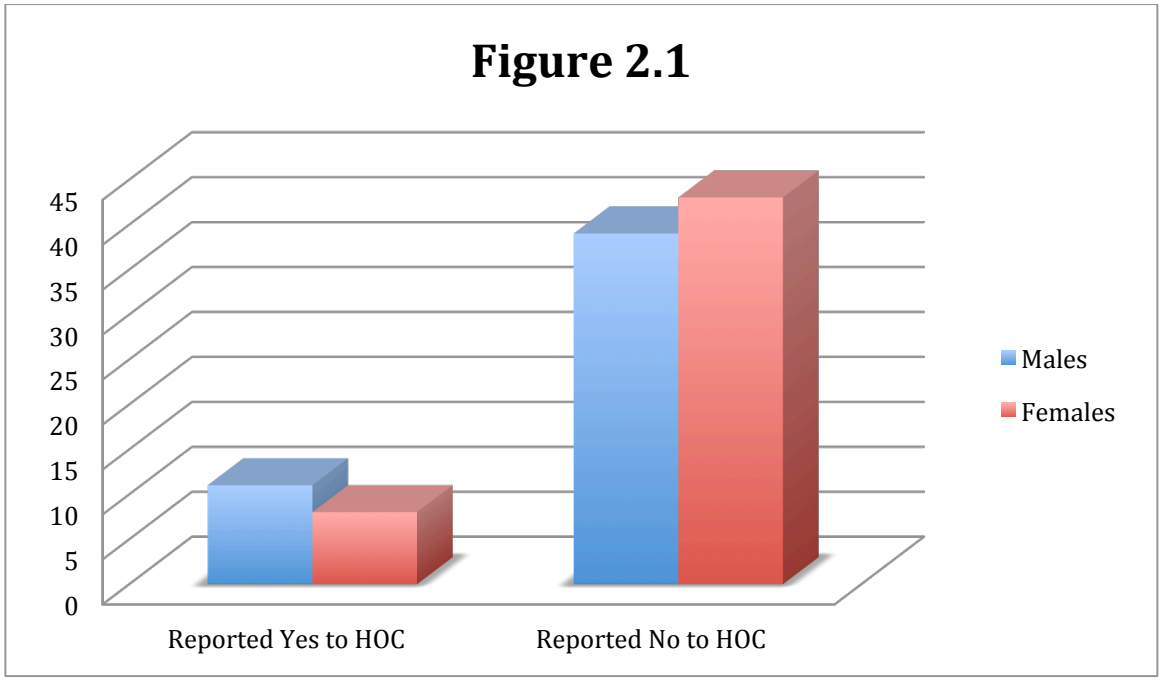
A pilot study at the University of Texas at El Paso (UTEP) Concussion Management Clinic was performed which investigated how sub-groups of athletes (gender and age) compared in their reports of a prior history of concussion when provided no standardized information about concussions. The athletes tested in this clinic are administered the ImPACT (Immediate Post-Concussion Assessment and Cognitive Testing) test for baseline and post-concussion evaluation. One question posed in the demographics section of the test asks the athlete to report their prior concussion history. A convenience sample of 101 athletes was obtained to gather their answers to this question and observe how sub-groups of athletes compared in their report of a history of concussion. The 101 athletes were from local high schools, collegiate teams, and a semi-professional hockey team. The data extracted was entered into an Excel spreadsheet. SPSS 20.0 was used to run a Chi Square analysis. This analysis was performed to examine the difference between males and females reporting concussion and the difference between athletes over the age of 18 and under the age of 18 reporting concussion. When using a Chi Square statistical test, any p-value equal to or below 0.05 is considered significant.

The results showed no significant differences between males who reported a history of concussion on the ImPACT (22.0%), and females who reported a history of concussion on the ImPACT (15.7%) (p = .417) (Table 2.1/Graph2.1). Other demographic information gathered for this pilot study such as age, gender, sport, grade, and whether athletes were 18 and over or 17 and under may be viewed in Tables 2.1-2.6/Graphs 2.1-2.6. The percentages in these tables were calculated for all respective groups, such as Table 2.1 reveals that 11 (22.0%) males out of 50 total reported a history of concussion while 8 (15.7%) females out of 51 total reported a history of concussion.

Table 2.1
Demographics of Gender for HOC Report in Pilot Study (N=101, percentage calculated separately for each gender)

Gender	***n***	Reported Yes to HOC	Reported No to HOC
Male	50	11 (22.0%)	39 (78.0%)
Female	51	8 (15.7%)	43 (84.3%)

Chi-Square ($p = 4.17$)

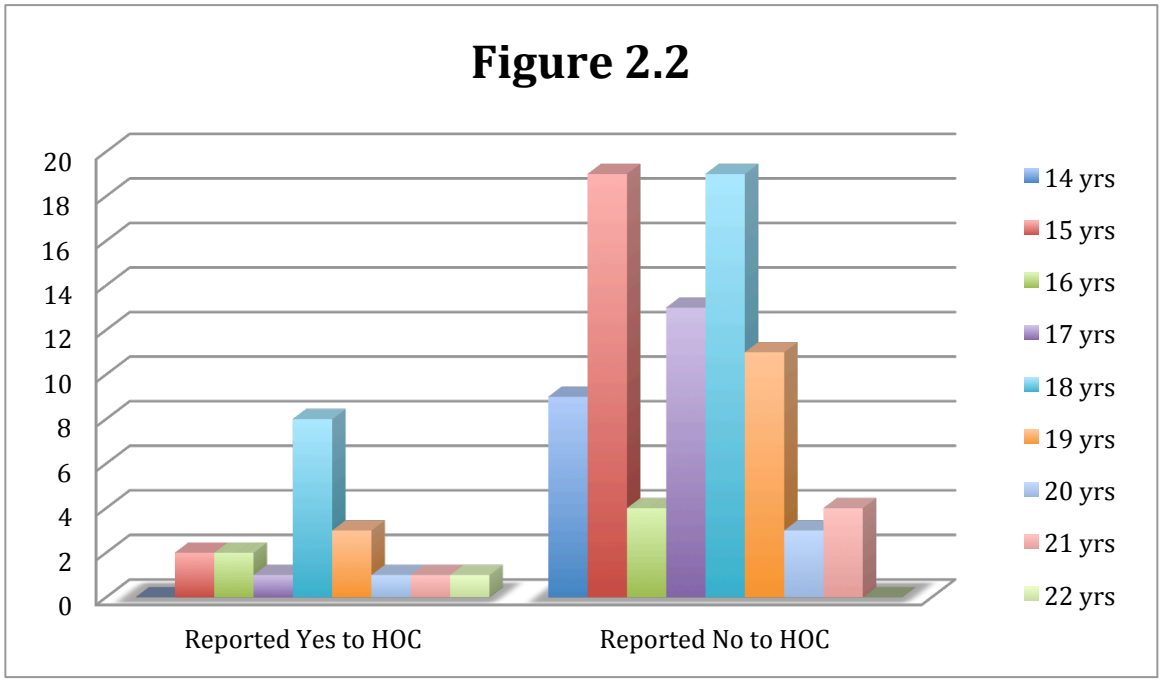


** Data from Table 2.1 is presented in the bar graph above*

Table 2.2

Demographics of Age for HOC Report in Pilot Study (N=101, percentage calculated separately for each age)

Age (years)	***n***	Reported Yes to HOC	Reported No to HOC
14	9	0 (0.0%)	9 (100.0%)
15	21	2 (9.5%)	19 (90.5%)
16	6	2 (33.3%)	4 (66.7%)
17	14	1 (7.1%)	13 (92.9%)
18	27	8 (29.6%)	19 (70.4%)
19	14	3 (21.4%)	11 (78.6%)
20	4	1 (25.0%)	3 (75.0%)
21	5	1 (20.0%)	4 (80.0%)
22	1	1 (100.0%)	0 (0.0%)



** Data from Table 2.2 is presented in the bar graph above*

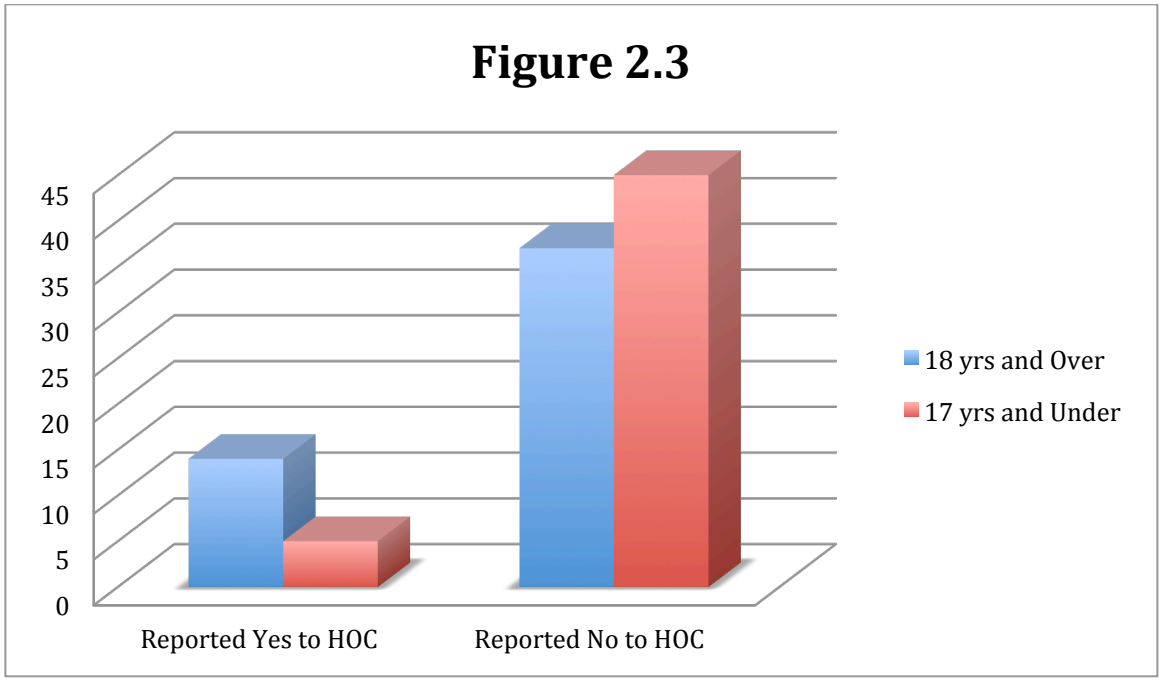
Among the athletes who reported a history of concussion, 2/21 athletes were 15 years old, 2/6 athletes were 16 years old, 1/14 athletes were 17 years old, 8/27 athletes were 18 years old, 3/14 athletes were 19 years old, 1/4 athletes were 20 years old, 1/5 athletes were 21 years old, and 1/1 athletes were 22 years old (Table 2.2/Graph 2.2).

Table 2.3

Demographics of 18 and Over/17 and Under Groups for HOC Report in Pilot Study (N=101, percentage calculated separately for each age group)

Over 18/Under 17 Groups	***n***	Reported Yes to HOC	Reported No to HOC
18 and Over	51	14 (27.5%)	37 (72.5%)
17 and Under	50	5 (10.0%)	45 (90.0%)

Chi-Square (p = .025)



** Data from Table 2.3 is presented in the bar graph above*

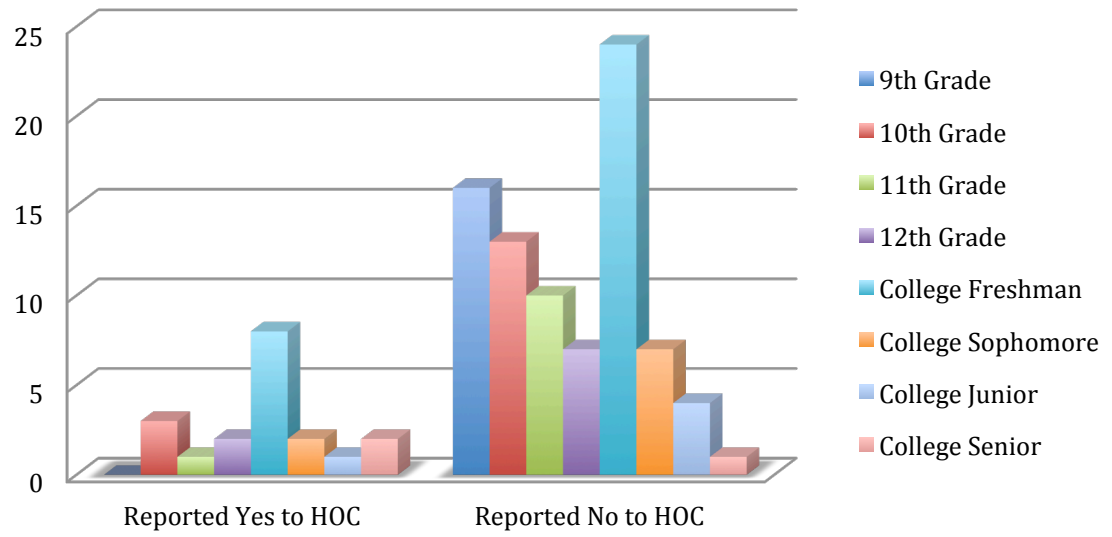
Of the 51 athletes who were 18 years of age and older, 14 reported a history of concussion, and of the 50 athletes who were 17 years of age and under, 5 reported a history of concussion (Table 2.3/Graph 2.3). School grades ranged from high school freshman (9th grade) to college seniors, with the following number of athletes in each grade level reporting a history of concussion: 0/16 athletes in 9th grade, 3/16 athletes in 10th grade, 1/11 athletes in 11th grade, 2/9 athletes in 12th grade, 8/32 athletes as college freshman, 2/9 athletes as college sophomores, 1/5 athletes as college juniors, and 2/3 athletes as college seniors (Table 2.4/Graph 2.4).

Table 2.4

Demographics of Grade for HOC Report in Pilot Study (N = 101, percentage calculated separately for each grade)

Grade	*n*	Reported Yes to HOC	Reported No to HOC
9th Grade	16	0 (0.0%)	16 (100.0%)
10th Grade	16	3 (18.8%)	13 (81.2%)
11th Grade	11	1 (9.1%)	10 (90.9%)
12th Grade	9	2 (22.2%)	7 (77.8%)
College Freshman	32	8 (25.0%)	24 (75.0%)
College Sophomore	9	2 (22.2%)	7 (77.8%)
College Junior	5	1 (20.0%)	4 (80.0%)
College Senior	3	2 (66.7%)	1 (33.3%)

Figure 2.4



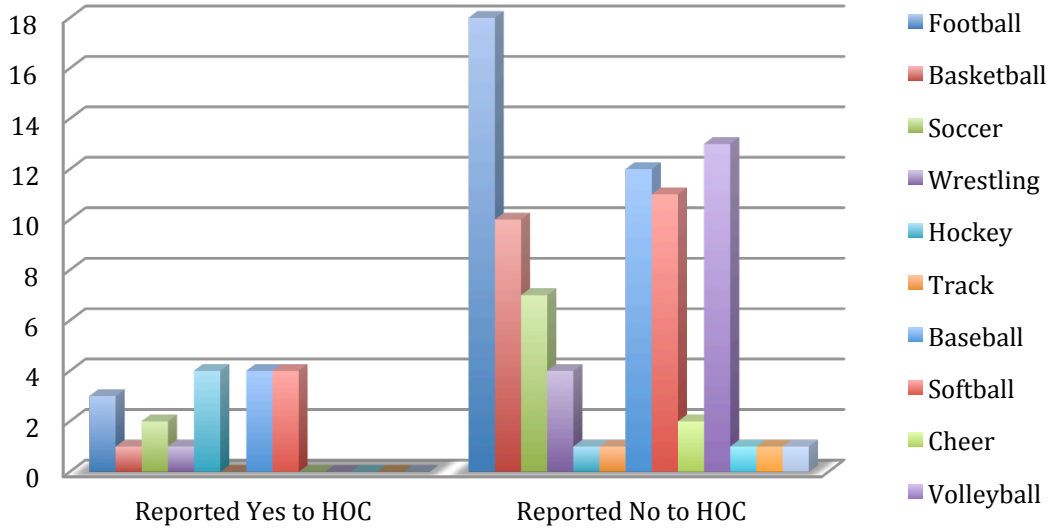
** Data from Table 2.4 is presented in the bar graph above*

Table 2.5

Demographics of Sport for HOC Report in Pilot Study (N=101, percentage calculated separately for each sport)

Sport	*n*	Reported Yes to HOC	Reported No to HOC
Football	21	3 (14.3%)	18 (85.8%)
Basketball	11	1 (9.1%)	10 (90.9%)
Soccer	9	2 (22.2%)	7 (77.8%)
Wrestling	5	1 (20.0%)	4 (80.0%)
Hockey	5	4 (80.0%)	1 (20.0%)
Track	1	0 (0.0%)	1 (100.0%)
Baseball	16	4 (25.0%)	12 (75.0%)
Softball	15	4 (26.7%)	11 (73.3%)
Cheer	2	0 (0.0%)	2 (100.0%)
Volleyball	13	0 (0.0%)	13 (100.0%)
Cross-Country	1	0 (0.0%)	1 (100.0%)
Roller Derby	1	0 (0.0%)	1 (100.0%)
Bicycling	1	0 (0.0%)	1 (100.0%)

Figure 2.5



** Data from Table 2.5 is presented in the bar graph above*

Amongst the athletes in the various sports, 3/21 football players reported a history of concussion, 1/11 basketball players reported a history of concussion, 2/9 soccer players reported a history of concussion, 1/5 wrestlers reported a history of concussion, 4/5 hockey players

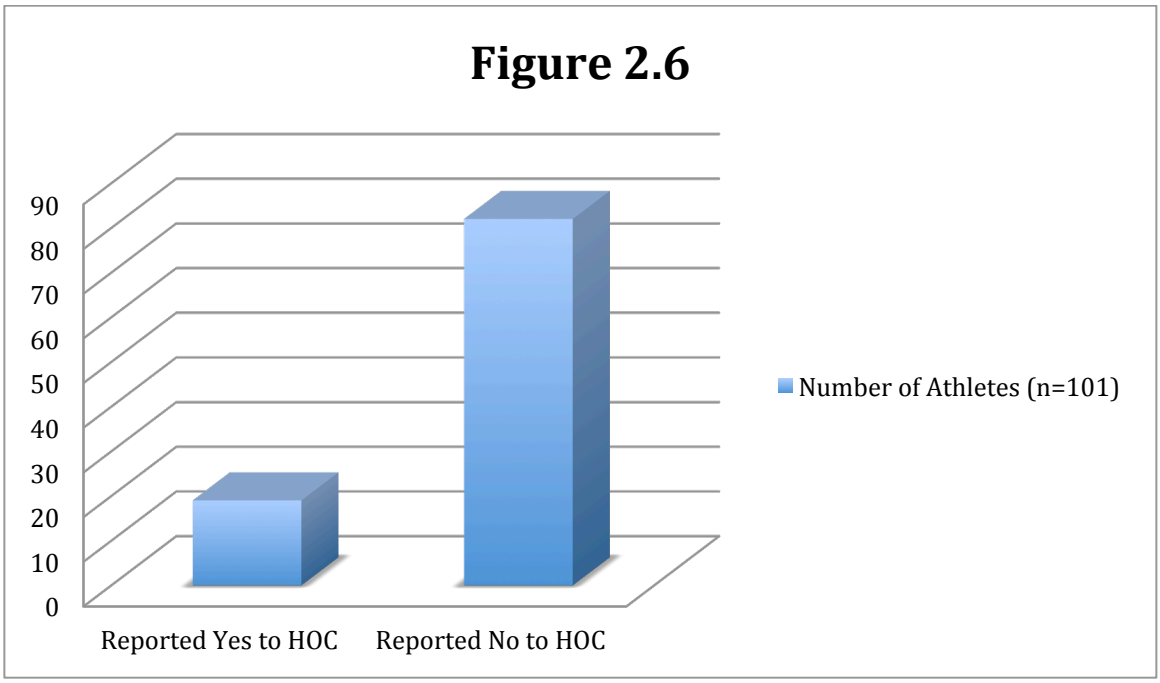
reported a history of concussion, 0/1 track athletes reported a history of concussion, 4/16 baseball players reported a history of concussion, 4/15 softball players reported a history of concussion, 0/2 cheerleaders reported a history of concussion, 0/13 volleyball players reported a history of concussion, 0/1 cross-country athletes reported a history of concussion, 0/1 roller derby athletes reported a history of concussion, and 0/1 bicyclists reported a history of concussion (Table 2.5/Graph 2.5). Out of the total 101 athletes, 19 athletes reported yes to a history of concussion, and 82 athletes reported no to a history of concussion (Table 2.6/Graph 2.6).

Table 2.6

Demographics of Report of History of Concussion (N=101)

HOC	Number of Athletes
Yes	19 (18.8%)
No	82 (81.2%)

Figure 2.6



** Data from Table 2.6 is presented in the bar graph above*

Although no significant results were yielded, it was observed that males reported a history of concussion slightly higher than females, thus, it was believed that significant results could be found if a larger study was conducted. Across age, results showed a significant difference between those who were 18 and over that reported a history of concussion on the ImPACT test (27.5%), and those who were 17 and under that reported a history of concussion on the ImPACT test (10%) (p=.025).This variation in age suggested that a difference in concussion reporting between older and younger athletes could also possibly be found if a larger study was conducted. Additionally, results demonstrate that approximately 18.8% or 19 out of the 101 athletes evaluated from our database reported having a history of concussion, which is higher than the 5-6% reported in the literature by Guskiewicz, et al. (2000).

The purpose of this investigation is to determine if knowledge of concussion has an effect on an athlete's self-reporting of the number of concussions they have suffered. It is assumed that the athletes given information about concussions prior to taking an ImPACT baseline test will report higher rates of concussion than the athletes who received the same information after they take the test.

Chapter 3: Methods

3.1 IRB Approval:

The institutional review board (IRB) for human subjects at UTEP approved this study.

3.2 Study Design:

This study used a group design comparing a Pre-Test Information Group and a Post-Test Information Group matched for gender and age**.**

3.3 Participants:

This study consisted of 214 athletes (participants) from UTEP, local middle/high schools, and a semi-professional hockey team from the El Paso region, which added 15 new participants to the retrospective data reported by Pfirman (2015). These athletes were between the ages of 12 to 25 years of age. Out of these athletes, 68 (32%) reported a history of concussion and 140 (69%) did not report a history of concussion.

3.4 Instruments:

The information provided to these athletes before or after testing is in a script (reading level: Grade 10.9) and pamphlet that explains what a concussion is and how to manage it. The script given to athletes before test taking is as follows:

"A concussion is a type of traumatic brain injury (TBI) caused by a bump, hit, or jolt to the head. Concussions can also occur from a fall or a hit to the body that causes the head to shake back and forth. Common phrases used to describe a concussion are "having your bell rung", "getting a ringer", and "seeing stars". They cannot be seen on x-rays or CT scans

because concussions change the way the brain functions, not the way it looks. These changes can show up symptomatically throughout the entire body, and they may affect how you feel physically and emotionally, your vision, balance, concentration, and sleep. Since brain injuries are not visible to the eye, someone with a concussion may "look normal." However, a concussion can be a very serious injury, identified mainly by concussion symptoms that you cannot just "walk off." It is important to be aware of the many indicators of concussions and understand the recovery process. If you ever suspect that you may have a concussion, tell your coach, parent, or trainer right away."

An anonymous questionnaire was given to all athletes in both the Pre-Test Information Group and the Post-Test Information Group. The questions on the questionnaire are as follows: Based on the information we have given you, as well as on your experience today, do you think you have ever had a concussion? What is your age? What school do you attend? What grade are you in school? Are you male or female? The questionnaire was created, so athletes are given a chance to report their concussions anonymously with no fear of repercussion from reporting. Additionally, it was created to obtain a more accurate depiction of self-reports, because the ImPACT asks "Have you ever been diagnosed with a concussion by a physician?"

3.5 Procedures:

Before athletes in the El Paso region begin their sports season, the UTEP Concussion Management Clinic provides baseline neurocognitive testing for these athletes. The athletes in this study were assessed using the ImPACT test, which is a computerized neurocognitive assessment. The athletes completed this test in UTEP computer labs or the athletes' middle/high school computer labs. As they came into the clinic, athletes were divided evenly into the two

groups according to the number that was present. The experimental group (Pre-Test Information Group) received information about what a concussion is prior to taking the ImPACT baseline test, and the control group (Post-Test Information Group) received the same information in pamphlet form after taking the baseline test. A clinician gives this script orally to the experimental group (Pre-Test Information Group) before the baseline test, while the control group (Post-Test Information Group) is placed in a separate room so they cannot hear the information. After completion of ImPACT testing and answering the questionnaire, all athletes are given a pamphlet comprising information about concussion before leaving testing facilities. The control and experimental group were not matched across age and gender, because a convenience sample was obtained, including only those tested in the UTEP Concussion Management Clinic and at local public middle/high schools.

3.6 Statistical Analysis:

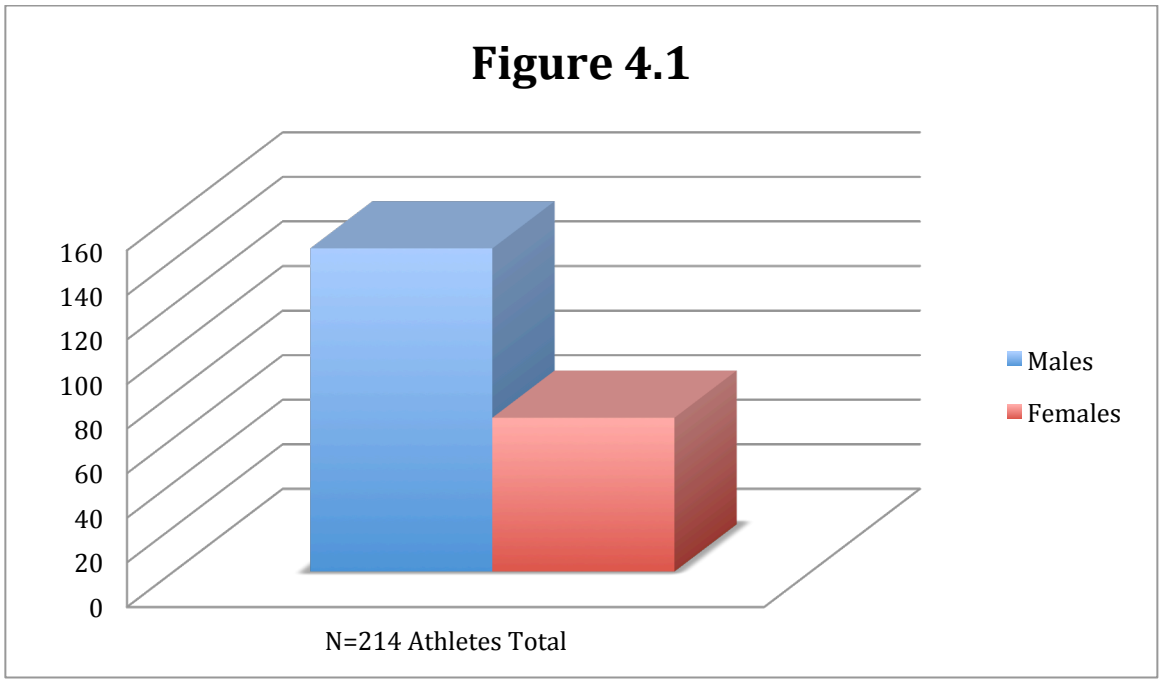
Each participant's questionnaire was reviewed, and the data was recorded and entered into an Excel file. The data was divided into a report of a history of concussion, gender, age, grade, and control group (Post-Test Information Group) and experimental group (Pre-Test Information Group). SPSS version 20.0 software was used to analyze the data. Pearson Chi-Square analyses were utilized to compare the report of the history of concussion in the Pre-Test Information Group and the Post-Test Information Group, as well as across gender and age. Age criteria were divided into two groups: athletes 18 and over and athletes 17 and under. Two independent scorers checked the data from the questionnaires with 100% agreement. A power analysis was also performed, which established that the study had an appropriate number of participants.

Chapter 4: Results

The data collected from the questionnaire was divided into a report of a history of concussion, gender, age, grade, and control group (Post-Test Information Group) and experimental group (Pre-Test Information Group). Tables 4.1-4.13 and Graphs 4.1-4.13 display the organization of this information based on the demographic information provided on the questionnaires.

Table 4.1
Demographics of Gender (N=214)

Gender	Number of Athletes
Male	145 (68%)
Female	69 (32%)

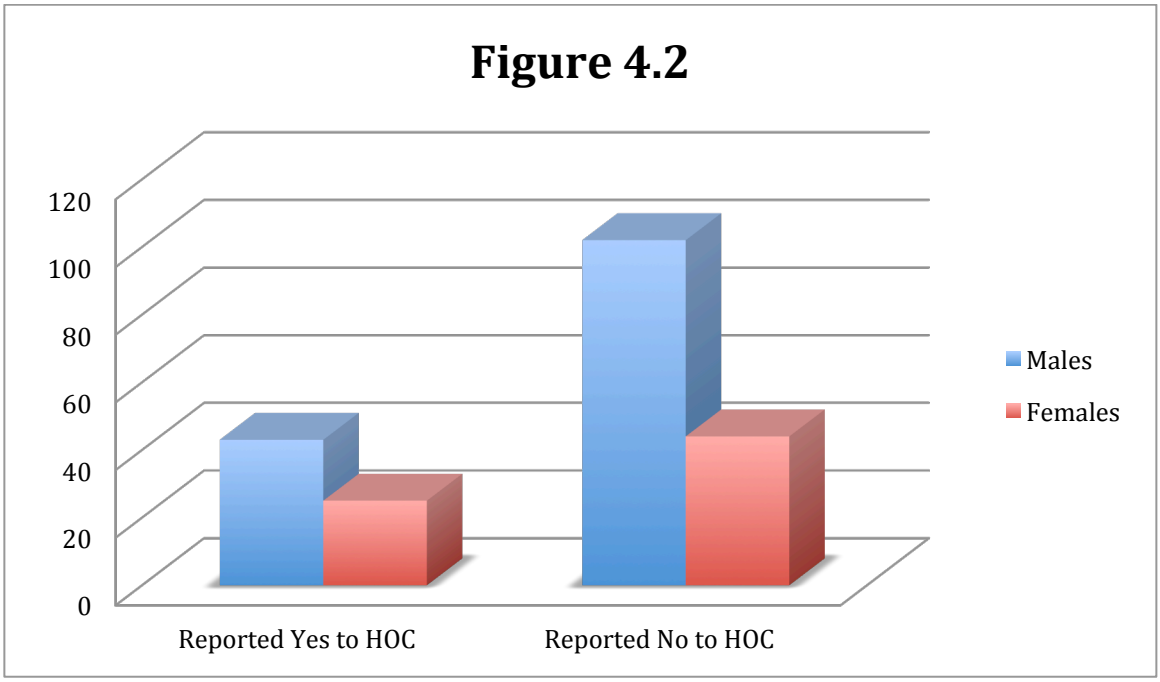


** Data from Table 4.1 is presented in the bar graph above*

Table 4.2

Demographics of Gender for HOC Report (N=214, percentage calculated separately for each gender)

Gender	*n*	Reported Yes to HOC	Reported No to HOC
Male	145	43 (29.7%)	102 (70.3%)
Female	69	25 (36.2%)	44 (63.8%)



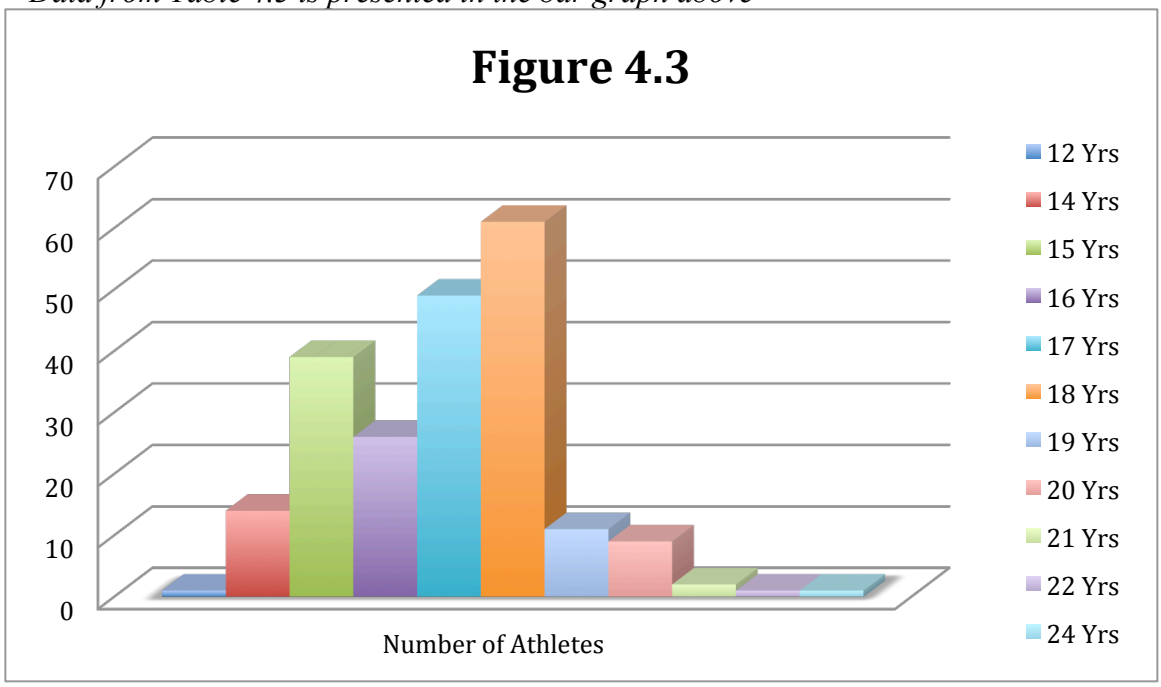
** Data from Table 4.2 is presented in the bar graph above*

Table 4.3

Demographics of Age (N=214)

Age (years)	Number of Athletes
12	1 (0%)
14	14 (7%)
15	39 (18%)
16	26 (12%)
17	49 (23%)
18	61 (29%)
19	11 (5%)
20	9 (4%)
21	2 (1%)
22	1 (0%)
24	1 (0%)

** Data from Table 4.3 is presented in the bar graph above*

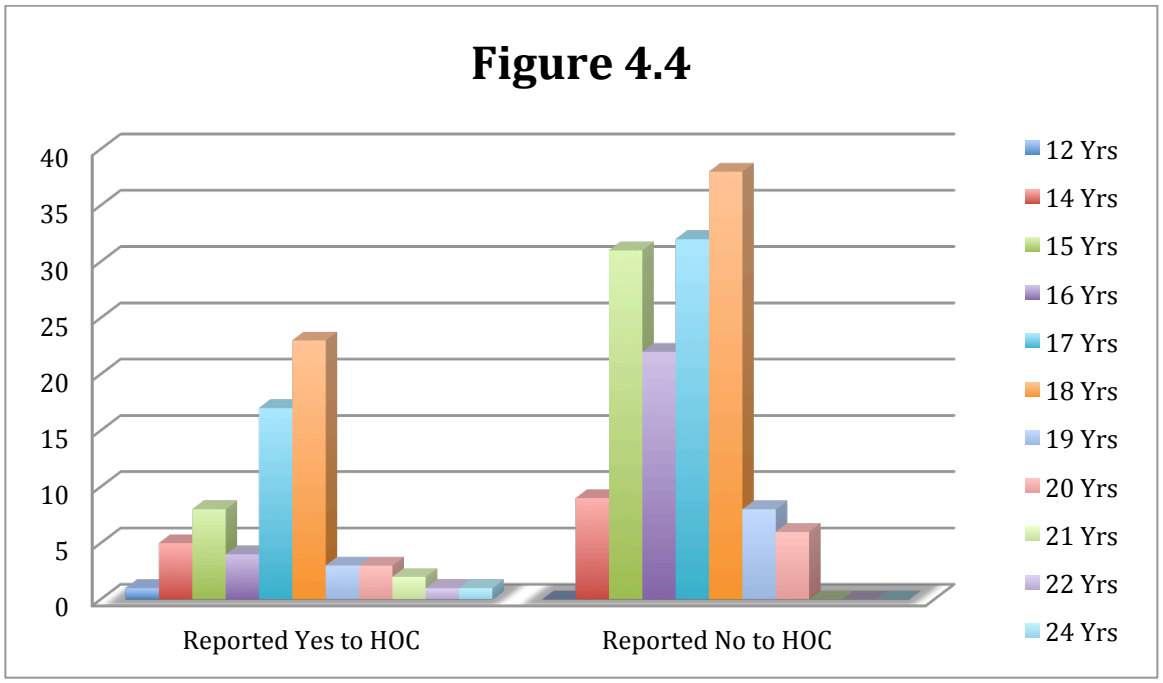


Most of the athletes were between the ages of 15 and 18 years, with the highest number of athletes being 18 (Table 4.3). Within the athletes who reported a history of concussion, 1 (100%) was 12 years old, 5 (35.7%) were 14 years old, 8 (20.5%) were 15 years old, 4 (15.4%) were 16 years old, 17 (34.7%) were 17 years old, 23 (37.7%) were 18 years old, 3 (27.3%) were 19 years old, 3 (33.3%) were 20 years old, 2 (100%) were 21 years old, 1 (100%) was 22 years old, and 1 (100%) was 24 years old (Table 4.4).

Table 4.4

Demographics of Age for HOC Report (N=214, percentage calculated separately for each age)

Age	*n*	Reported Yes to HOC	Reported No to HOC
12	1	1 (100%)	0 (0%)
14	14	5 (35.7%)	9 (64.3%)
15	39	8 (20.5%)	31 (79.5%)
16	26	4 (15.4%)	22 (84.6%)
17	49	17 (34.7%)	32 (65.3%)
18	61	23 (37.7%)	38 (62.3%)
19	11	3 (27.3%)	8 (72.7%)
20	9	3 (33.3%)	6 (66.7%)
21	2	2 (100%)	0 (0%)
22	1	1 (100%)	0 (0%)
24	1	1 (100%)	0 (0%)

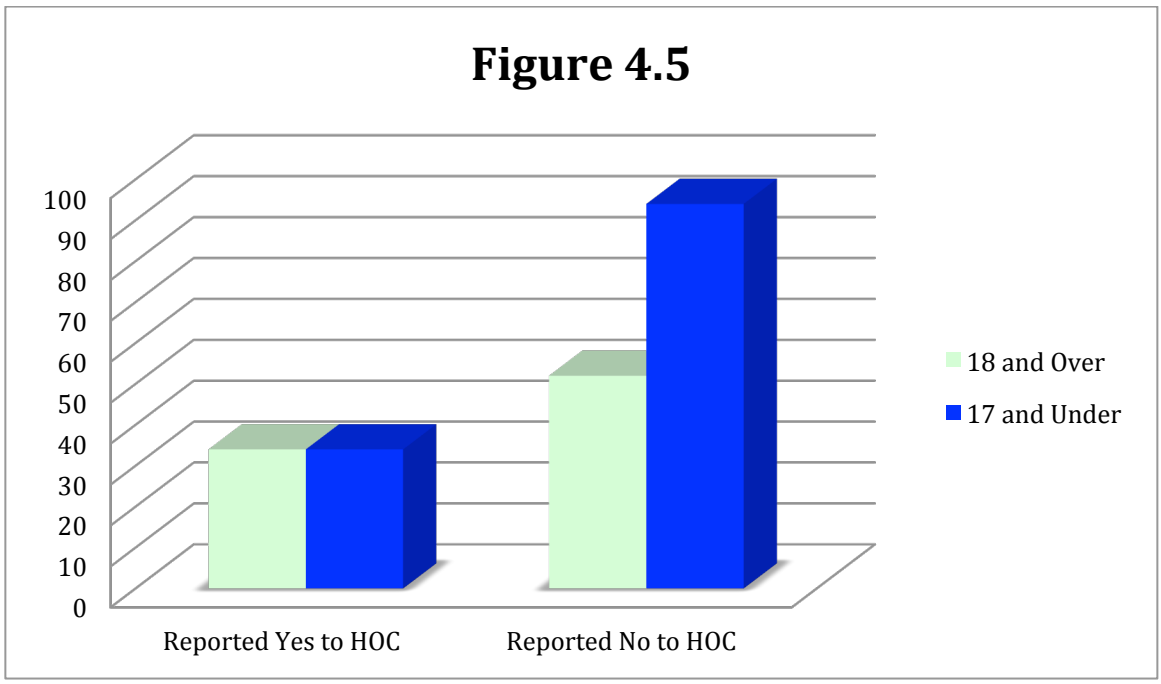


** Data from Table 4.4 is presented in the bar graph above*

Table 4.5

Demographics of 18 and Over/17 and Under Groups for HOC Report (N=214, percentage calculated separately for each age group)

Over 18/Under 17 Groups	*n*	Reported Yes to HOC	Reported No to HOC
18 and Over	86	34 (39.5%)	52 (60.5%)
17 and Under	128	34 (26.6%)	94 (73.4%)

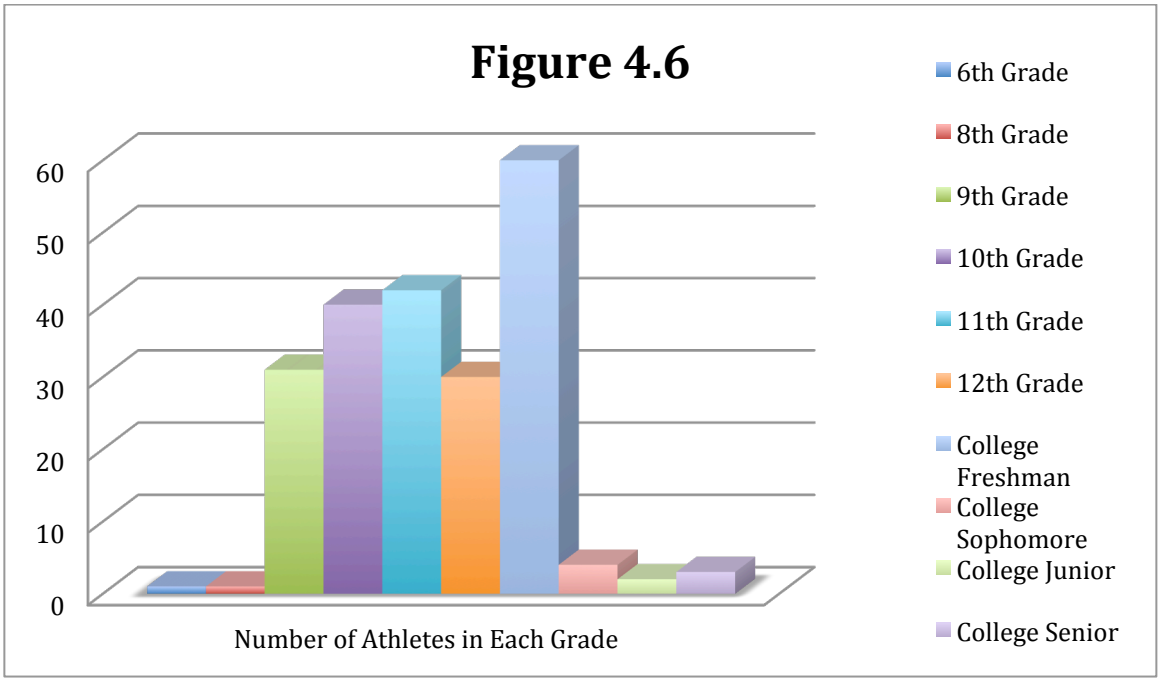


** Data from Table 4.5 is presented in the bar graph above*

Within the 18 and over age group, 34 (39.5%) athletes reported having a concussion, and in the 17 and under age group, 34 (26.6%) athletes reported having a concussion (Table 4.5).

Table 4.6
Demographics of Grade (N=214)

Grade	Number of Athletes
6th Grade	1 (0.5)
8th Grade	1 (0.5%)
9th Grade	31 (14.5%)
10th Grade	40 (18.7%)
11th Grade	42 (19.6%)
12th Grade	30 (14%)
College Freshman	60 (28%)
College Sophomore	4 (1.9%)
College Junior	2 (0.9%)
College Senior	3 (1.4=%)

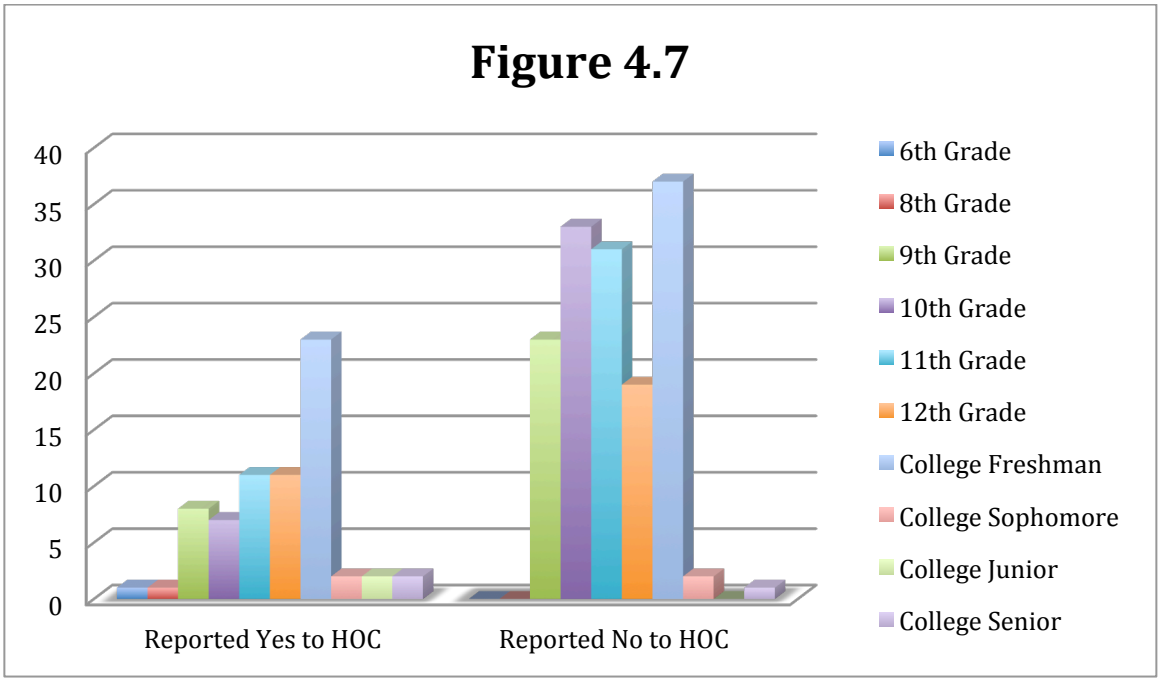


** Data from Table 4.6 is presented in the bar graph above*

Most of the athletes were in the grades 9th grade (high school) through college freshman, with the highest number of athletes being college freshman (60 athletes; 28%) (Table 4.6). The college freshman athletes also reported the highest number of a history of concussion (23 athletes; 38.3%) (Table 4.7).

Table 4.7
Demographics of Grade for HOC Report (N=214, percentage calculated separately for each grade)

Grade	***n***	Reported Yes to HOC	Reported No to HOC
6th Grade	1	1 (100%)	0 (0%)
8th Grade	1	1 (100%)	0 (0%)
9th Grade	31	8 (25.8%)	23 (74.2%)
10th Grade	40	7 (17.5%)	33 (82.5%)
11th Grade	42	11 (26.2%)	31 (73.8%)
12th Grade	30	11 (36.7%)	19 (63.3%)
College Freshman	60	23 (38.3%)	37 (61.7%)
College Sophomore	4	2 (50%)	2 (50%)
College Junior	2	2 (100.0%)	0 (0%)
College Senior	3	2 (66.7%)	1 (33.3%)

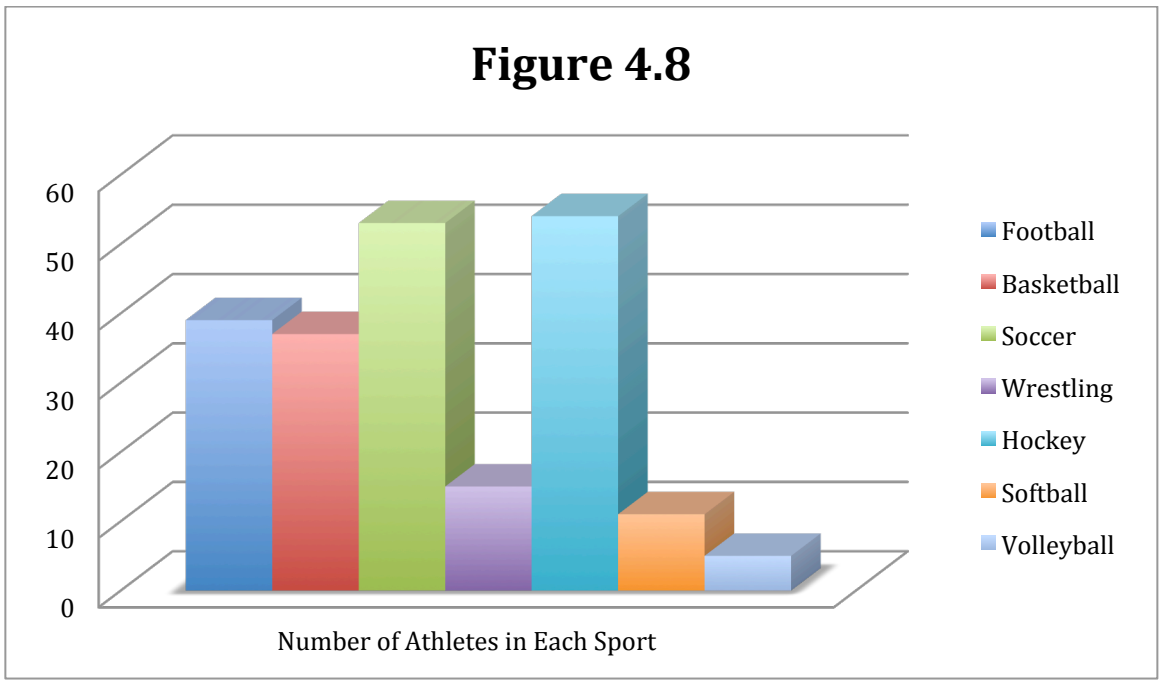


** Data from Table 4.7 is presented in the bar graph above*

Table 4.8

Demographics of Sport (N=214)

Sport	Number of Athletes
Football	39 (18.2%)
Basketball	37 (17.3%)
Soccer	53 (24.8%)
Wrestling	15 (7.0%)
Hockey	54 (25.2%)
Softball	11 (5.1%)
Volleyball	5 (2.3%)



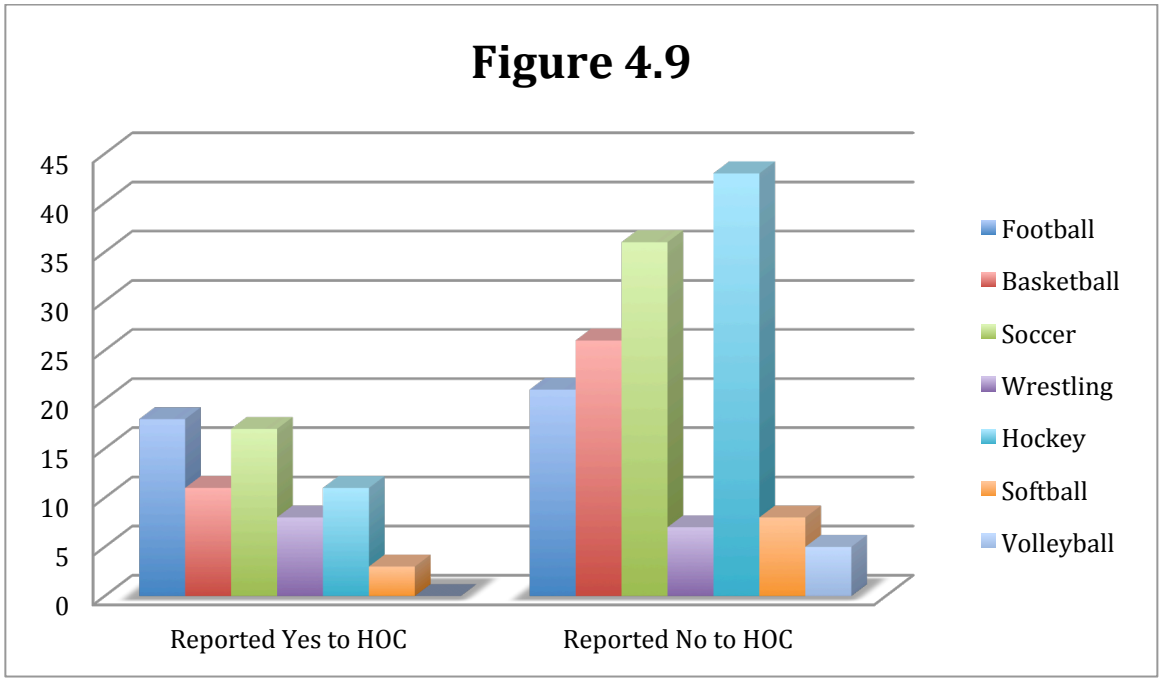
** Data from Table 4.8 is presented in the bar graph above*

The sport containing the most athletes was hockey with 54 (25.2%) athletes, followed by soccer with 53 (24.8%) athletes, football with 39 (18.2%) athletes, basketball with 37 (17.3%) athletes, wrestling with 15 (7.0%) athletes, softball with 11 (5.1%) athletes, and volleyball with 5 (2.3%) athletes (Table 4.8). Despite the higher number of athletes in hockey, football athletes reported the highest rate of a history of concussion (18 athletes; 46.2%), followed by soccer (17 athletes; 32.1%), basketball (11 athletes; 29.7%), hockey (11 athletes; 20.4%), wrestling (8 athletes; 53.3%), softball (3 athletes; 27.3%), and volleyball (0 athletes; 0%) (Table 4.9).

Table 4.9

Demographics of Sport for HOC Report (N=214, percentage calculated separately for each sport)

Sport	*n*	Reported Yes to HOC	Reported No to HOC
Football	39	18 (46.2%)	21 (53.8%)
Basketball	37	11 (29.7%)	26 (70.3%)
Soccer	53	17 (32.1%)	36 (67.9%)
Wrestling	15	8 (53.3%)	7 (46.7%)
Hockey	54	11 (20.4%)	43 (79.6%)
Softball	11	3 (27.3%)	8 (72.7%)
Volleyball	5	0 (0%)	5 (100.0%)

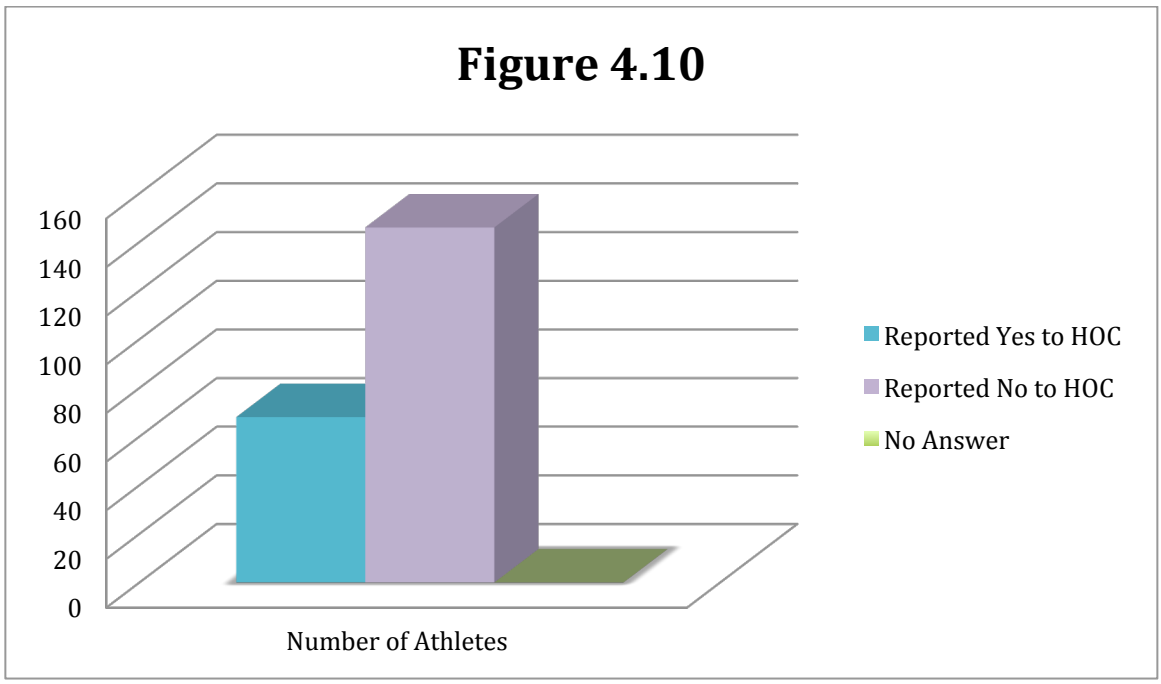


** Data from Table 4.9 is presented in the bar graph above*

Table 4.10

Demographics of Report of a History of Concussion (N=214)

HOC	Number of Athletes
Yes	68 (31.8%)
No	146 (68.2%)
No Answer	0 (0%)

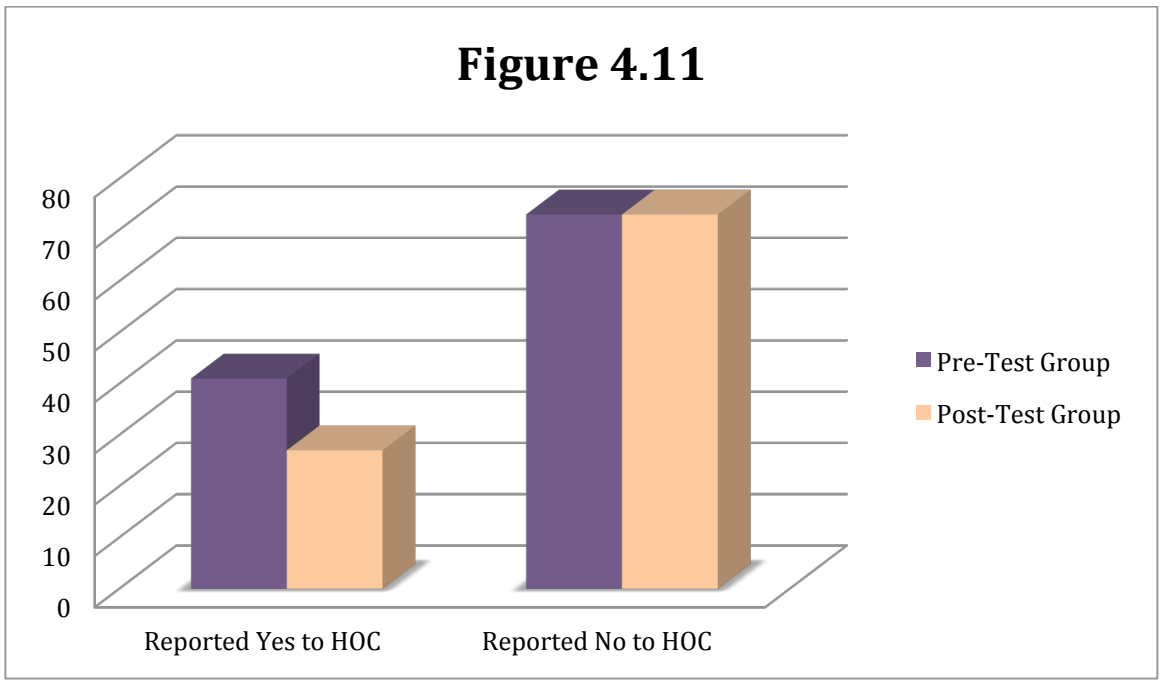


** Data from Table 4.10 is presented in the bar graph above*

Out of the total 214 athletes, 68 (31.8%) athletes reported yes to having a history of concussion, while 146 (68.2%) athletes reported no to having a history of concussion (Table 4.10). These athletes were randomized into 2 groups: the Pre-Test Group with 41 (36%) athletes reporting a history of concussion, and the Post-Test Group with 27 (27%) athletes reporting a history of concussion (Table 4.11).

Table 4.11
Report of a History of Concussion from the Pre-Test Information Group and Post-Group Information Group (N=214, percentages calculated separately for each group)

Test Group	**n**	Reported Yes to HOC	Reported No to HOC
Pre-Test Group	114	41 (36%)	73 (64%)
Post-Test Group	100	27 (27%)	73 (73%)

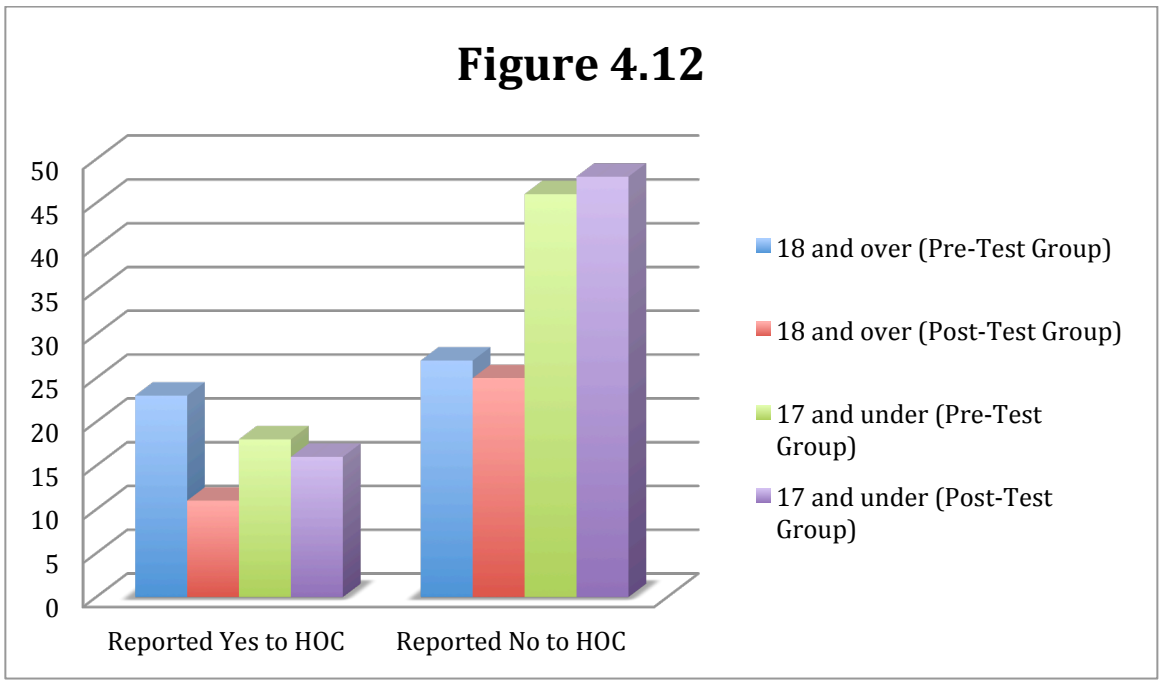


** Data from Table 4.11 is presented in the bar graph above*

Table 4.12

Report of a History of Concussion for 18 and Over/17 and Under (N=214, percentages from each group respectively)

Age Groups	Reported Yes to HOC	Reported No to HOC
18 and over (Pre-Test Group)	23 (46%)	27 (54%)
18 and over (Post-Test Group)	11 (30.6%)	25 (69.4%)
17 and under (Pre-Test Group)	18 (28.1%)	46 (71.9%)
17 and under (Post-Test Group)	16 (25%)	48 (75%)



** Data from Table 4.12 is presented in the bar graph above*

Within the Pre-Test Group, 23 (46%) athletes who were 18 and over reported a history of concussion, while 18 (28.1%) athletes who were 17 and under reported a history of concussion. Within the Post-Test Group, 11 (30.6%) athletes who were 18 and over reported a history of concussion, while 16 (25%) athletes who were 17 and under reported a history of concussion (Table 4.12/13).

Table 4.13
Report of a History of Concussion for 18 and Over/17 and Under (N=214, percentages calculated from age and HOC report groups)

Age Groups	Reported Yes to HOC	Reported No to HOC
18 and over (Pre-Test Group)	23 (67.6%)	27 (51.9%)
18 and over (Post-Test Group)	11 (32.3%)	25 (48.1%)
17 and under (Pre-Test Group)	18 (52.9%)	46 (48.9%)
17 and under (Post-Test Group)	16 (47.1%)	48 (51.1%)

The first research question of this study examined whether there would be a difference in report of a history of concussion between the Pre-Test Information Group/Experimental Group

(who received information about concussions before reporting a history of concussion) and the Post-Test Information Group/Control Group (who received information about concussions after reporting a history of concussion). The second research question investigated whether there would be a difference in report of a history of concussion between males and females. The third research question examined whether there would be a difference in a report of a history of concussion between those who were 18 and over and those 17 and under.

The total number of athletes that data was obtained from consisted of 214. The data was transferred into SPSS so that the data could be statistically reviewed. A Chi Square analysis was performed 3 separate times. The first time was performed to view the difference in reporting a history of concussion between the control group and the experimental group. The proportion of those who self-reported a history of concussion was not significantly different, between those who received information (36%) and those that did not receive information before baseline testing (27%) ($p=0.160$). The Chi Square analysis was completed a second time to examine the difference in reporting a history of concussion between males and females. The ratio of those who self-reported a history of concussion was not significantly different, between males (29.7%) and females (36.2%) ($p=0.160$). The Chi Square analysis was ran a third time to observe the difference in reporting a history of concussion between athletes 18 and over and athletes 17 and under. The proportion of those who self reported a history of concussion was not significantly different, between athletes 18 and over (39.5%) and athletes 17 and under (26.6%) ($p=0.160$). All of the above results may be viewed in Table 4.14.

Table 4.14

Pearson Chi Square Analyses of HOC Report between Pre-Test Information Group and Post-Test Information Group, HOC Report between Males and Females, and HOC Report Between Athletes 18 and Over and Athletes 17 and Under

Analysis	*p*
HOC * Pre/Post Test Analysis	.160
Males/Females Analysis	.160
18 and Over/ 17 and Under Analysis	.160

**Any p-value equal to or below 0.05 is considered significant; anything above is not considered significant*

Chapter 5: Discussion/Conclusion

This study examined three research questions: (1) If athletes are given information about what a concussion is before taking the ImPACT baseline test, will they be more likely to report having a concussion versus athletes who do not receive this information prior to taking the test? (2) Will males have a statistically significant higher self-report rate of a history of concussion versus females? (3) Will those 18 and over have a statistically significant higher self-report rate of history of concussion versus those who are 17 and under? The purpose of this study was to replicate and extend Pfirman (2015) in determining whether providing information about concussion will increase the self-report of a history of concussion. Furthermore, this study investigated whether there was a difference in self-reporting between males and females and between age groups (18 and over; 17 and under). The following discusses the research that leads to the results of these questions and the comparison's made between a previous pilot study and Pfirman (2015).

5.1 Problems/Solutions For Reporting Concussion: Is Providing Concussion Information to Athletes a Solution?

The first question of this study asked if athletes were given information about what a concussion is before taking an ImPACT baseline test, would they be more likely to report having concussion versus athletes who do not receive this information prior to taking the test; and it was assumed that the athletes given information about concussions prior to taking an ImPACT baseline test would report higher rates of concussion than the athletes who received the same information after they take the test. Although the vocabulary used in the script and

confidentiality of the participants' responses were taken into consideration, significant results were not found. While providing concussion information to athletes did not significantly increase reports of a history of concussion on the post-test questionnaire, trends were observed throughout the data. One major trend was that the Pre-Test Information Group reported a slightly higher rate of concussion than the Post-Test Information Group. This trend lends some support to the hypothesis that providing information about concussion may increase self-reports of a history of concussion. However, because this trend was not found to be significant, one should take into consideration that there may be other variables impacting the athletes and their self-report rates of concussions. For example, individual differences, levels of education, or the sport the athletes play may be other variables that are affecting self-report rates. Furthermore, only one script written at a 10.9 reading level was used to provide concussion information to all athletes. This did not take into consideration the age, education levels, or reading levels of the athletes, thus possibly affecting self-report rates. These variables should be researched and taken into perspective if this study is extended.

5.2 Gender and Age Differences in Athletes/Comparisons Between The Current Study and The Pilot Study

As previously mentioned, a pilot study at the UTEP Concussion Management Clinic was completed in which a Chi Square statistical test was used to examine the difference between males and females reporting concussion and the difference between athletes over the age of 18 and under the age of 18 reporting concussion. The results showed no significant differences between males who reported a history of concussion on the ImPACT (11 males; 22.0%), and females who reported a history of concussion on the ImPACT (8 females; 15.7%) ($p = .417$)

(Table/Graph 2.1). Although no significant results were found for gender differences, it was observed that males reported a history of concussion slightly higher than females. Nonetheless, across age, results revealed a significant difference between those who were 18 and over that reported a history of concussion on the ImPACT test (14 athletes; 27.5%), and those who were 17 and under that reported a history of concussion on the ImPACT test (5 athletes;10%) (p=.025).

Based on the findings in the pilot study, the current study was created to evaluate the self-reporting of concussion within a new group of athletes after they were provided with information about concussion. In relation to the pilot study, the second and third questions of this study were examined. Moreover, not all of the findings in the current study were similar to those of the results found in the pilot study, as one will see in the results to be compared.

In the current study, data was obtained from 214 male and female athletes between the ages of 12-24 years old. The second question of the current study asked would males have a statistically significant higher self-report rate of a history of concussion versus females; and it was hypothesized that males would report a statistically significant higher rate of concussion. The ratio of those who self-reported a history of concussion was not significantly different, between males (43 males; 29.7%) and females (25 females; 36.2%) (p=0.160). These findings do not support the hypothesis that males would report a higher number of concussions than females. Furthermore, there were no significant differences between genders in both the pilot study and the current study. Though there were more males (43) who reported a history of concussion than females (25), which also occurred in the pilot study (11 males vs. 8 females), the percentages from each group changed. In the pilot study, out of the 50 males, 22% reported a history of concussion and out of 51 females, 15.7% reported a history of concussion; where as in the

current study, out of 145 males, 29.7% reported a history of concussion and out of 69 females, 36.2% reported a history of concussion. The current study found a higher percentage of females reported a history of concussion than those who did in the pilot study. One should look at and interpret this data with caution, because there was a much greater difference in number of females and males between both studies. It is suggested that females had a higher percentage of self-reports, because they had a smaller sample size than the male group. When calculating percentages, it is expected that percentages will increase with a smaller number of participants. The pilot study had similar numbers of athletes in each gender group (50 males; 51 females), with a total of 101 athletes for the sample size. However, the current study had a sample size of 214 athletes with a larger number of male athletes than female athletes (145 males; 69 females), because the study utilized a convenience sample, which included only those tested in the UTEP Concussion Management Clinic and at local public middle/high schools. The difference in number of females and males in the current study could not be controlled for and pose a limitation and threat to external validity.

The third question of this study asked would athletes 18 and over have a statistically significant higher self-report rate of a history of concussion versus athletes 17 and under; and it was hypothesized that athletes 18 and over would report a statistically significant higher rate of concussion. In the current study the number of athletes who self reported a history of concussion was not significantly different between athletes 18 and over (34 athletes; 39.5%) and athletes 17 and under (34 athletes; 26.6%) ($p=0.160$). These results did not support the hypothesis that older athletes would report more concussions than younger athletes. These findings differ from the pilot study as well. The pilot study found significant differences between the two age groups, with the older athletes reporting a significantly higher number of concussions than the younger

athletes. However, the trend was similar across studies when looking at the percentages of athletes reporting a history of concussion. The percentages of self-reports of concussion were slightly greater in athletes who were 18 and over (27.5% pilot study; 39.5% current study) than those who were 17 and under (10% pilot study; 26.6% current study). These findings lead to the hypothesis that older athletes, particularly collegiate athletes, either sustain greater numbers of concussions, or they are able to understand and retain information about concussion marginally more than younger athletes. Moreover, a possible factor as to why older athletes self-reported more concussions may be due to the script provided to the athletes in the study. It was written at a 10.9 reading level, thus it may have been more comprehensible to the older athletes who have higher education levels.

5.3 Additional Comparisons: Statistical Comparisons To Past Studies

Carroll, et al., (2004) found that 25% of mild TBIs are seen in children 5-14 years of age. While Guskiewicz, et al., (2000) reported approximately 5% of high school and collegiate athletes experience a concussion. Within this study only 15/214 (7%) athletes were between the ages of 5 to 14 years old, with 6 of these athletes reporting a history of concussion. This is only 2.8% of the total number of athletes (214) involved in the study. On the other hand, 199/214 (93%) athletes were between the ages of 15 to 24 years old (high school/collegiate athletes), with 62 of these athletes reporting a history of concussion. This was 29% of the total number of athletes (214) involved in the study. It should be noted that this difference in percentages compared to Carroll et al., (2004) and Guskiewicz, et al., (2000) may be due to the larger number of participants that the current study had (Ages 5-14yrs: 7% vs. Ages 15-25yrs: 93%). Because the number of participants was not matched for the two age groups, it would be inappropriate to

compare this study's results of number of mTBIs reported to the results reported by Carroll et al., (2004) and Guskiewicz, et al., (2000). However, given the larger sample of participants in this study, one may argue that the results are more representative of the population.

5.4 Additional Observations: Similarities and Differences between Pfirman (2015) and the Current Study

Pfirman (2015) and the current study showed similar insignificant findings, however both studies show contrasting trends as well. Pfirman (2015) reported findings on 199 athletes (136 males; 63 females). Within his demographics he stated that there were 74 athletes who were 18 and over and 125 athletes who were 17 and under. Of the 74 athletes who were 18 and over, 27 (36.5%) of them reported a history of concussion; and of the 125 athletes who were 17 and under, 32 (25.6%) of them reported a history of concussion. There was no significant difference in self-reported history of concussion between the two age groups ($p = .199$). The current study also found no significant difference between the age groups, however the trends in each study differed. The current study reported data on 214 athletes while Pfirman reported the findings for 199 athletes. The current study added 15 more participants to Pfirman's sample size. There were 86 athletes who were 18 and over and 128 athletes who were 17 and under. Of the 86 athletes who were 18 and over, 34 (39.5%) of them reported a history of concussion; and of the 128 athletes who were 17 and under, 34 (26.6%) reported a history of concussion. In the current study there was no significant difference in self-reported history of concussion between the two age groups ($p = .160$). When comparing the data between the two studies we see the trend in Pfirman (2015) was younger athletes reporting slightly more concussions than the older athletes. However, in the current study the same number of athletes (34 athletes) reported a concussion in both groups. When calculating percentages for the total number of athletes in each age group, we

see a higher percentage of self-reported concussion in the older athletes (39.5%) compared to the younger athletes (26.6%), which is the reverse for the Pfirman study. Precautions should occur when interpreting these percentages, because there were a larger number of younger athletes than older athletes in the current study.

Secondly, Pfirman reported on the difference between the Post-Test Information Group and the Pre-Test Information Group. There were 107 athletes in the Pre-Test Information Group and 92 athletes in the Post-Test Information Group. Out of the 107 athletes in the Pre-Test Information Group, 36 (33.6%) reported a history of concussion. Of the 92 athletes in the Post-Test Information Group, 23 (25%) reported a history of concussion. There was not a significant difference in number of concussions reported between the Pre-Test Information Group and the Post-Test Information Group ($p = .183$). When observing the results in Pfirman's study and the current study, data shows there are similar trends between the two. In the current study, out of the 114 athletes in the Pre-Test Information Group, 41 (36%) reported a history of concussion, and out of the 100 athletes in the Post-Test Information Group, 27 (27%) reported a history of concussion. Similar to the Pfirman study, there was not a significant difference in number of concussions reported between the Pre-Test Information Group and the Post-Test Information Group ($p = .160$). However, in both studies, the Pre-Test Information Group reported a slightly higher number of concussions than the Post-Test Information Group. This trend in both studies may lead one to believe that providing information about concussion to athletes does increase self-reporting of a history of concussion, which in return may assist in reporting accurate numbers of concussions and aid in the health care of athletes. However further research and different approaches may be necessary to yield significant results. Suggestions toward this will be provided in the section Future Work.

5.5 Limitations

A chief limitation of this study is believed to be the difference in numbers of athletes in each of the groups. Firstly, within the gender groups, there were 60 females and 145 males. It should be noted that males might have produced higher self-reports of concussion, because there was a larger number of males than females. Secondly, the same should be said for the younger and older athletes, since there was a difference in sample size for each group. It should be noted that the younger athletes might have reported more concussions, because there was a larger number of younger athletes than older athletes in the study. Thirdly, the same cautions should be applied when comparing the Pre-Test Information Group and the Post-Test Information Group. Though there was not a large difference in sample size for the two groups, there is always a chance that the number of athletes played a roll in the differences of self-reports of concussion.

Another limitation found in this study has to do with the questionnaire. There were a few questionnaires that had to be discarded and not used in the study because they were inappropriately filled out. One may argue that instructions for the questionnaire should have been more clear and elaborated so this error would not have occurred. Furthermore, the questionnaires should have been reviewed upon completion to avoid such errors. However, reviewing each questionnaire as they are turned in may pose complications for keeping it anonymous.

Other factors that may have skewed results and that were not accounted for include participant levels of education, as there were participants in middle school, high school, and college, levels of sport (middle/high school, collegiate, semiprofessional), and the variation of sports included in the study. One script was used for providing athletes with concussion information, and it was written at a grade 10.9 reading level. This may have also been a limitation, as the athletes in this study varied in age and education level. The script should have

been altered based on the audience to whom it was being read. Each of these factors may have contributed to varying the results reported on a history of concussion, and further research should account for these in the future.

5.6 Future Work

Future work should focus on the individual athletes rather than group comparison's to observe how providing concussion information changes reporting of a history of concussion in athletes. To assess whether athletes understand the material being provided to them, a short examination about concussion should be administered. To perform this at an individual level, data on each athlete's reports of concussion should be gathered before and after delivering the information to track whether differences in reporting occur after information has been offered.

Furthermore, to enhance this study, future work should consist of comparing reports of concussion on the questionnaire to reports of concussion on the ImPACT Test. This will allow one to observe the differences of reporting anonymously through the questionnaire and reporting with one's name documented on testing materials.

Lastly, future work should move towards providing age appropriate or education level appropriate (middle school, high school, collegiate) concussion material to the athletes seen in the UTEP Concussion Management Clinic. Rather than using a standard script for all athletes as completed in the current study, the script should be altered to suit each level athletes are at.

5.7 Conclusion

This investigation addressed whether information about concussion might influence the self-reporting of a history of concussion. Overall, data from this study confirms that additional

research must take place in order to distinguish other variables that affect self-reporting of concussions, as significant results were not found. Although significant results were not found, trends were observed between gender, younger and older athletes, and the pre and post-test information groups. These trends suggest that concussion information does increase self-reporting of concussion. Future work should investigate age/education level appropriate concussion information, individual differences, and comparisons of report to the ImPACT Test. Future investigations may produce a strategy for more effective assessment of an individual's self-report of a history of concussion.

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Appendix A: Script Read to Athletes in the Study

A concussion is a type of traumatic brain injury (TBI) caused by a bump, hit, or jolt to the head. Concussions can also occur from a fall or a hit to the body that causes the head to shake back and forth. Common phrases used to describe a concussion are “having your bell rung”, “getting a ringer”, and “seeing stars”. They cannot be seen on x-rays or CT scans because concussions change the way the brain functions, not the way it looks. These changes can show up symptomatically throughout the entire body, and they may affect how you feel physically and emotionally, your vision, balance, concentration, and sleep. Since brain injuries are not visible to the eye, someone with a concussion may “look normal.” However, a concussion can be a very serious injury, identified mainly by concussion symptoms that you cannot just “walk off.” It is important to be aware of the many indicators of concussions and understand the recovery process. If you ever suspect that you may have a concussion, tell your coach, parent, or trainer right away.

Appendix B: Questionnaire For Participants in the Study

Based on the information we have given you, as well as on your experience today, do you think you have ever had a concussion?

What is your age?

What school do you attend?

What grade are you in school?

Are you male or female?

Vita

Kara Ashlan Greco was born in El Paso, Texas. The second daughter of Vince Greco and Kim Greco, she graduated in 2011 from Eastwood High School, El Paso, Texas and entered The University of Texas at El Paso in the fall with the Presidential Excellence Scholarship and the Ysleta Education Foundation Outstanding Achievement Scholarship. She completed undergraduate courses within three years, and while doing so, she became a research assistant at the University of Texas at El Paso after receiving the Campus of Undergraduate Research Initiatives Research Award in 2013-2014. She also volunteered at the Concussion Management Clinic, at the University of Texas at El Paso, under the supervision of Dr. Anthony P. Salvatore, and became the Concussion Management Clinic Coordinator in 2014-2015. This experience sparked her interest in sport-related concussions and in her current research study. She was then accepted to the Program of Speech-Language Pathology, at The University of Texas at El Paso, in the Fall of 2014. During her graduate studies, she also completed additional courses to receive a certification in Concussion Management, and she was chosen to present her thesis project at the American Speech-Language-Hearing Association national convention in Orlando, Florida

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