Bryant University

HONORS THESIS

Analysis of Concussion Experiences and Awareness in College Athletics at Bryant and Beyond

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ABSTRACT

The purpose of this thesis is to examine concussion experiences, awareness and education through a literature review and study of Bryant's students. The study assessed concussion awareness and experiences through a questionnaire sent out to club and division 1 athletes at Bryant through email and social media channels. The study yielded 98 responses, but after filtering out responses with insufficient information 62 usable responses remained. These responses consisted of 62% female and 34% male athletes on 13 different teams. Of the 62 participants, 34 (roughly half) reported being diagnosed with a concussion in their lifetime, and 18 athletes reported having more than one concussion. The athletes reported experiencing a variety of symptoms, with headache being the most prevalent, as all diagnosed athletes reported experiencing this symptom. Bryant's athletes scored well on a CDC awareness quiz with an average score of a 98%. Overall, Bryant and other student athletes can use more education on distinguishing between concussions and more severe brain injuries that would require hospitalization, concussion diagnosing, and assessing situations in which concussions can occur. Though reporting behaviors are relatively good, more education may help improve decision making and safety for athletes. Most of the athletes at Bryant scored well on the awareness quiz and felt relatively comfortable reporting their concussions to their coaches, but they also indicated that their teammates could benefit from more concussion education regardless. Therefore, it is safe to conclude that Bryant's athletes, along with many other college athletes, could benefit from more concussion education.

INTRODUCTION

The CDC defines a concussion as a type of traumatic brain injury caused by a hit to the head or violent jolting of the head and body. Though a concussion is viewed as a "mild" brain injury, the effects of a concussion can be serious. Though concussions can happen to anyone taking part in nearly any activity, it is beneficial to investigate this in specific settings, and in this case, collegiate athletes. This subject is of great importance because college athletes are being affected every day by concussions, and many do not understand the seriousness of their injuries. By educating athletes and making sure they understand the risks and possible implications of this injury on their future, athletes may be more apt to recognize the signs if they do have one and report it properly to ensure their personal health.

Literature on concussions is extensive and inclusive. To gain an understanding of the scope of this analysis, it is important to first understand some general information. Colleges must follow specific guidelines on concussion protocol. This includes pre-season education, pre-participation assessment, availability of medical professionals to diagnose and assess, and programs in place for return-to-learn and return-to-play (NCAA). These guidelines are put in place to ensure that athletes injuries are taken seriously and handled correctly. Because of these guidelines, school athletic programs provide some concussion education. However, studies have shown that there may be reason to believe that more education needs to be provided to athletes so they can understand the scope of the injury and make informed decisions before engaging in further risky behavior.

In one study, there was discussion on student athletes scoring lower on their baselines to allow for faster concussion clearance (Salazar et al., 2017). It was very interesting, and it brought up more questions, such as whether some athletes purposely scored lower because they did not really understand the potential harmful effects of going back to contact sports too early, or if they simply did not care and wanted to get back into the game as quickly as possible due to social pressure or other circumstances. This can be seen not only at the collegiate level, but also in younger generations of athletes (Cusimano et al., 2017). These baseline tests are done pre-season to assess athletes balance and brain function. Specifically, they measure memory and learning skills, concentration ability, reaction time, and problem

solving. Results from these tests can be used later in the season as a comparison if an athlete has a suspected concussion. These results, if used to examine potentially concussed athletes, should be assessed by a neuropsychologist. Studies have also shown that baseline testing is most accurate if completed yearly and prior to the first practice of the season (CDC). Due to this, if athletes purposely score lower on their baseline examinations, medical professionals cannot use the test to accurately assess whether the athlete is safe to return to play or not.

There are many potential lasting effects from concussions if they are untreated or repeated too many times. Notably, the NCAA does not have a specific limit on the number of concussions a college athlete can have. This leads some colleges to make their own rules and limitations, while other colleges let athletes back out on the field, concussion after concussion. That is extremely dangerous and raises their risk significantly for more future concussions and long-term health issues (Online Journalism Rewards). If athletes are not fully knowledgeable about long-term effects and the dangers of concussions, they may not realize that it could be in their best interest to allow for more recovery time or stop competing at that intense level. There are currently some attempts at implementing more concussion education at specific universities (Burnsed, 2016), and the following research should help provide some insights and show that more may need to be done.

CONCUSSION LITERATURE

There is a plethora of information available on concussions ranging from awareness to symptoms, effects, and more. These topics are all important in demonstrating the significance of concussion education. Many valuable studies have been conducted to contribute to this subject. In this section, these studies as well as further information to express the current state of concussion awareness and effects will be discussed based on the information available.

Awareness

One study conducted by Kirk et al. (2018) at various university sport and health departments evaluated knowledge and awareness of concussions in university sports. They evaluated 40 collegiate athletes and 8 experienced coaches. Using a variation of CDC concussion knowledge testing, they found out exactly what athletes and coaches knew, or what they had misconceptions of. Coaches scored higher than players on almost all aspects of their concussion knowledge, but the authors identified important gaps that even coaches needed education on. Specifically, this study showed that misconceptions were common in identifying concussions and returning to play after concussions. In identifying concussions, many selected the incorrect answer that a concussion diagnosis was done by "looking at scans of an athlete's brain", whereas the correct way to recognize concussions from the outside are from noticing confusion and amnesia. In the return to play questions, just below half of the players were aware of the return to play guidelines, which are important in decreasing risk as play is introduced. Many thought that right when their symptoms subsided, that they were fine to play again, skipping that crucial return to play step. They concluded that "Impaired knowledge of how to recognize a concussion and misunderstanding the need for rest and rehabilitation before return to play presents a hazard to health from second impact and more catastrophic brain injury." (Kirk et al., 2018) This further emphasizes the importance of evaluating this at Bryant and being sure that all athletes are educated to avoid further, potentially long-term, injuries.

In a meta-analysis on sports related concussions, also known as SRC's, in rugby players, concussions were found highly prevalent and continuously growing. In fact, head injuries, including concussions, head bruising, and lacerations on the head, accounted for about 25% of

injuries in rugby. The authors found that for every 1,000 player hours, 1.2 concussions were obtained throughout the Rugby Union and even higher rates when looking just at professional rugby. This likeliness of obtaining a head injury was not constant through all rugby activities though, it varied based on position and play type. Among this group of rugby players, concussion knowledge was found to vary. There were many common misperceptions on concussions found in the studies. Out of 25 athletes that did not believe they had been provided concussion information, 7 believed that they could go back to play in the same match that the concussion was obtained in. On the other hand, out of 40 players that believe they had been educated about concussions, 3 thought that they could go back to play in the same match. In a survey that went out to high schoolers that played rugby, over 50% were not fully aware of concussion guidelines, and most players (87%) went back to play within 7 days, not following return to play protocols (Gardner et al., 2014). This shows that athletes at all levels could use more education.

Knowledge of symptoms also varied greatly. The surveyed players identified an average of 2.6 symptoms with the most recognized being a headache followed by memory disturbance, nausea/vomiting, dizziness, and confusion. None of the players recognized irritability, sadness/emotion, nervousness, or sensitivity to light or noise as symptoms. Researchers found a positive correlation between concussions obtained and the number of symptoms listed (Gardner et al., 2014). From the data, we can see that concussion awareness, recognizing the symptoms, and concussion reporting are related.

Research done by the American Journal of Sports Medicine on Emergency concussion related healthcare in adolescents concluded that increased public awareness during the time period studied, 2005-2015, was likely the reason for a spike in emergency care. They originally intended to see how the “Lystedt Law,” the Concussion Management and Awareness Act, affected emergency department healthcare visits and brain imaging utilization, but found interesting results. They concluded that, “The period of greatest increases in EDCHVs and decreases in brain imaging utilization for SRCs preceded New York concussion legislation by several years, suggesting a minimal direct effect on emergency care–seeking behavior for concussions. Instead, increased public awareness of SRCs and imaging guidelines may have

driven EDCHV trends and imaging practices." (Baker et al., 2017). This proof that awareness increased the amount of people seeking medical attention for their SRC's without the increase of imaging shows that people understood the root of their injury better, so they could pinpoint why the symptoms were occurring, therefore not needing the imaging. This also seems to be a common trend, as you will see in Tjong's (2017) study, that as awareness and general knowledge about the injury increases, the stigma behind the injury decreases, and athletes are less likely to not report, or underreport symptoms. So, we can see that awareness is tightly tied to reporting.

Reporting and Play Type

In a study from the U.S. National Library of Medicine, interviews were conducted on varsity football players to evaluate psychological factors, athletic culture, and concussion education and awareness (Tjong et al., 2017). This source has many valuable insights about variables that come into consideration when an athlete decides to report an injury, or not. In terms of psychological factors, they found that prior football players tended to under report symptoms or not report at all. This was mainly due to the pressure of not letting the team down, not wanting to show pain, and not wanting to be replaced on the team (Tjong et al, 2017). Though this study shows that this is the case for football players, it may well be the case for many other athletes on a variety of sports teams.

In terms of athletic culture, a player's passion for the sport played a role in whether some concussions were reported or not. In some player's eyes, the sport that they love and are extremely passionate about would be taken away from them for an extended period of time, and that was the last thing they would have wanted to happen. Furthermore, awareness and new education were talked about with a positive connotation and seemed to be welcomed by the players interviewed. Many responded that they believe this kind of education is important and has helped lessen the stigma of the injury (Tjong et al., 2017). If this kind of education was provided to lessen the stigma of the injury in more situations, then players would not feel as badly about reporting their injuries, just because they do not want their teammates to think

they are weak (Tjong et al, 2017). Overall, this study supports that more should be done on concussion education for football players, at the very least.

In another study on Division 1 football players, concussion rates were analyzed based on the play-type as well as with changes in the NCAA Concussion Management Policy of 2010 (Houck et al.). The study occurred over 9 years, and of the 452 players analyzed, 118 of them were diagnosed with a concussion. Concussions obtained during preseason and games were significantly higher than concussions at practice. Understanding that concussions can happen at any point, especially during preseason when athletes are getting back into shape trying new things, is very important. It is also crucial that baseline testing is done prior to the beginning of preseason to ensure the most accurate results are held on file in case of an injury. Additionally, the study showed that after the 2010 NCAA concussion management policy was put into place, there was a significant increase in recognition of concussions among the athletes studied (Houck et al.). This further supports the point that awareness is key in recognition of the injury and reporting the symptoms. Other research covers more of a variety of athletics with some similar findings.

When evaluating concussion reporting and play type among the rugby players discussed above in the awareness section, there are many interesting findings. The researchers determined that athletes were about twice as likely to obtain a concussion during match-play than in training. Specifically, they most commonly occurred when tackling. Concussion rates also vary by playing position, with backs being slightly higher than forwards. Concussion rates may be even higher than the data shows due to absence of a trained professional to diagnose and due to unreported injuries. Additionally, men's rugby showed a much higher concussion rate than women's (Gardner et al., 2014). In the study, 85% of these athletes said that they would inform someone if they were concussed, and 83% said they would report it for a teammate. This was contradictory, however, because 25% reported continuing to play in the past knowing that they had obtained a concussion (Gardner et al., 2014). Because of the variation in prevalence and lack of concussion reporting found in this and many other studies, this thesis will investigate this issue in the Bryant athletic community as well.

Lininger et al. (2019) conducted a study to find out what effects stakeholders had on concussion-reporting behavior (CRB's). Lininger's study found that getting everyone on board, including coaches, trainers, and athletes, to encourage CRB to create a safe and open line of communication without penalties was the most effective way to improve CRB's. That, however, is not always heavily enforced because some frontline stakeholders have more to lose if it is influenced more heavily and their star players must stay out of the game (Lininger et al., 2019). So, what usually happens a more integrated approach to influence athletes CRB's, but not promote them too heavily.

In addition to getting stakeholders on board with a more supportive atmosphere around CRB's, athletic departments can look into implementing more testing procedures if a concussion is suspected. One protocol that could be implemented in addition to education would be taking an on-site Stroop Color and Word Test, also known as the SCWT, if a potentially concussive blow to the head was obtained. The SCWT is a neuropsychological test used to assess cognition, specifically the ability to inhibit cognitive interference when one stimulus prevents processing the other stimuli (Scarpina, 2017). This test displays the name of a color with text in the same or different color. The goal is to be able to determine when the color name and the color of the letters match. Scores are determined based on the selections. The SCWT is a part of the baseline testing exam already, but it could be quick and easy to administer on site by itself for more immediate results.

Another potential test that could be used for athletes that had questionable hits or jolts could be a spit test. New research shows that scientists can identify brain injury through saliva. Researchers from the University of Birmingham in the United Kingdom designed a spit test that uses genetic markers in saliva to find out whether a concussion occurred. This test was 94% accurate in a study the researchers did involving male rugby players (Romero, 2021). Though this is brand new as of 2021, this research shows that they may have found a way for easy sideline diagnostic testing down the line.

Symptom Analysis and Long-term Implications

On the CDC (2019) website, they have determined a variety of observable signs as well as symptoms of concussions. The observable signs include:

- Inability to recall events prior to or after a hit or fall
- Appearing dazed or stunned
- Forgetting instructions
- Moving clumsily
- Answering questions slowly
- Losing consciousness for any period of time
- Showing mood, behavior, or personality changes
- Becoming confused about an assignment or position, or becoming unsure of the game, score, or opponent.

Symptoms that the concussed athlete may experience include:

- Headache or “pressure” in head
- Nausea or vomiting
- Balance problems or dizziness, or double or blurry vision
- Sensitivity to light or noise
- Feeling sluggish, hazy, foggy, or groggy
- Confusion
- Concentration problems

- Memory problems
- Just not feeling right or feeling emotional

If an athlete portrays any of these warning signs or symptoms after a jolt or a blow to the head, then it is important an athlete gets properly assessed by a professional before returning to play.

Symptoms can be experienced in all different combinations. One person may experience different symptoms at different levels than the next. A comprehensive study investigated the epidemiology of SRC's regarding symptom prevalence, symptom resolution time and return to play time (Wasserman et al., 2015). The study used the National Collegiate Athletic Association (NCAA) Injury Surveillance Program to describe the epidemiology of SRC outcomes among 25 different collegiate sports. The most common symptoms shown from the SRC's was headache, at 92.2% of concussed athletes, and dizziness, at 68.9% of concussed athletes. Many of the athletes experienced resolved symptoms in the first week. Some took longer for symptoms to resolve however, 6.2% within four weeks, and 8.9% over four weeks. This shows that each experience is different, and without understanding the consequences of going back too early, athletes may not allow for ideal healing time. The study shows that over the span of four years, more and more athletes had taken longer on average before returning to play. This likely was due to improving concussion management practices that withheld players from returning too early and ensuring symptom resolution prior to returning to the sport. Though these practices have increased even more since this research was done, if athletes do not fully understand the extent of their injuries, they may even be more apt to underreport symptoms so that return to play protocol can begin sooner.

The research done on the epidemiology of SRC's also showed that symptoms varied by sex and when recurring concussions are obtained. Women showed more symptoms of headache, excessive drowsiness, and nausea/vomiting. Men showed more symptoms of amnesia and disorientation. For both genders however, athletes experiencing recurrent concussions reported more symptoms after the original concussion. These recurring concussions also took longer on average to see the symptoms resolve as well as a longer period before return to play

(Wasserman et al., 2015). By teaching athletes that they may all have different symptoms and experiences with each injury, they may be less apt to write off their injury because "it doesn't feel the same as my first concussion, so I am fine", or "I don't have the same symptoms as my friend had when they had a concussion, so I am probably fine".

The meta-analysis mentioned previously also looked at the knowledge of health effects of concussions. Of the individuals surveyed, 75% of them believed that concussions could lead to serious health consequences, but no other knowledge on long-term effects were evaluated (Gardner et al., 2014). Though 75% of athletes in this study realized that concussions could lead to future health issues, many do not know about the effects, or the extent to which these health issues can occur. Education on the long-term effects of head trauma needs more attention from athletes and coaches of all sports as well. Effects of repeated head trauma can cause many health issues later in life. Repeated head trauma is the main driver of CTE and is also associated with other neurodegenerations like Alzheimer's disease. Interestingly, in a study on CTE, 16% of published CTE subjects did not have a history of concussions. This leaves researchers to believe that repeated sub-concussive hits also contribute to CTE. The research concluded that exposure time to sub-concussive or concussive hits was significantly associated with worse tau, a protein involved in many degenerative diseases (Stein et al., 2015). This means, the more that an athlete has a blow to the head, or obtains a concussion, the more tau the athlete may build, further increasing their chances of having a degenerative disease over time.

Additionally, relatively new research shows that people that have experienced TBI's have an increased chance of developing a sleep disorder later in life (Preidt, 2021). This research was done on veterans that had obtained a head injury ranging anywhere from mild to severe, along with a control group with no history of head injury. The research monitored these veterans over a 14-year period. In that time, 23% of veterans that had a TBI in the past developed a sleep disorder, whereas only 16% of the veterans who had not experienced a TBI developed a sleep disorder. Specifically, the research showed an increased risk of insomnia, sleep apnea, sleep-related movement disorders and excessive daytime sleepiness, all of which the researchers included to look for in the study. "The study found that 11% of the veterans with

TBI developed sleep apnea and 12% developed insomnia, compared to 8% and 7%, respectively, of those without TBI." (Preidt, 2021) The severity of the TBI may affect this outcome, as well as other health factors. Though this study indicates a relationship, that relationship needs to be evaluated further since this is a relatively new research topic. Though this study was done on veterans, this pattern of sleep disorder development can affect anyone, including athletes. Because sleep is interrupted from these disorders, it can affect other areas of life too. Therefore, it may affect athletes in many ways long-term, however, more conclusive research needs to be done.

By increasing awareness of these facts, hopefully athletes will take head injury reporting and recovery more seriously as well see the importance of proper use of protective gear and practices.

Further, athletes and coaches should be aware of the warning signs and symptoms of more severe brain injuries to be able to assess whether hospitalization and further health evaluation may be necessary. According to the CDC (2019), danger signs and symptoms that would require hospitalization and potential procedures include:

- One pupil being larger than the other
- Drowsiness or inability to wake up
- A headache that gets much worse and does not go away
- Slurred speech, weakness, numbness, or severely decreased coordination
- Repeated vomiting or nausea, convulsions or seizures
- Unusual behavior, severely increased confusion, restlessness, or agitation
- Loss of consciousness

Some of these symptoms may overlap with concussion symptoms, however it is important that an athlete be taken to a medical facility in a timely manner if any of these danger signs

are present because time may be limited, and the injury could result in severe long-term effects or even death if a hematoma is formed.

Having a severe brain injury can affect all parts of someone's life including daily activities, relationships, and working. Lasting problems can affect thinking, memory, learning, coordination and balance, speech, hearing or vision, and emotions.

Being educated on all these aspects are important to maintain health and safety. The more athletes know about their injuries, the better decisions they can make about their health now and in the future. Due to this, it is an important topic to evaluate further on smaller settings like the following study at Bryant University. This research will dive into Bryant's student athlete concussion awareness, analysis of concussion symptoms, reporting behaviors, and suggestions for moving forward.

STUDY OF BRYANT ATHLETES

Methodology

The research was conducted through a questionnaire that was sent out to a convenience sample of D1 and club athletes through email and social media channels. In the questionnaire, there's a combination of personal concussion experience questions as well as a CDC awareness quiz to test how much the athletes know about concussions. The questionnaire yielded 98 total responses but after filtering out the responses that did not complete the awareness questionnaire or indicate a sports team, there were 62 usable responses left. The results eliminated included students that did not finish filling out the awareness quiz, and students that did not indicate whether or not they were on an athletic team at Bryant. A preview of the questions can be found in **Appendix A.**

Ethical Consideration

Ethical consideration was a priority, as all participants were fully informed about the use of their provided information and their rights. The survey was fully voluntary and asked about health records solely pertaining to their sports-related concussions and knowledge of concussions. This was explained on the consent form which was on the first page of the survey. A copy of the consent form can be found in **Appendix B**. Consent was obtained prior to any collection of information regarding the participant. Participation in the research could be stopped at any time if the participant did not want to provide further information, to which some participants took advantage of. To ensure anonymity throughout, names were not collected with the participant information. The only identifiable information collected was age, gender, sports team, and school. To further ensure ethical consideration, the research has been approved by the IRB board. A copy of the IRB approval can be found in **Appendix C**.

Results

As mentioned, the questionnaire yielded 98 responses from Bryant's students, and after filtering the responses, 62 responses were left to include in the analysis.

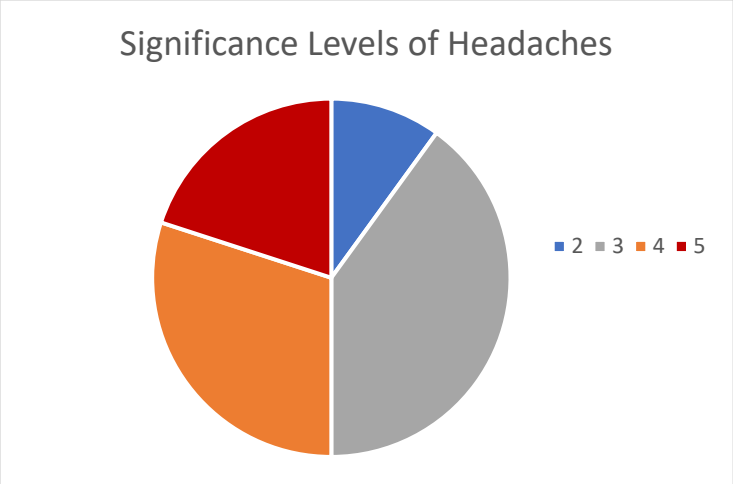
The data collected included 62% female and 38% male athletes. Most of these respondents are current Bryant's students, with only 4 students as recent alumni. Athletes from the following Club and/or Division 1, also known as D1 teams participated in this research: Basketball, Cheerleading, Tennis, Dance, Rugby, Softball, Baseball, Hockey, Track, Soccer, Lacrosse, Football, and Ultimate Frisbee.

Out of all these athletes, 34 (roughly half) reported being diagnosed with a concussion. Furthermore, 18 athletes reported having more than one concussion.

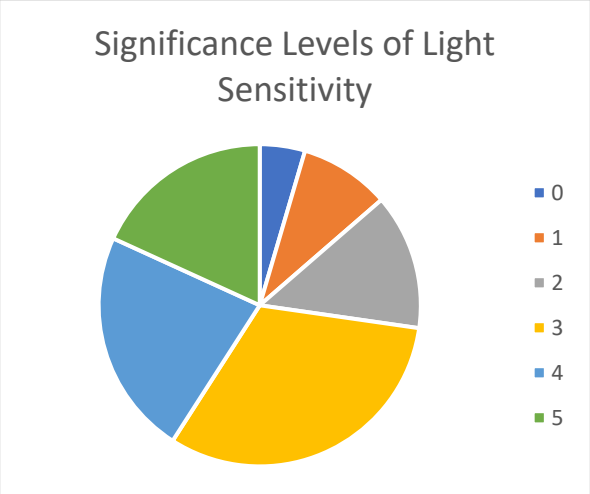
Symptoms of these concussions were analyzed on a scale of 0-5 with 0 meaning they did not experience the symptom and 5 meaning they experienced the symptom to a large extent. Note: some respondents left symptoms blank, all the blanks were filtered out in analysis. The symptoms included in the questionnaire and analysis include:

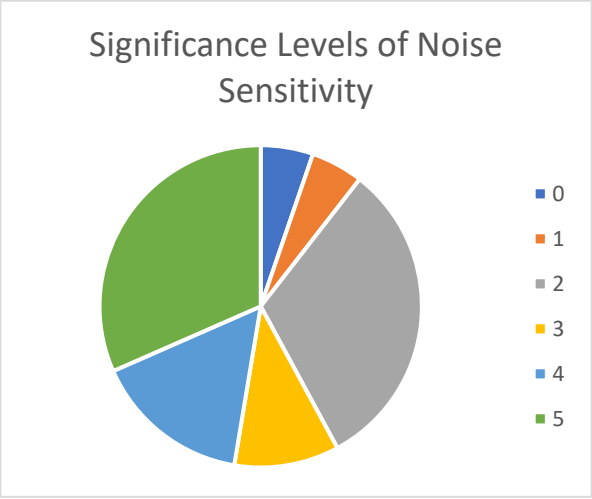
- Headache
- Confusion
- Lack of coordination
- Memory loss
- Nausea
- Vomiting
- Dizziness
- Ringing in the ears
- Sleepiness/ excessive fatigue
- Sensitivity to light
- Sensitivity to noise

The most reported symptom associated with these athletes' concussions were headaches. All respondents that indicated they had one or more concussions reported experiencing headaches. In the pie chart to the right, you can see the athletes' ratings of the symptom. All athletes rated headaches at a 2 or above, showing that this was likely a decent indicator that the athlete had obtained a concussion.



Sensitivity to light and noise were the second most commons symptoms, with only one respondent in each category selecting a 0, meaning they did not experience this symptom with their concussion. Sensitivity to light and noise showed to affect athletes at varying levels, but most ranked these symptoms in the 2-5 range. A comparison of these sensitivities can be seen in the charts below.

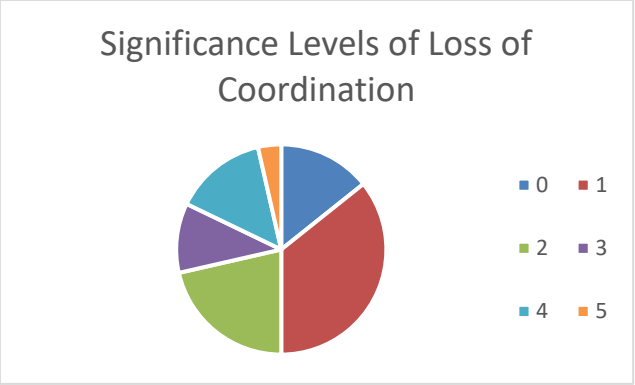




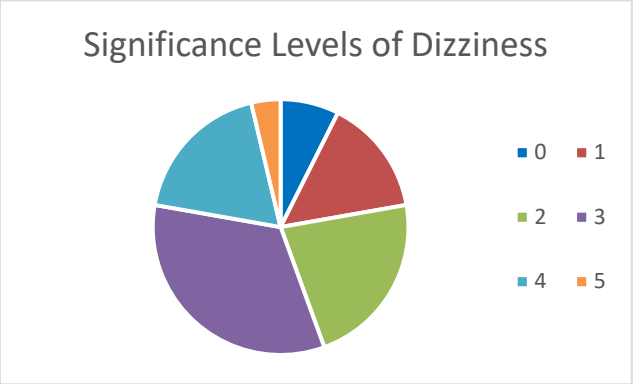
Only some athletes also experienced ringing in the ears. Athletes' experiences with this were mild if experienced at all.

Many athletes experienced moderate levels of fatigue and sleepiness during the period that they had the concussion. Most people rated fatigue and sleepiness at either a 5 or a 2 or 3. Few athletes rated sleepiness and fatigue at a 0 or 1. So, most athletes saw an increased level of fatigue and sleepiness during their injury.

Lack of coordination was experienced as well, mostly at lower levels. As you can see in the chart to the right, Loss of coordination was rated 1 the most, followed by 2.

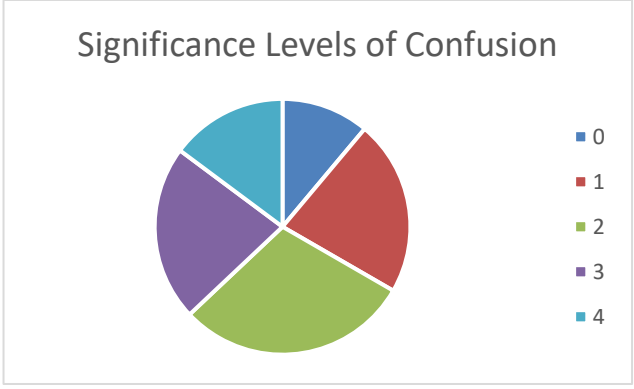


Dizziness was experienced by athletes to a decent extent too. The largest group of athletes rated their dizziness levels at a 3. There were also many that rated them in the 4's, 2's and 1's. A chart of dizziness levels can be seen on the right as well.

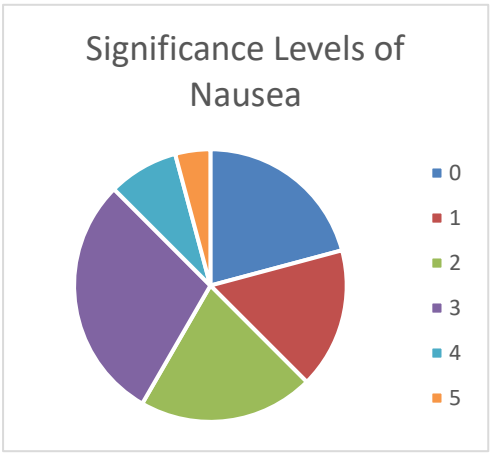


Memory loss was experienced by 15 of the individuals studied, mostly rated lower on the scale from 0-5.

Confusion was experienced by many of the athletes. The amount they were affected varied relatively evenly over the scale, excluding severe confusion. The breakdown can be seen to the right.



Nausea was also experienced by many respondents. The respondents ratings of their nausea levels can be seen in the chart to the right.



Though a significant number of athletes experienced nausea, only 7 athletes experienced vomiting. The few that did experience vomiting only rated this symptom from 1-3. So, this was the least prevalent symptom in the group of Bryant's students studied.

When analyzing the responses to the awareness quiz in the survey, Bryant's students did very well, averaging the score of a 98%. The breakdown of scores can be seen in the table below.

Score	# of Athletes
100%	43
91%	14
82%	3
45%	1

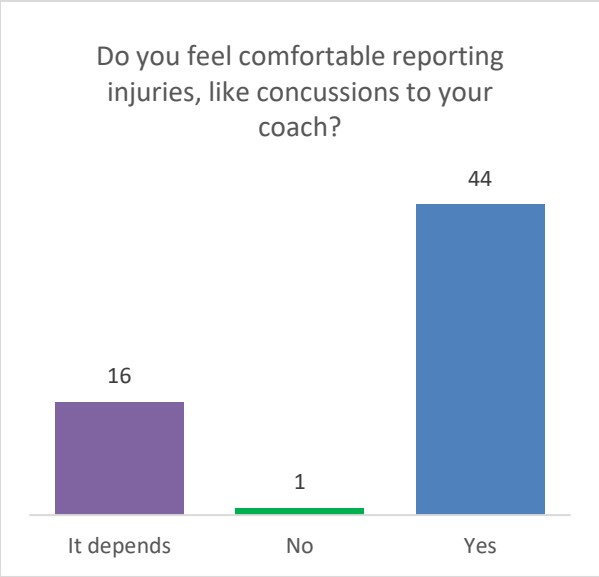
The question that was wrong the most often was: "Which of the following would be considered Danger Signs of a severe concussion and require rushing an athlete to the emergency department immediately?" The correct answer was. "The athlete lost consciousness, has slightly slurred speech, and seems to become increasing[ly] more confused and restless." The respondents that selected the wrong answers selected: "The athlete complains of a headache and appears slightly dazed or stunned." Which are signs of a concussion, versus the correct response were the symptoms of a potentially severe traumatic brain injury, also known as a TBI.

Another question that was answered incorrectly was "How do you identify a concussion?" The correct answer for that question was: "By watching for different types of signs or symptoms, such as a change in the athlete's behavior, thinking, or physical functioning." This was often confused with the incorrect response: "By looking at a CT or MRI scans of an individual's brain." In this case, these respondents mixed up concussions with other head injuries and/or medical conditions.

A third question that was answered incorrectly was: "When can concussions occur?" The correct answer to this question was: "In any organized or unorganized recreational sport or activity and most occur without loss of consciousness." The answer that was incorrectly selected was: "Only when the individual was hit or jolted and loses consciousness".

Overall, no other questions had more than 2 people select the wrong answer. Using these, we can see what aspects of concussions Bryant's students could use more education on.

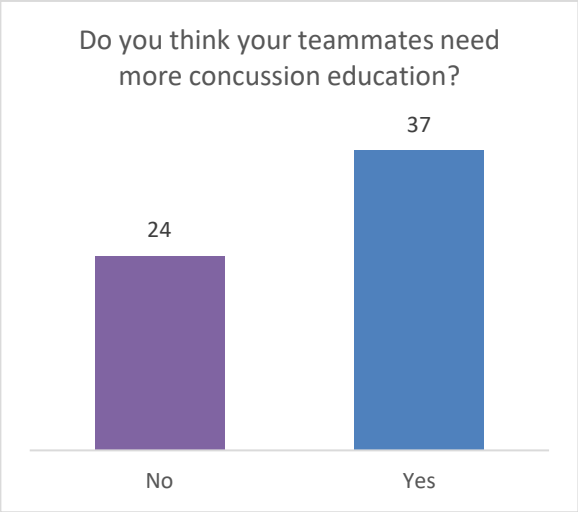
Some information regarding concussion reporting was collected too. When asking about comfort in reporting injuries to coaches, the majority responded that they do in fact feel comfortable reporting injuries like concussions to their coach. However, a significant amount also selected the response "It depends". You can see the response comparison on the graph to the right. When asked to elaborate on situations, if any, that they may not report a concussion, some of the responses were:



- "NEC competition / playoffs"
- "If I knew the team needed me and I felt it wasn't a bad concussion I probably wouldn't report it"
- "After it took me so long for them to clear me last time, I wouldn't want to miss that much of a season again."
- "If I sustain it mid game"
- "If it were a game deciding match"

- "If it didn't seem bad, I might not say anything, cause I don't want to be out too long"
- "Maybe if we had a big competition coming up"
- "If it's a win lose situation"

Many other responses about concussion reporting were along those lines as well.



The survey ended with the question: "Do you think your teammates need more concussion education?" Many athletes participating selected that their teammates could benefit from more concussion education. The graph to the left shows the comparison of responses. Additionally, when the respondents were asked if they thought of concussions as a serious injury, 93% responded that they were. Therefore, student athletes see that concussions are serious and conclude that more education may be beneficial.

Limitations

As with any study, this research had some limitations. One limitation was the sample size. If a larger sample was obtained, the results would be more representative of the full Bryant athletic population. Additionally, 36 respondents did not fill out sufficient information to be included in the study, so they were filtered out prior to analysis. Only responses that had a complete awareness questionnaire and indicated that they are/were a Bryant athlete were kept for analysis. Of the responses included in the study, there were occasional instances where a student missed a question or opted to skip a question, so those questions had less than 62 responses. In the case of these missed questions, the force response option in combination with a "prefer not to answer" option on the questionnaire may be a beneficial aspect if another study of this scope is completed. Additionally, if there was more of a variety of sports teams represented, then it would be more accurate as well. If this study were to be done again, a

combination of interviews and questionnaire results may be beneficial to get a more comprehensive look into the lives of student athletes that had concussions. Lastly, the sample ended up being comprised of a majority of females athletes, so in future studies it may be beneficial to look for a sample that is more evenly distributed among genders.

Conclusions

Overall, athletes at Bryant scored well on the awareness quiz, with an average of 98%. The topics that they can use more education on include distinguishing between concussions and more severe brain injuries that would require hospitalization, concussion diagnosing, and assessing situations in which concussions can occur. These topics are similar to the results of the study done by Kirk et al. that used a very similar variation of the CDC awareness quiz in the questionnaire for Bryant. Though the topics of the questions answered incorrectly were very similar, Bryant's students did significantly better overall, indicating that Bryant's concussion education is more extensive than the other universities included in the other study.

Concussion symptoms seem to have similar prevalence across studies, with headaches being the most common and most significant among a variety of studies. At Bryant and in other studies, all symptoms of concussions were experienced by at least some of the athletes in each study. The symptoms include headache or "pressure" in the head; nausea or vomiting; balance problems or dizziness, or double or blurry vision; sensitivity to light or noise; feeling sluggish, hazy, foggy, or groggy; confusion; concentration problems; memory problems; just not feeling right or feeling emotional. Again, knowing all the symptoms of concussions, as well as more severe traumatic brain injuries, are important to ensure they are recognized and properly treated.

Bryant athletes' reporting behaviors are relatively good, however, there are still situations where athletes may not report their injuries for the sake of the game, the team, and winning. This showed similarities with Tjong's study on football players reporting behavior where they admitted that their non-reporting was mainly due to the pressure of not letting the team down, not wanting to show pain, and not wanting to be replaced on the team. Education on long-

term effects in addition to stakeholders being more supportive of CRB's could help mitigate some of that non-reporting. Learning about the short-term implications, or symptoms, as well as the potential long-term implications, like CTE or sleep disorders, will help improve knowledge gaps in that category. Through the studies analyzed, we can see that the better-educated athletes are, the less likely they are to make risky decisions about their health and safety. So, even though concussion reporting behavior at Bryant is better than other studies mentioned, getting stakeholders on board with more education and support may improve reporting behaviors even more.

Additionally, in the future it may be beneficial for athletic departments to look into on-site concussion testing other than just the physical exam. Potentially introducing the Stroop Color and Word Test at sporting events can help with on-site diagnosis. As more research is done, making the spit test available could be a great improvement as well.

Though most of the athletes at Bryant scored well on the awareness quiz and feel relatively comfortable reporting their concussions to their coaches, a majority of the athletes surveyed indicated that their teammates could benefit from more concussion education. This shows that these athletes understand that concussions are serious and conclude that more education may still be beneficial.

Across all the studies, we can see that the more concussion education athletes get, the more likely they are to make good decisions about their health and safety. Therefore, it is safe to conclude that Bryant's athletes, along with many other college athletes, could benefit from more concussion education.

APPENDICES

Appendix A – (Questionnaire)

https://bryant.ca1.qualtrics.com/jfe/preview/SV_39mqd9RgGiJujat?Q_CHL=preview&Q_SurveyVersionID=current

Appendix B – (Consent Form)

Dear Participants,

You are being invited to take part in a research study about concussions in college athletics.

Although you may not gain personal benefit from taking part in this research study, your responses may help us understand more about athlete's perception of concussions and compile statistics about these types of athletic injuries.

You must be 18 or older to participate in the study. Please note that you are not required take to this survey and that you can stop at any time you wish. If you do not wish to take the survey, you may exit this site now as participation is completely voluntary.

The questionnaire should take less than 10 minutes to complete. There will be questions regarding the athletic activities you are involved in, your personal concussion information, and the level of education you have on concussions. You will not be required to put your name on the survey as to remain as anonymous as possible. The identifiable information collected may include school, sport, age, and gender. You have the right to withhold answering any questions you do not wish to provide a response to or stop answering at any time if desired.

It is the aim of the study to have more than 100 people complete the questionnaire, so your answers are very important to this research. As mentioned, participation is voluntary, and you are free to skip any questions or discontinue at any time.

If you have questions, concerns, or comments about the study, please feel free to contact me at jcappola@bryant.edu.

Thank you in advance for your participation with this research.

Appendix C – (IRB Approval)

October 2020

Juliana Cappola,

RE: IRB Proposal #2020-1018
TITLE: Concussion Awareness in College Athletics

Dear Juliana:

Your proposal, entitled "Concussion Awareness in College Athletics" was considered under IRB Guidelines for expedited review. The IRB Committee of Bryant University approved the proposal on October 18, 2020.

Bryant University is strongly committed to adhering to the basic ethical principles related to the conduct of research involving human subjects as set forth in *The Belmont Report: Ethical Principles and Guidelines for the Protection of Human Subjects of Research*. The submission of your proposal to the IRB Committee supports the goals of Bryant University and the IRB Committee and ensures that research involving any members of the Bryant community is in strict accordance with these ethical principles and guidelines.

Thank you for your submission, and good luck with your research.

Very truly yours,

Yoon sukki

Sukki Yoon
Chair, IRB Committee

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