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Football has been a popular sport in America since the 1920s. With the sport being so popular, there are many levels ranging from high school to college to various professional leagues. According to Kathryn Heinze and Di Lu (2017), the National Football League, the most popular professional football league, is the biggest and most powerful sports league in the United States. In 2015, the estimated revenue was \$13 billion (Heinze & Lu, 2017). Although extremely successful, concussions have become a major problem and pose a significant threat to the future of the sport. The National Football League is run by a commissioner, who right now is Roger Goodell, and an executive committee of owners and high officials from every team (Heinze & Lu, 2017). This group is responsible for changing and creating rules and running the league. One of the biggest problems this executive committee faces today is this concussion crisis. Ever since the early 2000s, the long-term brain effects of concussions have arisen to very high priority for this committee due to all kinds of research being done. Many different studies have shown the problems with concussions; however, many of these studies are taken out of context and scare fans and family members more than it should. In recent years, big strides have been made that have proven the National Football League is adaptable. Along with this, everyone needs to realize that the research done should be used to help make football safer, rather than using it to promote the end of the sport. Furthermore, more research should be done to fully understand concussions. With the increased awareness on concussions in recent years, the National Football League has made significant strides by using the research and changing the rules to try to make the sports safer and less concussion prone, and this adaptability is the main reason why the sport of football should not be in danger of ending.

History of the National Football League with Concussions

In order to understand the development of the concussion crisis, the history of concussions must be looked at. Even though concussions have been happening ever since football started, the topic of concussions in football was not talked about for a very long time. The first main stage of the connection between football and concussions occurred in the early 1990s with the increased popularity of football and the improved technology of the time. When people started questioning concussions, the National Football League immediately dismissed the problem. They claimed it was not a serious injury and other problems like steroids were more serious (Heinze & Lu, 2017). Surprisingly, a few people stepped up during this time and tried to explain how serious concussions were. For example, Leigh Steinberg, an NFL agent, criticized the NFL treatment of concussions saying, "It is a horrendous thought, but it might take someone to die on the field before the league takes this issue seriously" (Heinze & Lu, 2017, p. 504). Similarly, Dr. James Kelly, director of the brain injury program at the Rehabilitation Institute of Chicago, argued that "people are missing the boat on brain injuries. It isn't just cataclysmic injury or death that should concern people. The core of the person can change from repeated blows to the head" (Heinze & Lu, 2017, p. 504). Overall, in spite of the fact the National Football League did little for concussions, there were a few activists that stepped up during this time and that is one of the reasons concussions started becoming known. At this time, little was done because concussions were not known. This was the foundation for the crisis that was coming in the 2000s.

As the concussions started being researched more, a shift occurred in 2002 as the National Football League started to take concussions more seriously. They started making subtle

changes during this time; for example, they added to the roughing the passer rule to make sure defensive players did not tackle low on the quarterback (Heinze & Lu, 2017). This rule made sure the passer (quarterback) did not get tackled below the knee. Even small improvements like this showed progress which was good for the league because it proved the league was willing to adapt. Sadly, during this time 5 high profile football players died, and there was suspicion that it was related to their football past. With these deaths, football fans started freaking out and wondering what was happening. Dr. Bennet Omalu decided to look into it. In order to do this, he looked at Mike Webster's, a star center for the Steelers who struggled with depression and homelessness after football, brain and determined that he had chronic traumatic encephalopathy, also known as CTE ("Dr. Bennet Omalu," 2017). The National Football League met these findings with great resistance; however, once the movie *Concussion* came out about Omalu's findings, the National Football League could not deny the truth ("Dr. Bennet Omalu," 2017). With this finding, serious questions arose about the connection between football and long-term brain damage. Once this research got released to the public, fans of the sport had all kinds of opinions, but a few extremists claimed that football should be ended. This showed how some people immediately took research out of context. The study found that CTE was a problem, but nothing was found about the details of CTE.

In the 2010s, with the National Football League getting major backlash for the concussion problem, a shift occurred when the National Football League started making progressive changes. First, the HNS committee was created. With this new committee, the members were all neurologists or certified concussion professionals and had little to no affiliation with the league (Heinze & Lu, 2017). Along with this, the league created new rules and took other ones seriously. One new rule that was created was that players with symptoms of a concussion had to be approved by a neurologist not associated with the team to go back in the game (Heinze & Lu, 2017). Similarly, the National Football League has made 47 rule changes since 2002 to help fix the concussion problem (Lessley et al., 2018). All of these rule changes prove the National Football League is taking the concussion problem seriously and want to fix the problem. One of these rules was in 2017 when the National Football League put a rule in place to prevent players from leading with their head (Reuters, 2019). The league has also made all teams film every single practice to help the concussion research process (Alvarez, 2018). By changing all these different aspects of the sport, the National Football League proved to everyone that they are willing to make the sport safer. Furthermore, they changed rules on kickoffs to eliminate wedges (a type of blocking on kickoffs) and reduce the number of high-speed collisions (Reuters, 2019). To reduce the number of high-speed collisions, the National Football League removed the running start for the kickoff team. Over this time, the National Football League made real progress by implementing rules, advocating, and educating about concussions. I think these changes show that the league is willing to adapt, and this means that the future of football should not be in question.

Research

For concussions to become such a prevalent topic, a lot of research was done to find the long-term effects and the causes of concussions. Many studies have been done that have helped scientists understand how concussions work and how they lead to Chronic Traumatic Encephalopathy, or CTE; however, much of this research is taken out of context by many people. When playing a sport like football for multiple years, players get hit in the head hundreds of times every practice and every game. With this many blows to the head, traumatic brain damage

occurs like CTE. CTE is the buildup of tau proteins in parts of the brain, which leads to depression, dementia, and mood swings (Belson, 2019). One study done looking at long term effects of concussions looked at TSPO levels (Coughlin et al., 2015). TSPO, a five-transmembrane protein, can be used as a marker for TBI (Coughlin et al., 2015) because regular, healthy humans have low TSPO and TSPO increases when the brain tissue is damaged (Coughlin et al., 2015). This development was huge for scientists because it allowed them to see who had CTE or not. Therefore, this study showed how former football players had higher levels of TSPO than regular humans (Coughlin et al., 2015). It also showed volume loss in retired National Football League players on their right hippocampus (Coughlin et al., 2015). Along with this, these former National Football League players also struggled more with verbal learning and memory tests. For example, some former players were as bad as the 6th percentile (Coughlin et al., 2015). Even though this sounds bad, there is a lot of potential problems with this experiment. No one knows what percentile these players would have been in before football. It is very possible that many of these players would have had low percentiles before their brain was injured. Another new study showed that every 5.3 years of playing football, you double your chance of getting serious CTE damage (Belson, 2019). Also, the risk of getting CTE increased by 30% every year you played football (Belson, 2019). Similarly, these stats are controversial. Every player takes a different amount of hits every single year. For example, a wide receiver takes less hits than an offensive lineman. Also, certain players play more than others. Back in my high school days, I barely touched the field in practice or in games my sophomore year, but during my junior and senior year I played every single practice and every single game. Certain players may be deep in the depth chart causing them to rarely touch the field. Overall, this statistic is frightening but grouping everyone together leads to a much more frightening number. In the end, these statistics are certainly eye opening, but they must not be overexaggerated. For us right now, the goal is to be able to determine the amount of tau proteins in the brain in a living patient because this would allow scientists to find CTE patients while they are alive. If this became possible, the research possibilities would be endless, and this would allow us to understand concussions much better.

Other experiments looked into the main causes of concussions. One study looked into the 2015-2016 and 2016-2017 concussions to see the main causes. Out of the 322 concussions looked at, 50% of the concussions were on pass plays (Lessley et al., 2018). Not surprisingly, tackling was the most common action that caused concussions (Lessley et al., 2018). Finally, majority (62%) of the concussions occurred with multiple impacts. This is most likely because brain tissue is elastic and deformable; however, if the hits occur twice in a row, the tissue is deformed when the second hit occurs, and this causes the concussion (Lessley et al., 2018). All of these things are the main instances when concussions occur. With this research, rules have been added to reduce the amount of, for example, multiple impact hits on players. By doing this, the amount of concussions has been lowered even more. Sadly, these rules are fairly new, so the improvements have not been talked about much.

Sadly, CTE has proven to be very common in former football players. In a journal of the American Medical Association, researching found CTE in 99% of the brains donated to CTE research (Garcia, 2017). This number shows how common CTE is among retired National Football Players; however, it is not entirely true. In order to understand, put yourself in the scenario of a family of a retired football player. On one hand, your husband or dad retired from the National Football League and had a great life with no signs of emotional problems. In the end, he died at an old age and was happy his whole life. On the other hand, your husband or dad

retired from the National Football League and immediately started having problems. Instead of spending time with you and his friends, he shuts himself off and loses a significant amount of weight. Even though he was the nicest person in the world when he was younger, he suddenly has mean streaks. Finally, he dies at a young age because of alcohol abuse. Which family would donate their family member's brain to CTE research? Obviously, the family that's dad suspiciously died at a young age and acted out of character. This means that majority of the healthy retired football player's brains are not researched. This causes the data to look much worse than it actually is.

Improved Technology and Rules

With fans and parents being worried about concussions, the National Football League has worked to try to improve the safety of football. One of the main ways is through improved technology. For example, a new company called Vicis created a new helmet that uses new technology to keep players safer (Garcia, 2017). This helmet has four layers of protection (Garcia, 2017). The outside layer absorbs the impact like a tennis ball. The next layer helps reduce force. Next, the inner shell prevents skull fractures. Finally, the last layer is a foam layer for comfort. According to Ahiza Garcia (2017), this helmet has started being used by many famous players like Russell Wilson, Jadeveon Clowney, Richard Sherman, and Doug Baldwin. Another player who wears the helmet, Cliff Avril, claims "you don't feel the thuds as hard as they normally are" (Garcia, 2017, para. 10). During my senior year of high school, I wore this helmet. In previous years, I wore much older helmets and I definitely noticed a difference. After games, my head did not hurt like it did during my junior year after wearing a helmet with old technology. These progressive helmet companies have done a good job advertising their equipment. There was a 33% increase in players wearing new helmets like Vicis from the 2017-2018 season to the 2018-2019 season. According to Edgar Alvarez (2018), another new technology is Riddell, a popular helmet company, is starting to make custom helmets. Riddell has started custom fitting helmets, so every part of the head is protected well (Alvarez, 2018). Also, Riddell plans to make a censored helmet that measures the amount of force a player is receiving (Alvarez, 2018). Using this, coaches and trainers can see if someone might be injured. Also, according to Alvarez (2018), they could look at this data to see if a certain player has bad form. By technology adapting to the modern league, the issue with concussions can be solved.

Along with this, the National Football League has put many rules in the last 10 years to help the concussion crisis. For example, the new targeting rule that was put in place that reduces the amount of helmet to helmet hits helps because helmet to helmet hits cause the most amount of concussions. (Lessley et al., 2018) The National Football League has also taken initiative by changing team's practice schedules. First, the off season has been reduced from fourteen to nine weeks (Alvarez, 2018). Next, in the preseason, teams cannot practice twice in one day. Finally, before 2011 teams could practice with pads as much as they want; however, now they can only have two padded practices a week in season (Alvarez, 2018). These rules have already started to make an impact. Most importantly, they show that the National Football League is trying to fix the issues. During the 2015-2016 and 2016-2017 seasons, 458 concussions occurred (Lessley et al., 2018). The next season, 281 concussions occurred; however, once the new targeting rule and the changes to kickoffs got put in place, the 2018-2019 season had 214 concussions, a significant drop (Reuters, 2019). This 24% decline shows how helpful the rules have been in preventing concussions (Reuters, 2019). With these rules already having a positive effect on the game, it shows the game is in good shape going into the future.

Furthermore, in order to help promote research, the National Football League started a \$100 million concussion initiative in 2018, with \$60 million of it going to technology and the rest to medical research (Garcia, 2017). With this money, the game can hopefully become safer and long-term brain damage free. All of these things prove the National Football League's adaptability. This is crucial and should be a pivotal point in proving why the National Football League should not be abolished.

Conclusion

The National Football League has a major problem with concussions. Right now, they have made strides to help fix the problem; however, there is still a lot to be done. Looking at the number of concussions in the last season, it is obvious that the National Football League has done a good job implementing new rules and new equipment to prevent concussions. Overall, reducing the number of hits on player's heads is the most important thing and reducing the number of padded practices helps this a lot. With these rule changes being successful, there is no need to argue that football should be abolished. Yes, football needed to be reformed but the National Football League has proved that they have and will do this in the future. With them proving this, there is no need to worry about concussions. Along with this, more research needs to be done to find cures and ways to prevent long-term brain damage like CTE. With more research, the National Football League can understand how CTE works and the game of football can adapt to this. Right now, we barely know anything about CTE, and we should not jump to conclusions without proof. The most important thing the National Football League can do is make sure that everyone is aware of the dangers of football. Every player must know what they sign up for and every parent should be aware of the potential consequences. One potential way to do this is to have concussion programs every two years for every player in the National Football League. Another way is to make everyone sign a waiver to make sure they understand the consequences. Overall, if everyone is aware of concussions, I do not see any problem with the path the National Football League is on. In the end, by making everyone aware of concussions and continuing the progress they have made with preventing concussions, the National Football League should continue to stay the number one sports league in the United States.

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