Long Term Health Risks of Concussions in the NFL

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On my honor as a University Student, I have neither given nor received unauthorized aid on this assignment as defined by the Honor Guidelines for Thesis-Related Assignments

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Introduction

The National Football League (NFL) is an essential piece of American culture. It is even said the game of football is as American as apple pie or Budweiser beer (Cole, 2010). At NFL kickoff live in 2003 President Bush even argued that football displays values that keep America strong (Oates, 2004). Having operated for over 100 years, the NFL has become a billion dollar industry that affects the lives of millions across the United States. It was estimated in 2024 that the NFL made about $12 billion in the previous season (Eckstein, 2024). In polls sent out by the Washington Post, it was determined 60% of people say they are professional football fans and 37% of people say football is their favorite sport to watch (Kilgore & Clement, 2017). Although this game has great popularity among viewers, the health and safety of the players is becoming a major problem. As humans our health and safety is a priority that stands above all else. While football provides significant entertainment, it is crucial to recognize that human safety and long term well being are far more important than fan enjoyment. In those same Washington Post polls, 90% of people said head injuries causing long term health problems for players is an issue in football (ibid).

Head injuries, especially concussions, are a common injury NFL players experience. As humans, our brains control our nervous system and when damaged a person's personality, movement, vision, sleep, and other bodily functions can be altered (Martin, 2023). Because there is no test or imaging technique that can definitively diagnose a concussion, the injury is defined strictly based on symptoms. These symptoms include: headache, nausea, dizziness, fatigue, blurred vision, and/or sensitivity to light. Since the diagnosis is not definitive and the symptoms can vary, people have doubted the validity and influence of the injury. This has led to misconceptions about the risks NFL athletes are incurring. However, a recent discovery

regarding the potential link between concussions and chronic traumatic encephalopathy (CTE) is bringing about major concern for athletes' brain health. In recent years there has been a decrease in the number of high school football players due to increased attention to risk of head injury (Macy et al., 2021).

Repeated concussions and sub-concussive blows to the head increase an athlete's risk of developing CTE (Vanltallie, 2019). CTE negatively affects the human brain by causing symptoms like chronic depression, insomnia, paranoia, and impaired memory (Omalu et al., 2010). Unlike concussions CTE is permanent, the symptoms have a larger impact on human function, and it has a definitive diagnosis. However, this diagnosis can only come post mortum. With CTE being so dangerous and concussions being so prevalent in the NFL, it is crucial to understand why this problem is just now becoming apparent and what measures have already been taken to help prevent these injuries.

Context

In an interview with Jim Brown, NFL running back, in 1964 he mentioned a concussion he experienced during a football game. When he elected to stay on the bench after the injury, his head coach accused him of purposefully avoiding work (Concussion Alliance, n.d.). Because there was no way of proving that a player had a concussion, the injury was seen as a fabrication to avoid playing. It was not until 1994 that the NFL began to conduct research on concussions and create a committee whose goal was to monitor the effect of the injury on players. In the year 2006, the first report of a former NFL player having CTE came out. However, it was not until 2009 until the NFL acknowledged the link between concussions and a potential cognitive decline. Finally, in 2013 the NFL created a concussion protocol to be practiced in games to determine if players who undergo head impacts would be fit to return to play. In addition to this

protocol, in 2013 and 2016 the NFL made major rule changes to help prevent head injuries. Although the 2013 rule change specifically targeted concussions safety, the number of players who suffered head injuries did not decrease significantly (Sheth et al., 2018). While concussions were long an afterthought for the NFL, the league continues to show resistance to new discoveries regarding the brain health of players. Although there are currently safety measures in place for players after they experience a head impact, the helmet has always been on the front line of defense.

After five people were hospitalized in the Harvard-Yale football game in 1894, the first leather football helmet was created by Joseph Reeve, a player for Navy (Atavus, n.d.). Football itself includes instances of rough physical contact, as tackling another player to the ground is the main goal of the defending team. It is truly unbelievable that the game was once played without helmets. After Joseph Reeve's invention, the football helmet made large strides for player safety throughout the early 1900's and in 1943 the NFL mandated the use of a helmet for all players. Helmets in the mid 1900's did not provide optimal protection. Original helmets were small leather coverings that did not incorporate a face mask until the 1960's. In the eighties companies like Riddell began to introduce more modern helmets which were stronger and provided more protection. These helmets incorporated high-tech materials to help reduce impact forces on the head, while also being light and agile. Following in suit with these innovations, the NFL began to ban helmet models in the 2010's that did not meet an established set of safety standards (ibid). Being the only line of defense for a player's head, the helmet is a crucial piece of technology in the game of football, and it is important to consider these improvements when looking at concussion data.

STS Framework

To understand the issue of concussions in the NFL, I will be looking at football helmets as a piece of infrastructure. To do this I will be using the science technology and society (STS) framework developed by Star in "The Ethnography of Infrastructure." Star argues that infrastructure is taken for granted by people and only appears to be visible when broken (Star, 1999). Football helmets have been taken for granted by people for many years and on many instances have been in need of improvement because of their failure. As our knowledge of brain injuries has exponentially increased throughout history, so has the improvement of football helmets. More information regarding severity and legitimacy of concussions has on multiple occasions been a direct factor pushing the helmet industry to improve their technology. Recently, this visibility of failure has stemmed from increased awareness regarding the link between concussions and CTE. The lack of reliability in helmet protection has caused changes to laws, game rules, policies, and recovery management protocols (Guay et al., 2016). In our society, the priority of human health over entertainment has been the backbone of these developments. People care about their brain function and longevity and are willing to sacrifice playing football if the proper helmet technology cannot protect them against these dangers.

Star also argues that pieces of infrastructure are fixed in modular increments. In week 13 of the 2015-16 NFL season and week 1 of the 2016-17 season there were 12 different helmet types worn on the playing field (Colello et al., 2018). As mentioned before, there are helmets banned from use in the NFL, but not all the approved helmets provide the same amount of head protection. Since there are multiple companies making helmets, all these helmet styles are created based off of different resources and information, which leads to each helmet providing different levels of safety to players. In NFL locker rooms, there are posted signs made by biomechanical experts displaying the laboratory performance results of specific helmet types

ranging from better to worse (National Football League, 2024). On this sign, there are around 20 unique helmet types, all of which are not prohibited. This presents the question, if some helmets are better than others, why doesn't everyone wear the best helmet? The answer is some players prioritize comfort and style over safety. In order to solve the problem of head safety in the NFL, it is going to take time. As previously mentioned, the NFL has been historically slow on updating policies to accommodate medical findings, and players do not always adapt to new technology as well. In today's game we can see this taking place with guardian caps. Guardian caps are a new safety pad that can be worn on top of a football helmet to reduce impact forces. Even though they are proved to reduce head acceleration, only a few players have elected to wear the caps and the NFL is not requiring players to wear it. When a new helmet technology is developed, it will be forced to make changes in modular increments.

Lastly, Star argues that infrastructure has reach beyond one single event or practice. The game of football reaches far beyond the NFL. Although the NFL sets the standard for helmet use in other leagues, not all levels of football have the same resources and access that the NFL does. For instance in the United States, there are around 5.6 million people that play tackle football. This number accounts for professional players, college players, high school players, and even leagues for children over the age of six. It is safe to assume there are millions of people playing football in leagues without the helmet standards or access to technology that the NFL has. Although these leagues strive to meet the NFL's standards, it is important to understand that the distribution of new technology takes time but has to start somewhere. On top of this there is a correlation between participation in tackle football prior to age 12 and later life cognitive impairment (Stamm et al., 2015). This demonstrates that the helmet as a piece of infrastructure has reach far beyond elite athletes, but also the broader population who may be more vulnerable

to head injuries. Therefore, the NFL's decisions around helmet technology and safety standards have ripple effects that extend far beyond the professional field, influencing the well being of millions of players at all levels.

Methods

The research question I am seeking to answer in this thesis is: how are concussions in the NFL causing long term health risks for players? This question is important because of the implications it carries for player safety. The impact concussions can have on the human brain is not fully known. In the case that they are causing long term health risks; the landscape of the NFL and football could be in need of a serious change. To analyze this question, I will be utilizing three methods: a count of events, prior literature, and historical analysis.

The first method I will use is a count of events. In order to understand how long-term health risks are being developed it is imperative to determine how many players have experienced concussions. To attain this information, I will review the NFL injury logs in the past 5 years to see the quantity of players who may be at risk of CTE. This has been done previously by for the 2010-2019 seasons by using weekly injury reports from NFL teams to track major injuries (Sheth et al., 2020). With this data, I aim to support how pressing this issue is, based on the quantity I find. The higher the quantity is, there will be more proof of the dangers being caused in NFL play. In addition to simply counting the number of concussions, I will also look for patterns such as positions affected and the frequency of repeated concussions. This can help identify certain groups of players at higher risk, which may help inform prevention strategies. Furthermore, comparing year to year trends will show the development of the problem and if any progress is being made. This data will provide a foundation for understanding the scale of the issue and justifying the need for stronger infrastructure and policy changes within the NFL and beyond.

Next, I will use prior literature to prove the existence of CTE in NFL players. I plan to analyze existing reports that have taken the brains of deceased NFL players and evaluated them for CTE. Having knowledge of existing CTE in ex-NFL players will help to solidify the existence of the problem. Also, this kind of evidence highlights the severity of long-term consequences that can result from repeated head injuries sustained during play. Additionally, I will explore whether these studies discuss the severity of CTE in relation to the length of a player's career or position played. By combining this research with injury data, I can further demonstrate how ongoing participation in tackle football without adequate protection leads to serious, lasting health impacts.

The last method I will use is historical analysis. Concussions and CTE have not been diagnosed in the NFL from its beginning, so I plan to figure out when the NFL started reporting concussions. Since data on player injury has only been collected for a set amount of time, many years will be outliers and have "zero" injuries, but it is important to understand that these injuries were still occurring without documentation. This historical analysis will help to determine a timeline of injury reports in the NFL to help further interpret my count of events. I will also examine how the NFL's reporting practices, and concussion protocols have evolved over time, and find key policy changes and their impact on reported injury rates. Additionally, I will explore whether early resistance or denial from the NFL contributed to underreporting and delayed the recognition of the dangers of repeated head trauma. This historical perspective will strengthen my overall argument by showing how institutional decisions have shaped both awareness and the documentation of player injuries.

Results

Over the past five NFL seasons (2020-2024) the number of concussions has fluctuated. As seen in Figure 1, there are a considerable number of concussions being incurred by players each season. In addition to the substantial number of concussions, there has been no sign of a

Season	Total Concussions	Percentage Change from Previous Season
2020	172	-
2021	187	+8.7%
2022	213	+13.9%
2023	219	+2.8%
2024	226	+3.2%

Figure 1: NFL Concussion Data

decrease. Although the percentage change from the previous season varies, there is still an increase in concussions each year for the last five years. This presents an obvious risk to players who engage in play. More specifically, certain positions are at a higher risk for concussions than others. From Figure 2,

Position	Average Annual Concussions (2020-2024)
Offensive Linemen	35
Defensive Backs	32
Linebackers	28
Wide Receivers	25
Running Backs	22
Quarterback	18

Figure 2: Position Specific Concussion Data

it is apparent that skill position players are at a lower risk for concussions than other players. In football, positions like linemen, defensive backs, and linebackers engage in physical contact every single play. On the other hand, skill position players are less likely to get concussions because they don't engage in physical contact as often. For example, a wide receiver or running back is only subject to physical contact when they are given the ball. This consistent exposure for linemen and linebackers creates a cumulative effect of head trauma that may not always result in a diagnosed concussion but can still contribute to long term neurological damage. In addition, repeated sub concussive impacts and concussive impacts over the course of a season further increase the likelihood of future concussions. These patterns emphasize the need for targeted prevention strategies tailored to the positions most at risk. Without focused intervention, players in these high contact positions will continue to bear the greatest burden of risk. Furthermore, this risk is not only regarding concussions, but according to recent studies it also creates risk regarding the development of CTE.

In a recent study of 111 NFL brains conducted by Dr. Ann McKee of Boston University, 110 of them were determined to have CTE (Ward and Manchester, 2017). Although this test has selection bias since brains are selected based on lifetime symptoms, this study sets a solid groundwork that CTE is occurring. This work has continued at Boston University, and as of 2023, 345 former NFL players have been diagnosed with CTE out of the 376 players that have been studied (Boston University School of Medicine, 2024). In a 2018 study of 164 random men and women only 1 brain was determined to have CTE, and it was a former college football player (ibid). These studies have led to the conclusions that the chief risk factor for CTE is repetitive head impacts, which is an inherent part of NFL play. A survey of 1980 retired NFL football players conducted by Harvard University found that one third of respondents believe to

have CTE. These survey results of perceived CTE were guided by symptoms being experienced. Symptoms included suicidal thoughts, forms of dementia, or diagnosis of Alzheimer's disease (Gorenstein, 2024). This survey establishes a wider range of potential CTE diagnosis. Most of the research conducted on CTE pertains to a small number of brains which are selected based on symptoms during the players' lifetime. However, the survey conducted by Harvard did not have the same level of selection bias but still found a large portion of players experiencing CTE symptoms. The problem is clear, NFL players engage in physical contact that results in repeated head trauma which puts them at risk for CTE, a lifechanging condition.

Historically speaking, the NFL has not always acknowledged concussions and CTE. The NFL did not consistently start tracking and reporting concussions until the early 2000's. Before that, injuries went unnoticed or were ignored, leaving a gap in understanding the long-term effects of repeated head trauma. In 1994, the NFL created the Mild Traumatic Brain Injury Committee (MTBI) to oversee head injuries. In that same year, the commissioner of the league described concussions as a "pack journalism issue" (Ezell, 2013). In 1997, the American Academy of Neurology established a set of guidelines regarding return to play. These guidelines stemmed from research that suggested repetitive concussions can cause brain damage. MTBI criticized these guidelines in 2000 and claimed that they were based on insufficient research. In addition, the MTBI questioned the danger of being knocked out, and let a player return to a game in 2003 after being knocked out cold during play (ibid). In 2004, the MTBI disputed reports that repeated concussions led to slowed neurological function. The committee stated that the studies do not support the conclusions being made. This claim came after CTE had been found in multiple NFL brains in 2002 and 2004. On top of this, MTBI committee also published a paper that suggested NFL players are less susceptible to brain injury. Finally in 2009, an NFL

spokesperson admitted that concussions had long term effects, seven years after CTE had been found in the brains of NFL players. This change came from commissioner Goodell's new initiatives on concussion research and complete re-staffing of the MTBI committee. In 2011, the NFL changed its kick-ff rules in order to reduce the speed of collisions during the kickoff, and in 2013 the NFL announced that an independent neurologist will be on the sideline of every game to assess for concussions through a symptom checklist, an examination, and a balance assessment (ibid). Although the NFL began to fund research, communicate risk, and institute further safety measures, the timeline shows that these actions came after years of denial. Now the question is, are these measures enough?

Discussion

The results of this research indicate that concussions and long-term neurological damage, such as CTE, are major issues within the NFL. These findings reinforce the relevance of Star's framework regarding infrastructure, as the helmet has repeatedly failed to protect players. According to Star, infrastructure is visible upon failure. The increasing number of concussions each year and the large amount of CTE diagnoses in former NFL players show this visibility. Despite major advancements in helmet technology, the data shows that concussions are not decreasing. This suggests that the improvements made have not yet been sufficient to meet the demands of the game's physicality. Furthermore, the presence of multiple helmet models with varying degrees of protection aligns with Star's concept of modular increments. Change is happening, but it is slow and uneven, leaving room for players to have preferences between safety, comfort, and style.

The historical analysis supports this conclusion, showing that the NFL has been reluctant to fully acknowledge the presence of a head safety issue. The delay in policy adaptation and

safety protocols demonstrates institutional resistance to change. Changes only occurred after years of public scrutiny and major personnel swaps within leadership. The current policy on guardian caps, which are proven to reduce impact force but are not mandatory, reflects the same pattern of gradual and uneven adoption of new safety measures.

Additionally, the broader reach of helmet infrastructure beyond the NFL is a key concern. The ripple effect on youth, high school, and college football players cannot be overstated. Without consistent and enforced helmet standards at these levels, millions of younger players remain vulnerable. Since evidence suggests that early exposure to head trauma increases the risk of long-term cognitive decline, this issue extends far beyond professional athletes and into public health. The findings suggest that the NFL, as the top authority in football, has both the influence and the responsibility to lead more decisive action.

Conclusion

This research demonstrates that concussions and the risk of CTE in the NFL are not only persistent but worsening issues. Through the lens of Star's infrastructure framework, helmets, as a critical safety device, have not fully kept pace with the evolving dangers of the game. Despite improvements, concussions continue to rise, and long-term effects are being increasingly recognized. The NFL's slow response historically and its piecemeal adoption of safety measures emphasize the need for stronger, more uniform action.

It matters because the impact reaches beyond the NFL to millions of athletes at all levels of play. The health and cognitive futures of current and future players are at risk. What comes next should include mandating the safest equipment, such as guardian caps, continued funding for research, and stronger educational initiatives to shift player culture toward prioritizing health

over personal comfort or aesthetics. Additionally, the NFL must continue to influence and support lower levels of play by distributing resources and setting stricter safety standards that extend to youth leagues. Without swift and comprehensive action, the risks to human health and well-being will continue to overshadow the entertainment value of the game.

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