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National Football League Concussions from 2009 – 2015: A Secondary Data Analysis

Ethan Kelly

In recent years, the National Football League (NFL) has made an effort to lower the prevalence of concussions, partially by enacting rule changes designed to limit contact to the head. This study aims to determine whether NFL rule changes from 2009 – 2015 have resulted in a decrease in the number of reported concussions through analyzing publicly available injury reports, which were compared with rule changes for each season. A second component of the study aims to determine whether teams are underreporting the number of concussions suffered by gathering concussion data for each team. This study found that there was a general increase in the number of concussions from 2009 – 2015 and it is not possible to determine whether rule changes are effective in decreasing head impact exposure. This study also found that certain teams reported a significantly low number of concussions throughout the years analyzed, and underreporting is likely occurring.

Keywords: concussion, underreporting, National Football League, rule changes

Introduction

Throughout the twentieth century, various studies were published regarding the detrimental effects of concussions. It was not until 2005, when Dr. Bennet Omalu published his research on Chronic Traumatic Encephalopathy in deceased National Football League (NFL) players, that concussions became one of the greatest concerns facing sports players, parents, and multi-billion dollar leagues.

While often criticized for disregarding these findings, the NFL has increased its effort in the research and prevention of concussions by recently investing \$100 million in concussion research and by consistently implementing rule changes designed to prevent concussions since around the time of Omalu's findings (Belson, 2016). While there have been vast amounts of research performed on the effects of concussions

in NFL players, there is a lack of research determining whether or not the NFL's concussion prevention strategies are indeed protecting the players. From approximately 2009 onwards, the NFL has implemented several new penalties varying in punishment from five to fifteen yards, as well as possible fines and suspensions. When a penalty is enforced, the penalized team will have the football moved back by the corresponding number of yards to that particular penalty. With these punishments, a negative incentive is placed to discourage players from acts that could cause concussions, and this study attempts to determine whether these negative incentives are working. A second portion of the study seeks to address the issue of the underreporting of concussions by NFL teams. This issue has been discussed in the media and by former players but has yet to be analyzed in an academic study. Thus, the question that will be explored is: are the recent National Football League rule changes designed to limit

brain trauma achieving their desired effect of lowering the prevalence of concussions and are NFL teams accurately reporting these concussions?

This study analyzed National Football League injury reports from 2009 – 2015 in order to determine whether the rate of concussions has been decreasing in unison with the rule changes. This study also tracked the number of concussions reported by every NFL team in order to determine whether teams have been underreporting concussions. Since the research has already been gathered by an outside source, a secondary data analysis was used to present the findings. The goal of this study is to provide a greater level of clarity to a growing issue of concern in the sport of football.

Literature Review

There has been extensive research on the effects and dangers of concussions in the National Football League (NFL), as well as in other football leagues. In the famed 2005 study conducted by Dr. Bennet Omalu which inspired a Hollywood film, Chronic Traumatic Encephalopathy (CTE) was first discovered in a former NFL player. Omalu investigated the case of former NFL player Mike Webster, by performing an autopsy on his brain. Omalu's discoveries were shocking, as he found grey matter on the brain of the player, which showed extensive damage to the brain. What further made this discovery noteworthy was that Webster had no recorded concussions throughout his career (Omalu, 2005). Omalu then proposed that the grey matter found on the brain was a result of repetitive, non-concussive, hits to the head. Over time, while there may have not been great force on the hits, the sheer number of hits resulted in extensive damage to the brain. Omalu then named this condition Chronic Traumatic Encephalopathy (Omalu, 2005). This study is particularly noteworthy as an autopsy had never been performed on the brain of a former NFL player (Omalu, 2005). One major limitation of this study was that due to the nature of the procedure, it could only be performed on deceased players (Omalu, 2005). So while Omalu's findings caused great concern and outrage among the medical and football communities, there was still no way of diagnosing CTE in living players (Omalu, 2005). New methods

of investigating brain injury were attempted, and in 2008, a study involving Omalu used a technique called Positron Emission Tomography (PET) scanning, and the results were encouraging (Small et. al, 2008). In this investigation, five retired NFL players aged 45 to 73 years were compared with a control group of similar age and body characteristics. The results found that signals were much higher in the experimental group, particularly in regions of the brain known to produce tau deposits, which Omalu had discovered in his 2005 study. This development was noteworthy, as the PET scanning successfully filled a gap in the ability to identify traumatic brain injury in living humans. Despite this encouraging breakthrough, more research is necessary to fully comprehend CTE and its possible treatment and identification options (Tator, 2014).

It is essential to outline in this paper a definition for what constitutes a concussion. According to the *British Journal of Sports Medicine*, they state:

Sport related concussion is a traumatic brain injury induced by biomechanical forces. Several common features that may be utilised in clinically defining the nature of a concussive head injury include: SRC may be caused either by a direct blow to the head, face, neck or elsewhere on the body with an impulsive force transmitted to the head. SRC typically results in the rapid onset of short-lived impairment of neurological function that resolves spontaneously. However, in some cases, signs and symptoms evolve over a number of minutes to hours. SRC may result in neuropathological changes, but the acute clinical signs and symptoms largely reflect a functional disturbance rather than a structural injury and, as such, no abnormality is seen on standard structural neuroimaging studies. SRC results in a range of clinical signs and symptoms that may or may not involve loss of consciousness. Resolution of the clinical and cognitive features typically follows a sequential course. However, in some cases symptoms may be prolonged. The clinical signs and symptoms cannot be explained by drug, alcohol, or medication use, other injuries (such as cervical injuries, peripheral vestibular dysfunction, etc) or other comorbidities (eg, psychological factors or coexisting medical conditions) (McCrory et al., 2017).

As can be interpreted from this definition, concussions have a wide array of symptoms, which could lead to the possibility of some teams having different interpretations of what classifies a concussion.

Recent breakthroughs in concussion research have placed a greater focus on the issue of concussion prevention through advances in helmet technology along with rule changes in various sports. When addressing concerns over concussion prevention measures, NFL Commissioner Roger Goodell stated, “Within the NFL, safety-related rules will always be clearly defined and strictly enforced, and we will continue to work with our players, coaches, and others to identify new and safer ways to play the game” (Bachynski & Goldberg, 2014, p. 324). Despite these promises to increase player safety, researchers such as Kathleen Bachynski and Daniel Goldberg (2014) argue that they find “little evidence that these strategies prevent concussive and subconcussive head impacts or significantly reduce the associated long-term risks” (p. 324).

While large sums of money have been invested in concussion research, there has not been a substantial amount of research performed on the effects of the NFL rule changes designed to limit the impact to the brain. In 2015, a study was performed that investigated the effects of the changes to the free kick rules in the 2010 and 2011 seasons on injuries (Ruestow, Duke, Finley, & Pierce, 2015). Ahead of the 2011 season, the free kick was moved from the 30-yard line to the 35-yard line. This rule was designed to limit the number of kick returns, a notoriously dangerous play, by increasing the likelihood the ball will be kicked deep into the opponent’s territory. The data was collected from NFL injury reports to determine the number of injuries on special teams plays. The study found that there was a noticeable decrease in injuries on these plays when comparing data from the 2010 season without the rule change to the 2011 season (Ruestow, Duke, Finley, & Pierce, 2015). Although it could not be definitively determined whether the reduction in injuries was caused by the rule changes, some inferences could be made. The authors determined that due to an increase in the number of touchbacks, there were fewer plays run, and therefore fewer opportunities for injury (Ruestow, Duke, Finley, & Pierce, 2015). It is important to note that this study did not distinguish between concussions and other injuries. While this study found an overall decrease in total injuries, it did not claim to find a decrease in the number of concussions.

In 2016, a study was performed that analyzed the effects of limiting full-contact high school practices

on the exposure to head impact. Through performing a cross – sectional study, the researchers determined that limiting full-contact practices resulted in an average of a 42% decrease in head impact exposure (Broglia, Williams, O’Connor, & Goldstick, 2016). Along with the study discussed in the paragraph above, there appears to be a trend that lowering the number of contact plays tends to result in a decrease in the number of injuries. While this study does not take into account how much contact NFL players are exposed to in practices, it is important to note that practice conditions may affect concussion rates.

In a report released by the National Football League, the number of total concussions rose considerably from 2014 to 2015 (Breslow, 2016). According to NFL Senior Vice President of Health and Safety Policy Jeff Miller, the NFL has been attempting to identify what has led to this increase (Breslow, 2016). One hypothesized explanation is that there has been a shift in player behavior. As Miller stated, “We’re seeing unprecedented levels of player reporting signs and symptoms of concussions” (Breslow, 2016). If this statement were accurate, an increase in the number of concussions should be expected as it is assumed NFL players have not been consistently reporting concussion-related symptoms in the past. As author Jason Breslow points out, however, the NFL does not track data on the incidence of self-reported concussions, hindering the ability to gather a quantitative account of a possible shift in concussion culture (Breslow, 2016).

There have been many studies regarding concussions in sports; however, the field remains relatively young and requires substantially further research to provide greater understanding and context to the current knowledge on concussions and CTE. Many of the studies analyzed in this review produced inconclusive results, which further reinforces the need for additional studies. Through the research analyzed, a general trend can be seen that in rule changes that result in decreased exposure to contact, a reduction in injury rates has been shown. Due to the current sample size, this trend holds little value and certainly warrants further research. While there have been various studies performed regarding concussions and injuries in the NFL, few have analyzed the impact rule changes have had on the number of recorded concussions.

Method

Publicly available injury reports from the National Football League have been analyzed in order to determine the total number of concussions diagnosed for each season from 2009 – 2015. This data was collected from the websites *Pro Football Reference* and *PBS Frontline: Concussion Watch*. The website *PBS Frontline: Concussion Watch* contains the number of concussions suffered by each position and each team from 2012 – 2015 (Breslow, 2015). The website *Pro Football Reference* contains all of the injury reports from each team of the NFL from 2009 onwards and was used to collect data from 2009 – 2011 (Pro Football Reference, 2017). For data collection from *Pro Football Reference*, the injury reports of each team were thoroughly examined and any injury under the designation *concussion* or *head* were counted in the study. This is the same method *PBS Frontline: Concussion Watch* used for its data collection, which ensures consistency throughout the entire study (Breslow, 2015). The data regarding the numbers of concussions per year was then compared to the rule changes put in place for each respective year in order to determine which rules are achieving their desired effects. Furthermore, the number of concussions suffered by each position was collected in order to determine the possible effects the rule changes had on different positions. The positions that were analyzed were quarterback (QB), running back (RB), wide receiver (WR), tight end (TE), offensive line (OL), defensive line (DL), linebacker (LB), and defensive back (DB). A secondary data analysis research method is most suitable for this study as only one variable is in place, the number of concussions, and this data

has already been collected by *PBS Frontline: Concussion Watch* and *Pro Football Reference*. In a 2013 study, a similar method was used to describe the impact of moving the free kick forward five yards on the total number of injuries in the 2011-2012 NFL season (Ruestow, Duke, Finley, & Pierce, 2013). By analyzing the number of concussions alongside rule changes that penalize certain forms of head impact, this study aims to determine the effectiveness of the rule changes. In order to address the possibility of teams underreporting concussions, this study has counted the number of concussions reported by each team from 2009 – 2015. An average value was then calculated for each season to determine the average number of concussions suffered per team, as well as the average of the total number of concussions suffered over all seven years of the study. Trends have been analyzed from this data set in order to determine whether or not concussions are being accurately reported.

Findings

Overall, 1038 concussions were observed during the seven-year period from 2009 – 2015. The position group that suffered the highest number of concussions were defensive backs with 288 reported concussions, while quarterbacks suffered the lowest number with 50 concussions (Table 1). For each year of the study, all relevant rule changes are explained below. It is important to take into account that not all rule changes impact each position identically. Some rule changes will only have a bearing on the concussion data from certain position groups, which has been identified below.

Table 1

Number of Concussions by Position

<u>Year</u>	<u>QB</u>	<u>RB</u>	<u>WR</u>	<u>TE</u>	<u>OL</u>	<u>DL</u>	<u>LB</u>	<u>DB</u>	<u>Total (by year)</u>
2009	5	13	10	13	12	9	16	23	101
2010	11	9	25	12	17	17	19	36	146
2011	7	15	19	13	19	15	24	41	153
2012	7	18	29	19	24	13	13	45	168
2013	6	15	20	16	21	15	15	43	151
2014	2	11	15	9	20	7	16	42	122
2015	12	11	24	17	34	17	24	58	197
Totals (N = 1038)	50	92	142	99	147	93	127	288	

Note. Data from 2009 - 2011 collected from *Football Outsiders*. Data from 2012 - 2015 collected from *PBS Frontline: Concussion Watch*.

2010

There were four notable rule changes implemented in the 2010 season that penalize trauma to the head. The first of these rule changes states that “A player who has just completed a catch is protected from blows to the head or neck by an opponent who launches” (NFL Evolution, 2013). The second states, “All ‘defenseless players’¹ are protected from blows to the head delivered by an opponent’s helmet, forearm, or shoulder” (NFL Evolution, 2013). The third states, “quarterbacks after a change of possession are protected from blows to the head delivered by an opponent’s helmet, forearm, or shoulder, instead of just helmet-to-helmet contact.” (NFL Evolution, 2013). The fourth states, “The ball is declared dead at the spot if a runner’s helmet comes completely off” (NFL Evolution, 2013). All of these rule changes would primarily impact players on offense.

2011

Two rule changes were implemented this season that could have had a bearing on concussion numbers. The first states that “The restraining line for the kicking team is moved from the 30- to the 35-yard line in an effort to increase touchbacks” (NFL Evolution, 2013). This rule could impact players on offense and defense. The second states, “A receiver who has completed a catch is a ‘defenseless player’ until he has had time to protect himself or has clearly become a runner. A receiver/runner is no longer defenseless if he is able to avoid or ward off the impending contact of an opponent. Previously, the receiver who had completed a catch was protected against an opponent who launched and delivered a blow to the receiver’s head” (NFL Evolution, 2013). This rule change would only have an effect on offensive players.

2012

Only one rule change was added in the 2012 season that could impact concussion frequency and it states that “The list of ‘defenseless players’ is expanded to include defensive players on crackback

¹ A *defenseless player* is considered to be a player who is not in a position to be able to avoid contact (Blandino, 2017). A player that is labelled as *defenseless* is protected from hits to the head or neck area (Blandino, 2017).

blocks, making it illegal to hit them in the head or neck area” (NFL Evolution, 2013). This rule change would strictly impact defensive players.

2013

One rule change was implemented this season that seeks to decrease contact to the head. The rule “Prohibits a runner or tackler from initiating forcible contact with the crown of the helmet outside the tackle box” (Goodell, 2013) (p. 2). Both offensive and defensive players would be affected by this rule change.

2014

There were no rule changes implemented this season that sought to decrease the risk of concussion (Goodell, 2014).

2015

One rule change was added in this season that could impact concussion risk and this rule “Gives the intended receiver of a pass defenseless player protection in the immediate continuing action following an interception or potential interception” (Goodell, 2015) (p. 2). This rule change would only affect offensive players.

Concussion Reporting by Team

In addition to collecting concussion data by position, this study also tracked the number of concussions that were reported by all 32 NFL teams from 2009 – 2015 and is shown in Table 2. This table also shows the average number of concussions per team for each season, as well as the average number of reported concussions per team for all seven seasons of data. There was a large range in the total number of reported concussions by team for all seasons of data, with the average number of reported concussions being 32.7 (Table 2). At the low end of the spectrum were the Miami Dolphins, Buffalo Bills, and Atlanta Falcons with 12, 18, and 23 concussions respectively through the seven seasons (Table 2). At the high end of the spectrum were the Cleveland Browns, Oakland Raiders, and Minnesota Vikings with 58, 47, and 46 reported concussions respectively (Table 2).

Discussion

The purpose of this study was to determine whether or not the NFL rule changes designed to limit contact to the head have been effective in reducing the number of concussions, as well as to determine whether some NFL teams have been guilty of underreporting concussions. While there were not very strong trends relating rule changes to changes in the number of concussions, the data regarding concussion reporting by NFL teams suggests the possibility that some teams have been underreporting concussions. Both aspects of the study will be discussed in this section, as well as the limitations and suggestions for future research.

The Impact of Rule Changes

The NFL mostly saw an increase in the number of concussions from 2009 – 2012 even though rule changes were implemented fairly consistently each season that sought to penalize certain forms of hits to the head. While the number of concussions did recede in 2013 and 2014, the number of concussions then increased substantially in 2015, making it difficult to infer that rule changes had an impact on the low 2013 and 2014 figures. This result seems somewhat counter-intuitive, as one would naturally assume that more penalties penalizing hits to the head would result in fewer concussions due to the negative incentive placed on hitting the opponent's head. One

Table 2

Number of Concussions by Team

<u>Team</u>	<u>2009</u>	<u>2010</u>	<u>2011</u>	<u>2012</u>	<u>2013</u>	<u>2014</u>	<u>2015</u>	<u>Total (by team)</u>
Arizona Cardinals	4	6	2	4	2	4	3	25
Atlanta Falcons	4	3	6	2	3	1	4	23
Baltimore Ravens	9	7	8	9	3	5	4	45
Buffalo Bills	2	2	1	3	0	4	6	18
Carolina Panthers	5	11	8	3	2	3	6	38
Chicago Bears	1	3	5	5	1	4	7	26
Cincinnati Bengals	2	4	0	4	12	10	4	36
Cleveland Browns	3	9	8	10	7	5	16	58
Dallas Cowboys	3	7	2	7	1	4	6	30
Denver Broncos	2	3	4	4	5	8	3	29
Detroit Lions	3	8	5	5	6	4	6	37
Green Bay Packers	7	3	5	6	5	3	3	32
Houston Texans	3	0	2	4	5	3	8	25
Indianapolis Colts	4	3	4	9	7	3	4	34
Jacksonville Jaguars	3	6	5	9	9	3	5	40
Kansas City Chiefs	2	2	2	9	4	5	9	33
Miami Dolphins	0	2	2	2	3	0	3	12
Minnesota Vikings	5	9	9	5	7	2	9	46
New England Patriots	4	4	5	5	6	4	5	33
New Orleans Saints	2	4	1	4	4	3	6	24
New York Giants	1	3	6	4	3	4	9	30
New York Jets	2	3	3	7	5	3	7	30
Oakland Raiders	5	6	10	12	7	5	2	47
Philadelphia Eagles	3	6	6	5	4	1	8	33
Pittsburgh Steelers	1	6	3	5	5	1	7	28
San Diego Chargers	2	1	5	2	6	7	16	39
San Francisco 49ers	4	4	5	6	4	5	8	36
Seattle Seahawks	3	6	10	3	6	3	4	35
St. Louis Rams	5	5	8	4	6	3	9	40
Tampa Bay Buccaneers	2	1	6	4	4	2	5	24
Tennessee Titans	5	3	4	4	5	5	3	29
Washington Redskins	2	6	3	6	5	5	4	31
Averages	3.2	4.6	4.8	5.3	4.8	3.8	6.2	32.7

Note. Data from 2009 - 2011 collected from *Football Outsiders*. Data from 2012 - 2015 collected from *PBS Frontline: Concussion Watch*.

possible explanation for the increase in the number of concussions is that the NFL altered its concussion reporting policy after the 2009 season (Schwarz, 2009). Prior to the 2010 NFL season, players that suffered hits to the head were allowed to return to the same game if their symptoms weakened (Schwarz, 2009). However, from the 2010 season onward the NFL mandated that players exhibiting significant signs of concussion (this includes amnesia, improper balance, and persistent headaches) would not be allowed to return to games even if the symptoms later subsided (Schwarz, 2009). The imposition of this new guideline for diagnosing and treating concussions makes it reasonable to assume that more concussions would be reported on injury reports, as teams could no longer send a player with concussion-like symptoms back into a game. This assumption lines up with the data found in this study, as the number of reported concussions rose considerably after the 2009 season and never receded back to this low level.

This result of a general increase in concussions aligns with a study published in *The American Journal of Sports Medicine* which analyzed the number of reported concussions in 25 American high schools over an 11-year span (Lincoln et. al., 2011). This study found that the number of reported concussions rose consistently for every year analyzed (Lincoln et. al., 2011). The paper suggests that one possibility for the increase in concussions over the years could be due to greater sensitivity in diagnosing concussions as well as more widespread guidelines in terms of diagnosing and treating concussions (Lincoln et. al., 2011). While the study analyzes data from 12 high school sports instead of only football, the increase in concussions draws a parallel to the results found in the NFL. Another possible reason for the increase in concussions could have been an increase in player awareness about the detrimental effects of concussions. In a 2011 study surveying high school soccer players, it was found that players who had been educated about concussions were more likely to self-report a concussion to their coach than their counterparts who had not received any concussion education (Bramley, Patrick, Lehman, & Silvis, 2011). It is certainly possible that NFL players have become increasingly educated about concussions, which could lead to an increase in self-reporting. The NFL has cited that they believe there has been a shift in the culture surrounding con-

cussions and that increases in self-reporting could be one of the main explanations of the increasing concussion numbers (Breslow, 2016).

Contrarily, there have also been studies that have found a correlation between rule changes and concussion rates, which was not observed in this paper. For example, a 2011 study discussed in the Literature Review portion of this paper determined that alterations to a rule regarding the free kick were likely the cause for an observed decrease in injuries (Ruestow, Duke, Finley, & Pierce, 2015). While the study does find a correlation between a rule change and a decrease in injuries, the paper does not examine the effect of this rule change on the number of concussions. So while a rule change may decrease the risk of other injuries, the paper does not state that rule changes can aid in preventing concussions (Ruestow, Duke, Finley, & Pierce, 2015).

Reporting of Concussions by Team

Through analyzing the number of concussions reported by each NFL team from 2009 – 2011, trends that were found could suggest the presence of under-reporting concussions by some teams. A reasonable assumption to make prior to examining the data would be to assume that the number of concussions reported by each team would be fairly consistent with each other, as there should not be a reason one team should suffer more concussions than another. However, when examining the data collected, there is a very substantial difference in the number of reported concussions amongst all teams. The team that reported the highest number of concussions, the Cleveland Browns, reported 58 concussions over the seven years of the study, which is almost five times greater than the number of concussions reported by the Miami Dolphins, who reported only 12. For reference, the average number of concussions over the seven years in this study was 32.7 per team. While it is reasonable to expect teams to have some years that are outliers with unusually low or high figures, this level of discrepancy was not expected. There is no incentive for a team to over-report the number of concussions; however, a team that underreports their concussions would be able to have players play in games that they would otherwise not be medically cleared for if they were diagnosed with a concussion. Furthermore, it

is not only the low seven-year concussion total that raises concern, but rather the consistency of low numbers of reported concussions throughout each season studied. For example, in all seven years of the study, the Miami Dolphins were below the league average in reported concussions each season, including two years where they reportedly did not suffer a single concussion. The Buffalo Bills, the team with the second least concussions (18), was below the league average in six of the seven years of the study. Given how low these figures are compared to the league average and to teams with high numbers of concussions, it is reasonable to suspect that there may have been cases of underreporting with teams including, but not limited to, the Miami Dolphins and Buffalo Bills.

The suspicion of underreporting that has arisen from this study is not a new topic. While there may not be any formal scholarly papers on the underreporting of concussions, there have been many instances of former players, the media, and the medical community criticizing the NFL for its handling of concussions. One example is the case of Kris Dielman. On October 23, 2011, Dielman, an offensive lineman for the San Diego Chargers, was hit hard during a game and although he was clearly wobbly after getting up, he remained in the game (Mortensen, 2011). Following the game on his team's flight home, Dielman suffered a seizure close to the end of the flight and was later hospitalized (Mortensen, 2011). Four and a half months later, Dielman decided to retire from the NFL due to the concussion he suffered (Wilson, 2012). Clearly, the San Diego Chargers' medical staff made a severe error in allowing Dielman to return to the game; a mistake that cost the player his career. While this anecdotal case does not prove the widespread underreporting of concussions, it does show that underreporting did occur to some extent.

Limitations

While the findings of this study do suggest a possibility of NFL teams underreporting concussions, there are some limitations that must be addressed. Concussions are injuries that have many variables as to how they may be suffered, such as contact from another person or the playing surface, poor equipment, or dangerous tackling techniques. Therefore, it is pos-

sible that a team may have a low number of concussions because they use more advanced helmet technology or they teach safer tackling techniques than other teams. Neither of these factors were considered in the study. Furthermore, the data presented in this study includes concussions suffered during practices. While it can be ensured that each team is subjected to the same rules regarding contact during games, it is possible that certain teams may have a greater number of full-contact practices than others, which is not accounted for in this study.

Suggestions for Further Research

The field of studying concussions is still relatively young and there remains a lot of information to be studied. In particular, one subject that has not been studied thoroughly is the underreporting of concussions in the NFL. In this paper, some suggestions were made that teams may have been guilty of underreporting in the years from 2009 – 2015; however, more studies must be performed on the matter in order to truly comprehend the issue. One suggestion for a study that could address this topic would be to survey NFL personnel such as team doctors, players, and coaches, and attempt to determine from them whether they believe concussions have been underreported. Since no data exists on unreported concussions, a qualitative study would most likely be the most effective way to conduct this type of study.

After the end of the 2015 NFL season, the league imposed a new concussion protocol that designates an independent neurologist to be on the sidelines at each game and handle all brain-related injuries (National Football League, 2016). This is a major advancement for properly diagnosing concussions, as the neurologists would not be pressured to send a player back into a game who may have a concussion, as they are not affiliated with a team. It would be very interesting to analyze the number of reported concussions on each team from the 2016 season onward in order to see whether or not the number of concussions becomes more balanced across all teams with the addition of independent neurologists.

Although neurologists may help identify and diagnose concussions, this is not a preventative measure. In a 2012 study it was suggested that return to play

guidelines, such as the NFL concussion protocol, are not the most effective way in solving the problem of concussions (Johnson, 2012). Instead, this study suggests that measures that help prevent concussions should be explored and utilized (Johnson, 2012). One possible alley for future research that could help prevent concussions is further research into new helmet technologies. In a 2016 study, it was determined that the common helmet manufacturers today all provide a similar level of protection against concussions (Collins et. al., 2016). This means that further research and funding must be invested into discovering new helmet technologies in order to increase player safety.

While this paper analyzes concussion data in the NFL, future research could investigate concussions in high school and college football, which could add a greater level of clarity and understanding to the field.

Conclusion

Due to the general increase in the number of reported concussions from 2009 – 2015, it was not possible to determine whether or not rule changes are affecting the rate of concussions. In the second component of the study, through analyzing the number of concussions reported by individual NFL teams there arose evidence of possible underreporting of concussions. Although these findings suggest certain teams may have been guilty of underreporting concussions, more investigation is warranted to confirm this trend in the gathered data.

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