Concussed: Unintended Consequences of the Guardian Cap Mandate in the NFL

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Abstract

Guardian Caps are padded shells worn over American football helmets to cushion impacts and reduce concussion risks. In 2022, the NFL mandated their use for specific position groups during preseason practices, later expanding this requirement. While the league praised the Caps for enhancing player safety, skeptics argue they may promote riskier tackles and create a false sense of security. This article explores the unintended consequences of the NFL's Guardian Cap mandate, revealing that these Caps do not significantly lower concussion rates. In fact, concussions in the position groups using Guardian Caps increased after the mandate was implemented.

Keywords: National Football League, Guardian Caps, Football, Concussions

JEL Codes: J28, Z22, Z28

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1 Introduction

Concussions in contact sports, like football, seem to be an unavoidable cost of playing the sport. The National Football League (NFL) reported that there were 1.6 concussion evaluations per game in 2023 (Reed, 2024). And, despite the number players missing games due to injury declining from the 2022 to 2023 season, the concussion numbers did not budge. Looking further back, Casson et al. (2010) find that from 1996 to 2007 there was no meaningful change in total concussions in the NFL, but observed that over the period of study, teams became a lot more conservative in their management of concussions, resulting in players being held out of play longer. Due to changes in reporting requirements and detection methods, it is difficult to say that there has been a statistically meaningful decline in concussions in the past few decades. Yet, studies continue to uncover a lot of the harms associated with concussions. Repeated brain trauma is the only known cause of a condition known as CTE (chronic traumatic encephalopathy), which is associated with depression, loss of judgement, loss of impulse control, rage, memory loss, and ultimately, dementia (McKee et al., 2009). Observation of former football players shows that CTE symptoms often arise several years after retirement, but evidence of CTE has been found in young and current players as well (Caplan and Kearns, 2024).

Amid growing concerns and evidence of long-term health consequences of concussions, and especially repeated concussions, observed in former professional football players, the National Football League (NFL) instituted several policy changes and introduced new safety equipment. This article focuses on the impact of the Guardian Cap mandate on the prevalence of concussions in the NFL. Guardian Caps are soft-shell covers worn over a helmet to absorb the impact from helmet-to-helmet and helmet-to-ground contact. In results from laboratory studies, Guardian reports that the Caps absorb 11 to 12 % of the force when a player is hit. Further, the impact is reduced by roughly 20% when both players are wearing the cap and have a helmet-to-helmet hit. These are substantial reductions in impact that should, as Guardian and the NFL have argued, reduce concussions for NFL players.[1]

The Guardian Caps were first validated by the NFL and NFL Player's Association (NFLPA) in 2019. By 2020, the league allowed teams to use the Caps. The Jacksonville Jaguars was the first team to wear the Caps during practice. By 2021, 7 teams had their players wear the Caps during practice (Bears, Bills, Chargers, Dolphins, Jaguars, and Panthers). In 2022, the NFL owners voted to mandate the use of the Guardian Caps through the second preseason game for all linemen, linebackers, and tight ends. By September of that year, the NFL reported that the concussions in practice for players that wore the Caps reduced by 52%. In 2023,

[1]Guardian Caps are also worn by football players from collegiate-level to Pop Warner. This study focuses on the NFL due to the league's mandate for all players to wear the Caps during practice and data availability.

the mandate was expanded to all contact practice from pre-season through the post-season. Running backs and full backs were added to the list of players who have to wear the Caps. In 2024, the mandate expanded yet again. First, by adding wide receivers and defensive backs. And, second, by permitting players to wear the Guardian Cap, if they choose, during games (Guardian, 2024).[2]

Our research takes advantage of this staggered implementation of the mandate in our empirical strategy, and use a difference-in-differences approach. Our outcome variable is *all* concussions, not just those reported during practices. We hypothesize that wearing the Guardian Caps incentivizes riskier tackling due to the perceived safety from wearing the Cap. Players may not accurately calculate the risk of a helmet-to-helmet hit if they place a lot of faith in the Cap's ability to absorb the shock. And, if the players only wear the Caps in practice and not during games, they may actually end up hitting harder and protect themselves less when falling to the ground in games without the Caps because of their practiced behavior. Stated differently, the moral hazard created by increased safety during practice leads to riskier habits regarding how players tackle and fall to the ground, and these habits in riskier technique extend to game play even though the players no longer have the added head protection, potentially leading to increased rates of head injury.[3]

Skeptics of the Guardian Caps efficacy include former University of North Carolina (UNC) Chancellor Kevin Guskiewicz. When UNC football players started wearing Guardian Caps during practice in 2022, Guskiewicz publicly expressed that he believed there would not be a reduction in concussions on the practice field as a result of the Guardian Caps. His reasoning was three-fold. First, that exterior coverings on helmets may not prevent the brain from moving around the skull when hits occur. Second, that the padding, unlike the exterior of a regular helmet, can create friction when hit with another padded helmet, which increases the risk of spinal injury. And third, that the Guardian Caps may create a false sense of security, resulting in riskier and harder hits (Blake, 2022).

When the NFL first announced the Guardian Cap mandate, head coach of the New York Jets, Robert Saleh, expressed his concerns about impact of Guardian Caps on player behavior. He was especially concerned about how players were supposed to wear them during pre-season and then could stop. By his observation in Jets practices, he thought that players with Caps on were using the helmets more because of the perceived protection, and did not know if they would update their behavior after they were no longer required (Cimini, 2022). Green Bay Packers head coach Matt LaFleur offered similar concerns over whether the players would develop a false sense of safety during practices, stating "You don't want guys to feel confident that you can

[2]Our analysis focuses on the 2021-2023 seasons because the 2024-25 season has not yet completed at the time of this manuscript's submission. But future work in this area should examine the impact of the NFL's expanded mandate in 2024.

[3]Guardian reports that as of 9/26/2024 only seven players have opted to wear the Caps during games through the first three weeks of the 2024-25 NFL season. (https://guardiansports.com/2024/09/26/in-games/)

use your head ... false confidence (can mean) the technique suffers" (Edmonds, 2022).

However, other NFL coaches were more supportive of the Cap mandate during its initial roll-out. In response to an interview question concerning the Guardian Caps, then Tennessee Titans head coach Mike Vrabel offered support for the mandate, stating "Our game is only as good as our players, our team is only as good as our players, and we need everybody. There's nothing more important than the health and safety of our players ... and not only immediate health, but the long-term health" (Smith, 2022). Former Washington Commanders head coach Ron Rivera, who served on the NFL Competition Committee with Vrabel when the Cap mandate was put in place, has also been supportive, emphasizing that the Caps "absorb some of the shock and take a lot of the shock off the players' helmets and heads" resulting from incidental helmet-to-helmet contact (Associated Press, 2022)

Players have also spoken out about their thoughts on the Caps and the reviews are mixed. As for Carolina Panthers offensive lineman Brady Christensen, he did not see a downside to wearing the Cap: "Anything to protect my brain a little bit more, I'm all in. I want to remember my kids' names when I'm 50" (Reed, 2021). Greenbay Packers linebacker De'Vondra Campbell questioned the effectiveness of the practice only mandate: "You say you're doing it to protect us, but the minute we take them off, we're going to be so used to hitting with them, that when you hit without it, it's going to feel a lot different" (Edmonds, 2022). Others have mentioned that the caps are heavy and uncomfortable to play in, like Dolphins linebacker Jordyn Brooks said when asked if he would wear a Guardian Cap in games, which became an option for the 2024-25 season: "No way. It's like an extra 10 pounds on your head, makes it a lot hotter, heavier. No, I wouldn't do it" (Hecken, 2024). For some players like Dolphins safety Elijah Campbell, the criticism of the Caps is more about style: "I don't like the aesthetics of it; I'll leave it at that" (Hecken, 2024).

And while the opinions of players and coaches matter a great deal in how well the mandate is enforced and participation rates in the optional use, the efficacy of the Guardian Caps is ultimately an empirical question that cannot be answered with anecdotes. Researchers have only begun to weigh in on the Caps debate, and the results don't seem to be as clear-cut as the previous research conducted in Guardian's lab studies.

Quigley et al. (2023) looked at seven NCAA Division I football players wearing instrumented mouthguards across 6 similar workouts, 3 of which they wore Guardian Caps and 3 they just wore traditional helmets. The instrumented mouthguards capture head kinematics data. While this is a very small sample size, they find no difference in any of the measures of head impact captured by the mouthguards, and conclude that the Guardian Caps are not effective in absorbing contact to the head (Quigley et al., 2023). Another study

used a device called the Head Impact Telemetry System, which consists of sensors that capture linear and rotational accelerations and total impact. They compare 5 NCAA Division I football players wearing the Guardian Caps to another 5 players that just wore traditional helmets for all practices in a season. They find no statistical difference in the various measures of head impact captured by the telemetry system, and also conclude that the Guardian Cap's shell padding did not reduce head impact for the college football athletes (Sinnott et al., 2023).

These findings contradict reports from the NFL and Guardian, which say that concussions in preseason practices decreased by 52% in 2022 with the implementation of the mandate. We believe that it is important to consider the entire season to see if there is any merit to the claims that players will play with a false sense of security or perhaps practice tackling in an unsafe way while wearing the Caps, which could carry over to their behavior when they are no longer wearing the Caps in regular season games.

2 Literature Review

This article builds on an existing literature in sports health and sports economics focusing on the prevalence of concussions in sports and in the NFL specifically. Injuries for professional athletes is an occupational safety issue. Injuries can be categorized into uncontrollable and controllable risks. Playing sports, and especially contact sports, can result in accidental injury that is difficult or even impossible to avoid. But athletes also can make riskier choices that increase the likelihood of injury (Cisyk and Courty, 2024). And athletes tend to have a higher risk acceptance than other jobs, even other dangerous jobs (Chen et al., 2019). There is also evidence that NFL players take on more risky behavior when the game has higher stakes, such as playoff implications (Courty and Cisyk, 2024).

Cisyk and Courty (2024) discuss how sport injury policy is determined and the potential pitfalls when sports organizers do not account for risk preferences of athletes, or when the athletes themselves create the policies. Policies that can de-escalate risk are under-adopted by sports organizers. The authors suggest that return-to-play rules, where players need to wait and get evaluated before they can participate in the game if there is a suspected concussion, reduce risk in two ways. First, it reduces the chance of re-aggravating the injury, and second, the possibility of missing playing time disincentivizes riskier behavior. On the other hand, they argue that mandatory protective gear can escalate risk and are often over-adopted.

Our hypothesis that the Guardian Cap mandate incentivizes riskier and more dangerous tackling is inspired by the work of Sam Peltzman, who has argued and shown that well-intended safety regulations can

incentivize even more dangerous behavior, and perhaps offset the intended outcome (Peltzman, 1975). This is often referred to as "The Peltzman Effect." There is an extensive literature inspired by Peltzman's work, studying the intended and unintended consequences of safety regulation. Our work connects most closely to research examining the intended and unintended consequences of helmet laws. Youth bicycle helmet laws did indeed reduce fatalities and increase helmet use, but also reduced youth bike riding overall (Carpenter and Stehr, 2011). Motorcycle helmet laws also improve safety, but there are fewer organ donations as an unintended consequence (Dickert-Conlin et al., 2011). Perhaps the Guardian Cap mandate does improve player safety in the practices when they are worn, but once those helmets are taken away, players could fail to update their risk tolerance. There are also applications of the Peltzman Effect in sports, such as Hanson et al. (2017), which looks at the consequences of Crown-of-the-Helmet Rules in the NFL. The rule prohibited players from leading with the top of their head whilst tackling another player. And, Sobel and Nesbit (2007) find that improvements in automobile safety in NASCAR have led to an increase in the incentive to drive recklessly, partially or completely offsetting the overall safety improvements.

Using injury data from the 2021-2022 to 2023-24 NFL seasons, we look into the efficacy of the Guardian Cap mandate during this period and investigate the possible unintended consequences of the NFL's policy. Consistent with the conclusions of Cisyk and Courty (2024), Hanson et al. (2017), and many others regarding the Peltzman Effect in sports, we find that in the seasons where players are required to wear Guardian Caps, there is no reduction in concussions, and perhaps even an increase in concussions. As the league continues to update the helmets and mandates for players, we argue that the unintended consequences should be included in these conversations between the NFLPA and the league.

3 Data & Methodology

Our data comes from a variety of sources. We use data from the weekly NFL injury reports to know which players are injured each week of the season for the 2021-2022, 2022-2023 and 2023-2024 seasons. Across different specifications we control for the game time, week of season, player position, team, opponent, a home team dummy variable, the percentage of plays that were a pass for an offense in a season, and the altitude of where the game was played. Many of the controls are meant to account for variations in the intensity of play, player fatigue as the season progresses, and home-field advantage. We also control for the percentage of offensive plays that were a pass for each team each season, because there is evidence that passing plays are more likely to have injuries (Burke et al., 2021). There is also evidence that there is a

higher rate of concussions at higher altitudes, so we control for the altitude of the stadium where the game was played (Lynall et al., 2016).

Our data and methodological approach has some limitations. First, our observations are all injuries documented on injury reports, but we do not have a way to observe a pure counterfactual, such as big hits that did not result in a player with an injury.

We also cannot observe players that were perhaps taken out of a game or practice but were not listed as injured, nor can we know when they were injured during that week of the season, which is why we do not control for the team's opponent every specification, because the injury may have occurred during practice. There is also a chance that a player will appear on the injury reports multiple weeks in a row for the same injury. However, most concussed players (83.5%) returned to play in less than 7 days, so we are not as concerned about players having concussions for multiple weeks in our data (Casson et al., 2010).

Further, there is evidence that sports-related concussions are under-reported by the NFL, which is where we obtained our data (Bretzin et al., 2024). For the purposes of our analysis, the under-counting of concussions means our results would be biased downward, as long as there are no systematic differences in the reporting of concussions across the position groups.

The summary statistics of our data are provided in Table 1. We observe that the treated positions group, those who were mandated to wear Guardian Caps, makes up about 53% of all injuries, but only 42% of concussions. Concussions make up about 6% of all reported injuries in the NFL, which is relatively small compared to ankle injuries (15.9%) and knee injuries (17.9%), but keep in mind that we do not account for players that show up multiple weeks on the injury report for the same injury, this is less of a concern for concussions, but would happen more often for knee and ankle injuries. There are 456 injury reports for concussions observed in our data. In Tables 2 and 3 we show concussion percentages by position and by team, respectively. There is considerable variation across organizations and player positions, which is why we control for both team and position across specifications.

The model we estimate is demonstrated in Equation 1:

1. $Concussion_{pws} = \beta_0 + \beta_1 TreatedPosition * PostMandate + \beta_2 X_{pws} + \epsilon_{pws}$

We employ a difference in differences approach, where we look at the difference in concussion prevalence between the positions that were mandated to wear Guardian Caps in 2022 and those that were not both before and after the mandate. The *Concussion* variable is a dummy variable that indicates if the injured player had a concussion during that week of the season. The subscript "pws" for that variable represents the player 'p' in week 'w' in season 's.' The variable of interest is the interaction term $TreatedPosition * PostMandate$

which captures the difference in the differences of the two groups of positions (treated and untreated) before and after the mandate. If that variable is positive and significant, we will argue that concussions are more prevalent after the mandate in positions that were required to wear the Guardian Caps than they were before the mandate. The "treated" positions are those who were mandated to wear the caps in 2022: linemen, linebackers and tight ends, and then full backs and running backs join the treated group for the 2023-24 season. X_{pws} is a vector of controls specific to the injured player such as team and position, weekly controls for that game such as game time, day of the week, opponent, home game, and altitude, and finally, we control for the percentage of offensive plays that were a pass for that player's team that season. We also include season and week of season controls in some specifications.

We repeat this process while looking at injury types that we believe should be unrelated to the use of Guardian Caps, knee and ankle injuries. We consider this to be similar to a placebo test, and helps us understand if our main results are driven by some aspect of how the data is collected and reported or something other than what we are trying to measure, which is the impact of the Guardian Cap mandate.

Then, we aggregate to team by week observations, with concussion counts for treated versus untreated position groups and game specific controls. We lose the ability to control for some of the player specific factors in these specifications, but we are now comparing concussion counts for the two position groups rather than looking at the prevalence of concussions across all reported injuries.

4 Results

Table 4 presents the our main results, estimating Equation 1. We find a consistently positive and significant relationship between players that were mandated to wear Guardian Caps after the mandate took place and concussions. This suggests that relative to before the mandate concussions after the mandate were more likely to for players in the position groups affected by the mandate, when looking at the total number of injuries across the NFL.

As a quasi-placebo effect, we look at two injury types that arguably would not be affected by the use of Guardian Caps, knee and ankle injuries. There is no reason that wearing the Caps in practice would affect these types of injuries directly. Table 5 presents these results. We find no statistically significant relationship between the implementation of the mandate and knee or ankle injuries.

For the previous two sets of results, the data is constructed so that an observation is a player on the injury report. One advantage to this is we are able to observe the player's position, but our results are

more likely to be affected by unobserved factors that impact other injury types. Therefore, we consider the counts of concussions among players in the treated position group versus untreated positions for every regular season game in the 2021-22, 2022-23, and 2023-24 seasons. In Table 6, the observation level is an NFL team by game played. We are still able to account for game specific characteristics, and each home and away team are considered two unique observations. We repeat the main results specification, where the variable of interest still is comparing the two groups of players, those who were mandated to wear Guardian Caps and those who were not, and the difference between those groups before and after the mandate. The coefficient on our variable of interest is consistently positive and statistically significant, suggesting that the prevalence of concussions among players that were mandated to wear the Guardian Caps increased compared to other players after the mandate went into effect. The magnitude of our coefficients suggest about 0.07 more concussions per game for the treated group of positions on a team relative to the untreated group of positions on the team. This may seem small, but considering the observation is per team and per game, our estimates suggest there were about 36 more concussions per NFL season across all lineman, linebackers, tight ends, full backs and running backs required to wear Guardian Caps than in the season before the mandate.

We also conducted a series of robustness checks. We repeat the specifications presented in Table 4 and in 6, but drop kickers, punters and long snappers from the data/control group. The results are nearly identical to those in Table 4 and 6, respectively. We also drop the teams that were early adopters of the Guardian Caps, and had players wearing Caps in our "pre-mandate" period. Again, we find consistent results across all specifications. We also have tried every possible combination of controls and find that our estimates are very consistent. All of our robustness checks results are available upon request. Another way to view our results is with multiple difference in means tests, presented in Table 7. We examine the difference in average number of concussions among the treated and untreated position groups both before and after the Guardian Cap mandate. Concussions are more common in the untreated position group, but do not change in any statistically meaningful way after the mandate is in effect. For the treated positions, however, there is a significant increase in concussions after the mandate, which shrinks the gap between the treated and untreated groups, which is is reflected in the positive and significant coefficients we observe in our main specification.

5 Conclusion

Concussions are a serious problem in contact sports like football, and the NFL's made several efforts to reduce the number of concussions in the league through the introduction of new penalties, safety protocols, and equipment. In 2022, the NFL required lineman, linebackers, and tight ends to wear Guardian Caps on their helmets during pre-season practices. They expanded the mandate to include running backs and full backs in 2023. While the NFL reported that concussions during pre-season practices declined, several players and coaches expressed their concerns about how the Guardian Caps could incentivize players to take less precautions in how they hit and tackle, and this riskier behavior could carry over to regular season games and practices when they were no longer wearing the Caps. Therefore, we hypothesize that players who were mandated to wear the Guardian Caps experienced more concussions after the NFL instituted the mandate.

To test our hypothesis, we use a difference-in-differences approach and data from NFL injury reports. We find that there was a consistent and statistically significant increase in concussions for the players who were mandated to wear Guardian Caps after the mandate in 2022 compared to the players that did not wear the Caps. Our results correspond with an estimate of about 36 more concussions per NFL season across all lineman, linebackers, tight ends, full backs and running backs required to wear Guardian Caps than in the season before the mandate. There are roughly 200 concussions in the NFL each year, so this is a fairly large effect. Further, *any* increase in the prevalence of concussions due to the Guardian Caps should be of concern to the NFL and the NFL player's association. The mandate's goal was to reduce the number of concussions in the league, and we find evidence that it did not reduce concussions and perhaps even increased them. Our results are not causal, but they are informative of the players' response to the Guardian Caps, which we argue provided a false sense of security and increased risky behavior.

The NFL should focus on policies that reduce the number of injuries by incentivizing players to take on less risk. While the appropriate solution may not be as extreme as that suggested by retired Pittsburgh Steeler wide receiver Hines Ward who suggested "If you want to prevent concussions, take the helmet off: Play old-school football with the leather helmets, no facemask" (Pro Football Talk, 2012), increasing player-perceived safety via the Guardian Cap may not be the solution either. The league should feel obligated to implement policies that measurably improve player safety, not hinder it. Further, injuries are very strongly tied to franchise success (Gregory-Smith, 2021) and injuries impose massive costs in contact sports like football (Fair and Champa, 2019). It is in everyone's best interest, the league, franchises, players, and fans, to fully understand the unintended consequences of policies like the Guardian Cap mandate.

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Table 1: Summary Statistics

	Mean	St Dev	Min	Max	N
Treated Position Dummy (all injuries)	0.528	0.499	0.000	1.000	7,613
Treated Positions Concussion Dummy	0.4211	0.494	0.000	1.000	456
Concussion Dummy	0.059	0.237	0.000	1.000	7,613
Ankle Dummy	0.159	0.366	0.000	1.000	7,613
Knee Dummy	0.179	0.384	0.000	1.000	7,613
Pass Play %	0.556	0.048	0.403	0.661	7,613
Altitude	605.700	1,007.668	3.000	5,280	7,613
Home Team Dummy	0.497	0.500	0.000	1.000	7,613

Note: An observation is an individual injury report (N = 7,613). Therefore the dummy variables' means can be interpreted as a percentage of all injury reports over the period of study (2021-22 – 2023-2024).

Table 2: Percentage of Total Concussions by Position

Offensive Lineman	14.25
Defensive Lineman	6.58
Linebackers	9.87
Tight Ends	9.21
Running Backs & Full Backs	6.58
Quarterbacks	7.02
Wide Receivers	19.08
Defensive Backs	27.41

Note: There were 456 injury reports for concussions during the period of study. This table reports the percentage of those reported concussions experienced by each position group across the whole sample.

Table 3: Percentage of Total Concussions by Team

49ers	3.29	Giants	1.75
Bears	4.39	Jaguars	1.54
Bengals	0.66	Jets	3.51
Bills	1.54	Lions	2.63
Broncos	3.29	Packers	3.29
Browns	6.14	Panthers	4.82
Buccaneers	3.51	Patriots	7.89
Cardinals	1.75	Raiders	3.07
Chargers	3.07	Rams	0.88
Chiefs	1.32	Ravens	1.75
Colts	6.14	Saints	3.29
Commanders	4.39	Seahawks	1.75
Cowboys	1.54	Steelers	1.75
Dolphins	3.07	Texans	3.95
Eagles	1.97	Titans	6.80
Falcons	1.97	Vikings	3.29

Note: There were 456 injury reports for concussions during the period of study. This table reports the percentage of those reported concussions experienced by each NFL team across the whole sample.

Table 4: Concussions and The Guardian Cap Mandate: Main Results

	Concussions				
	(1)	(2)	(3)	(4)	(5)
Treated Position*	0.021*	0.022*	0.023*	0.026**	0.026**
Post Mandate	(0.012)	(0.012)	(0.012)	(0.012)	(0.012)
Pass Play %					-0.039
					(0.099)
Altitude					0.000
					(0.000)
Home Team					0.011*
					(0.005)
Team		✓	✓	✓	✓
Opponent				✓	✓
Position				✓	✓
Game Time			✓	✓	✓
Day of Week			✓	✓	✓
Week of Season		✓	✓	✓	✓
Season		✓	✓	✓	✓
Observations	7,613	7,613	7,613	7,613	7,613
Adjusted R-Squared	0.003	0.014	0.015	0.021	0.021

Note: Difference-in-differences results where an observation is an injury report. Significance denoted as * $p < 0.1$; ** $p < 0.05$; *** $p < 0.01$.

Table 5: Other Injuries and The Guardian Cap Mandate: Placebo Test

	Knee Injuries			Ankle Injuries		
	(1)	(2)	(3)	(4)	(5)	(6)
Treated Position*	-0.016	-0.024	-0.023	0.028	0.014	0.014
Post Mandate	(0.019)	(0.019)	(0.019)	(0.018)	(0.018)	(0.018)
Pass Play %			-0.399**			0.343**
			(0.159)			(0.152)
Altitude			-0.000*			0.000
			(0.000)			(0.000)
Home Team			-0.002			-0.003
			(0.009)			(0.008)
Team	✓	✓	✓	✓	✓	✓
Opponent		✓	✓		✓	✓
Position		✓	✓		✓	✓
Game Time		✓	✓		✓	✓
Day of Week		✓	✓		✓	✓
Week of Season	✓	✓	✓	✓	✓	✓
Season	✓	✓	✓	✓	✓	✓
Observations	7,613	7,613	7,613	7,613	7,613	7,613
Adjusted R-Squared	0.016	0.022	0.023	0.010	0.016	0.017

Note: Difference-in-differences results where an observation is an injury report. Significance denoted as * p < 0.1; ** p < 0.05; *** p < 0.01.

Table 6: Concussions and Guardian Cap Mandate: Team by Week Results

	Concussions				
	(1)	(2)	(3)	(4)	(5)
Treated Positions*	0.065*	0.072**	0.072**	0.072**	0.070**
Post Mandate	(0.034)	(0.033)	(0.033)	(0.033)	(0.033)
Pass Play %					-0.387**
					(0.170)
Altitude					0.000
					(0.000)
Team		✓	✓	✓	
Opponent				✓	
Game Time		✓	✓	✓	✓
Day of Week		✓	✓	✓	✓
Week of Season		✓	✓	✓	✓
Season		✓	✓	✓	✓
Observations	2,785	2,785	2,785	2,785	2,785
Adjusted R-squared	0.006	0.044	0.046	0.042	0.016

Note: Difference-in-differences results where an observation a team's injuries reported per week. Significance denoted as * p < 0.1; ** p < 0.05; *** p < 0.01.

Table 7: Difference in Means Tests

	Treated Positions	Untreated Positions	Difference (Treated - Untreated)
Pre Guardian Cap Mandate	0.034	0.074	-0.040***
Post Guardian Cap Mandate	0.054	0.073	-0.019***
Difference (Post - Pre)	0.020***	-0.001	-

Note: Difference in means (t-test) results where an observation is an injury report. The means are for the concussion dummy variable, which is therefore interpreted as the percentage of concussions across the different subsets of the data. Significance denoted as * $p < 0.1$; ** $p < 0.05$; *** $p < 0.01$.