



# Safety regulation in professional football: Empirical evidence of intended and unintended consequences<sup>☆</sup>



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## ABSTRACT

In response to increasing public awareness and negative long-term health effects of concussions, the National Football League implemented the “Crown-of-the-Helmet Rule” (CHR). The CHR imposes penalties on players who initiate contact using the top of the helmet. This paper examines the intended effect of this policy and its potential for unintended consequences. We find evidence supporting the intended effect of the policy— a reduction in weekly concussion reports among defensive players by as much as 32% (34% for all head and neck injuries), but also evidence of an increase in weekly lower extremity injury reports for offensive players by as much as 34%.

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## 1. Introduction

Between 2012 and 2014, the National Football League (NFL) diagnosed 446 separate incidences of concussions among its players (Public Broadcasting System, Concussion Watch). Even after initial recovery, medical research suggests a single concussion can cause persistent headaches, sleep problems, memory disorders, and reduced attention span (Edwards and Bodle, 2014). Multiple concussions can contribute to more severe, longer-term problems such as aggressiveness, depression, suicide, dementia, and Parkinson’s disease (Edwards and Bodle, 2014). In a recent legal settlement, the NFL agreed to compensate former players up to \$5 million each for serious medical conditions associated with

repeated head trauma. Estimates place the settlement’s total value at \$1 billion (Belson, 2016).

In response to litigation and general concern for worker safety, the NFL implemented the “Crown of the Helmet Rule” (CHR) after the 2012–2013 season. The CHR attempts to reduce the incidence of concussions and head injuries by penalizing a player who intentionally initiates contact with another player using the top of his helmet. We first examine if the CHR alters the incidence of concussion (in addition to head and neck) injuries among affected players. Then, following an established literature on health and safety regulations (Peltzman, 1975; DiNardo and Lemieux, 2001; Conlin et al., 2009; Dickert-Conlin et al., 2011; Carpenter and Stehr, 2011), we examine if the CHR has an unintended consequence. We hypothesize that players substitute towards other forms of game-play because of the CHR, increasing the incidence of lower extremity injuries among offensive players.

We examine the intended and unintended effects of the CHR on player injuries using a difference-in-differences framework. The treatment group includes players who are typically involved in collisions that occur in open space on the field of play (wide receivers and defensive backs, for example). This group is nearly always subject to the CHR, as it applies only in certain on-field circumstances. The comparison group includes players who are typically making

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contact at shorter distances and not in the open field (offensive and defensive linemen, for example), where the CHR does not apply. We examine how the CHR influences the probability of reporting an injury in any given week using individual micro-level data on all players participating in regular season games during the 2012–2013 (prior to CHR) and 2013–2014 (after CHR) seasons. We extend the analysis to examine how the CHR affects the severity of player injuries by focusing on how many games players miss during the regular season by injury type.

Results from the analysis provide evidence supporting the intended effect of the policy – a reduction in concussion reports among defensive players by as much as 32% (or 34% for all head and neck injuries). However, we also find strong evidence suggesting that the CHR increases lower extremity injury reports for offensive players by as much as 34%. Additionally, the CHR is responsible for increasing the severity of offensive player injuries – resulting in an additional half game missed per lower extremity injury. The marginal increase in missed games for offensive players results in a net productivity loss (net of both the intended and unintended effects) of approximately \$27 million in the season after implementation, with a net total cost from the CHR measured in value of statistical life at \$285 million for injuries occurring in the 2013/2014 season.

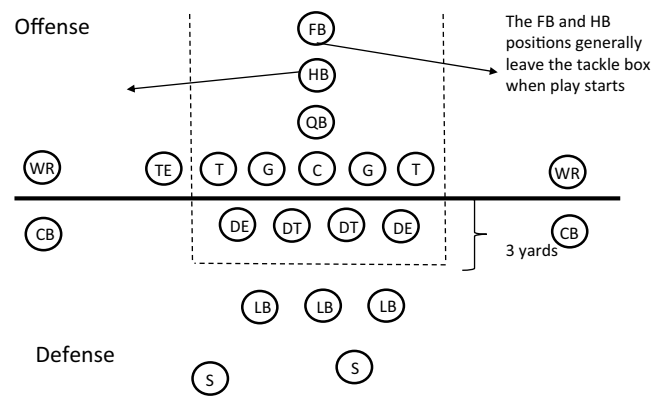
The remainder of the paper proceeds as follows: Section 2 provides background about concussion injuries and the CHR rule. Section 3 describes the difference-in-differences estimation strategy. Section 4 gives details about our data and summarizes injuries in the NFL. Section 5 presents our results. Section 6 discusses several robustness checks, and the final section of the paper offers a discussion of the net benefits of the CHR and concludes.

## 2. Background and institutional details

In recent years, medical experts have become more aware of the long-term health risks of head-related injuries (Niemeier et al., 2015). As medical research has become clearer, and a demonstrated link between head-injuries and health risks has become more apparent with football, the NFL has increasingly had to answer to the media and current and former players about how the league deals with long-term health concerns (PBS, 2013). In 2013, Ryan Swope announced his retirement from professional football due to concussions before ever playing a single professional game (Strauss, 2013). Concerns over concussions have even affected youth football participation. Pop Warner, the country's largest youth football program, experienced a 9.5% decline in participation between 2010 and 2012 (Fainaru and Fainaru-Wada, 2013). Two main reasons cited for the decline are youth athletes concentrating on a single sport and concerns over head-related injuries, with the latter being the most important. Decreases in Pop Warner enrollment are particularly worrisome for the league because it serves as a stepping-stone into playing professionally, with 60–70% of NFL players having participated in the program.

Due to concerns of general worker safety and long-term league viability, the NFL has taken a major step in regulating game play in an attempt to reduce the incidence of head-related injuries. Following the 2012–2013 season, league owners ratified the “Crown of the Helmet Rule,” which went into effect the first week of the 2013–2014 season. Rule 12, Section 2, Article 8 of the NFL Rulebook states the rule and associated penalty:

*It is a foul if a runner or tackler initiates forcible contact by delivering a blow with the top/crown of his helmet against an opponent when both players are clearly outside the tackle box (an area extending from tackle to tackle and from three yards beyond the line of scrimmage to the offensive team's end line). Incidental con-*



**Fig. 1.** The Tackle Box.

Notes: This figure demonstrates a typical alignment, but teams employ multiple formations of players throughout a game. In terms of defining a treatment/control group, the only positions that are less likely to be outside of the tackle box are the TE and FB positions.

*tact by the helmet of a runner or tackler against an opponent shall not be a foul.*

*Note: The tackle box no longer exists once the ball leaves the tackle box.*

*Penalty: Loss of 15 yards. If the foul is by the defense, it is also an automatic first down. The player may be disqualified if the action is flagrant.*

Several aspects of the CHR are important for the purposes of determining its effect on injuries. First, it applies to both offensive and defensive players. Defensive players cannot use the crown of the helmet to initiate a tackle and must substitute towards other methods. Offensive players cannot use the crown of the helmet to deliver a blow to a defensive player in an attempt to avoid the tackle. Second, the rule only applies to play outside of the tackle box. Fig. 1 shows the tackle box in relation to representative offensive and defensive player formations.

The group of offensive players directly affected by the CHR includes wide receivers (WR), tight ends (TE), halfbacks (HB), and fullbacks (FB). Players assigned to these four positions constitute our offensive treatment group. As Fig. 1 demonstrates, players in the WR position are typically not inside the tackle box. Wide receivers are in the open field of play and are subject to direct hits from defensive players. The same is true for players in the TE position. However, because coaches use TEs for receiving and blocking purposes, players in this position may not always be in the open field. The HB and FB positions generally begin play inside of the tackle box and leave it with the football during running plays. As with TEs, coaches regularly use FBs for blocking purposes to allow the quicker HB access to the defense's secondary. Therefore, they might not always be in the open field. Before the 2013–2014 season, players in these positions, particularly WR and HB, would be subject to crown of the helmet contact.

The group of defensive players directly affected by the CHR includes cornerbacks (CB), linebackers (LB), and safeties (S). Players assigned to these three positions constitute our defensive treatment group. Fig. 1 shows that these defensive positions typically line-up outside of the tackle box. The LB and S positions can move up the field and line-up inside the tackle box.

The remaining offensive positions (quarterback [QB]; offensive tackle [T]; guard [G]; center [C]) and defensive positions (defensive tackle [DT]; defensive end [DE]) constitute our comparison group we use to estimate the CHRs effect on the probability and severity of injuries. As Fig. 1 shows, these positions are nearly always inside

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