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Headstrong, Flagged Later: Concussions and Arrest Risk Among NFL Players

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Abstract

Head injury has been associated with impaired neurobehavioral regulation, including increased impulsivity and aggression. National Football League (NFL) players experience a disproportionately high incidence of head trauma relative to the general public, yet limited research has examined whether documented concussions are associated with criminal justice system contact. Using publicly available data on documented concussions 2010-2020 and arrests 2010-2024 for 6,201 NFL players who played at least one game from 2010 through 2020, we examined whether a documented concussion history was associated with any booking-based arrest. In unadjusted models, players with documented concussions had higher odds of arrest than those without documented concussions. Associations for violent arrest were in a similar direction but did not reach statistical significance. These findings provide preliminary evidence of an association between documented concussion history and booking-based arrest among NFL players in unadjusted models. However, because the association was sensitive to temporal-order restrictions and the analyses were unadjusted, the results should be interpreted cautiously and not as causal evidence. Still, the findings support continued investigation into how neurobiological risk may relate to criminal justice contact in high head-impact populations.

Keywords: Concussion, Head Trauma, Traumatic Brain Injury (TBI), National Football League (NFL), Arrest, Violent Arrest, Biosocial Criminology, Criminal Justice Involvement

INTRODUCTION

Criminologists consider biopsychosocial influences, such as head injury, as important for understanding how changes in the brain may increase the likelihood of offending behavior. Prior research on head injury and behavior has highlighted associations with crime, with traumatic brain injury (TBI) being associated with increases in violent crime (Fazel et al. 2011; Schofield et al. 2015; Theadom et al. 2023). Much of this work highlights reductions in impulse control and inhibition of aggressive behavior as key mechanisms connecting TBI to offending, particularly when injuries affect frontal and temporal brain regions involved in behavioral regulation (Chan et al. 2024; Maresca et al. 2023). The NFL has drawn attention as a population that may experience higher risks of criminal justice system involvement because of the increased rates of head injury among players (Mack et al. 2021; Pietrosimone et al. 2015). The cumulative toll of head injury can result in conditions such as Chronic Traumatic Encephalopathy (CTE), a progressive neurodegenerative disease documented among NFL players and others with high head impacts (Baugh et al. 2014; Mez et al. 2020; Stern et al. 2011). NFL players have been associated with lower public-order and property-related arrest rates, while violent arrest rates exceeded the general population in some yearly comparisons (Leal et al. 2015).

However, the complete understanding of how head injury influences professional football players is challenging to determine due to limited data sources, which are primarily restricted to injury reports and post-career self-report studies (Alosco et al. 2017; Bretzin et al. 2024). The evolution of diagnosis and prevention of concussion in the NFL is an ongoing process that is revised regularly as new technology and science emerge (Dreyer et al. 2019; Ellenbogen et al. 2018; Jacobi et al. 2023). Given the established links between head injury, behavioral regulation and violent offending, greater transparency in concussion identification and stronger post-career

symptom monitoring for former players may be warranted. The current study seeks to explore this under-researched area and to inform future work on head injury and offending among professional football players.

Given concussion documentation requires medical recognition, official records likely capture only a subset of true head-injury exposure. At the same time, NFL players are subject to substantial medical surveillance, so documented cases should not be assumed to represent only the most severe injury. Accordingly, documented concussion should be interpreted as an imperfect exposure measure rather than a complete measure of head trauma.

LITERATURE REVIEW

Traumatic brain injury (TBI) is an important health concern because of limitations in accurate diagnosis and the risk of persistent cognitive and behavioral after-effects. TBIs can occur through concussive or subconcussive blows from rapid acceleration and then deceleration, which in the brain causes deformation and elongation of neurons, glial cells, and blood vessels (McKee and Daneshvar 2015). Its effects can include personality changes, such as agitation, aggression, and depression (Robert 2020). Cognitive impairments can manifest as adverse behavioral outcomes, including impulsive and aggressive behavior, both of which are implicated in offending behaviors.

The label “concussion” may be used interchangeably with “mild traumatic brain injury” when neuroimaging is normal or not indicated (Silverberg et al. 2023). Mild TBI has been described as a ‘hidden disability’ as symptoms may be subtle and not externally observable (Allely 2016), which can complicate diagnosis. Research suggests that individuals with a TBI have significantly higher rates of violent crime compared to controls with some evidence suggesting repeated injuries may elevate risk (Theadom et al. 2023). Together, these findings

suggest that head injury may be relevant to externalizing outcomes. Professional football players represent a relevant study population given high concussion incidence rates. A study of retired National Football League (NFL) players found 60.8% reported having at least one concussion during their career (Pietrosimone et al. 2015). However, this prevalence may be underestimated because diagnosing concussions among professional football players is difficult, as concussion symptoms may vary and not immediately be recognized (Jacobi et al. 2023). Cognitive impairment following concussion may affect self-regulation and increase the likelihood of behaviors associated with police contact and arrest.

Head Injury, Aggression, and Violence

The impacts of head injury on aggression and violence have been demonstrated in general and system-involved populations. Large-scale general population cohort studies in Sweden and Denmark have indicated that 8.8% of people who experienced a TBI were later convicted of a violent offense after their diagnosis, compared to 3.0% of the comparison group (Fazel et al. 2011). Furthermore, 11% of individuals convicted of one or more violent crimes experienced TBI beforehand (Ineson et al. 2023).

These large-scale study observations are also supported by smaller populations with a higher TBI prevalence, such as those incarcerated or on probation. One study comparing probationers with self-reported history of TBI to probationers without a TBI history found that 47% of those on probation reported having a TBI, and the probation TBI group had markedly more felonies and reoffenses than the comparison group (Gorgens et al. 2021). Schwartz et al. (2022) in a jail cohort study tracking admissions for 24 months prior and after a first reported TBI, found that felony admissions were relatively stable pre-injury but increased in the post-TBI period. For individuals' post-incarceration, the outcome remains similar, with longitudinal data

indicating that the number of violent arrests was higher for those with TBI than without (Lattimore et al. 2022). Even when excluding individuals with previous crime convictions, one study found that TBI is still associated with an increased risk of a violent conviction for men (Schofield et al. 2015). Collectively, this research outlines the behavioral implications of TBI, consistent with the well-documented literature on the association between TBI and violent offending (Bickle et al. 2024; Mongilio 2022; Schwartz 2021; Schwartz et al. 2018).

TBIs are a complex injury that can result in a host of physical and cognitive deficits. The most vulnerable areas are the frontal and temporal cortices (Chan et al. 2024). The connection between TBI and the facilitation of emotional changes is well documented; for instance, a history of TBI is associated with increased aggressiveness (Maresca et al. 2023). A study of violent offenders found that TBI was associated with increased aggressive antisocial behaviors (Katzin et al. 2020). Ferguson and Coccaro (2009) similarly found that lifetime history of mild TBI was associated with aggression, regardless of whether participants had a personality disorder.

Behavior changes resulting from TBIs are an important risk factor for offending behavior. Impulsivity, characterized by lack of premeditation and risk-taking, was associated with generalized aggressive behavior. Individuals with high sensation-seeking, a facet of impulsivity, were also more likely to report aggressive acts (Derefinko et al. 2011). One study found that impulsive aggression was significantly related to recidivism for incarcerated individuals with antisocial personality disorder (Martin et al. 2019). A study of people incarcerated for extremely violent crimes, found that impulsivity scores were significantly related to their aggression scores and urgency (a subscale measure of impulsivity) among violent offenders is substantially higher than that of controls (Værøy et al. 2016).

Head Trauma, Concussion, and Criminal Outcomes in Football

Football is associated with a higher burden of head injuries, and repetitive head impacts that occur in football have become a public health concern (Macy et al. 2021). Long-term neurological and behavioral concerns have been documented among retired professional football players, including impulsivity, aggression, mania, and thinning of the left anterior temporal lobe (Goswami et al. 2016). Further, collegiate football players with a concussion history have significantly thinner cortex in the left ventromedial prefrontal cortex (Meier et al. 2016). These neurological changes can manifest in behavioral changes, and populations with high TBI exposure, such as NFL players, provide an opportunity to examine these associations.

While the data for incarcerated populations presents consistent prevalence findings, the method of TBI documentation for NFL population studies is more complex. A study using the NFL's Electronic Health Records (EHR) data found that 1,302 concussions were identified from 2015 to 2019, with 80% of the concussions occurring in-game. They discovered that the regular season had a concussion rate of 61.7 per 100 games; further, the defensive secondary and offensive line incurred the most concussions (Mack et al. 2021). In a study examining rule changes aimed at lowering the helmet penalties, the NFL's concussion incidence per play was on average 0.45% for regular-season games (Waller et al. 2024). There have been several improvements to the NFL's concussion diagnosis procedures across the time frame of our study. In 2011, the NFL assigned athletic trainers as spotters during games to identify mechanisms consistent with concussions (Mack et al. 2019). The NFL released sideline concussion evaluation through new protocols in 2013 (National Football League 2013). Further, the NFL changed from targeted reporting to EHR-based injury surveillance which substantially increased the number of reported injuries (Dreyer et al. 2019). Additions between 2015 and 2019 included adding an unaffiliated neurotrauma consultant, improving player education and rule changes intended to

decrease head contact (Ellenbogen et al. 2018; Mack et al. 2021). Evolutions in the procedures to diagnose and better prevent head injuries are relevant to the current study, as any significant yearly changes in documented concussions may reflect policy changes rather than true changes in injury rates. This measurement issue is important for the present study because differences in documented concussion counts across years may reflect changes in surveillance, diagnosis and reporting practices rather than only changes in underlying injury prevalence.

Concussion data for the NFL relies heavily on players and medical staff recognizing symptoms, which likely results in underreporting and limits the complete assessment of concussion incidence rates in the NFL. A study of 95 former NFL players found that reported concussion histories changed substantially when players were provided with a current definition of concussion; the number of reported concussions increased fivefold and was associated with self-reported behavioral and mood impairment, including impulsivity (Alosco et al. 2017). Kerr et al. (2015) found that former collegiate athletes failed to recall 32% of clinically documented concussions and also reported additional concussions, 77% of which were not clinically documented. Separately, Didehbani et al. (2017) found temporal reliability in self-reported concussion histories among retired NFL players. NFL concussion diagnosis has multiple logistical challenges based on the specific sideline and field environment including the rapid speed of the game, player pileups, and injuries away from the ball which hinder medical staff's observations (Jacobi et al. 2023). While former players' reporting limitations can be driven by definition-based misinterpretation of a concussion, it is also essential to consider the mechanism of concussion reporting by the team doctors and health reports that identify concussions during games.

Even though data on the prevalence of the NFL non-concussive head trauma is limited, high school and college data are more robust, providing context to the effect of cumulative hits outside of concussions. Analyzing the severity of head impacts in professional and Division I (D1) football games, Gabler et al. (2025) assessed 243 football players from the NFL and D1 NCAA using mouthpieces capable of measuring head impacts. They found no significant differences between the two levels in how hard players were being hit and concluded that head impact severity is similar for D1 and NFL players. Another study of D1 college football athletes found an average of 51.5 recorded head impacts per week during the preseason and 36.7 during the regular season, with consistent results across both seasons (Stemper et al. 2019). For high school football players, one study found that the average player sustained 652 impacts during a season with the total burden increasing substantially for players who played multiple seasons (Broglio et al. 2011).

The presence of both severity and cumulative magnitude of head impacts in high school and college football outlines a key logistical challenge for assessing the impacts of NFL concussions, given that many players begin playing football in high school and are thus potentially exposed to nearly a decade of risk for head injury. Chronic traumatic encephalopathy (CTE) is an identified concern for football players. CTE is a neurodegenerative disease associated with a history of repetitive head impacts (Baugh et al. 2014). The disease is characterized by regional atrophy (shrinkage of the brain), ventriculomegaly (enlargement of the fluid-filled areas of the brain), and brain abnormalities. Repeated head injury is the most consistently identified risk factor for CTE (Baugh et al. 2014; McKee and Daneshvar 2015; Stern et al. 2011). A study of deceased American football players found that the odds of CTE double every 2.6 years of football, and odds increase 10-fold every 9 years. Further, players who had

CTE were 10 times more likely to have played greater than 14.5 years compared to those without CTE, concluding that duration played is a good classifier of CTE status (Mez et al. 2020). Another study found that college players have 2.38 times the risk of CTE as high school players, and professional players have 2.47 times the risk. LeClair et al. (2022), using a selection-bias analysis, estimated a minimum cumulative incidence of CTE diagnosis among professional football players of 10,703 per 100,000 deaths.

The associations between TBI and aggressive antisocial behaviors have limited empirical analysis for NFL players. Erickson et al. (2017) found that NFL players with documented concussions were arrested at a similar rate to the matched controls. Further, Blumstein and Benedict (1999) found that NFL player assault related arrest rates were less than half those of the general population when stratified by race and age. In another analysis nearly a decade and a half later, Leal and colleagues (2015) analyzed database data from the work by journalist Brent Schrotenboer in his USA Today active player arrest database and San Diego Union-Tribune database (Schrotenboer 2000). Leal et al. (2015) found lower public-order and property arrest rates among NFL players, while violent arrest rates exceeded the general population in several yearly comparisons. A follow-up study by Leal et al. (2016) found that 27% of player arrests in their sample were for violent arrests. Interestingly, the likelihood of violent arrests increased with arrest frequency. Further research found that for NFL players the number of on-field penalties and penalty yards gained was positively associated with total and nonviolent criminal arrest, suggesting that the behavioral outcomes of players may arise on and off the field (Leal et al. 2017). The varying results of NFL crime data present a compelling argument for a more nuanced examination of the data. The neurological mechanisms that affect behavioral change following concussion, combined with prior NFL arrest research, provide a rationale for

examining whether documented concussion history is associated with arrest outcomes among football players.

The Current Study

The current study examines whether documented concussion history is associated with the likelihood of booking-based arrest among NFL players, with a secondary emphasis on violent arrest. We expect that NFL players with documented concussions will demonstrate higher odds of any arrest compared to players without documented concussions, while recognizing that the observational design and limitations in exposure timing do not permit causal inference. Beyond the NFL, our findings inform continued inquiry into whether head injury may relate to criminal justice contact in high head-impact populations, including system-impacted groups.

METHODS

The goal of this study is to determine whether NFL players with at least one documented concussion had higher odds of any booking-based arrest compared to players without documented concussions, with violent arrest examined as a secondary outcome. We created a unique dataset from publicly available arrest records, statistical metrics, weekly injury reports, and player profile data. This approach aligns with prior research on NFL populations (Erickson et al. 2017; Leal et al. 2015). A strength of this approach is that it links several publicly available sources into a player-level dataset that contains concussion history, roster information, and booking-based arrest outcomes. This provides an opportunity to examine an understudied association among professional football players, while also ensuring that the data sources and coding decisions remain transparent and replicable.

Data and Sample

Our dataset contains five sources of information. First, we draw upon data from **Stathead Football** (Sports-Reference) to gather information on a sample of players from the 2010 through 2020 seasons. Stathead Football is a widely used sports statistical database for the NFL and other professional sports. This data source provides customized search capabilities allowing us to select individuals who had played at least one game in the regular season in alignment with our inclusion criteria.

Our second data source is **Pro-Football-Reference (PFR)**, another statistical database provided by Sports-Reference that offers advanced statistics on teams, individuals by season, and injury reports.[1] Data from PFR provided weekly NFL injury reports (including concussions) for all active players between the 2010 and 2020 NFL seasons. Concussion entries in the PFR injury logs were identified by selecting injury designations containing 'concuss'. We did not infer concussions from other injury terms. Third, to measure arrests, we used data on NFL player arrests from the **USA TODAY** NFL arrest database compiled by Brent Schrotenboer, and for the purposes of our study spanned from January 1, 2010, to December 31, 2024 (Schrotenboer 2000). As a result of publicly available NFL arrest databases relying on public records and media reports that may not be fully complete, arrest outcomes should be interpreted as observed incidents rather than a complete measure of offending (Leal et al. 2015; Schrotenboer 2000).

Our final two data sources included **Pro Football Focus (PFF)** and **ESPN**. PFF is a sports analytics company, and both PFF and ESPN provide player **profiles**, allowing us to link each unique player to both arrest and injury report data. Below, we describe how our data sources were used to create our study population and primary variables of interest (see Table 1). The study population includes all active NFL players (e.g. those who appeared in at least one

[1] Stathead and Pro-Football-Reference operate under the parent company Sports-Reference.com.

regular season game) between 2010 and 2020.[2] The final analytic sample included 6,201 players. Tables 1-4 are provided in a separate tables document.

Dependent Variable

The dependent variable for this study is booking-based arrest. A violent arrest is defined as a booking-based arrest event classified as violent under the offense-type coding scheme described below. Following prior published work using the USA TODAY NFL arrest database (Leal et al. 2015; Leal et al. 2016), we established an analysis window of January 1, 2010, to December 31, 2024. The start date aligns with the beginning of our concussion recording period (2010-2020), while arrests were measured through 2024 to allow for post-concussion follow-up. While prior research using publicly available NFL arrest databases have generally defined arrest as a recorded incident, with or without a confirmed booking (Leal et al. 2015; Leal et al. 2016), this study defines arrests more narrowly as booking-based events, instead of non-booking events (e.g. entries noted as cited, detained, or warrants without custody/booking).

We counted an arrest only when a player was booked, defined in the USA Today database as (a) "arrested/booked/taken into custody/jailed/remanded", (b) "warrant serve" resulting in custody/booking, or (c) a documented "self-surrender/turn-in", with subsequent "booked and released" status. We excluded entries categorized as "Cited", "Detained," "Died," as well as warrant-related entries when the player's interaction was categorized as "issued", "lifted", or "rescinded."

[2] Players with no PFR concussion data were kept in the dataset to preserve the unexposed comparison group. Data were collected using Sports-Reference.com's Stathead Football, which provides customized search capabilities. Using the "Player Season Finder" function, we selected all positions for each season from 2010-2020. Within statistical filters we specified games "≥1" and "Regular Season". This process produced a comprehensive dataset. We utilized R to identify duplicate players across seasons. Players appearing for the same team and position were treated as the same player and kept as a single unique record. Players appearing across different teams, but in the same position were kept and verified against their PFR profile to ensure accuracy.

Additionally, we constructed offense-type classifications for each booking-based arrest event from the USA TODAY arrest narratives using a mutually exclusive, rule-based scheme. When an arrest event included multiple charge descriptors, we assigned a single offense category using a 'most serious offense' hierarchy (violent > property > public order > criminal-justice related), consistent with prior NFL arrest research (Leal et al. 2016). Offense-type counts reflect arrest events (not unique individuals) and may exceed the number of arrested players due to some players having multiple booking-based arrests.

Independent Variable

The key independent variable is any documented concussion. Concussion data were taken from publicly available web-scraped datasets of NFL injury reports published weekly to Pro-Football-Reference. We combined unique concussion weeks across regular season and postseason periods spanning weeks 1 through 21. To account for intermittent reporting and week-to-week concussion protocol, for those players who had more than one concussion during a season, a concussion episode was coded as present if (and only if) a subsequent documented concussion was greater than two weeks (excluding bye weeks) after the previous concussion. For example, a concussion listed for a player in week 3 as well as in week 5 is coded as one episode, while concussions in weeks 3 and 6 are coded as two distinct episodes. This approach balances potential overcounting and undercounting biases.[3] For final analysis, we retained earliest concussion episode dates and the binary concussion indicator (e.g. had concussion or not), and the categorical concussion episode category.

[3] To confirm the validity of this algorithm we examined alternative specifications with gap = 1 and gap = 3. To line up concussion dates with arrest dates, we created Sunday-based calendar anchoring and week 1 of every season was defined as the Sunday after Labor Day that year. Subsequent weeks were calculated by adding 7 day increments to the Week 1 date. We documented start and end dates for each concussion episode including the year and weeks missed.

Analytic Strategy

Analysis began with descriptive statistics for documented concussion prevalence, concussion counts, arrest prevalence, charge frequency, offense type distributions, and total arrest counts. Next, we employed chi-square tests (with odds ratios and 95% confidence intervals) to examine the relationship between "any arrest" (0/1) and "had concussion" (0/1). We fit two logistic regression models to explain variation in odds of arrest, with the first including only documented concussion status explaining a dichotomous outcome, and the second including the three-level concussion episode category (0, 1, 2+) predicting any booking-based arrest. Because demographic, socioeconomic, and other potentially important covariates were not consistently available through public NFL player data, the models are presented as unadjusted associations and should be interpreted as descriptive rather than causal. Further, we conducted two sensitivity analyses. To limit bias from unequal post-career follow time, we re-estimated the primary model restricting to arrests that occurred through December 31, 2020 (within the player observation window). Second, to assess exposure-before-outcome ordering, we reestimated the primary model after excluding cases where the earliest arrest date preceded the earliest documented concussion date, keeping players with no arrests, no concussions, or concussion that occurred on or before the earliest arrest. All analyses were conducted using IBM SPSS Statistics Version 31.

Ethics Statement

This study exclusively relied on publicly available records and did not involve interaction with human subjects, intervention, or access to private records. Therefore, institutional review board approval and informed consent were not required.

RESULTS

Sample Characteristics

Among 6,201 rostered NFL players who appeared in at least one regular season game between 2010 and 2020, 942 (15.2%) had at least one documented concussion. Arrests were uncommon, occurring in 345 players (5.6%), 102 (1.6%) of which involved a violent arrest. Offense types included 115 violent, 11 property, 225 public order, and 63 criminal justice-related offenses. Offense type totals represent arrest events and not unique individuals; thus totals may exceed the number of arrested players given that some players have multiple arrests. Among players with both a concussion and arrest (n=72), 54% experienced their first documented NFL concussion, not necessarily their first lifetime head injury, before their earliest arrest. This figure should be interpreted cautiously because the study does not capture pre-NFL head-injury history, and documented NFL concussions may not reflect players' first lifetime head injuries (Broglio et al. 2011; Stemper et al. 2019). Sample descriptives are summarized in Table 2.

Bivariate Associations

We first examined bivariate associations between concussion status and arrest outcomes (see Table 3). Concussion exposure was associated with higher prevalence of arrest. Among players without documented concussions, 273 of 5,259 (5.2%) had any arrest, compared to 72 of 942 (7.6%) among those with documented concussions. A chi-square test examining the association between any arrest and the concussion status of players was significant (χ^2 (1) = 9.143, p = .002). The odds ratio was 1.51 (95% CI [1.15-1.98]), indicating players with documented concussions had roughly 50% higher odds of any booking-based arrest than players without documented concussions in the unadjusted comparison.

For violent arrests, although there was a similar pattern – 80 of 5,259 (1.5%) players without concussions had a violent arrest compared to 22 of 942 (2.3%) players with concussions – this association did not reach statistical significance (χ^2 (1) = 3.274, p = .070).

Unadjusted Regression Results

We estimated two unadjusted logistic regression models to examine the association between any documented concussion and any arrest (see Table 4). Model 1 included a binary indicator for documented concussion, model 2 included a three-category concussion episode variable (0, 1, 2+ episodes). We found that concussions were significantly associated with arrest (*OR* = 1.511, *p*= 0.003, 95% CI [1.154-1.979]). Based on Model 1, the predicted probability of any arrest was 5.19% for players without a documented concussion and 7.64% for players with a documented concussion, an absolute difference of 2.45 percentage points.

The second model used a three category concussion episode variable, collapsing the original 0-5 episode count given the limited counts beyond two concussions. Each incremental increase was associated with higher odds of arrest (*OR* = 1.393, 95% CI [1.148–1.691], $p <$ .001). These findings suggest that arrest odds were higher across concussion episode categories in the unadjusted model, although this pattern should be interpreted cautiously given the study's limited covariate adjustment and sensitivity to temporal ordering.

For the sensitivity analyses, when restricting the arrest outcome to events that happened through December 31, 2020, the results suggest a similar and slightly stronger association between documented concussion history and any booking-based arrest (*OR* = 1.701, 95% CI [1.291-2.242], $p < .001$; N = 6,201). However, in the exposure-before-outcome sensitivity analysis, which excluded cases in which the earliest arrest preceded the earliest documented concussion, the association was attenuated and no longer statistically significant (*OR* = 0.819,

95% CI [0.581-1.154], p = .253; n = 6,168). This result indicated that the primary finding is sensitive to temporal ordering.

DISCUSSION

The current study examined whether documented concussion history was associated with booking-based arrest among NFL players. In unadjusted analyses, players with documented concussions had higher odds of any arrest than players without documented concussions. This pattern was consistent with prior work linking traumatic brain injury to adverse behavioral outcomes (Bickle et al. 2024; Maresca et al. 2023). At the same time, the central finding was sensitive to model specification. Although the association remained when arrests were restricted to 2010-2020, it was no longer statistically significant in the exposure-before-outcome analysis that excluded cases in which the earliest arrest preceded the earliest documented concussion. The association with violent arrest did not reach statistical significance. Accordingly, the findings should be interpreted as preliminary evidence of an association in unadjusted models, not as causal evidence that documented concussion history increases arrest risk. Although the findings from the current study should not be interpreted causally, they are broadly consistent with prior literature suggesting that traumatic brain injury can affect prefrontal regions involved in behavioral regulation. Specifically, disruption to the prefrontal cortex can impair response inhibition of aggression and impulsive behavior (Maresca et al. 2023). Further analyses suggest that the results were sensitive to the exposure-before-outcome restriction. When the arrest window was restricted to 2010-2020, the positive association remained statistically significant. However, the association was no longer statistically significant after excluding cases in which the earliest arrest occurred before the earliest documented concussion. Underreporting and a lack of complete life-course concussion data for individual players may explain this finding.

The present findings also raise several policy considerations, even though they should be interpreted cautiously. First, the NFL has implemented multiple improvements to concussion diagnosis and management across the study period, including changes in sideline evaluation, surveillance, and monitoring protocols (Dreyer et al. 2019; Ellenbogen et al. 2018; Jacobi et al. 2023). These changes are important not only for players' safety, but also because they may affect which concussions become documented in public records. Even with those improvements, NFL players remain a population with substantial exposure to head impacts. Accordingly, routine post-game screening, stronger baseline assessment, and access to counseling and neuropsychological services during recovery may help improve detection and support for players experiencing post-injury changes in emotional regulation, sleep, and impulse control (Jacobi et al. 2023; Mack et al. 2021). Outside of NFL-specific populations, there is a need for policy for populations with high levels of TBI, such as prisons, and providing incarcerated individuals with similar increases to screening and improving resources to coping skills and increasing knowledge about head injuries (Buchan and McMillan 2022; Mitchell et al. 2021). Our findings, alongside the prior research on brain injury tailored support programs, indicate that improvements to detection, reducing exposure, and providing post-injury support are critical to ensuring successful recovery and safeguarding individuals from negative behavioral and cognitive health outcomes.

These findings must be interpreted considering several limitations. The absence of demographic data, such as income data or education, limits our ability to control for socioeconomic factors that may influence arrest patterns. Further, because this study only considers male professional football players with unique physical profiles, we cannot generalize associations about head injury to broader populations. While we created a unique dataset to best

assess the prevalence of the key variables among professional football players, our concussion data derives from documented concussions reported to PFR. Because undiagnosed concussions would misclassify some exposed players as unexposed, the exposure measure is vulnerable to misclassification and should be interpreted as documented concussion history rather than complete head-injury history. The observed associations may be biased in either direction, although under ascertainment of concussion exposure may attenuate estimated relationships. Similarly, this study does not have access to or incorporate pre-NFL head injury history. Because players' football careers often begin years before the NFL, the present analysis does not account for the full cumulative span of prior concussive and subconcussive exposure. This is important because we cannot examine how the number of prior head injuries affects the behavioral outcomes when a concussion occurs during a player's career. We lack detailed information on concussion severity and symptoms presented to medical staff. Although we can estimate time missed, we cannot observe the full neurological extent of injury, symptom severity, or whether a player had fully recovered before returning to play. In addition, the analyses are unadjusted and cannot rule out alternative explanations such as selection effects by position, preexisting behavioral differences, or other unmeasured confounders. In particular, a player's position may be associated with both concussion risk and arrest outcomes, making position an important potential confounder for future research. Further, the criminal history of players before the NFL is not measured in this study. This poses a limitation, as research has indicated that pre-NFL arrest is significantly and positively associated with violent NFL arrests (Leal et al. 2019). The non-significant exposure-before-outcome sensitivity result further underscores that the observed association should be interpreted cautiously.

Overall, this study provides preliminary evidence that documented concussion history is associated with criminal justice contact among NFL players in unadjusted analyses. While research on NFL crime data has been explored, the knowledge surrounding the specific mechanism of harm is limited. Future research should test these relationships using stronger longitudinal designs, richer covariate adjustment, and more complete life-course measures of head-injury exposure before drawing causal conclusions about neurobiological risk and criminal justice contact. Additionally, future research should better capture life-course head injury exposure and criminal justice system contact prior to a player's NFL career. Matched designs that account for position played, pre-NFL criminal history, and college head injury exposure would strengthen causal inference. Future work should also examine whether changes to NFL concussion protocols across the study period affected the observed association. Importantly, the expansion of sideline surveillance and independent neurological evaluation beginning in 2012–2013 may have moderated the observed association. Protocol changes implemented by the NFL may affect the relationship between documented concussion history and future criminal justice contact.

Disclosure of Interest

The authors report that there are no competing interests to declare.

Data Availability Statement

The data that support the findings of this study were derived from publicly available and commercially accessible sources identified in the Methods section, including USA TODAY NFL arrest records, Pro-Football-Reference injury reports, Stathead Football, ESPN, and Pro Football Focus. The author-constructed analytic dataset and coding documentation are available from the

corresponding author upon reasonable request, subject to the terms of use of the source databases.

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Table 1. Primary Variables and Data Sources

Domain	*Variable (concept)*	*Coding/Value Range*	*Primary Data Source*
Players	Unique player identifier	Stable cross-source ID	PFF / ESPN profiles
Players	Roster inclusion	Appeared in ≥1 regular-season game, 2010–2020	Stathead Football (Player Season Finder)
Concussion	Any concussion exposure	0 = no merged episodes; 1 = ≥1 merged episode	PFR weekly injury logs
Concussion	Number of concussion episodes	0, 1, 2, 3, 4, 5 (merged episodes, gap=2)	PFR weekly injury logs
Concussion	Concussion episode category	0 = none; 1 = one; 2 = two or more episodes	Derived from merged episode counts (PFR)
Arrest	Any booking-based arrest	0 = none; 1 = ≥1 booking-based arrest	USA TODAY arrest database
Arrest	Arrest count	Integer ≥0	USA TODAY arrest database
Arrest	Violent arrest	0 = none; 1 = ≥1 violent arrest	USA TODAY arrest database
Arrest	"Charged" indicator	0 = “charged” never appears; 1 = appears ≥1 time	USA TODAY arrest database
Offense type	Offense type counts	Integer ≥ 0 per category (violent, property, public order, CJ related)	USA TODAY

Note. Offense-type categories were constructed by the authors from USA TODAY arrest narratives using the mutually exclusive hierarchy described in the Dependent Variable section.

Table 2. Sample Characteristics (N = 6,201)

Category	*Measure*	*Value*
Exposure	Any documented concussion	942 (15.2%)
	Total concussion episodes	0: 5,259 (84.8%); 1: 716 (11.5%); 2: 159 (2.6%); 3: 52 (0.8%); 4: 14 (0.2%); 5: 1 (~0.0%)
Arrest outcomes	Any booking-based arrest	345 (5.6%)
	Violent arrest	102 (1.6%)
Offense types	Violent	115
	Property	11
	Public order	225
	CJ-related	63
Counts (overall)	Arrest count, mean (SD)	0.07 (0.31)

Note. Offense-type totals reflect arrest events (not unique individuals) and may exceed the number of arrested players.

Table 3. Bivariate Association Between Concussion History and Arrest Outcomes.

Outcome	*No concussion: % with outcome*	*Concussion: % with outcome*	*$\chi^2(1)$*	*p*	*OR (95% CI)*
Any arrest	273/5,259 (5.2%)	72/942 (7.6%)	9.143	.002	1.511 (1.154–1.979)
Violent arrest	80/5,259 (1.5%)	22/942 (2.3%)	3.274	.070	1.548 (0.961–2.494)

Table 4. Logistic Regression Models Predicting Any Booking-Based Arrest

Independent Variables	*Model 1: Any Concussion* (0/1)	*Model 2: Episode Category (0,1,2+)*
Had concussion (0 = no, 1 = yes)	0.413**	
	(0.137)	
Concussion episode category (0, 1, 2+)		0.332***
		(0.099)
Constant	-2.905***	-2.906***
	(0.062)	(0.061)
Observations	6,201	6,201

Note. Entries are logit coefficients (b) with standard errors in parentheses; odds ratios are exp(b). *p < .05, **p < .01, ***p < .001. Dependent variable = any booking-based arrest (0/1). Models are unadjusted (no covariates)

Biographical Notes

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