

# Concussion Nondisclosure During Professional Career Among a Cohort of Former National Football League Athletes

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**Background:** Despite a focus on the incidence and effects of concussion, nondisclosure of sports-related concussions among retired players from the National Football League (NFL) has yet to be examined.

**Purpose:** Examine the prevalence of and factors associated with nondisclosure of sports-related concussions in former NFL athletes.

**Study Design:** Cross-sectional study; Level of evidence, 3.

**Methods:** A sample of 829 former NFL players completed a general health survey. This historical cohort included players who had played before World War II to 2001. Respondents retrospectively recalled sports-related concussions that they sustained during their professional careers and whether at least one of these sports-related concussions was not reported to medical staff. We computed the prevalence of nondisclosure among those recalling sport-related concussions during their professional careers. Multivariable binomial regression estimated adjusted prevalence ratios (PR) with 95% confidence intervals (CIs) controlling for race/ethnicity, number of years played, primary position played, professional career concussion history, and playing era. Playing era was categorized by whether the majority of a player's career was before or after a 1976 rule change to limit contact ("spearing").

**Results:** Overall, 417 (50.3%) respondents reported they had sustained a concussion and did not inform medical staff at least once during their professional playing career. Nonwhite respondents had a higher prevalence of nondisclosure than white/non-Hispanic respondents (adjusted PR = 1.19; 95% CI, 1.02-1.38). An interaction between professional career concussion history and playing era was also found ( $P = .08$ ). Compared with those in the pre-spearing rule change group with 1 or 2 concussions, all other groups had larger prevalences of nondisclosure (increases ranging from 41% to 153% in multivariable models). Across concussion strata, nondisclosure prevalence was generally higher in the post-spearing rule change group than the pre-spearing rule change group, with the largest differences found among those with 1 or 2 concussions or those with 3 or 4 concussions.

**Conclusion:** A large proportion of former NFL players in this historical cohort reported at least one instance of not disclosing sports-related concussions to medical staff. Future research on concussion nondisclosure needs to identify mechanisms to improve football players' intentions to disclose concussion-related symptoms to health care providers and to equip health care providers with more effective strategies for timely identification of concussion.

**Keywords:** epidemiology; sport; underreporting; traumatic brain injury

The National Football League (NFL) is a professional sports league noted for its concerning incidence of concussion.<sup>2,3</sup> Previous studies of retired NFL players have observed associations between recurrent concussion and long-term adverse health outcomes such as depression,<sup>8,11</sup> mild

cognitive impairment,<sup>7</sup> and chronic traumatic encephalopathy.<sup>28</sup> In response to these and related concerns, the NFL instituted a concussion protocol in the 2009-2010 season. The current version of the protocol (1) requires immediate removal from competition of players suspected of concussion, (2) requires neurological examination by the NFL team physician and an unaffiliated neurotrauma consultant, and (3) forbids same-day return to play if concussion is confirmed after examination.<sup>22</sup>

Even the most sophisticated concussion protocol is dependent to some extent upon the willingness of the

athlete to seek care and disclose symptoms. Numerous factors may influence disclosure behavior, including individual characteristics, interpersonal relationships with teammates and coaches, the physical and social environments, and policy or legislation.<sup>13</sup> Previous research has established that substantial numbers of athletes, in a wide variety of sport settings, report that they failed to disclose concussion symptoms at time of injury.<sup>4,12-14,16,20</sup> To date, however, no study has examined nondisclosure of concussion symptoms among former NFL players.

Studies of former athletes provide a unique opportunity to examine concussion nondisclosure.<sup>12</sup> Whereas current athletes may face internal (eg, desire to compete) or external (eg, employment) pressures that decrease their willingness to report nondisclosure,<sup>15</sup> former athletes may not face these pressures or biases and may be more willing to discuss previously sustained concussions that were not disclosed to team medical staff. The purpose of this study was to examine a sample of retired NFL players to determine factors of nondisclosure of at least one concussive event to team medical staff during their professional careers.

## METHODS

This study used a retrospective survey design. We used data from the Retired NFL Players General Health Survey (GHS).<sup>7,8,11</sup> The study cohort was composed of a diverse group of retired professional football players, ranging from those who played before World War II to those who played into the late 1990s and early 2000s. The instruments used to obtain concussion disclosure and other health data in this cohort are detailed below. This study was approved by the Institutional Review Board at the University of North Carolina at Chapel Hill.

### Data Collection

We administered the GHS instrument to the sample of living former NFL players at two time points, 2001 and 2010.<sup>11</sup> The baseline 2001 GHS of retired NFL players was first sent to all living members of the NFL Retired Players Association (n = 3729) through the Center for the Study of Retired Athletes at the University of North Carolina at Chapel Hill. The GHS was initially mailed in May 2001 and was followed by repeat emails to nonrespondents in August 2001 and February 2002 and additional telephone follow-up. A total of 2536 (68.0%) of the eligible sample completed the 2001 GHS. In August 2010, we sent

a follow-up GHS to 2102 retired players who had completed the 2001 GHS and who were not lost to contact or deceased (n = 434), with additional follow-up in October and December 2010. The 2010 GHS used the same measures as the 2001 GHS. A total of 1316 retired players (62.6%) completed and returned the 2010 GHS.

For this paper, we used data from the 2010 GHS to the extent possible, despite the smaller sample size, because it likely provides a more accurate representation of their professional playing career concussion experience. Nearly one-third of respondents noted more concussions in the 2010 GHS than in the 2001 GHS.<sup>10</sup> It is believed that respondents may have had a better knowledge of concussion and thus were apt to report concussions more accurately in the 2010 GHS, given the significant increase in litigation, overall awareness, and media attention surrounding the injury during that time. If respondent data were not available from the 2010 GHS, we used their 2001 GHS.

## Measures

*Self-reported Concussion History During Professional Career.* The GHS defined a concussion as “an injury resulting from a blow to the head followed by a variety of symptoms that may include any of the following: headache, dizziness, loss of balance, blurred vision, seeing stars, feeling in a fog or slowed down, memory problems, poor concentration, nausea, or throwing-up.” Participants were reminded that they did not need to be “knocked out” or unconscious to sustain a concussion. This definition has been used in other studies outside of those using the GHS.<sup>18</sup> Participants were asked to report the total number of recalled concussions during their professional career. We opted to limit recall to concussion during respondents’ professional careers because they would be more recent than concussions sustained during collegiate and high school participation, and recall was likely to be better.<sup>6</sup>

*Self-reported Concussion Nondisclosure During Professional Career.* In both the 2001 and 2010 GHS, participants reported whether they had ever not disclosed a concussion to medical staff during their professional career. Those reporting that they had not disclosed a concussion to medical staff were classified as having concussion nondisclosure. Note that this measure does not account for the frequency of nondisclosure in the sample but rather the presence of at least one concussion not being disclosed. If respondent data were not available from the

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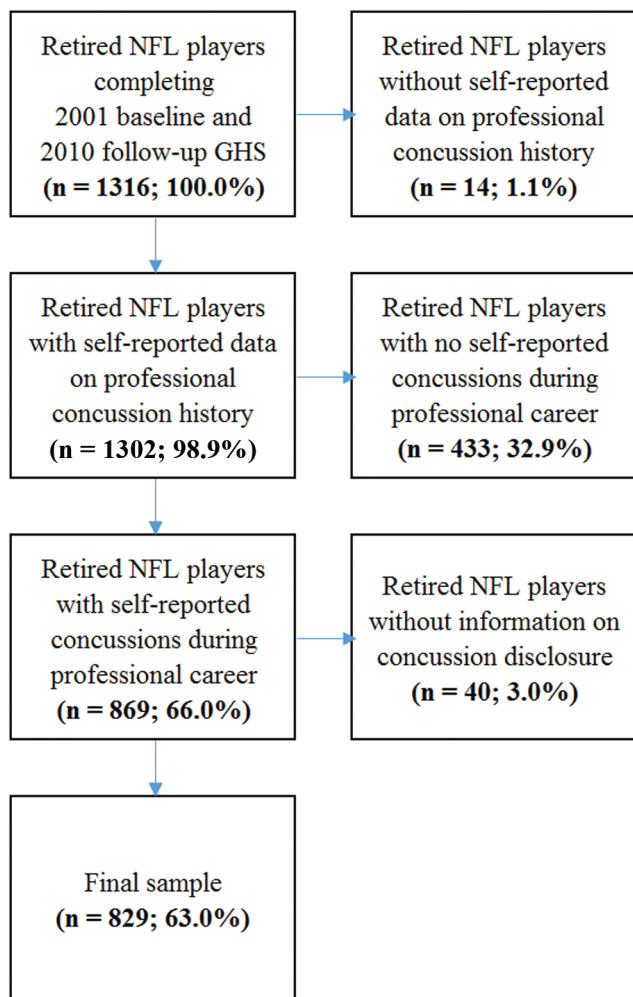
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**Figure 1.** Flowchart of final sample of retired National Football League (NFL) players used in study analyses. GHS, General Health Survey.

2010 GHS, we used their 2001 GHS. This occurred in 75 cases for professional career concussion history and 151 cases for concussion nondisclosure (60 cases were missing data for both measures from the 2010 GHS). In sensitivity analyses limited to 2010 GHS data only, effect estimates generated did not differ in direction from those presented below in our final analyses.

*Demographics and Playing History.* We obtained self-reported information on race/ethnicity, age, professional career playing history, and primary position played.

### Statistical Analyses

Of the 1316 retired NFL athletes who completed both the 2001 baseline and 2010 follow-up GHS, 14 respondents (1.1%) did not provide data on their professional career concussion history and were excluded (Figure 1). Of the 1302 remaining, 433 (33.0%) reported having no concussions during their professional careers and were also

excluded. Finally, of the 869 remaining, 40 (4.6%) did not have data on concussion disclosure and were excluded, leaving the final sample of 829 for analysis.

We estimated the prevalence of nondisclosure among retired NFL players during their professional careers overall and in relation to race/ethnicity, professional career playing history, primary position played, and age. Race/ethnicity was categorized as white/non-Hispanic and nonwhite. Number of years played professionally was treated as a categorical variable (1-5, 6-10, 11-15, and  $\geq 15$  years) in descriptive analyses and as a discrete variable in regression analyses. Playing era was categorized as whether players played the majority of their career before or after a 1976 rule change to limit contact (“spearing”); in the case of a tie, players were coded as post-rule change. Primary position played was categorized as cornerback/safety, defensive line, linebacker, offensive line, quarterback, running back, special teams, tight end, and wide receiver. Professional career concussion history was categorized as 1 or 2 concussions, 3 or 4 concussions, 5 to 9 concussions, and  $\geq 10$  concussions.<sup>11</sup> Current age (as of 2010) was excluded from models because of its strong correlation with year started professional career ( $r = -0.98$ ) and year ended professional career ( $r = -0.93$ ), both of which were used to determine playing era.

Multivariable binomial regression models were used to model the prevalence of nondisclosure and to estimate prevalence ratios (PR) and 95% confidence intervals (CI). All binomial regression models used Poisson residuals and robust variance estimation to stabilize model fit.<sup>5,26,29</sup> Because the prevalence of at least one instance of nondisclosure may be inherently tied with professional career concussion history, interaction effects were examined between professional career concussion history and other variables; if the interaction term yielded a  $P$  value less than .10, it was included in the multivariable model as well.

## RESULTS

### Sample Characteristics

The majority of respondents included in analyses were aged 61 years and over in 2010 (55.6%) and were white/non-Hispanic (76.5%; Table 1). The largest proportion of respondents had played for 6 to 10 years (49.1%) and had played the majority of seasons in the pre-spearing rule change era (ie, before the 1976 season; 56.8%). The majority of respondents had primarily played as an offensive lineman (23.2%), linebacker (15.2%), or cornerback/safety (14.7%). More than two-thirds of respondents self-reported 1 to 4 concussions during their professional careers (67.4%).

### Prevalence of Concussion Nondisclosure During Professional Playing Career

A total of 417 (50.3%) respondents reported they had sustained a concussion and did not inform medical staff at least once during their playing career. The prevalence of nondisclosure was higher among nonwhites (56.2%), those playing after the spearing rule change (59.8%), and

**TABLE 1**  
**Characteristics of Retired NFL Players Self-reporting Concussions During Their Professional Career,**  
**and Percentage Not Disclosing Concussion to Team Medical Staff at Least Once<sup>a</sup>**

Characteristic and Category	Sample in Category, n (%)	Nondisclosure, n (%)
Current age (as of 2010), y		
≤50	153 (18.5)	97 (63.4)
51-60	209 (25.2)	117 (56.0)
61-70	274 (33.1)	123 (44.9)
71-80	162 (19.5)	68 (42.0)
≥80	25 (3.0)	9 (36.0)
Missing	6 (0.7)	—
Race/ethnicity		
White/non-Hispanic	634 (76.5)	310 (48.9)
Nonwhite	185 (22.3)	104 (56.2)
Black/non-Hispanic	159 (19.2)	—
Mixed race	17 (2.1)	—
Other	9 (1.1)	—
Missing	10 (1.2)	—
Number of years played		
1-5	288 (34.7)	137 (47.6)
6-10	407 (49.1)	212 (52.1)
11-15	120 (14.5)	61 (50.8)
≥15	14 (1.7)	7 (50.0)
Playing era		
Pre–spearing rule change (before 1975)	471 (56.8)	203 (43.1)
Post–spearing rule change (1976 and later)	356 (42.9)	213 (59.8)
Missing	2 (0.2)	—
Primary position played		
Offensive line	192 (23.2)	105 (54.7)
Linebacker	126 (15.2)	72 (57.1)
Cornerback/safety	122 (14.7)	58 (47.5)
Running back	91 (11.0)	32 (35.2)
Defensive line	90 (10.9)	47 (52.2)
Wide receiver	84 (10.1)	42 (50.0)
Tight end	53 (6.4)	28 (52.8)
Quarterback	38 (4.6)	16 (42.1)
Special teams	30 (3.6)	16 (53.3)
Missing	3 (0.4)	—
Professional career concussion history		
1 or 2 concussions	321 (38.7)	114 (35.5)
3 or 4 concussions	238 (28.7)	120 (50.4)
5-9 concussions	170 (20.5)	108 (63.5)
≥10 concussions	100 (12.1)	75 (75.0)

<sup>a</sup>Percentages may not total to 100.0 due to rounding error. NFL, National Football League.

linebackers (57.1%; Table 1). The position with the lowest prevalence of nondisclosure was running back (35.2%). Finally, the prevalence of at least one nondisclosure event was higher in those with more professional career concussions, ranging from 35.5% in the group with 1 or 2 concussions to 75.0% in the group with 10 or more concussions.

### Multivariable Analyses

Nonwhite respondents had a significantly higher prevalence of nondisclosure than white/non-Hispanic respondents (adjusted PR = 1.19; 95% CI, 1.02-1.38; Table 2). In addition, the prevalence of nondisclosure varied by position; the prevalence of nondisclosure in running backs was smaller than that in linebackers, offensive linemen, and defensive linemen. No other statistically significant

differences among positions were found. The number of years played was not associated with prevalence of nondisclosure (10-year increase PR = 0.87; 95% CI, 0.72-1.06).

The final model also included an interaction term between professional career concussion history and playing era ( $P = .08$ ; Table 3). Compared with those in the pre–spearing rule change group with 1 or 2 concussions, all other groups had a larger prevalence of nondisclosure (increases ranging from 41%-153% in multivariable models). Within all strata of professional career history, the prevalence of nondisclosure was higher in the post–spearing rule change group than the pre–spearing rule change group, except for the group with the most concussions (defined as  $\geq 10$ ). Thus, the increase due to later playing era was greatest in the group with 1 or 2 concussions (adjusted PR = 1.41; 95% CI, 1.05-1.89) and the group

TABLE 2  
Prevalence Ratios (PR) and 95% CI for Main  
Effects Associated With Retired NFL Players  
Not Disclosing Concussion to Team Medical  
Staff at Least Once<sup>a</sup>

Variable	PR (95% CI)
Race/ethnicity	
Nonwhite	1.19 (1.02-1.38)
White/non-Hispanic	1.00
Number of years played	
10-year increase	0.87 (0.72-1.06)
Primary position played <sup>b</sup>	
Linebacker	1.53 (1.11-2.11)
Offensive line	1.46 (1.06-2.00)
Special teams	1.48 (0.97-2.27)
Tight end	1.44 (0.99-2.09)
Defensive line	1.48 (1.04-2.08)
Wide receiver	1.40 (0.99-1.98)
Cornerback/safety	1.26 (0.90-1.77)
Quarterback	1.19 (0.74-1.91)
Running back	1.00

<sup>a</sup>Model includes race/ethnicity, number of years played, primary position played, professional career concussion history, playing era, and interaction term for professional career concussion history and playing era.

<sup>b</sup>No significant differences were detected when using other positions as the referent group for PR.

with 3 or 4 concussions (adjusted PR = 1.37; 95% CI, 1.07-1.74) but was not apparent in the group with 10 or more concussions (PR = 0.93; 95% CI, 0.75-1.18).

## DISCUSSION

This study is the first to examine the prevalence of nondisclosure in a cohort of retired NFL players who played from the 1940s to the 2000s. We found that approximately half of retired NFL players who sustained a concussion in their professional career did not inform medical staff about at least one of their self-reported concussions. Variations in this estimate of nondisclosure were also found based upon concussion history, playing era, race/ethnicity, and position, with later playing era and more concussions being associated with increased prevalence of recalled nondisclosure. Several important caveats need to be noted. These data are based on self-report, which is influenced by multiple factors.<sup>10</sup> Additionally, the association between concussion history and nondisclosure reflects in part the fact that the opportunity for nondisclosure increases as the number of concussions increases. Despite these limitations, our findings are consistent with prior research<sup>12,13</sup> and support continued efforts to educate football players about the importance of concussion risk, symptoms, and increasing disclosure. In addition, our results highlight the fact that interventions related to increasing disclosure among professional American football players need to account for individual characteristics that may alter intention to disclose concussions.

## Prevalence of Nondisclosure

Assessments of nondisclosure based on self-report are inherently prone to measurement error, since they depend on "reports of nonreports."<sup>10</sup> Despite this limitation, self-report is the most common method of capturing nondisclosure that has been used. Previous estimates of concussion nondisclosure are widespread, ranging from 33% to 62%.<sup>12,13</sup> Our estimate of 50.3% among retired NFL players falls within the range seen in previous research.<sup>12,13</sup> Notably, estimates of nondisclosure prevalence among football players appeared higher at the high school (57.2%)<sup>18</sup> and collegiate levels (68.3%)<sup>12</sup> when compared with the current study's NFL cohort. While this is a positive trend, it is important to note that among a sample of former collegiate athletes, football players had the highest prevalence of nondisclosure compared with all other sports.<sup>12</sup> Again, this may reflect increased opportunity for nondisclosure associated with increasing concussion history.

Variations in nondisclosure prevalence depend on the characteristics of the samples used, including level of competition, area of origin, and timeframe of play. In particular, although our study includes a wide range of retired NFL players across many decades of play, our sample does not include more recent retirees after 2001. Thus, continued examination of the prevalence of nondisclosure is needed with more recent players and among more levels of competition, including middle school sports and youth recreational leagues.

In this study, we were unable to examine the reasons for nondisclosure, as in previous research.<sup>12,14,18,23</sup> Kerr et al<sup>13</sup> summarized nondisclosure as the function of two properties: first, a lack of concussion-related knowledge, which means that the athlete does not understand he sustained a concussion and/or that the concussion was not perceived as serious enough to merit disclosure; and second, pressures to play while concussed that either are self-imposed by the athlete or originate from outside sources (eg, coaches, teammates). According to Kroshus et al,<sup>15</sup> pressure on an individual athlete from sources such as a coach, teammate, parent, or even fan has been shown to negatively affect the intention of athletes to report concussive symptoms. These motivations related to nondisclosure have typically been examined in younger, amateur populations and may not apply to our older, historical cohort, some of whom may have been less educated about concussion and, thus, less apt to understand the severity of the injury.

Nevertheless, in the context of current professional football, fans may play a particularly large role in concussion-reporting behavior. The NFL has a strong media focus and fan base, and future research is needed to examine how concussion nondisclosure in professional sports is influenced by stadium environment, traditional media, and social media. More important, professional sports need to identify strategies to counteract pathways by which these and other factors may act as barriers to concussion disclosure. Recently, the NFL announced fines and forfeitures of future draft picks as potential punishments for failing to follow concussion protocols.<sup>21</sup> However, as per the socioecological model,<sup>13</sup> effective interventions need to consider

TABLE 3  
Prevalence Ratios (PR) and 95% CI for Interaction  
Between Professional Career Concussion History and Playing Era<sup>a</sup>

Professional Career Concussion History	Pre-Spearing Rule Change (Before 1976)		Post-Spearing Rule Change (1976 and later)		PR (95% CI) for Each Strata of Concussion History (Post vs Pre)
	Nondisclosure, n (%)	PR (95% CI)	Nondisclosure, n (%)	PR (95% CI)	
1 or 2 concussions	58 (29.9)	1.00	56 (44.4)	1.41 (1.05-1.89)	1.41 (1.05-1.89)
3 or 4 concussions	62 (43.1)	1.45 (1.09-1.92)	58 (61.7)	1.97 (1.51-2.58)	1.37 (1.07-1.74)
5-9 concussions	50 (55.6)	1.84 (1.38-2.44)	57 (72.2)	2.30 (1.78-2.96)	1.24 (0.99-1.57)
≥10 concussions	33 (76.7)	2.53 (1.93-3.31)	42 (73.7)	2.37 (1.82-3.09)	0.93 (0.75-1.18)

<sup>a</sup>Model includes race/ethnicity, number of years played, primary position played, professional career concussion history, playing era, and interaction term for professional career concussion history and playing era. The outcome of interest was the prevalence of retired NFL players not disclosing concussion to team medical staff at least once during their professional playing career.

multiple levels of influence: individual, interpersonal, environmental, and legislative. In particular, within the NFL, intervention efforts need to target individual athlete knowledge, team dynamics, rules of the sport to improve safety, and policymakers' ability to discover and implement changes to improve concussion care. Moreover, interpersonal levels, particularly within the team environment, also need to be addressed. The more we understand about levels of influence regarding concussion and concussion disclosure, the better likelihood of addressing the behaviors and issues surrounding concussion in sport.

### Professional Career Concussion History and Playing Era

Our final multivariable model included an interaction between playing era and concussion history, indicating that the prevalence of nondisclosure was highest among athletes who played after the spearing rule change and sustained a larger number of concussions. However, playing era did not affect nondisclosure for those with 10 or more professional concussions. In other words, the synergistic interaction between playing era and concussion history appeared to "cap out" at ≥10 concussions. This finding may be possibly due to a ceiling effect (ie, the potential for nondisclosure reached a maximum in the ≥10 concussions group).

It is unknown how the 1976 spearing rule change affected the prevalence of nondisclosure. The change seen after 1976 may not be related to the rule change itself; rather, the rule change may reflect a change in the focus on the NFL as well as the health and safety of its athletes. Considering that the amount of focus on the NFL increased over the second half of the 20th century (due to the growth in popularity of the sport), it is plausible that internal and external pressures influencing nondisclosure of potential injuries have increased over time. This could include increased pressure from fans due to more widespread televising of games and increased competition for spots on NFL rosters as well as increased salaries that may have made it more attractive to stay in the games. Athletes with a higher number of previous concussions may feel

even more pressure to not disclose for fear of losing playing time and potentially being cut from the team, particularly as they near the end of their career. These results may also reflect a variety of factors, such as age differences in how athletes recall and disclose concussions (eg, older athletes may be less willing to report nondisclosure), as well as changes over time regarding how concussions were perceived, defined, detected, and managed.<sup>19</sup> Nevertheless, we emphasize that the current study is retrospective in design; although retrospective studies can identify potential associations among variables, such studies are less apt to identifying cause-and-effect relationships. Caution should be taken when interpreting findings.

What is most important to consider is that despite the advancements in concussion research and education over the past 30 years, we should expect to see players being more likely to report concussions due to fear of what will happen to their health in the future. The results clearly suggest that increased concussions and having played more recently interact synergistically to increase the probability of nondisclosure. Nevertheless, because our cohort played up to 2001, we stress the need for more up-to-date examinations of current and former athletes to determine how well current estimates of nondisclosure would fit into this increasing trend.

### Positional Differences in Nondisclosure

Our study was the first to examine the prevalence of nondisclosure by American football position. Running backs and quarterbacks had the lowest prevalence of nondisclosure, whereas offensive linemen had the highest prevalence; however, in multivariable models controlling for race/ethnicity, years played, playing era, and professional career concussion history, the only main difference was that running backs reported less nondisclosure relative to linebackers, offensive linemen, or defensive linemen. Such variations by position may be associated with factors including athletic identity, pressures associated with the position that may be affected by a suspected concussion, or personality type. These variations may also reflect visibility of the effect, with running backs experiencing more

open-field collisions and therefore having reduced potential for nondisclosure.

### Race/Ethnicity Differences

Despite being able to detect subtle differences in nondisclosure of concussions by race/ethnicity, we are unable to specify why such a difference was found. The findings may indicate that among various races or ethnicities there are differences in the relationships between team medical staff and the athlete reporting symptoms of a possible concussion. The majority of NFL players identify as black/African American,<sup>27</sup> whereas less than 9% of physicians in the United States identify as persons of color.<sup>1</sup> Previous research in other fields has indicated that individuals who share a race or cultural identity with their physician are more likely to be satisfied with their care and therefore potentially more likely to report health care needs.<sup>9,17,24,25</sup> Alongside racial/ethnic discordance in the patient-doctor dyad, individual athletes may also have differing experiences related to medical care, including past insurance hardships or negative perceptions of health care, thus furthering the divide. Further research needs to better examine race/ethnicity differences within concussion disclosure as well as concordance and discordance between concussed individuals and the individual to whom they may disclose symptoms.

### Limitations

Our sample of retired NFL players may not be generalizable to nonparticipating members of the NFL Retired Players' Association. In particular, our sample did not include anyone who had retired after 2001; thus, our findings may not be generalizable to more recent players. It is also difficult to determine how generalizable these findings are to players at other levels of competition or other sports. Thus, further research is needed to help validate our current findings in other athlete populations. As previously noted, we did not obtain information as to why nondisclosure occurred. Such information would help identify barriers specific to this population. Bias inherent to self-report data (eg, recall bias, social desirability bias), as well as knowledge gain and changes in the social environment, may influence how our sample perceived, defined, detected, and managed their concussions.<sup>13</sup> Respondents may have had difficulty accurately remembering such reports of nondisclosure. In addition, we cannot verify the accuracy of responses; as noted in prior research,<sup>12</sup> it is unknown whether concussions would have met a clinical definition or whether retired NFL players mistook other injuries for concussions.<sup>10</sup> As such, we used prevalence of at least one instance of nondisclosure instead of percentage of concussions disclosed. Last, we focused solely on concussions occurring during participation in professional football; further research on lifetime concussion history that is inclusive of non-sport-related concussions may benefit our knowledge of concussion nondisclosure. Despite these limitations, we believe that our findings further the

discussion regarding concussion nondisclosure and highlight the need for more in-depth examinations on the topic.

### CONCLUSION

In a sample of retired NFL players who had played from the 1940s to the early 2000s and reported at least one concussion during their professional career, more than half (50.3%) reported not disclosing a concussion to team medical staff. The prevalence of nondisclosure was associated with race/ethnicity, position, playing era, and professional career concussion history. Future research on concussion nondisclosure is needed to identify mechanisms for improving football players' intentions to disclose symptoms associated with concussion to health care providers and equip health care providers with more effective strategies for timely identification of concussion.

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