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Suicide Mortality Among Retired National Football League Players Who Played 5 or More Seasons

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Background: There is current disagreement in the scientific literature about the relationship between playing football and suicide risk, particularly among professional players in the National Football League (NFL). While some research indicates players are at high risk of football-related concussions, which may lead to chronic traumatic encephalopathy and suicide, other research finds such a connection to be speculative and unsupported by methodologically sound research.

Purpose: To compare the suicide mortality of a cohort of NFL players to what would be expected in the general population of the United States.

Study Design: Cohort study; Level of evidence, 3.

Methods: A cohort of 3439 NFL players with at least 5 credited playing seasons between 1959 and 1988 was assembled for statistical analysis. The vital status for this cohort was updated through 2013. Standardized mortality ratios (SMRs), the ratio of observed deaths to expected deaths, and 95% CIs were computed for the cohort; 95% CIs that excluded unity were considered statistically significant. For internal comparison purposes, standardized rate ratios were calculated to compare mortality results between players stratified into speed and nonspeed position types.

Results: Suicide among this cohort of professional football players was significantly less than would be expected in comparison with the United States population (SMR = 0.47; 95% CI, 0.24-0.82). There were no significant differences in suicide mortality between speed and nonspeed position players.

Conclusion: There is no indication of elevated suicide risk in this cohort of professional football players with 5 or more credited seasons of play. Because of the unique nature of this cohort, these study results may not be applicable to professional football players who played fewer than 5 years or to college or high school players.

Keywords: suicide; football; National Football League; concussion

A rigorous debate is currently being conducted in the scientific literature and in the court system about the relationship between playing football in the United States (US)

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and suicide risk. Those who support this connection primarily refer to autopsy-based case reports that identified relatively large numbers of suicide cases among contact-sport athletes, including those who played football.^{17,19-21,31,33} Presumably, those suicides resulted from, or were exacerbated by, a disease known as chronic traumatic encephalopathy (CTE), a syndrome that is theorized by some to develop after repetitive concussive and subconcussive impacts to the head and is manifested by a complex set of progressive neurodegenerative and/or psychiatric disorders.^{16,17} The logic follows that because football players are at high risk of concussions, they would also be at high risk of CTE and suicide.

Those who question the football play/concussion/CTE/suicide connection most commonly reference the significant limitations of the evidence used to support the connection: the selection bias of cases examined for CTE, the lack of information about preexisting or comorbid conditions, and the incomplete ascertainment of individual head injury medical histories.^{11,18,30,36} A study of a cohort of professional football players has also been cited as a refutation

of any connection.^{1,11,36} The 2012 study that primarily focused on cardiovascular mortality in the cohort reported causes of death for multiple categories, including mortality from suicide.¹ Suicide mortality in the cohort was significantly less than would be expected compared with the general US population: 21.8 deaths expected, 9 observed, standardized mortality ratio (SMR) = 0.41 (95% CI, 0.19-0.78).¹

The purpose of this article is to provide updated suicide mortality data for this unique cohort of retired professional football players who played 5 or more seasons in the National Football League (NFL). We will briefly discuss these findings in the context of the research that has been conducted to date on suicide among football players and other professional athletes.

METHODS

Full details of the cohort have been previously described.^{1,5,14} Briefly, the cohort includes 3439 NFL players identified by a pension fund database of vested players with at least 5 credited playing seasons between 1959 and 1988. Vital status follow-up was ascertained from pension fund records, the Social Security Administration, and the Internal Revenue Service. In our original study, players were matched to the National Death Index (NDI) beginning in 1979 (when the NDI began) through 2007. In this article, vital status updating and NDI matching have been extended through December 31, 2013. The NDI provided causes of death coded to the International Classification of Diseases (ICD) revision in effect at the time of death. Death certificates were obtained from state vital statistics offices and coded by a certified nosologist when death information was not provided by the NDI. Institutional review board approval for this study was obtained under the auspices of the National Institute for Occupational Safety and Health (NIOSH), HSRB 06-DSHEFS-04XP.

Mortality was analyzed using the NIOSH life table analysis system (LTAS.NET).²⁷ Analyses used US male mortality rates (1960-2009) for 119 cause of death categories; rates for 2010-2013 are estimated based on rates for the 2005-2009 time period.²⁵ Because all cohort members had a minimum of 5 credited seasons, a risk begin date was determined as the approximate date at the end of the fifth credited season (assigned as February 1). Each cohort member accumulated person-years at risk (PYAR) for each year of life from the risk begin date until the date of death or the study end date, whichever came first. To calculate the expected number of deaths, the PYAR were stratified into 5-year intervals by age and calendar time and then multiplied by the appropriate male US race- and cause-specific mortality rates. The ratio of observed to expected number of deaths was expressed as the SMR; 95% CIs were obtained using exact methods when the observed number of deaths was ≤ 10 or approximate methods when the observed number of deaths was > 10 . We considered 95% CIs that excluded unity to be statistically significant.

Intentional self-harm is a term used in ICD revision 10 and is equivalent to the term *suicide* that we will use

throughout this article. The following ICD codes, by revision, were used to identify causes of death from suicide in this analysis: ICD revision 8, E950 to E959; ICD revision 9, E950 to E959; and ICD revision 10, X60-X84 and Y87.0.³⁴

To determine if there were mortality differences based on the characteristics of football playing positions, we stratified players into 2 position categories: "speed" positions that include quarterback, running back, halfback, fullback, wide receiver, tight end, defensive back, safety, and linebacker and "nonspeed" positions that include all defensive and offensive linemen. Biomechanical studies of football-related concussions among college players indicate certain positions place players at higher risk of high speed impacts to the head and thus at higher risk of concussive-level head injuries.^{8,26} Speed position players are those who may be at higher concussion risk compared with players in nonspeed positions and thus may be at higher risk of suicide. Punters and kickers were excluded from the stratified analysis because their positions generally did not involve contact that resulted in a risk of head injury. LTAS.NET was used to calculate directly standardized rate ratios (SRRs) and 95% CIs for suicide using the nonspeed players as an internal referent.

RESULTS

By the end of follow-up in 2013, the final cohort of 3439 players contributed 122,843 person-years at risk. Summary results of the updated mortality analysis are provided in Tables 1 and 2. As of December 31, 2013, a total of 537 members of this cohort were deceased, an increase of 203 deaths from the last analysis (as of December 31, 2007). Overall mortality (SMR = 0.60; 95% CI, 0.55-0.65) and mortality from cancer (SMR = 0.59; 95% CI, 0.50-0.70), heart diseases (SMR = 0.75; 95% CI, 0.65-0.86), and assault/homicide (SMR = 0.14; 95% CI, 0.04-0.37) continue to be significantly less than expected. The NFL cohort also experienced a significantly reduced risk of mortality from suicide, with 12 suicide deaths observed compared with 25.6 that would be expected in a comparable sex/race/age sector of the US population (SMR = 0.47; 95% CI, 0.24-0.82). There were 6 suicides among players in speed positions and 6 suicides among players in non-speed positions. Suicide was significantly reduced in the speed position stratum compared with the US referent population (SMR = 0.39; 95% CI, 0.14-0.86) and was reduced, but not significantly, compared with the nonspeed position stratum (SRR = 0.47; 95% CI, 0.14-1.51).

Characteristics of the suicide deaths are shown in Table 3. Fifty-eight percent of the suicide deaths were among white players and 42% were among black players, virtually equal to their representation in the entire cohort (59% white, 41% black). While the cohort comprised approximately two-thirds speed position players and one-third nonspeed position players, the number of suicide deaths was equally distributed between the 2 player categories. Although accounting for only 22% of the cohort, players who first played in the 1980s accounted for 42% of the suicide deaths. The median number of seasons played for

TABLE 1
Overall Mortality, Selected Causes, National Football League Player Cohort (1960-2013)^a

Underlying Cause of Death	Observed	Expected	SMR (95% CI)
All deaths	537	901.7	0.60 (0.55-0.65)
All cancers	137	230.8	0.59 (0.50-0.70)
Heart diseases	207	277.1	0.75 (0.65-0.86)
Suicide	12	25.6	0.47 (0.24-0.82)
Assault and homicide	4	27.6	0.14 (0.04-0.37)

^aSMR, standardized mortality ratio (US referent rates).

those committing suicide (8.5 seasons) was comparable with the number of seasons for all players (8 seasons).

DISCUSSION

Although there have been opinions expressed in both the popular and scientific literature that football players are at higher risk of suicide than the general population, this study did not find that to be the case among this cohort of professional football players. This NFL cohort had rates of suicide mortality that were less than half of what would be expected in a comparable sex/race/age grouping from the general US population. In an earlier study of neurodegeneration in this NFL cohort, an indirect method was used to assess any possible relation between concussion and neurodegeneration because concussion data were not available for individual players.¹⁴ Two strata were created based on playing positions classified as “speed” and “nonspeed” positions. Studies of the incidence of concussion in football players generally have found that players in speed positions experienced concussions more commonly than players in nonspeed positions. Because some research has linked CTE to both neurodegeneration and to suicide, we reran the speed/nonspeed analysis for suicide mortality. Unlike the results of the earlier study, which found statistically elevated neurodegeneration mortality among speed players, suicide mortality was not elevated in either the speed or the nonspeed player stratum. There was no significant statistical difference in suicide mortality when the 2 strata were directly compared.

To date, few studies have examined suicide or suicide risk factors in sports cohorts. One report that examined 34 years of the medical literature on suicide in athletes (that included football players) found that football players accounted for a significant portion of the total number of suicide cases (42%). The author speculated that these proportionately large numbers may be due to characteristics of football play such as heightened aggression and high prevalence of substance abuse and serious injury. However, few conclusions could be drawn from that report because no distinction was made as to the level of football played (professional, college, high school, other), and no numbers could be provided as to the number of athletes and years at risk for each sport.²

A 9-year study of suicide among National Collegiate Athletic Association athletes reported a significantly lower

TABLE 2
Suicide Mortality, National Football League Player Cohort, Stratified by Position Type (1960-2013)^a

Player Category ^b	Obs	SMR (95% CI)	SRR (95% CI)
Nonspeed	6	0.65 (0.24-1.42)	Referent
Speed	6	0.39 (0.14-0.86)	0.47 (0.14-1.51)

^aObs, observed number of deaths; SMR, standardized mortality ratio (US referent rates); SRR, standardized rate ratio.

^bPlayer position was collapsed into 2 strata for analysis purposes: “speed” positions (fullback, halfback, defensive back, quarterback, wide receiver, running back, linebacker, and tight end) and “nonspeed” positions (defensive and offensive linemen); punters and placekickers (n = 79) were excluded from this analysis.

TABLE 3
Characteristics of the National Football League Player Cohort and Suicide Deaths (1960-2013)

Characteristic (% of Total Cohort) ^a	Suicide Deaths (n = 12)
Race	
White (59%)	7
Black (41%)	5
Other (<1%)	
Position played	
Offensive line (20%) ^b	3
Defensive line (15%) ^b	3
Offensive nonline (33%) ^c	1
Defensive nonline (32%) ^c	5
Decade, first season played	
1950-1959 (9%)	1
1960-1969 (29%)	4
1970-1979 (40%)	2
1980-1989 (22%)	5
No. of seasons played, median (range)	
Total cohort	8.0 (3-22)
Suicide deaths	8.5 (5-14)
Age at death, median (range), y	
Suicide deaths	45.3 (30.8-66.3)

^aPunters and placekickers were not included (n = 79).

^bOffensive and defensive line positions constitute the “nonspeed” stratum.

^cOffensive and defensive nonline positions constitute the “speed” stratum.

annual suicide rate among student athletes (0.93/100,000) compared with the rate for all college students (7.5/100,000). Study authors noted that the highest rate in the sports sectors occurred in football players (2.25/100,000); the relative risk (RR) among football players was more than twice as high as other non-football playing male athletes (RR = 2.21; 95% CI, 1.05-4.61). However, the football player rate was still significantly lower than the reported suicide rate of 9/100,000 reported for all male college students.²⁴

Only 1 study has quantified suicide mortality in a large cohort of professional athletes. A study of 5389 Italian professional-league soccer players reported that suicide mortality among the players was not statistically different

from suicide mortality found in a general population referent group (SMR = 0.81; 95% CI, 0.35-1.59).³¹ It has been postulated that soccer is comparable with American-style football in that players from both sports experience recurrent blows to the head that may result in CTE.¹⁶

Five studies have examined depression, a significant risk factor for suicide,²⁹ among professional football players. A survey of 2552 retired NFL players (average career of 6.6 years) found that players reporting 1 or 2 concussions were 1.5 times more likely to be diagnosed with depression than players reporting no concussion history.⁹ Players with 3 or more concussions were 3 times more likely to report depression.⁹ A follow-up study of the original cohort reported a strong exposure-response relation between concussion history and depression diagnosis during the 9-year follow-up period.¹³ A second study, a survey of 1617 retired NFL players with an average age of 53.4 years and playing career of 7.1 years, reported player depression levels similar to what would be found in the general US population.²⁸ Study authors cautioned that players experiencing ongoing problems with pain management may be at increased risk for not only depression but also suicide.²⁸ The survey did not ask questions relating to concussions or head injuries.²⁸ A third survey of 1063 retired NFL players asked younger (age <50 years) and older (age \geq 50 years) retirees questions about depression; results were then compared with the general US male population.³² Overall, self-report of major depression was 3.9% among the younger retirees compared with 3.0% in the general population.³² No notable differences were detected within the older retiree stratum.³² Because the survey focused on postretirement issues, no data were captured on concussion or head injury that may have occurred while playing football.³² A fourth study involved neurological and neuropsychological testing of 34 retired NFL players (9.7 years career average).¹⁰ Most (32 of the 34) players reported sustaining at least 1 concussion during their careers with an overall lifetime average of 4 concussions per player.¹⁰ Prevalence of depression was higher among the NFL players (24%) than would be expected in a comparable age grouping in the general population (15%).¹⁰ A similar study reported data derived from a convenience sample of 45 retired NFL players who completed a battery of neurological and psychological tests.³ These players played an average of 6.8 years in the league and reported an average of almost 7 concussions incurred during their playing careers.³ Thirty-three percent of these players were found to exhibit some level of depression, which is higher than the 15% to 20% reported for the general population.³ However, the percentage of players found to have moderate to severe depression was within the prevalence range found in the general population.³ Furthermore, none of the depression scores were statistically associated with football-related exposures.³ On the basis of these results, the study authors concluded that a career in the NFL is not causally related to later-life depression.³

To date, the connection among football play, suicide, and CTE has been based primarily on autopsy case reports. The first reports, published in 2005 and 2006, chronicled the deaths of 2 long-career, professional football players

with histories of multiple concussions. Both died 12 years after retiring from football.^{22,23} A 2013 article reported the results of an autopsy-based study that included 35 former professional football players with histories of multiple concussions. Thirty-four of the 35 players were found to have some form of CTE, and 3 of the 34 died of suicide.¹⁷ The biological mechanism for this connection is not clear, although it is reportedly related to the disruption of normal neuronal functioning caused by neurofibrillary tangles and neuritic threads in specific areas of the brain that result in mood, neuropsychiatric, or cognitive disorders.^{16,17,21}

In the past few years, a number of studies have been published that strongly caution against drawing the premature conclusion that a concussion-CTE-suicide pathway has been scientifically established.^{4,11,12,15,18,35,36} Main criticisms involve the weakness of the evidence used to support the relationships,^{11,36} the selection bias associated with the autopsies of contact sports professionals,^{15,18} and the lack of information about the number and severity of the head injuries that may have been incurred by those diagnosed postmortem with CTE or those who committed suicide.³⁵ In recently published reviews of CTE research, Iverson et al¹² and Castellani et al⁴ unequivocally assert that the link between CTE and depression/suicide has not been established because no scientific study has been published that confirms such a link. They note that between 1928 (when a neuropathology related to contact sports was first identified) and 2010, suicide had not been identified as a clinical feature of CTE. In 2010, Omalu et al²¹ published a case report of an autopsy of a deceased professional football player; in that article, they identified suicide as one of the potential outcomes of CTE. Iverson et al¹² and Castellani et al⁴ note that this conclusion appears to be based solely on the fact that 2 of the 3 football players that Omalu et al²¹ had examined had committed suicide. Since that time, suicide has been accepted by most CTE researchers as a clinical outcome of CTE. The review articles conclude that much more epidemiological and clinical evidence is needed before claims can be substantiated that neurotrauma causes CTE and that CTE is associated with suicide.

Limitations

In addition to the lack of concussion data, our study had several limitations. First, our study may not be generalizable to all professional football players. At the time our cohort was assembled, complete records were only available for players who were vested in the NFL pension plan (players who played on or before 1988 with 5 or more credited seasons in the NFL). Our cohort had an average career length of 8 seasons, which is longer than the 4.6 seasons played by the average professional player.⁶ Our longer term career players may be inherently different from shorter career players, possibly due to factors related to football play or personal medical conditions. Second, because of the unique capabilities and risk factors experienced by professional players, our results would not be directly applicable to nonprofessional football players. Third, we did not have information on risk factors for

suicide or information about psychological morbidity. Fourth, we did not have specific income or other socioeconomic information for cohort members and therefore were unable to account for the potential protective effect that an NFL salary and pension may have had on suicide risk. There is a body of research that suggests higher income individuals may be at lower risk of suicide due to better access to mental health treatment and to other aspects of daily life.⁷ Fifth, because reference population mortality data were available only through 2009, we applied rates for 2005-2009 to the 2010-2013 calendar period; however, rates for suicide were similar in the 2 time periods for nonwhite males across all age groups and only slightly different for white males (slightly lower for ≥ 70 years; slightly higher for 40 to < 70 years), so this likely had little effect on the results. Finally, because our study was a mortality study, we only accounted for those players who died from a suicide attempt. Our study did not account for living players who may have experienced significant psychological impairments or for deceased players who also had such impairments but died from other causes.

CONCLUSION

There is no indication of elevated suicide risk in this cohort of professional football players with 5 or more credited seasons of play. Because of the unique nature of this cohort, these study results may not be applicable to professional football players who played fewer than 5 years or to college or high school players. Clearly, our one study does not resolve the issue of suicide in football. Before reliable conclusions can be drawn on any relationship among football play, concussion, CTE, and suicide, more work needs to be done in several areas: (1) quantitatively assessing football-related risk factors, particularly in collecting valid concussion data; (2) collecting longitudinal non-football related suicide risk factor data, including the existence and prevalence of recurring pain among current and retired players; and (3) analysis of how the higher income and socioeconomic profile of professional football players compared to the general population positively or negatively affects suicide risk.

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