

Mortality from mental disorders and suicide in male professional American football and soccer players: A meta-analysis

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Objective: To determine the risk of mortality from mental disorders and suicide in professional sports associated with repeated head impacts.

Methods: A systematic search was performed in PubMed, Web of Science, Scopus, and SPORTDiscus (since inception to June 8, 2021) to find studies comparing the incidence of mortality from mental disorders or suicide in former or active professional athletes of sports characterized by repeated head impacts vs athletes with no such exposure or the general non-athletic population.

Results: Seven retrospective studies of moderate-to-high quality that included data from boxers and from basketball, ice hockey, soccer, and National Football League (NFL) players, respectively (total = 27 477 athletes, 100% male) met all inclusion criteria. Former male NFL players ($n = 13\,217$) had a lower risk of mortality from mental disorders (standard mortality rate [SMR] = 0.30; 0.12–0.77; $p = 0.012$) and suicide (SMR = 0.54; 0.37–0.78; $p < 0.001$) than the general population. This finding was also corroborated in male soccer players ($n = 13,065$; SMR = 0.55; 0.46–0.67; $p < 0.001$). Male athletes participating in sports associated with repeated head impacts ($n = 18,606$) had also a lower risk of all-cause, cardiovascular disease (CVD), and cancer mortality (all $p < 0.01$) than the general population.

Conclusions: Participation of male athletes in American football or soccer at the professional level might confer a certain protective effect against mortality from mental disorders or suicide, besides its association with a lower risk of all-cause, CVD, or cancer-related mortality.

KEYWORDS

chronic traumatic encephalopathy, concussion, professional athletes, traumatic brain injury

1 | INTRODUCTION

Participation in top-level sports is associated with a lower risk of all-cause mortality and of mortality from major noncommunicable conditions (cardiovascular disease (CVD) and cancer).¹ Indeed, elite athletes seem to live on average 3–5 years longer than the general population.^{2,3} Further, regular exercise is also associated with improved mental health. Meta-analytical evidence supports implementation of exercise intervention as an adjuvant treatment against depression, anxiety, schizophrenia, or substance use disorders.^{4–9} Notably, a large cross-sectional study conducted on more than 1.2 million adults found that those who exercised had better mental health than those who did not.¹⁰

In addition to the benefits of exercise on mental health, athletes might have a lower risk of death from mental disorders than the general population. Duncombe et al.¹¹ recently analyzed a cohort of former athletes who had participated in the Olympics between 1912 and 2012. Although there were some exceptions (notably shooters, who actually showed a trend toward a higher risk), this study found a 32% lower risk of death attributable to mental and eating disorders or to suicide in former athletes than in the general population. The finding of a lower risk of death from these conditions or from suicide in athletes was corroborated in subgroup analyses for individual sports such as athletics, rowing, or swimming (as well as for “all other sports” combined as a single category).¹¹

Whether the abovementioned benefits on mental health are generalizable to top-level sports, particularly those associated with repeated head impacts (eg, boxing, American football) is, however, less clear. In fact, individuals with a previous history of repeated head impacts have more depression symptoms and an impaired cognitive function compared with people without this history.¹² For example, a systematic review suggested an association between sports-related concussion and impaired mental health (particularly depression symptoms) in elite athletes.¹³ Further, multiple concussions in retired athletes appear to be a risk factor for mental health problems,¹⁴ resulting in a “disproportionate” number of suicides among current and former National Football League (NFL) players (ie, 11 suicides between 2009 and the end of 2015).¹⁵ By contrast, a recent review concluded that former NFL players were not at greater risk of suicide than the general non-athletic population.¹⁶

The aim of the present systematic review and meta-analysis was to compare the risk of mortality from mental disorders or suicide between athletes participating (or having participated) in professional sports characterized by repeated head impacts and athletes with no such exposure

or the general (non-athletic) population—of note, based on the International Classification of Diseases codes for mental disorders it is possible to identify whether the deaths reported in a given study were caused by several specific mental conditions such as anxiety, depression, and drug/alcohol use, bipolar or affective mood disorders, respectively. In addition, we also compared the risk of all-cause, CVD, and cancer-related mortality between the aforementioned groups.

2 | METHODS

This systematic review and meta-analysis (Prospero registration#CRD42020200923) followed the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) (Supplementary file 1).¹⁷

2.1 | Systematic search

Two authors (GSL and JSM) independently conducted the systematic search on the electronic databases PubMed, Web of Science, Scopus, and SPORTDiscus for relevant articles written in English (with no restriction on the starting date and up to June 8th, 2021). Details of the full search strategy can be found in Supplementary File 2. In addition, the reference list of all relevant studies and reviews identified were checked to avoid missing relevant studies. We eliminated the following types of articles: letters, case reports, abstracts, expert opinions, and reviews.

2.2 | Study selection and data extraction

Studies were included if they met the following criteria: (A) evaluated professional athletes (whether retired or not, both sexes) of sports associated with repeated head impacts; and (B) compared mortality risk from mental disorders or suicide in these athletes vs the general non-athletic population, a control group representing the general population, or athletes not exposed to repeated head impacts. Citations were independently screened by title and abstract, and the full texts of the studies that met the inclusion criteria were assessed by two authors (GSL and JSM). Disagreements between authors were resolved through consensus or after consultation with a third reviewer (PLV).

Two authors (GSL and JSM) extracted the main outcome data from each study, when available, as standard mortality rate (SMR = observed deaths/expected deaths) and 95% confidence interval (CI). This information was

reviewed by a third author (ACG) to ensure accuracy and completeness.

2.3 | Quality assessment

The quality of each included study was independently rated by two authors (ACG and JSM) using the Newcastle-Ottawa Scale (NOS) for cohort studies,¹⁸ with eventual disagreements resolved through discussion with a third author (PLV). We chose the NOS scale for practical reasons (*ie*, the NOS scale is a widely used tool, it is easy to apply, and our group is highly familiarized with it). For the selection, comparability, and exposure categories, a maximum score of 4, 2, and 3 stars, respectively, can be awarded for each study. Thus, the NOS has a score range of 0 to 9 (0 = minimum and 9 = maximum), with a score of 7–9 indicating high quality and low risk of bias, a score of 4–6 points moderate quality and moderate risk of bias, and 0–3 points low quality and high risk of bias.¹⁸

2.4 | Statistical analysis

A random-effects meta-analysis was performed to compare the pooled mortality risk (expressed as SMR and 95%

CI) when ≥ 2 studies analyzed a given outcome. The Begg's test was used to assess publication bias and the Q and I^2 statistics were used to determine heterogeneity across studies when ≥ 3 studies analyzed a given outcome. The level of significance was set at 0.05. All statistical analyses were performed using MIX 2.0 Pro for Excel software.¹⁹

3 | RESULTS

3.1 | Studies' characteristics

From the retrieved articles, seven retrospective studies (total $n = 27\,477$ athletes, 100% male) met all the inclusion criteria (Figure 1, Table 1).^{20–26} Three studies shared the same sample,^{20,22,24} and thus, we used only one to calculate the total number of participants. Five studies had a quality score of 8,^{20,22–25} and the other two had a score of 7²⁶ and 6,²¹ respectively. Thus, all included studies were considered to have a moderate-high quality. The participants were active or retired male athletes participating or having participated in boxing, basketball, ice hockey, soccer, or American football (NFL). The average age at death of the athletes who died due to mental disorders or suicide ranged from 36 to 68 years. The methods used by the studies for identifying participants' vital status and cause of

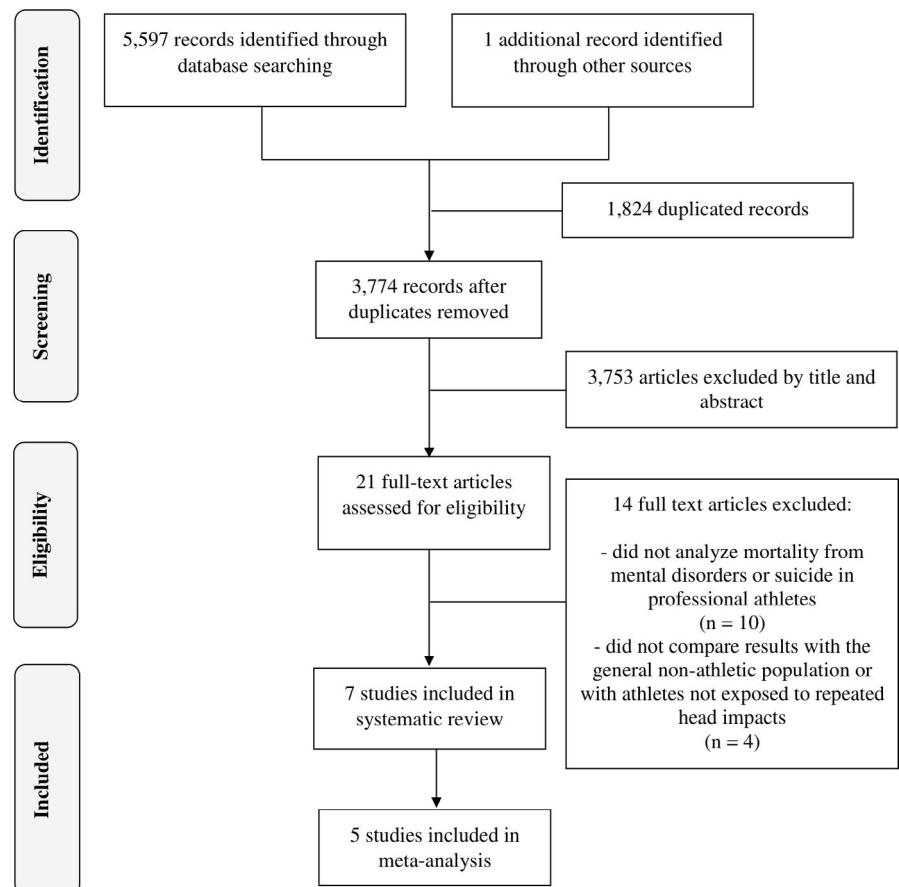


FIGURE 1 Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) flow diagram detailing the search strategy

TABLE 1 Main characteristics of the studies included in the systematic review

Authors	Athletes' group	Comparator	Age at death in athletes* [mean \pm SD or median (range)]	NOS quality score (highest possible =9 stars)	Main findings
Baron et al. ²⁰	3 439 retired NFL male players	US population, using the NIOSH life-table analysis system	54 (27–81) years	<i>Total: 8 stars</i> Selection: **** Comparability: ** Exposure: **^^	Lower risk of mortality from mental disorders and suicide in retired NFL players Lower all-cause, CVD and cancer mortality in retired NFL players
Kettunen et al. ²¹	Former Finnish male elite athletes participating in soccer (<i>n</i> = 309), ice hockey (<i>n</i> = 168), basketball players (<i>n</i> = 92), boxing (<i>n</i> = 302), and wrestling (<i>n</i> = 324)	1 712 controls (matched for birth cohort)	N/R	<i>Total: 6 stars</i> Selection: *** Comparability: * Exposure: **	Higher mortality from suicide in power sports Lower all-cause mortality in team sports, and lower CVD and cancer mortality in power sports
Lehman et al. ²²	3 439 retired NFL male players	US population, using the NIOSH life-table analysis system	45 (31–66) years	<i>Total: 8 stars</i> Selection: **** Comparability: ** Exposure: **	Lower risk of mortality from suicide in retired NFL players Lower all-cause, CVD and cancer mortality in retired NFL players
Lincoln et al. ²³	9 778 retired NFL male players	US men of the same age, race, and calendar year	38 (23–61) years	<i>Total: 8 stars</i> Selection: **** Comparability: ** Exposure: **	Lower risk of mortality from mental disorders and suicide in retired NFL players Lower all-cause, CVD and cancer mortality in retired NFL players
Nguyen et al. ²⁴	3 419 NFL male players	2 708 former MLB players (comparable to NFL cohort on playing era and birth cohort)	60 \pm 13 years	<i>Total: 8 stars</i> Selection: **** Comparability: ** Exposure: **	No between-group differences in mortality from suicide Higher mortality from all-cause and CVD in NFL players
Russell et al. ²⁵	7 676 retired professional male soccer players	23 028 controls selected from the general population, in a 1:3 ratio, on the basis of sex, year of birth, and degree of social deprivation	68 \pm 13 years	<i>Total: 8 stars</i> Selection: **** Comparability: ** Exposure: **	No differences in risk of suicide between retired soccer players and controls
Taiolfi ²⁶	5 389 professional male soccer players (active or retired)	General Italian population stratified by calendar period and where possible by age (in order to represent the age range observed in the cohort of soccer players)	36 \pm 10 years	<i>Total: 7 stars</i> Selection: **** Comparability: * Exposure: **	Lower mortality risk from suicide in active/retired soccer players Lower mortality from all-cause, CVD and cancer in active/retired soccer players

Note: Quality was assessed using the Newcastle-Ottawa Scale (NOS).¹⁸

Abbreviations: N/R, not reported; NFL, National Football League; NIOSH, National Institute for Occupational Safety and Health; SD, standard deviation; SymbolCVD, cardiovascular disease; US, United States.

*Indicates age of those athletes who died from mental disorders or suicide.

death are detailed in Supplementary file 3. Regarding the comparator group, four studies used a dataset representing the general population,^{20,22,23,26} one study included a control group of non-athletic subjects,²⁵ one used athletes not exposed to repeated head impacts (*ie*, baseball players),²⁴ and another one combined both non-athletic controls and athletes that were not exposed to repeated head impacts.²¹

Chronic traumatic encephalopathy (CTE) was not assessed as a diagnosis in any of the included studies.

3.2 | Outcomes

Two studies assessed the risk of mortality from mental disorders in retired male NFL players (total $n = 13\ 217$) compared with the general population.^{20,23} The pooled analysis of these two studies showed a lower risk in the former (Figure 2A).

All seven studies^{20–26} assessed the incidence of mortality from suicide, but only four (conducted in retired male NFL players^{22,23} and in active or retired male soccer players,^{25,26} total $n = 26\ 282$) were meta-analyzed. The reason was that three studies^{20,22,24} shared the same sample (and thus only one²² was meta-analyzed) and the other excluded study²¹ assessed together athletes of sports characterized by repeated head impacts and athletes with no such exposure. Pooled analysis of the four included studies^{22,23,25,26} showed a lower risk of mortality from suicide in male athletes than in the general population (Figure 2B). There were no signs of risk of bias (Begg's $p = 0.734$) or of heterogeneity between studies ($I^2 = 0\%$, $Q = 1.23$). These findings were confirmed in separate analyses for retired male NFL players ($n = 13\ 217$; SMR = 0.54; 95% CI 0.37–0.78; $p < 0.001$)^{22,23} or for male soccer (retired or active) players ($n = 13\ 065$; SMR = 0.55; 95% CI 0.46–0.67; $p < 0.001$).^{25,26}

Risk of mortality from all-cause, CVD, and cancer was assessed in six of the seven studies included in the systematic review.^{20–24,26} Because three studies^{20,22,24} shared the same sample, only one of them was included in the meta-analysis. Another study was excluded from the meta-analysis²¹ because the authors assessed together athletes of sports characterized by repeated head impacts and athletes with no such exposure. Although small-to-large heterogeneity was found, athletes (13 217 former male NFL players and 5389 retired/active male soccer players) showed a lower risk of all-cause (SMR = 0.61; 95% CI 0.44–0.87; $p = 0.006$; Begg's $p = 1.000$; $I^2 = 92\%$; $Q = 26.3$), CVD (SMR = 0.62; 95% CI 0.52–0.74; $p < 0.001$, Begg's $p = 0.297$; $I^2 = 27\%$; $Q = 2.752$), and cancer-related mortality (SMR = 0.46; 95% CI 0.32–0.67; $p < 0.001$; Begg's $p = 0.296$; $I^2 = 63\%$; $Q = 5.4$).

4 | DISCUSSION

To the best of our knowledge, this is the first systematic review and meta-analysis to assess the risk of mortality from mental health or suicide in professional male athletes of sports characterized by a high rate of head impacts. The present study suggests that participation of male athletes in American football (NFL) or in professional soccer might be associated with a lower risk of death from mental disorders (70% reduction) and suicide (46%), or with a lower risk of suicide (45%), respectively, compared to the general population. Additionally, a lower risk of mortality from all-cause, CVD, and cancer-related mortality (39, 38, and 54% reduction, respectively) could be confirmed for both types of athletes. The latter findings are in line with previous findings in professional/Olympic-class, as well as soccer athletes.¹

Controversy exists as to whether participation in sporting events associated with repeated head impacts could increase the risk of mortality from mental disorders or suicide.^{14–16} A recent systematic review concluded that repeated head impacts are associated with long-term cognitive impairments in athletes.²⁷ In the same line, a recent meta-analysis found a twofold higher risk of suicide in individuals who had experienced concussion and/or mild traumatic brain injury (TBI) compared to controls free from these conditions.²⁸ A broad range of psychiatric and psychosocial problems including depression and suicidal thinking are common clinical features associated with CTE.¹⁶ Indeed, previous evidence has revealed a high prevalence of depression and other mental health problems among former professional athletes participating in contact sports (notably, American football, ice hockey, soccer, and rugby).^{29,30} However, a recent study reported that former professional soccer players had a lower risk of hospitalization due to mental health disorders (anxiety, depression, or drug/alcohol use, bipolar, and affective mood disorders, respectively) compared with non-athletic controls.²⁵ These results support the findings of the current study. On the contrary, there appear to be no differences in the risk of suicide when comparing athletes participating in sports associated with repeated head impacts and athletes with no such exposure.²⁴

As a limitation of the study, it must be noted that although the sports included in our systematic review and meta-analysis are associated with repeated head impacts, no information on the incidence of concussion was available, and CTE was not included as a diagnosis. In this regard, it has been reported that the number of sports career-related concussions is associated with the prevalence of symptoms of common mental disorders. For instance, former professional athletes reporting a history of 4–5 and ≥ 6 career-related concussions are 1.5 and 2–5

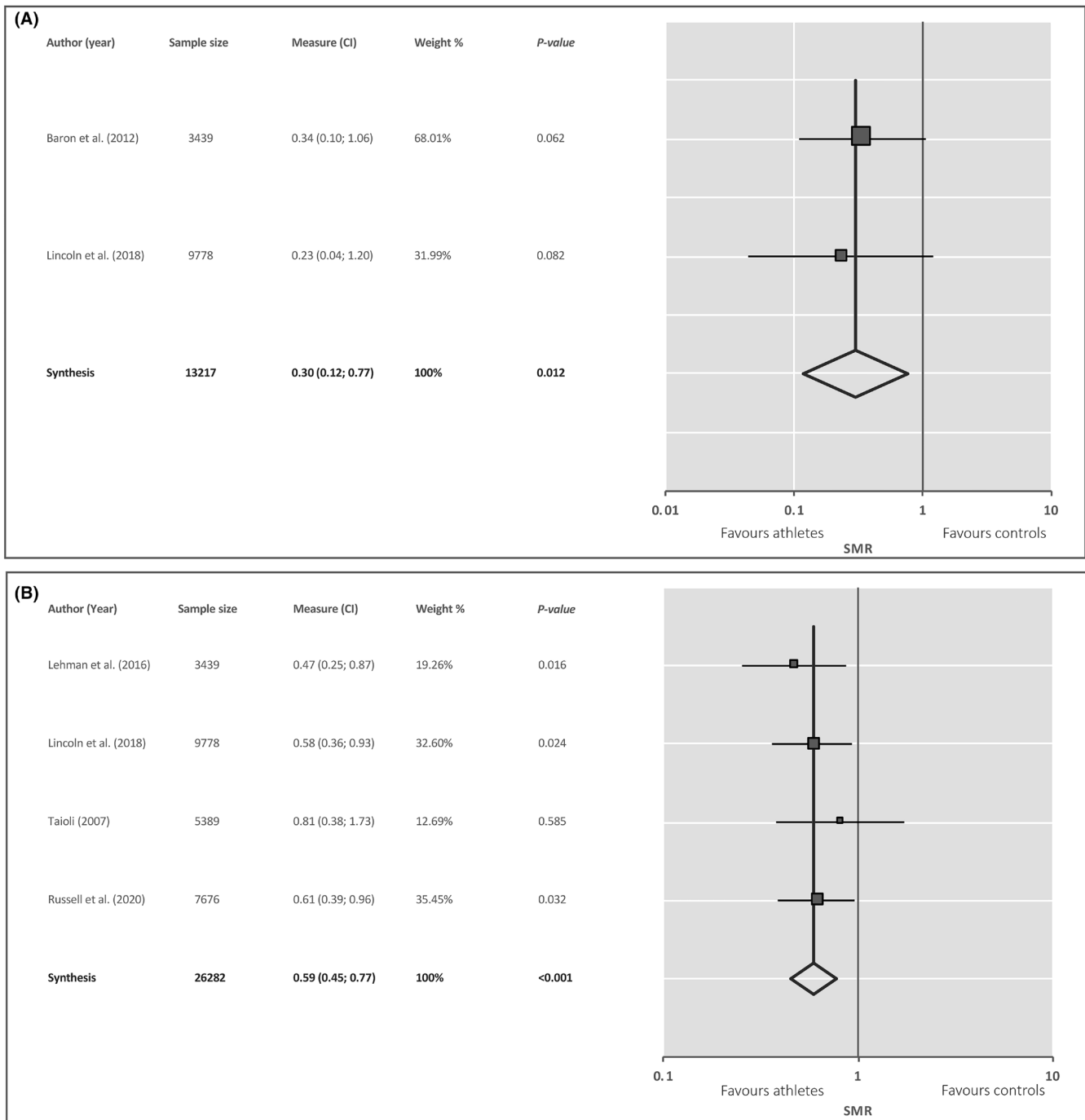
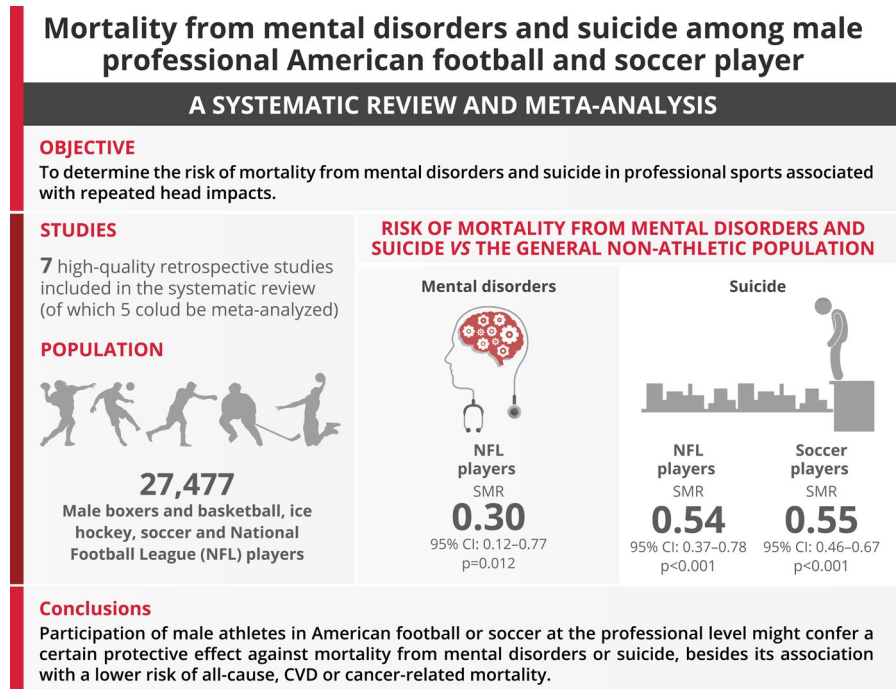


FIGURE 2 Mortality risk from mental disorders in retired national football league (NFL) male players (panel A) and from suicide in retired NFL players and active/retired male soccer players (panel B), respectively, compared with the general population. A standard mortality rate (SMR) <1 indicates a lower risk in athletes

times more likely, respectively, to report symptoms of common mental disorders than former professional athletes reporting no concussions.³⁰ Thus, the actual risk of mortality from mental disorders or suicide in those athletes with a history of concussions remains to be determined. A further limitation of our meta-analysis is the low number of included studies, which limits the generalizability of our results. More research is thus needed to confirm

whether the present findings can be extrapolated to other sports that were not included in the present systematic review and meta-analysis but are characterized by repetitive head impacts such as ice hockey, rugby, martial arts, or wrestling, among others. In addition, research is warranted to determine the risk of mortality from mental disorders and suicide in people who practice contact sports at a recreational or amateur level as well as in female

FIGURE 3 Graphical abstract of main study findings



athletes. Regarding the latter, there seem to be some sex-specific trends, with women being at a higher risk of both TBI³¹ and mental disorders than men.³² In turn, a major strength of our study is the large number of male professional athletes (NFL and soccer players) analyzed and the overall high quality of the included studies.

In summary, besides decreasing all-cause and noncommunicable disease-related mortality, professional participation of male athletes in American football and soccer, two sports associated with repeated head impacts, appears to be associated with a lower risk of mortality from mental disorders and suicide, and a lower risk of mortality from suicide, respectively, compared with the general non-athletic population (Figure 3).

5 | PERSPECTIVES

Participation of male athletes in American football (NFL) or soccer at the professional level might confer a certain protective effect against mortality from mental disorders or suicide. More research is, however, needed with female athletes and other types of sports associated with repeated head impacts (such as ice hockey, rugby, martial arts, or wrestling, among others) to corroborate the generalizability of the present findings.

CONFLICT OF INTEREST

The authors have no conflict of interest to declare. The material presented in this manuscript is original, and it has not been submitted for publication elsewhere.

DATA AVAILABILITY STATEMENT

The data that support the findings of this study are available from the corresponding author upon reasonable request.

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REFERENCES

- Lucia A, Santos-Lozano A, Sanchis-Gomar F, et al. Elite athletes live longer than the general population: a meta-analysis. *Mayo Clin Proc.* 2014;89:1195-1200.
- Clarke PM, Walter SJ, Hayen A, Mallon WJ, Heijmans J, Studdert DM. Survival of the fittest: retrospective cohort study of the longevity of Olympic medallists in the modern era. *Br J Sports Med.* 2015;49:898-902.
- Antero J, Tanaka H, De Larochelambert Q, Pohar-Perme M, Toussaint JF. Female and male US Olympic athletes live 5 years longer than their general population counterparts: a study of 8124 former US Olympians. *Br J Sports Med.* 2021;55:206-212.
- Kvam S, Kleppe CL, Nordhus IH, Hovland A. Exercise as a treatment for depression: a meta-analysis. *J Affect Disord.* 2016;202:67-86.

5. Gorczyński P, Faulkner G. Exercise therapy for schizophrenia. *Cochrane Database Syst Rev*. 2010;5:CD004412.
6. Cooney GM, Dwan K, Greig CA, et al. Exercise for depression: Some benefits but better trials are needed. *Saudi Med J*. 2013;34:1203.
7. Wang D, Wang Y, Wang Y, Li R, Zhou C. Impact of physical exercise on substance use disorders: a meta-analysis. *PLoS ONE*. 2014;9(10):e110728. <https://doi.org/10.1371/journal.pone.0110728>
8. Schuch FB, Stubbs B, Meyer J, et al. Physical activity protects from incident anxiety: a meta-analysis of prospective cohort studies. *Depress Anxiety*. 2019;36:846-858.
9. Schuch FB, Vancampfort D, Firth J, et al. Physical activity and incident depression: a meta-analysis of prospective cohort studies. *Am J Psychiatry*. 2018;175:631-648.
10. Chekroud SR, Gueorguieva R, Zheutlin AB, et al. Association between physical exercise and mental health in 1.2 million individuals in the USA between 2011 and 2015: a cross-sectional study. *Lancet Psychiatry*. 2018;5:739-746.
11. Duncombe SL, Tanaka H, De Laroche Lambert Q, Schipman J, Toussaint JF, Antero J. High hopes: lower risk of death due to mental disorders and self-harm in a century-long US Olympian cohort compared with the general population. *Br J Sports Med*. 2021;55(16):900-905.
12. Alosco ML, Tripodis Y, Baucom ZH, et al. Late contributions of repetitive head impacts and TBI to depression symptoms and cognition. *Neurology*. 2020;95:e793-e804.
13. Rice SM, Parker AG, Rosenbaum S, Bailey A, Mawren D, Purcell R. Sport-related concussion and mental health outcomes in elite athletes: a systematic review. *Sport Med*. 2018;48:447-465.
14. Manley G, Gardner AJ, Schneider KJ, et al. A systematic review of potential long-term effects of sport-related concussion. *Br J Sports Med*. 2017;51:969-977.
15. Webner D, Iverson GL. Suicide in professional American football players in the past 95 years. *Brain Inj*. 2016;30:1718-1721.
16. Iverson GL. Retired national football league players are not at greater risk for suicide. *Arch Clin Neuropsychol*. 2021;35:332-341.
17. Moher D, Liberati A, Tetzlaff J, Altman DG. Preferred reporting items for systematic reviews and meta-analyses: the PRISMA statement. *J Clin Epidemiol*. 2009;62:1006-1012.
18. Ottawa Hospital Research Institute.
19. Bax L, Yu LM, Ikeda N, Tsuruta H, Moons KGM. Development and validation of MIX: comprehensive free software for meta-analysis of causal research data. *BMC Med Res Methodol*. 2006;6:50.
20. Baron SL, Hein MJ, Lehman E, Gersic CM. Body mass index, playing position, race, and the cardiovascular mortality of retired professional football players. *Am J Cardiol*. 2012;109:889-896.
21. Kettunen JA, Kujala UM, Kaprio J, et al. All-cause and disease-specific mortality among male, former elite athletes: an average 50-year follow-up. *Br J Sports Med*. 2015;49:893-897.
22. Lehman EJ, Hein MJ, Gersic CM. Suicide mortality among retired national football league players who played 5 or more seasons. *Am J Sports Med*. 2016;44:2486-2491.
23. Lincoln AE, Vogel RA, Allen TW, et al. Risk and causes of death among former national football league players (1986–2012). *Med Sci Sports Exerc*. 2018;50:486-493.
24. Nguyen VT, Zafonte RD, Chen JT, et al. Mortality among professional American-style football players and professional American baseball players. *JAMA Netw Open*. 2019;2:1-13.
25. Russell ER, McCabe T, Mackay DF, et al. Mental health and suicide in former professional soccer players. *J Neurol Neurosurg Psychiatry*. 2020;91:1256-1260.
26. Taioli E. All causes mortality in male professional soccer players. *Eur J Public Health*. 2007;17:600-604.
27. Gallo V, Motley K, Kemp SPT, et al. Concussion and long-term cognitive impairment among professional or elite sportspersons: a systematic review. *J Neurol Neurosurg Psychiatry*. 2020;91:455-468.
28. Fralick M, Sy E, Hassan A, Burke MJ, Mostofsky E, Karsies T. Association of concussion with the risk of suicide: a systematic review and meta-analysis. *JAMA Neurol*. 2019;76:144-151.
29. Baker JG, Leddy JJ, Hinds AL, et al. An exploratory study of mild cognitive impairment of retired professional contact sport athletes. *J Head Trauma Rehabil*. 2018;33:E16-E23.
30. Gouttebauge V, Aoki H, Lambert M, Stewart W, Kerkhoffs G. A history of concussions is associated with symptoms of common mental disorders in former male professional athletes across a range of sports. *Phys Sportsmed*. 2017;45:443-449.
31. Levin HS, Temkin NR, Barber J, et al. Association of sex and age with mild traumatic brain injury-related symptoms: a TRACK-TBI study. *JAMA Netw open*. 2021;4:e213046.
32. Riecher-Rössler A. Sex and gender differences in mental disorders. *The Lancet Psychiatry*. 2017;4:8-9.

SUPPORTING INFORMATION

Additional supporting information may be found online in the Supporting Information section.

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