




OPEN ACCESS

Depression and anxiety-related disorders and suicide among Swedish male elite football players: a nationwide cohort study

Manzur Kader,¹ Björn Pasternak,^{1,2} Carl-Emil Lim,¹ Martin Neovius,¹ Magnus Forssblad,³ Henrik Svanström,^{1,2} Jonas F Ludvigsson,^{4,5} Peter Ueda ¹

► Additional supplemental material is published online only. To view, please visit the journal online (<http://dx.doi.org/10.1136/bjsports-2023-107286>).

¹Clinical Epidemiology Division, Department of Medicine, Solna, Karolinska Institutet, Stockholm, Sweden

²Department of Epidemiology Research, Statens Serum Institut, Kobenhavn, Denmark

³Department of Molecular Medicine and Surgery, Stockholm Sports Trauma Research Center, Karolinska Institutet, Stockholm, Sweden

⁴Department of Medical Epidemiology and Biostatistics, Karolinska Institutet, Stockholm, Sweden

⁵Department of Pediatrics, Örebro University Hospital, Örebro, Sweden

Correspondence to

Dr Peter Ueda, Clinical Epidemiology Division, Department of Medicine, Solna, Karolinska Institutet, Stockholm, Sweden; peter.ueda@ki.se

Accepted 2 October 2023

ABSTRACT

Objective To assess whether male elite football players, during and after their active career, were at increased risk of depression and anxiety-related disorders and suicide, as compared with the general male population.

Methods We included male football players active in the Swedish top division 1924–2019 and general male population (matched to football players based on age and region of residence) aged <65 years in 1997. Using nationwide registers, we followed the football players from their first season in the top division (or the date of their first registered residency in Sweden) or 1 January 1997, and compared the risk of depression and anxiety-related disorders (captured through diagnoses from hospital admissions and outpatient visits, and use of prescription drugs) among football players versus controls. In a secondary analysis using data from death certificates, we compared the risk of suicide between football players and general population males who were alive in 1969 (when cause of death became available).

Results During follow-up through 31 December 2020, 504 (13.6%) of 3719 football players and 7455 (22.3%) of 33 425 general population males had a depression or anxiety-related disorder. In analyses accounting for age, region of residence and calendar time, the risk of anxiety and depression-related disorders was lower among football players versus general population males (HR 0.61, 95% CI 0.55 to 0.66). The protective association was attenuated with increasing age, and from around age 70 years the risk was similar in the two groups. The risk of suicide was lower among football players versus general population males (HR 0.48, 95% CI 0.32 to 0.72).

Conclusions In this nationwide cohort study in Sweden, elite male football players had a lower risk of depression and anxiety-related disorders and suicide as compared with the general population.

WHAT IS ALREADY KNOWN ON THIS TOPIC

⇒ It has been hypothesised that elite athletes, including elite football players, may be at increased risk of depression and anxiety-related disorders and suicide due to psychosocial stressors, including pressure to perform, public attention and fame and repeated head trauma, and stressors associated with retirement from the sport. Questionnaire studies have shown that symptoms indicative of mental disorders are common among active and retired elite football players.

WHAT THIS STUDY ADDS

⇒ In this nationwide cohort study, male football players who played in the Swedish top division between 1924 and 2019 had a lower risk of depression and anxiety-related disorders (HR, 0.61, 95% CI 0.55 to 0.66) as compared with males in the general population. The protective association was attenuated with increasing age, and from around age 70 years the risk was similar in football players and males from the general population. Football players also had a lower risk of suicide (HR 0.48, 95% CI 0.32 to 0.72).

HOW THIS STUDY MIGHT AFFECT RESEARCH, PRACTICE OR POLICY

⇒ The overall evidence from large cohort studies indicates that male elite football players have a lower risk of depression and anxiety-related disorders and suicide as compared with males from the general population. Further research is required to better understand the factors that lead to this protective association, and to assess if this finding applies to other populations of football players.

INTRODUCTION

There are concerns that elite football players may be at increased risk of adverse mental health outcomes, including depression and anxiety. Elite football players face psychosocial stressors, including pressure to perform, public attention and fame, and the risk of being outcompeted by other players. Such stressors may increase the risk of depression and anxiety.^{1–3} Moreover, the period of transitioning out of elite sports can be challenging, and retirement from elite sports has been linked with mental health problems.^{3–7} Further, it has been suggested that contact sport athletes,

including football players,^{8–10} are at increased risk of neurodegenerative disease as a result of repeated trauma to the head.^{11–14} This risk increase, which has been observed for elite football players,^{15 16} may be partly caused by a neuropathological condition called chronic traumatic encephalopathy (CTE). While it can only be diagnosed during autopsy and uncertainty remains regarding the condition's link to patient outcomes, CTE can manifest as neuropsychiatric symptoms, including depression, anxiety, impulsivity, aggression and suicidality.^{17 18}



© Author(s) (or their employer(s)) 2023. Re-use permitted under CC BY-NC. No commercial re-use. See rights and permissions. Published by BMJ.

To cite: Kader M, Pasternak B, Lim C-E, et al. *Br J Sports Med* Epub ahead of print: [please include Day Month Year]. doi:10.1136/bjsports-2023-107286

Table 1 Data sources and years for which data were used

Data source	Years
Information about all football players in Allsvenskan from the Swedish Association of Football Historians and Statisticians	1924–2019
Total population register	1969–2020
Cause of death register	1969–2020
National patient register (hospitalisations)	1987–2020
National patient register (outpatient care visits)	2001–2020
Prescribed drug register	July 2005–2020
Swedish Military Conscription Register	Football players and general population males born between 1951 and 1987

Although previous questionnaire studies have shown that symptoms indicative of mental disorders are common among professional football players, the studies have been small or lacked a control group of individuals from the general population.^{1–3 19 20} In the only large-scale cohort study of mental health outcomes among elite football players performed to date²¹ male former professional football players in Scotland had a lower risk of depression, anxiety and stress-related disorders (recorded as diagnoses in health registers) as compared with general population controls; there was no statistically significant difference in the risk of suicide between football players and controls. However, the earliest start of follow-up in the Scottish study was at age 40 years and it did not assess mental health outcomes during the football players' active careers.

In this nationwide cohort study in Sweden, we aimed to assess the risk of diagnosis of depression and anxiety-related disorders and suicide during and after the active careers of elite male football players as compared with population controls.

METHODS

Data sources

The study cohort was constructed using data from various sources, which are described in the online supplemental material. Information about football players was compiled by the Swedish Association of Football Historians and Statisticians and covered all current and former players in the Swedish top division, *Allsvenskan* (table 1, online supplemental material). Nationwide health and administrative registers, including the Total Population Register, the Patient Register, the Cause of Death Register, the Prescribed Drug Register, Statistics Sweden and the Swedish Military Conscription Register, were used to gather additional data on outcomes (hospital admissions, outpatient hospital visits, prescription drug use and cause of death) and other variables, including vital status, region of residence, region of birth, income, education and results from psychological and physical tests at military conscription. Data on female football players were not available.

Study population

Figure 1 displays a flow chart for the study population. All football players who had played in at least one game in *Allsvenskan*, from its inaugural season in 1924 through 2019, were eligible for inclusion. We excluded players whose personal identity number was not available in the databases as described in the online supplemental material.

Using the Total Population Register each football player was matched in a 1:10 ratio, based on year of birth (1-year categories), municipality of residence, and vital status, with males from

the general population to create a base cohort. The matching date was either 1 January of the year in which the football player first played in *Allsvenskan* or the date of the football player's first registered residency in Sweden (if this occurred after his first season in *Allsvenskan*). For players who played their first season in *Allsvenskan* before 1969 (the start of the Total Population Register), we selected males from the general population based on their vital status and region of residence on 1 January 1969.

We then made further exclusions from the base cohort. We excluded football players (and their matched general population men) who were not born in Sweden and did not have their first date of residency in the country before the age of 15. This exclusion criterion was applied since foreign players tend to emigrate during or shortly after their football career, which could hinder long-term follow-up. Next, we excluded football players and their matched general population males and general population males who had died or emigrated before 1 January 1997 (start of follow-up). To avoid left truncation bias,²² we also excluded those who were 65 years or older on 1 January 1997. We chose 1997 as the earliest start of follow-up due to the availability of nationwide coverage for diagnoses registered during hospitalisation and the introduction of International Classification of Diseases (ICD)-10 codes in this year, which enabled a more specific and contemporary classification of outcome diagnoses compared with the previous ICD versions. Moreover, the start of nationwide coverage for diagnoses during outpatient hospital visits (2001) and prescription drug use (July 2005) meant that most of the follow-up time had coverage with respect to these types of outcome data. Cohort entry was either 1 January 1997, or the matching date for football players and males from the general population if this occurred after 1 January 1997.

Outcomes

The primary outcome was diagnosis of depression and anxiety-related disorders recorded in the National Patient Register (primary or secondary diagnosis during hospitalisation or outpatient visits), or the Prescribed Drug Register (filled prescriptions for antidepressants). The secondary outcome was suicide as registered in the Cause of Death Register (primary or contributing cause of death). The ICD codes and anatomical therapeutic chemical codes used for the outcome definition are shown in table 2.

Given our sample size and follow-up time (described below) and an expected risk of the primary outcome of around 20%,^{23 24} we estimated that our study would be able to detect relative risk differences as small as 10% (80% power, alpha 0.05).

Statistical analyses

We followed football players and males from the general population from cohort entry until emigration, outcome event, death or the end of follow-up on 31 December 2020. Emigration, death without an outcome event and the end of follow-up were considered censoring events. We used Cox regression analysis with age as the time scale and adjusted for region of residence, place of birth and calendar year as a time-varying covariate (online supplemental table 1) to calculate the HR for the primary outcome comparing football players with males from the general population. Additionally, we separately examined the risk of diagnosis of depression and anxiety-related disorders among outfield players and goalkeepers versus their matched population controls and then compared outfield players with goalkeepers. We performed

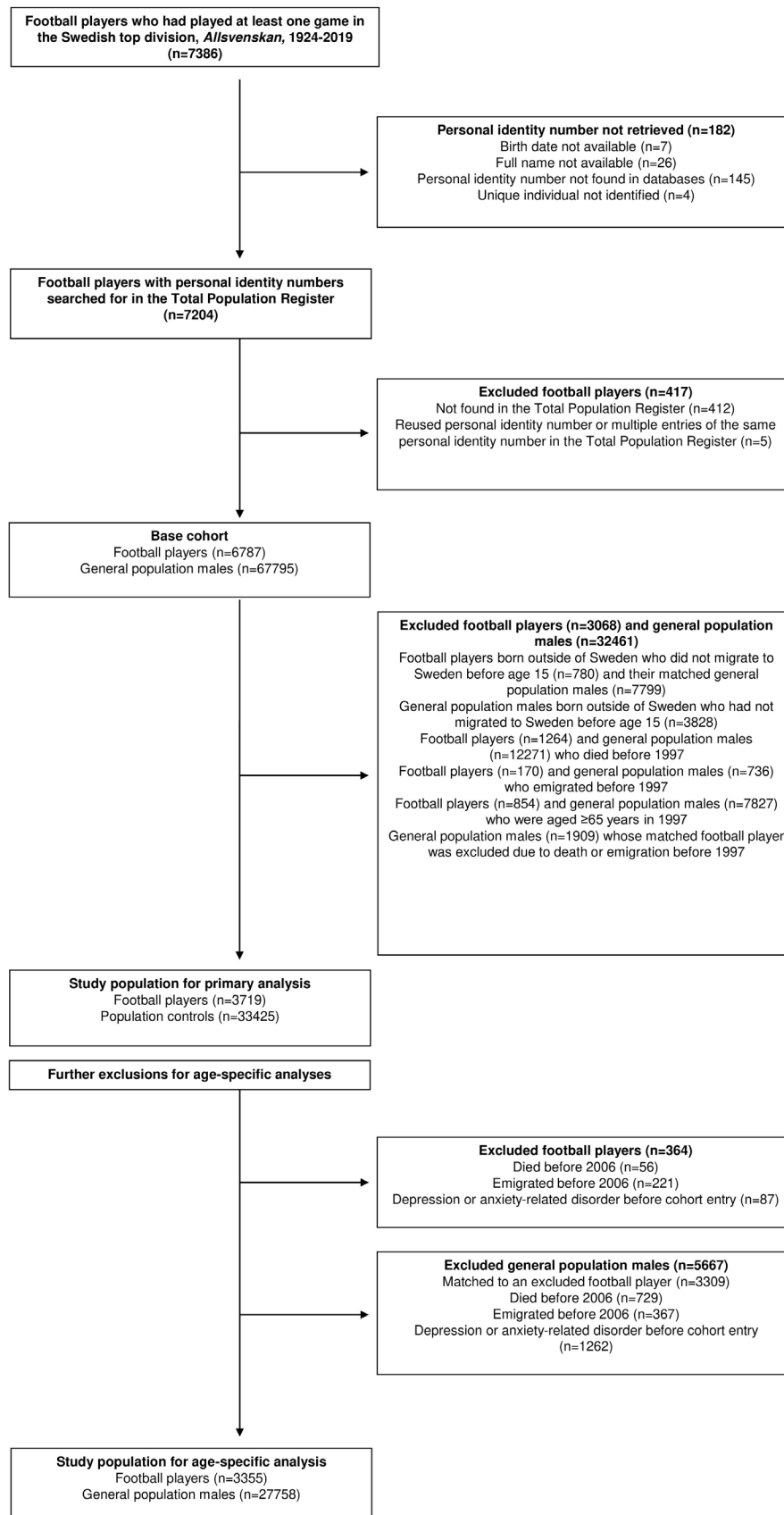


Figure 1 Flow chart for study population.

these analyses because a link between head trauma, including both concussions and milder repetitive head impacts such as those sustained when heading the ball might increase risk of

depression and anxiety (possibly associated with chronic traumatic encephalopathy¹¹⁻¹⁴ and goalkeepers rarely head the ball.²⁵

Table 2 ICD codes and ATC codes used for the definition of study outcomes

Outcome	ICD-codes	Register/position
Diagnosis of depression and anxiety-related disorders	ICD-10: F32–F34, F38, F39, F41	National Patient Register Any type of visit, any position
	ATC: N06A	Prescribed Drug Register Filled prescription
Suicide	ICD-8: 950–959 ICD-9: 950–959 ICD-10: X60–X84	Cause of Death Register Primary or contributing cause of death

ATC, anatomical therapeutic chemical; ICD, International Classification of Diseases.

Studies have suggested that elite athletes may be at an increased risk of depression and anxiety-related disorders following their retirement from elite careers due to changes in life circumstances associated with retirement.^{3 4 26} As such, we examined whether the risk of diagnosis of depression and anxiety-related disorders between football players and males from the general population varied across lifespan. Since outcome data from hospitalisations may not accurately reflect the timing of the initial diagnosis, we set the earliest cohort entry date to 1 January 2006, which was 5 years after nationwide coverage for outpatient hospital visits in the National Patient Register began and 6 months after the nationwide coverage for prescription drug use in the Prescribed Drug Register began. We excluded football players (and their matched general population men) and general population males who had died, emigrated or had a history of depression and anxiety-related disorders before cohort entry. We calculated the HR of the risk of diagnosis of depression and anxiety-related disorders for football players versus males from the general population using the total follow-up time in this analysis, as well as in another analysis using the Stata STPHCOXRCS module²⁷; in this analysis we modelled age using restricted cubic splines with three knots (positions determined based on Harrell's recommended percentiles²⁸) and the age-specific HR was modelled based on the interaction between age and the exposure (football player vs controls).

Using data from the Military Conscription Register,²⁹ we conducted exploratory analyses to evaluate the impact of accounting for various characteristics that may differ between elite football players and males from the general population; the variables were measured prior to most of the football players' first season in the top division and were hypothesised to be associated with the outcome. We first included all football players and males from the general population born between 1951 and 1987, as military conscription was mandatory at approximately 18 years of age for males born during these years²⁹ (online supplemental material (data sources) and online supplemental table 2). Since individuals living abroad and those with certain health conditions and functional impairments were exempt from conscription or tests, we then performed the analyses excluding football players and males from the general population born between 1951 and 1987 without complete data on test results, which included stress resilience, cognitive ability, body mass index, muscle strength and cardiorespiratory exercise capacity (online supplemental table 2). Next, we performed an analysis after having excluded those with a diagnosis of a psychiatric disorder (depression and anxiety-related disorders and alcohol or drug misuse (online supplemental table 2) at military conscription. We then conducted analyses adjusting for

Table 3 Characteristics of football players and males from the general population

	Football players (n=3719)	General population males (n=33 425)
Age at first season in years, median (IQR)	22 (19–24)	–
Age at cohort entry in years, median (IQR)	31 (22–48)	30 (21–46)
Year of birth, n (%)		
1925–1934	147 (4)	1053 (3)
1935–1944	537 (14)	4285 (13)
1945–1954	587 (16)	5145 (15)
1955–1964	509 (14)	4671 (14)
1965–1974	585 (16)	5513 (16)
1975–1984	516 (14)	4893 (15)
1985–1994	588 (16)	5549 (17)
1995–2004	250 (7)	2316 (7)
Country of birth, n (%)		
Sweden	3527 (95)	31 666 (95)
Other European countries	109 (3)	912 (3)
Outside Europe	83 (2)	847 (3)
Region of residence, n (%)		
Stockholm metropolitan area	603 (16)	5270 (16)
Rest of Mid Sweden	654 (18)	5883 (18)
Southern Sweden metropolitan area	821 (22)	7286 (22)
Rest of Southern Sweden	1404 (38)	12 771 (38)
Northern Sweden	237 (6)	2215 (7)
Player position, n (%)		
Goalkeeper	315 (8)	–
Outfield	3404 (92)	–
Player statistics, median (IQR)		
Number of seasons played	3 (1–7)	–
Number of games played	26 (7–84)	–

stress resilience and cognitive ability scores. Finally, we further adjusted the model for body mass index, muscle strength and cardiorespiratory exercise capacity.

We then assessed the secondary outcome of suicide. As data on cause of death was available from 1969, we set the earliest cohort entry date to 1 January 1969. The study population for this analysis was constructed by excluding from the base cohort football players (and their matched general population men) and general population males who were not born in Sweden and did not have their first date of residency in the country before the age of 15.

Analyses were conducted using STATA (V.16.1). HRs whose CIs did not overlap 1.0 were considered as statistically significant.

RESULTS

A total of 3719 football players and 33 425 general population males were included in the primary outcome analysis. The median (IQR) number of games played in the top division among football players was 26 (7–84) (table 3), and they had higher stress resilience, muscle strength and cardiorespiratory capacity scores and a lower prevalence of diagnosis of psychiatric disorders at military conscription than males from the general population (online supplemental table 3). In the primary outcome analysis, football players, compared with general population males, were more likely to be censored due to emigration and slightly less likely to be censored due to death (online supplemental table 4).

Table 4 Diagnosis of depression and anxiety-related disorders and suicide among football players and males from the general population

	Football players		General population men		HR (95% CI)
	n	n outcome events (%)	n	N outcome events (%)	
Diagnosis of depression and anxiety-related disorders*					
Total	3719	504 (13.6)	33 425	7455 (22.3)	0.61 (0.55 to 0.66)
Outfield†	3404	458 (13.5)	30 610	6822 (22.3)	0.61 (0.55 to 0.67)
Goalkeeper‡	315	46 (14.6)	2815	633 (22.5)	0.62 (0.46 to 0.84)
Suicide‡					
Total	6007	24 (0.4)	56 168	473 (0.8)	0.48 (0.32 to 0.72)

*In analyses with the earliest cohort entry in 1997. The outcome was a composite of diagnoses registered during hospitalisations and outpatient visits, and use of antidepressants.

†Analyses by field position included only controls who were matched to football players of the investigated field position.

‡In analyses with the earliest cohort entry in 1969. The outcome included suicide as cause of death.

Primary outcome analyses

During a median (IQR) follow-up time of 18.5 (9.0–24.0) years, 504 (13.6%) football players and 7455 (22.3%) general population males were diagnosed with depression and anxiety-related disorders. Compared with general population men, reasons for censoring among football players were more likely to be emigration and slightly less likely to be death. The risk of diagnosis of depression and anxiety-related disorders was lower among football players than males from the general population (HR 0.61, 95% CI 0.55 to 0.66). The lower risk was observed among both outfield players and goalkeepers (table 4). The HR was 0.94 (95% CI 0.69 to 1.27) for outfield players compared with goalkeepers.

Analysis by age

The analysis by age with the earliest cohort entry set to 2006 to enable capture of incident outcome events included 3355 football players and 27758 males from the general population (figure 1 and online supplemental table 5). In the total age range, football players had a lower risk of diagnosis of depression or anxiety-related disorders compared with males from the general

population (HR 0.63, 95% CI 0.57 to 0.69). The HR increased with age, and the risk was similar in football players and males from the general population from around age 70 years (figure 2).

Exploratory analyses

Exploratory analyses including all of those born between 1951 and 1987 yielded a HR of 0.52 (0.45 to 0.59), with this association being slightly attenuated by excluding football players and males from the general population without complete test results from military conscription (HR 0.57, 95% CI 0.49 to 0.66), but not by further exclusion of those with diagnosis of a psychiatric disorder (HR 0.59, 95% CI 0.51 to 0.69). Adjusting for cognitive ability and stress resilience further attenuated the association (HR 0.68, 95% CI 0.58 to 0.79), and additional adjustment for body mass index, muscle strength and cardiorespiratory exercise capacity had little effect on the result (HR 0.72, 95% CI 0.61 to 0.84) (table 5).

Secondary outcome analysis

For the secondary outcome analysis of suicide, the study population included 6007 football players and 56 168 males from the general population (online supplemental figure 1). During a median (IQR) follow-up time of 27 (14–42) years, 24 (0.4%) football players and 473 (0.8%) of general population males died by suicide. Football players had a lower risk of suicide compared with males from the general population (HR 0.48, 95% CI 0.32 to 0.72) (table 4).

DISCUSSION

This nationwide cohort study found that male elite football players in the Swedish top division had a risk of diagnosis of depression and anxiety-related disorders that was around 40% lower than that of general population males who were matched based on age and region of residence. The protective association was strongest during the ages when footballers are typically active. Contrary to the hypothesis that the risk of such disorders may increase after retirement from elite football,^{3 5 6} the lower risk persisted even after the age at which players typically retire, although the association became weaker with increasing age.

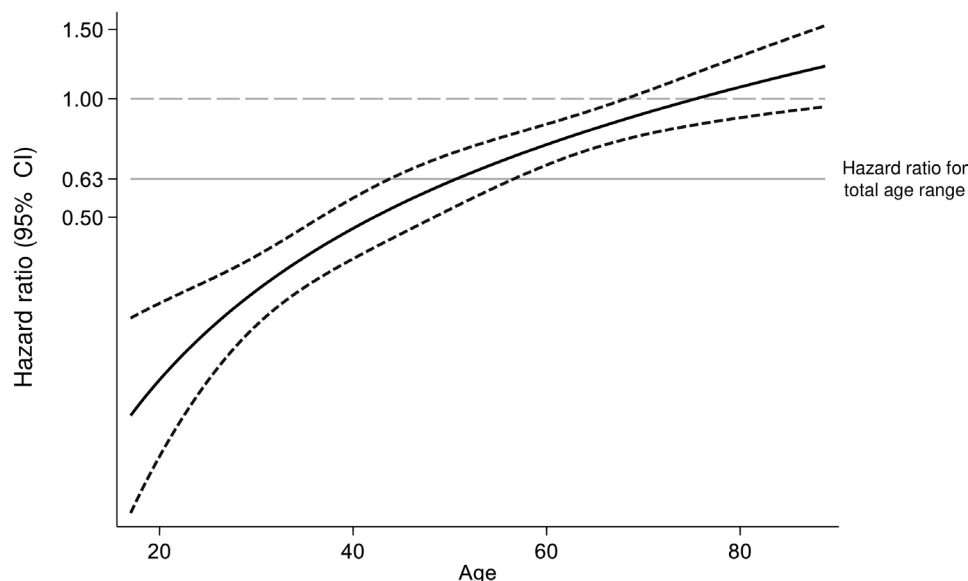


Figure 2 HR and 95% CI for diagnosis of depression and anxiety-related disorders among elite football players versus general population males by age. The solid line represents the point estimate for the HR and the dotted lines represent the 95% CI.

Table 5 Exploratory analyses of diagnosis of depression and anxiety-related disorders

	Football players		General population males		HR (95% CI)
	n	n outcome events (%)	n	n outcome events (%)	
Analyses using military conscription data in study population born between 1951 and 1987					
All born between 1951 and 1987	2004	218 (10.9)	18 698	4197 (22.4)	0.52 (0.45 to 0.59)
Excluding those without complete military conscription results	1567	180 (11.5)	12 343	2634 (21.3)	0.57 (0.49 to 0.66)
Excluding those with diagnosis of psychiatric disorder at military conscription	1548	177 (11.4)	11 674	2407 (20.6)	0.59 (0.51 to 0.69)
Adjusting for cognitive ability score and stress resilience	1548	177 (11.4)	11 674	2407 (20.6)	0.68 (0.58 to 0.79)
Adjusting for cognitive ability score, stress resilience, muscle strength score, cardiorespiratory exercise capacity score and body mass index	1548	177 (11.4)	11 674	2407 (20.6)	0.72 (0.61 to 0.84)

Additionally, elite football players had around 50% lower risk of suicide.

Depression and anxiety-related disorders among active and retired elite athletes have been a focus of concern and research interest.^{1–6} Although previous questionnaire-based studies^{2–5 20} have shown high prevalence of adverse mental health conditions among active or retired professional football players, only one large-scale cohort study assessing such outcomes has been performed. The study from Scotland showed that male former professional football players, when compared with general population men, had 36% lower risk of diagnosed depression, 63% lower risk of a diagnosis for anxiety and stress-related disorders and 31% lower risk of suicide (although the group difference was not statistically significant for this outcome).²¹ Our findings of lower risk of depression and anxiety-related disorders and suicide among elite football players also align with findings from studies showing a lower risk of mortality from mental disorders as compared with the general population among other types of elite athletes including Olympians in various sports,³⁰ and American footballers.³¹

We have previously found that elite football players in Sweden, when compared with general population men, have a lower risk of alcohol-related disorders and disorders related to other drug abuse, with the risk reduction being most pronounced in ages when the football player is typically active.³² Lower risk of alcohol and drug-related disorders, which have also been observed for former professional football players in Scotland,²¹ may protect against depression and anxiety-related disorders,³³ although depression and anxiety-related disorders may also increase alcohol consumption.³⁴ Other factors that could explain the lower risk of depression and anxiety-related disorders and suicide among elite football players include that mental health problems may lower the chances of becoming an elite football player, although exclusion of those with prevalent depression and anxiety-related disorders at cohort entry or at military conscription at around age 18 did not materially affect the results. It is also possible that elite football players are protected from depression and anxiety-related disorders by physical activity,³⁵ the social support network³⁶ of teammates, coaches and support staff and the socioeconomic status^{37 38} (including higher income) associated with being an elite football player. Our analyses of results from tests during military conscription showed that elite football players had better stress resilience, muscle strength and cardiorespiratory fitness as compared with general population males (although the protective association remained after adjustment for these variables) and previous analyses have shown that elite football players in Sweden have higher income than general population men.³²

However, elite or professional football players in both Sweden¹⁶ and Scotland^{15 39} had a higher risk of neurodegenerative disease.

In Scotland, the increased risk among former professional football players was observed for all types of neurodegenerative disease, including Alzheimer's disease, other types of dementia, motor neuron disease and Parkinson's disease.^{15 39} In Sweden, the risk increase was only observed for dementia.¹⁶ It has been suggested that these findings may be attributable to heading of the ball or other traumatic head injuries associated with football. Although neurodegenerative disease (including CTE) may manifest as, or increase the risk of, depression and anxiety-related disorders, the risk increase for neurodegenerative disease emerged when football players reached older ages while the reduced risk of depression and anxiety-related disorders among football players in our study was most pronounced in younger ages. It could be speculated that part of the diminished protective association for depression and anxiety-related disorders observed in older ages among elite football players could be due to their increased risk of neurodegenerative disease. The attenuation of the association with increasing age could be also due to depletion of general population controls most susceptible to depression and anxiety-related disorders.^{40 41}

Given that individuals who become elite football players likely differ from general population controls with respect to many factors other than those accounted for in our analyses, the association observed in our study should not be interpreted as the causal effect of elite football on the risk of depression and anxiety-related disorders. Nonetheless, irrespective of causality, our study shows that elite football players are less likely to be diagnosed with depression and anxiety-related disorders compared with general population controls. Importantly, this finding does not diminish the importance of addressing mental health issues in elite football. Although the occurrence was lower than in the general population, around one in seven football players were diagnosed with depression and anxiety-related disorders in our study, and questionnaire studies with broader outcome definitions have indicated that many elite footballers suffer from symptoms of adverse mental health.^{2–5 20}

Limitations

First, outcome events were identified by diagnoses recorded during hospitalisations and outpatient care visits, and by the filling of antidepressant prescriptions. It is possible that individuals with depression or anxiety-related disorders may have delayed seeking healthcare, leading to a delay in the registration of outcome events. Moreover, individuals who did not seek healthcare may not have received a diagnosis or been prescribed an antidepressant despite having fulfilled the criteria for depression or anxiety-related disorders. It is possible that the propensity to seek care for mental health problems differ between football players and general population men. Second, diagnoses

registered in the primary care were not available. To capture depression and anxiety-related diagnoses from primary care we therefore included use of antidepressants in our outcome definition. As not all individuals with depression or anxiety-related disorders are prescribed antidepressants and as antidepressants may be used also for other types of conditions, including obsessive-compulsive disorder and eating disorders (although uncommon among men), there is a risk of outcome misclassification. Third, in our analyses, football players were more likely to be censored due to emigration than population controls and we have previously shown that elite football players have a slightly lower risk of all-cause mortality¹⁶; if the likelihood of censoring is associated with the outcome or covariates adjusted for in our analyses, this may have affected the results. Finally, the study was limited to male elite football players. The extent to which the findings can be generalised to female elite players, as well as male and female amateur and youth players, who constitute most football players globally, remains uncertain.

CONCLUSIONS

This nationwide register-based cohort study in Sweden found that male elite football players had a lower risk of diagnosis of depression and anxiety-related disorders and suicide than males from the general population.

Contributors PU, BP, MN and MK conceived and designed the study. All authors contributed to the acquisition, analysis and interpretation of data. PU and MK did the statistical analysis. PU drafted the report. All authors critically revised the report for important intellectual content. PU and BP obtained funding for the study. All authors approved the final manuscript. PU and MK are guarantors for this study. The corresponding author attests that all listed authors meet authorship criteria and that no others meeting the criteria have been omitted.

Funding The study was funded via unrestricted research grant support from Strategic Research Area Epidemiology programme at Karolinska Institutet, The Swedish Research Council for Sport Science, Folksam Research Foundation, Hedberg Foundation, Neurofonden and Åhlen Foundation. BP was supported by a consolidator investigator grant from Karolinska Institutet.

Competing interests MF is the Chairman of the Swedish Football Association medical committee and member of the medical committees of UEFA and FIFA. The other authors received no support from any organisation for the submitted work (except funding organisations as described below); no financial relationships with any organisations that might have an interest in the submitted work in the previous 3 years; no other relationships or activities that could appear to have influenced the submitted work.

Patient and public involvement Patients and/or the public were not involved in the design, or conduct, or reporting, or dissemination plans of this research.

Patient consent for publication Not applicable.

Ethics approval The study was approved by the Swedish Ethical Review Authority (2021-04248). Informed consent was not required according to ethical approval. This was a register-based study.

Provenance and peer review Not commissioned; externally peer reviewed.

Data availability statement Data may be obtained from a third party and are not publicly available. No additional data available. The data analysed in this study were based on Swedish nationwide registers. Individual-level data in the registers can only be accessed through secure servers and only export of aggregated data, as presented in research articles, is allowed as per Swedish law. Permission to access data can be made only after fulfilling specific requirements to safeguard the anonymity of the study participants. For these reasons, data cannot be made generally available.

Supplemental material This content has been supplied by the author(s). It has not been vetted by BMJ Publishing Group Limited (BMJ) and may not have been peer-reviewed. Any opinions or recommendations discussed are solely those of the author(s) and are not endorsed by BMJ. BMJ disclaims all liability and responsibility arising from any reliance placed on the content. Where the content includes any translated material, BMJ does not warrant the accuracy and reliability of the translations (including but not limited to local regulations, clinical guidelines, terminology, drug names and drug dosages), and is not responsible for any error and/or omissions arising from translation and adaptation or otherwise.

Open access This is an open access article distributed in accordance with the Creative Commons Attribution Non Commercial (CC BY-NC 4.0) license, which permits others to distribute, remix, adapt, build upon this work non-commercially, and license their derivative works on different terms, provided the original work is properly cited, appropriate credit is given, any changes made indicated, and the use is non-commercial. See: <http://creativecommons.org/licenses/by-nc/4.0/>.

ORCID iD

Peter Ueda <http://orcid.org/0000-0002-3275-8743>

REFERENCES

- Goutteborge V, Aoki H, Kerkhoffs G. Symptoms of common mental disorders and adverse health Behaviours in male professional soccer players. *J Hum Kinet* 2015;49:277–86.
- Goutteborge V, Backx FJG, Aoki H, et al. Symptoms of common mental disorders in professional football (soccer) across five European countries. *J Sports Sci Med* 2015;14:811–8.
- Goutteborge V, Castaldelli-Maia JM, Gorczynski P, et al. Occurrence of mental health symptoms and disorders in current and former elite athletes: A systematic review and meta-analysis. *Br J Sports Med* 2019;53:700–6.
- Goutteborge V, Aoki H, Kerkhoffs GM. Prevalence and determinants of symptoms related to mental disorders in retired male professional Footballers. *J Sports Med Phys Fitness* 2016;56:648–54.
- Carmody S, Anemaat K, Massey A, et al. Health conditions among retired professional Footballers: a Scoping review. *BMJ Open Sport Exerc Med* 2022;8:e001196.
- van Ramele S, Aoki H, Kerkhoffs GMMJ, et al. Mental health in retired professional football players: 12-month incidence, adverse life events and support. *Psychology of Sport and Exercise* 2017;28:85–90.
- Mannes ZL, Waxenberg LB, Cottler LB, et al. Prevalence and correlates of psychological distress among retired elite athletes: A systematic review. *Int Rev Sport Exerc Psychol* 2019;12:265–94.
- Putukian M, Echemendia RJ, Chiampas G, et al. Head injury in soccer: from science to the field; summary of the head injury summit held in April 2017 in New York city, New York. *Br J Sports Med* 2019;53:1332.
- McCunn R, Beaudouin F, Stewart K, et al. Heading in football: incidence, Biomechanical characteristics and the association with acute cognitive function—A three-part systematic review. *Sports Med* 2021;51:2147–63.
- Snowden T, Reid H, Kennedy S, et al. Heading in the right direction: A critical review of studies examining the effects of heading in soccer players. *J Neurotrauma* 2021;38:169–88.
- Maas AIR, Menon DK, Adelson PD, et al. Traumatic brain injury: integrated approaches to improve prevention, clinical care, and research. *Lancet Neurol* 2017;16:987–1048.
- McKee AC, Daneshvar DH, Alvarez VE, et al. The neuropathology of sport. *Acta Neuropathol* 2014;127:29–51.
- Smith DH, Johnson VE, Stewart W. Chronic Neuropathologies of single and repetitive TBI: substrates of dementia. *Nat Rev Neurol* 2013;9:211–21.
- Smith DH, Johnson VE, Trojanowski JQ, et al. Chronic traumatic encephalopathy — confusion and controversies. *Nat Rev Neurol* 2019;15:179–83.
- Mackay DF, Russell ER, Stewart K, et al. Neurodegenerative disease mortality among former professional soccer players. *N Engl J Med* 2019;381:1801–8.
- Ueda P, Pasternak B, Lim C-E, et al. Neurodegenerative disease among male elite football (soccer) players in Sweden: a cohort study. *Lancet Public Health* 2023;8:e256–65.
- Montenigro PH, Baugh CM, Daneshvar DH, et al. Clinical subtypes of chronic traumatic encephalopathy: literature review and proposed research diagnostic criteria for traumatic encephalopathy syndrome. *Alzheimers Res Ther* 2014;6:68.
- Stern RA, Daneshvar DH, Baugh CM, et al. Clinical presentation of chronic traumatic encephalopathy. *Neurology* 2013;81:1122–9.
- Junge A, Feddermann-Demont N. Prevalence of depression and anxiety in top-level male and female football players. *BMJ Open Sport Exerc Med* 2016;2:e000087.
- Ito T, Fetters MD, Kippes C, et al. Depressive symptoms among male professional soccer players in Japan. *Asian Journal of Sport and Exercise Psychology* March 2023.
- Russell ER, McCabe T, Mackay DF, et al. Mental health and suicide in former professional soccer players. *J Neurol Neurosurg Psychiatry* 2020;91:1256–60.
- Vandenbroucke J, Pearce N. Point: incident exposures, prevalent exposures, and causal inference: does limiting studies to persons who are followed from first exposure onward damage epidemiology. *Am J Epidemiol* 2015;182:826–33.
- Folkhälsomyndigheten. Statistik om psykisk hälsa i Sverige (In Swedish), Available: <https://www.folkhalsomyndigheten.se/livsstillkor-levnadsvanor/psykisk-halsa-och-suicidprevention/statistik-psykisk-halsa/>
- Ljungman H, Wemrell M, Khalaf K, et al. Antidepressant use in Sweden: an Intersectional Multilevel analysis of individual heterogeneity and discriminatory accuracy (MAIHDA). *Scand J Public Health* 2022;50:395–403.
- Tierney GJ, Higgins B. The incidence and mechanism of heading in European professional football players over three seasons. *Scand J Med Sci Sports* 2021;31:875–83.

- 26 Wylleman P, Reints A. A LifeSpan perspective on the career of talented and elite athletes: perspectives on high-intensity sports. *Scand J Med Sci Sports* 2010;20 Suppl 2:88–94.
- 27 Discacciati A, Oskarsson V, Orsini N. STPHCOXRCS: STATA Module to check proportional-hazards assumption using restricted cubic Splines. In: *Statistical Software Components S458073*. Boston College Department of Economics,
- 28 Harrell FE. Regression modeling strategies. In: *Regression Modeling Strategies With Applications to Linear Models, Logistic Regression, and Survival Analysis*. New York, NY: Springer, 2001.
- 29 Ludvigsson JF, Berglind D, Sundquist K, et al. The Swedish military conscription register: opportunities for its use in medical research. *Eur J Epidemiol* 2022;37:767–77.
- 30 Duncombe SL, Tanaka H, De Laroche Lambert Q, et al. 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;55:900–5.
- 31 Morales JS, Castillo-García A, Valenzuela PL, et al. Mortality from mental disorders and suicide in male professional American football and soccer players: A Meta-Analysis. *Scand J Med Sci Sports* 2021;31:2241–8.
- 32 Ueda P, Pasternak B, Svanström H, et al. Alcohol related disorders among elite male football players in Sweden: nationwide cohort study. *BMJ* 2022;379:e074093.
- 33 Boden JM, Fergusson DM. Alcohol and depression. *Addiction* 2011;106:906–14.
- 34 Turner S, Mota N, Bolton J, et al. Self-medication with alcohol or drugs for mood and anxiety disorders: A narrative review of the Epidemiological literature. *Depress Anxiety* 2018;35:851–60.
- 35 Pearce M, Garcia L, Abbas A, et al. Association between physical activity and risk of depression: A systematic review and meta-analysis. *JAMA Psychiatry* 2022;79:550–9.
- 36 Gariépy G, Honkaniemi H, Quesnel-Vallée A. Social support and protection from depression: systematic review of current findings in Western countries. *Br J Psychiatry* 2016;209:284–93.
- 37 Freeman A, Tyrovolas S, Koyanagi A, et al. The role of socio-economic status in depression: results from the COURAGE (aging survey in Europe). *BMC Public Health* 2016;16:1098.
- 38 Muntaner C, Eaton WW, Miech R, et al. Socioeconomic position and major mental disorders. *Epidemiol Rev* 2004;26:53–62.
- 39 Russell ER, Mackay DF, Stewart K, et al. Association of field position and career length with risk of neurodegenerative disease in male former professional soccer players. *JAMA Neurol* 2021;78:1057–63.
- 40 Renoux C, Dell’Aniello S, Brenner B, et al. Bias from depletion of Susceptibles: the example of hormone replacement therapy and the risk of venous thromboembolism. *Pharmacoepidemiol Drug Saf* 2017;26:554–60.
- 41 Hernán MA. The hazards of hazard ratios. *Epidemiology* 2010;21:13–5.