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Review

Bidirectional relationship between mental health and sport injuries: a review of reviews

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ABSTRACT

Mental health disorders are one of the most relevant problems in athletes and, as in the rest of the population, they seem to have increased since the COVID-19 pandemic. Sports injuries seem to be a relevant risk factor for mental health. The purpose of this review is to answer the relationship between sports injuries and mental health not only because of mental disorders, but also as generators of mental health deficits. A systematic review of the scientific literature was carried out following the PRISMA guidelines, the PICO strategy and interobserver concordance for quality control of the registry. Six databases were consulted, PubMed, Scielo, WebScience, Teseo, Dialnet and Scopus, selecting 12 review articles and 13 empirical articles. The results indicate that there is a significant relationship between mental health and sports injuries and that the symptomatology of mental health indicators in the athlete affects the injury or precedes it for a slower recovery. In conclusion, by checking the published scientific literature we can find a possible significant relationship between mental health and sports injuries that will help us to establish the current body of knowledge on this issue.

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Introduction

The World Health Organization (WHO) defines mental health as, "a state of well-being in which a person realizes his or her capabilities and is able to cope with the normal stresses of life, to work productively, and to contribute to his or her community".[1] In 2019, one in eight people in the world (equivalent to 970 million people) suffered from a mental disorder; the most common are anxiety and depressive disorders, which in 2020 increased significantly due to the COVID-19 pandemic; initial estimates show a 26 % and 28 % increase in anxiety and major depressive disorders in just one year.[2] The WHO definition is in line with the interest in knowing the psychosocial impact that can influence the process of preparation and competition of athletes, because mental health is a fundamental component of the culture of excellence in sport.[3] The WHO estimates that millions of people in the world are suffering from common mental disorders, and in the sports context they are related to different specific aspects of sports practice, such as the management of popularity, withdrawal, or injuries, these being one of the variables with a greater association to mental disorders.[4] Adverse life events, together with injuries or surgeries related to long recovery periods are associated with symptoms and mental disorders for both active and former athletes.[5]

A large part of the mental health disorders and symptoms refer to stress, anxiety, depression, addictions or sleep disorders.[6,7] In addition, it is important to bear in mind that the COVID-19 pandemic has caused an unprecedented global crisis, with drastic changes in the living conditions and mental health of people,[7] including obviously the athlete population. Thus, the prevalence of pathologies and mental disorders has increased not only in the general population, but also in athletes, in addition, the inability to be active because of the disease has brought different types of consequences and sequelae, both physical and mental.[8,9]

Several researchers have focused their attention on the mental health of athletes and on the positive consequences of physical exercise.[10,11] Sport is often associated with health-related aspects, although it also involves a high risk of injury for those who practice it, whether in maintenance physical activities, school competitions or professional sport.[12] In addition, the relationship between stress and other psychological variables was found to increase the risk of injury.[13]

Consequently, the scientific literature shows the great importance that psychological factors have on both the risk of injury and recovery from injury.[14,15] During an athlete's sports career, several mental health indicators are manifested, including generic and sport-specific

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Resumen

Los trastornos de salud mental se han convertido en uno de los problemas más relevantes de los deportistas y, al igual que en el resto de la población, parece que se han acrecentado desde la pandemia de la COVID-19. Las lesiones deportivas parecen ser un factor de riesgo relevante para la salud mental. El propósito de esta revisión es dar respuesta a la relación entre las lesiones deportivas y la salud mental no solo como consecuentes de trastornos mentales, sino como generadores de estados de déficit de salud mental. Se realiza una revisión sistemática de la literatura científica siguiendo las directrices de PRISMA, la estrategia PICO y la concordancia entre interobservadores para el control de la calidad del registro. Se consultaron 6 bases de datos, PubMed, Scielo, WebScience, Teseo, Dialnet y Scopus, seleccionando 12 artículos de revisión y 13 artículos empíricos. Los resultados indican que existe una relación significativa entre la salud mental y las lesiones deportivas y que la sintomatología de los indicadores de salud mental en el deportista incide en la lesión y/o la precede para una recuperación más lenta. En conclusión, comprobando la literatura científica publicada podemos encontrar una posible relación significativa entre la salud mental y las lesiones deportivas que nos ayudará a establecer el actual cuerpo de conocimiento sobre esta problemática.

Palabras clave

Salud mental, lesiones deportivas, revisión sistemática.

stress factors that can increase the risk of mental health symptoms and disorders. In Goutterbarge's study,[16] it is pointed out that athletes can face 600 different stress factors, such as adverse life events, conflicts with the coach, professional dissatisfaction, which can lead to psychological pathologies. Other studies on mental health problems in athletes have focused on sport-specific phenomena, such as injuries, retirement or performance, or on the prevalence of these in different contexts.[17]

The practice of sports, especially professional or elite sports, is immersed in a context of great competitiveness and performance demands, which can favour the appearance of certain mental disorders, or high levels of anxiety, stress or depression.[18] Authors such as Murillo,[19] mention that there is a need for more research on psychological aspects and how they affect the athlete's performance, or how certain sporting factors favour the appearance of stress, anxiety or depressive symptoms, such as sports injuries.[18,20] In this sense, greater awareness of mental health disorders in elite sport has led to a significant increase in research.[17]

From a mental health perspective, researchers studied stress as a relevant variable in its association with sports injuries. Stress cannot only affect sports performance, but also the quality of life of the athlete.[21,22] It is also one of the most studied psychosocial factors in the sports field due to its association with vulnerability to sports injury.[13,23–27] It is the psychological variable that received the most attention since the publication in 1988 of the Andersen and Williams Sports Injury Stress Model,[28] pointing out that in potentially stressful situations, athletes can manifest a stress response that increases muscle tension, which, in turn, hinders motor coordination, reduces flexibility and alters attentional capacity.[29] Researchers have shown that sport at all levels of performance exposes the athlete to high levels of stress and anxiety,[30] although in competition the maximum demand required and the presence of others can significantly increase the levels of competitive stress, anxiety, and the existence of significant changes in mood states. In addition, there are "risk profiles" or "vulnerability profiles" that amplify these levels of stress and anxiety.[31] The stress and injury model of Andersen and Williams,[28] proposes anxiety as a personality variable, which can act as an antecedent and influence between stress response and injury. Some studies[32] show anxiety as one of the most important variables in the possible occurrence of injury. Anxiety is a mental health indicator that related to sport has a negative effect on its practice, since it leads to a higher risk of injury or delays the rehabilitation of the same.

On the other hand, it is important to consider the relationships between the different psychological variables as indicators of mental health, mainly stress, anxiety and depression. Authors such as Gouttebarge[5] identified that the prevalence of mental disorders in high performance athletes ranges from 16 % to 34 %, with anxiety and depression being the most common complications. Rice[33] considers that anxiety is directly related to depressive symptoms or their diagnosis, and even concludes that athletes under 25 years of age tend to have the highest level of anxiety. Reese[34] reports that injuries can affect the mental health of athletes by triggering depression and anxiety. He also adds that sports injuries can lead to imbalance and discomfort in athletes' lives even after the injury, and this physical disability prevents them from succeeding in their sport.

Another relevant indicator of mental health is the quality of the athlete's sleep. It plays a crucial role in physical and cognitive performance and is an important factor in reducing the risk of injury.[35] Research indicated that injured athletes reported worse sleep quality than non-injured athletes, and also showed a close relationship with fatigue.[36] Therefore, if athletes do not evidence a correct rest, it will not be possible to improve or avoid an injury. According to Copenhaver and Diamond,[37] people with sleep deficiency are at greater risk of acute illness, traumatic sports injuries and the development of chronic diseases.

In athletes, sleep is the most effective and natural way to favour and accelerate recovery processes; during sleep, cells are regenerated through the elimination of metabolic waste from the brain, which protects against fatigue.[38,39] On the other hand, Halson,[40] points out that sleep for high performance athletes is an essential method for optimal recovery and is considered a factor that directly affects sports performance. Athletes' sleep should be regulated, and training programs should be adjusted to their circadian and homeostatic rhythms. Alterations in sleep quality can affect performance and increase the risk of injury. The aim of this study is to review the existing scientific literature that relates mental health with sports injuries, considering these either as an antecedent of mental health disorders or because of mental health deficits.

Methodology

Search procedure and inclusion/exclusion criteria

In this article, a systematic review of the scientific literature was carried out in accordance with the guidelines of the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) .[41] The aim was to achieve adequate standards of consistency, scientific and methodological rigor, ensuring the reproducibility of the study, as well as scientific evidence that would contribute to the advancement of knowledge. Along these lines, a summary of reviews of secondary studies [systematic reviews and possible meta-analyses (the search strategy did not yield results] was also carried out. The aim was to bring together and provide greater scientific robustness to the subject matter addressed.[42–44] Specifically, the criteria elaborated in the Cochrane Manual were followed, which focuses on the performance of systematic reviews in Cochrane and non-Cochrane databases, also addressing the summaries of systematic reviews.[44–47] As the scientific literature shows, several studies already include this type of review,[48–50] thus increasing the sources of scientific evidence. In addition, it enriches the discussion of the results found in the systematic reviews analysed and contrasts the conclusions by also dealing

with the summaries of systematic reviews extracted from these.[42,43,47]

Systematic review summaries, also known as overviews, share the methodology of systematic reviews.[42,45] Table 1 shows the comparison of methodological aspects of systematic reviews and review summaries.

As can be seen in Table 1, the methodological processes carried out are the same in both types.

Inclusion criteria included being an athlete (playing any sport in an amateur or professional capacity) and having a relationship with sports injuries or mental health. In addition, the search strategy was carried out with a standardized test in which the research question was established based on a PICO search strategy in Fig. 1.

Six online databases were consulted: PubMed, Scielo, WebScience, Teseo, Dialnet, Scopus (Fig. 2). The search included different combinations of the following key descriptors, both in English and Spanish: "salud mental y lesiones deportivas"; "mental health and sport injuries"; "ansiedad y lesiones deportivas"; "anxiety and sport injuries"; "estrés y lesiones deportivas"; "stress and sport injuries": "calidad del sueño y lesiones deportivas"; "quality of dream and sport injuries"; "depresión y lesiones deportivas"; "depression and sport injuries". Articles were searched from 2015 to 2023 for updated information.

Fig. 3 shows the flow diagram,[41] which represents the process of searching for and including studies. To select the study sample, quantitative and qualitative articles published in English and Spanish were included, and articles relating mental health to athletes and its possible relationship with sports injuries were registered. The application of these inclusion criteria was done by first reading the title and abstract of the article and then systematically reading the full text of 25 articles. The exclusion criteria were duplicity of the articles, lack of clarity in the text and/or results, or for not corresponding to the subject matter in question.

Evaluation of the quality of the study

The methodological quality of all the included studies was evaluated based on a previously used quality assessment tool.[52] Systematic reviews (SR) and meta-analyses (MA) have historically constituted one of the bases for clinical and quantitative research and constitute an effective tool for bias control through the use of a replicable and reproducible scientific process for the literature search and quality assessment of the included studies.[41]

The following quality dimensions are included: (I) measurement of multidimensional perfectionism, (II) sample size, (III) research design, (IV) mental health indicators, (V) injury history, (VI) sample design. In addition, interobserver agreement (cohen's kappa)[53] was used to control the quality of the registry. Dimensions of scientific evidence were evaluated for the 25 selected studies using an instrument designed for the critical appraisal of original articles.[54] On the other hand, as indicated in the statistical analysis section, the analysis of Cohen's Kappa Coefficient[53] was carried out for the qualitative requirement variables, the results of which ranged from 0.700 to 1 (Fig. 4).

Research design

According to Montero and León,[55] this is a classic theoretical review study.

Data analysis

The data analyses applied are predominantly quantitative, although some quantitative statistical analyses are included. For the interrater (interobserver) analysis of the quality assessment of the selected studies, the Kappa coefficient[53] was applied. For the qualitative analyses, the studies were selected according to compliance or noncompliance with established criteria.

Results

Study eligibility was determined in two steps. In step 1, a total of 63 potentially relevant citations were collected. Fifteen of these were eliminated for duplicity, leaving a total of 44 citations. In step 2, exclusion criteria were applied and 9 of the citations were eliminated, then the full-text studies were assessed and reviewed. The verification of the articles resulted in the elimination of 10 more citations for not having significant results due to small samples and/or lack of concordance.

Accordingly, this systematic review includes 25 original studies that provide evidence on mental health in sport and its relationship to sports injuries.

Table 2 shows the most relevant aspects of the included review studies.

As can be seen in Table 2, there are 7 systematic review studies, 3 of which also include meta-analyses, 1 narrative review study and 4 literature review studies. Among the most relevant findings we find that; injuries can increase the risk of mental health problems and adverse behaviours. Mental health indicators (anxiety, depression, sleep and stress) can lead the athlete to a greater occurrence of injuries and obstructs and delays their rehabilitation. Furthermore, we can affirm that sports injuries and mental health have a bidirectional relationship in the rehabilitation process, and this premise gives us enough information to prove it scientifically and to be able to establish prevention strategies, identifying and recognizing mental health problems in the athlete and/or developing treatment and intervention programs so that during the injury the athlete is not predisposed to suffer from a mental health disorder.

Table 3 shows the most relevant aspects of the empirical studies included in the review of reviews.

Table 1
Comparison of methods among systematic reviews summaries of reviews

Criteria	Cochrane Intervention Reviews	Cochrane General Reviews
Objectives	Summarize evidence from studies on the effects of interventions.	Summarize evidence from systematic reviews on the effects of interventions.
Selection criteria	Describe the inclusion and exclusion criteria for the studies.	Describe the inclusion and exclusion criteria for the reviews.
Search	Conduct an exhaustive search for relevant studies.	Search for reviews of relevant interventions.
Data collection	Extract data from the included studies.	Extract data from included systematic reviews. If necessary, authors of review abstracts can search primary studies included in the reviews.
Evaluation of limitations	Assess the risk of bias in the included studies.	To evaluate the included systematic reviews.
Quality of evidence	Evaluate the quality of evidence based on the important results in the studies.	Rely on the evaluations reported in the included systematic reviews, to the extent possible.

Note: Adapted from Comparison of methods of Cochrane reviews of interventions and abstracts of Cochrane reviews"[47].

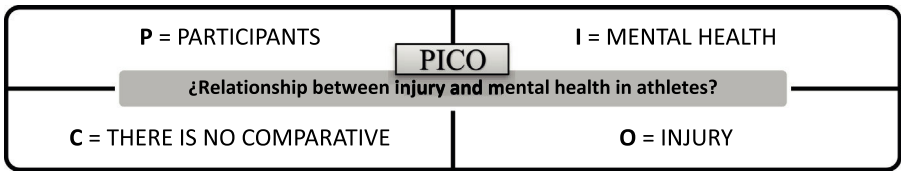

Fig. 1. PICO strategy. Adapted from "PICO strategy for constructing the research question and searching for evidence" (p.508–511).[51]

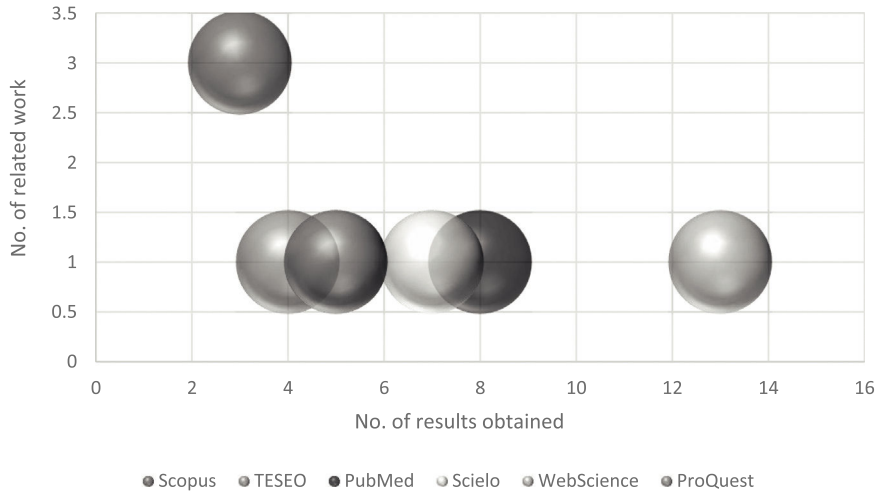

Fig. 2. Databases consulted. Own elaboration.

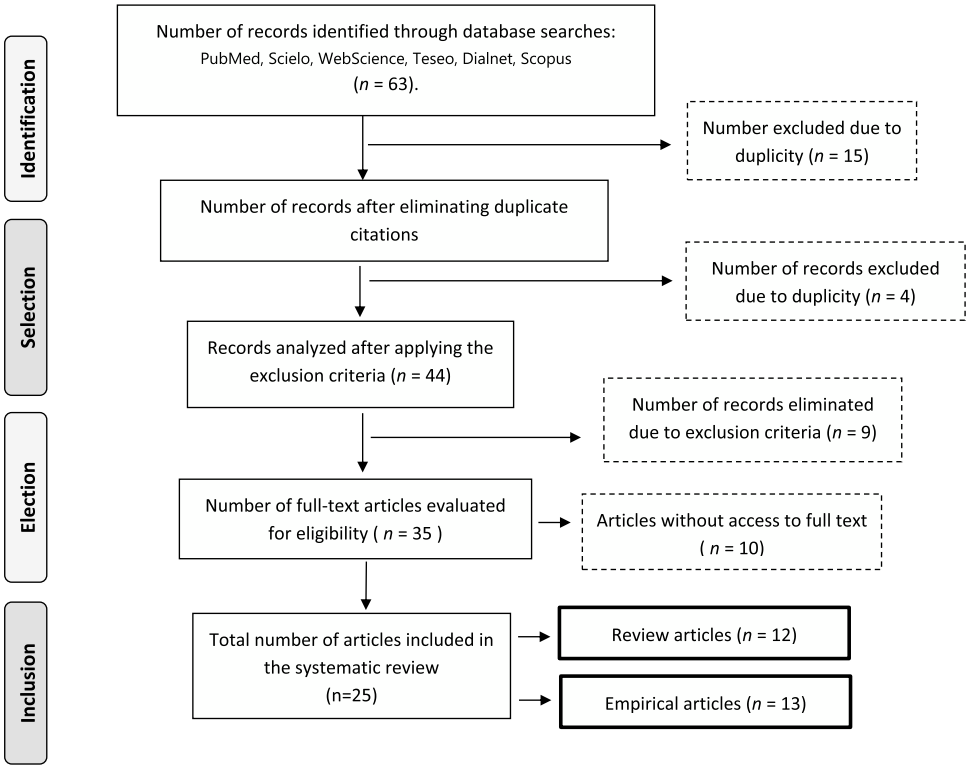

Fig. 3. Flow diagram. Own elaboration.

As can be seen in Table 3, there are 5 cross-sectional studies, 2 correlational studies, 1 cross-sectional-correlational study, 1 prospective study, 1 qualitative descriptive study and 3 unclassified studies. Among the most relevant findings we find that stress, anxiety and depression are positively related to the number of injuries and that this incidence is more prevalent in competition, since its problems cause disorders in the mental health of the athlete. We also observed that the higher the level of stress, the higher the risk of more serious

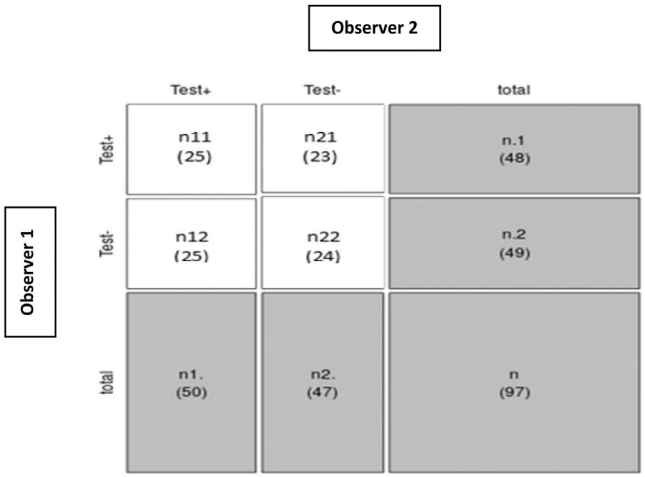

Fig. 4. Interobserver Cohen's Kappa interpretation. Own elaboration.

injuries. As well as sleep, which plays a crucial role in reducing the risk of injury and should be addressed with preventive psychological intervention.

Discussion

The aim of the present study was to review the existing scientific literature that relates mental health to sports injuries, considering the latter either as an antecedent of mental health disorders or as a consequence of mental health deficits. Specifically, firstly, to determine which are the most relevant mental health indicators in relation to injuries; secondly, to determine the relationship between mental health indicators and the vulnerability to injury of the athlete; and finally, to determine the relationship between the injury suffered and its rehabilitation process with the mental health indicators of the injured athlete.

From a general perspective, the literature confirmed with a large amount of evidence that there is a close, multifaceted and significant relationship between mental health and physical performance. After conducting the present systematic review, the relationship between mental health and sports injuries[56,57] is significantly observed in athletes.

From what was analysed in the reviews, 5 of them do not indicate the data collection system, as well as the sample (2) and/or the statistical test used (9), so some deficiencies can be observed in these articles.

In reference to the analysis of the empirical articles, the design of the studies (3) is not reported, and in one of them, neither the sample, nor the statistical test (3), nor the data collection. In addition, there is no experimental study, which would help us to analyse a cause-effect relationship of these variables of a primordial nature.

The results indicate that, regarding the objective of determining which are the most relevant mental health indicators in their relationship with injuries, anxiety appears in 8 of the studies, of which the significant relationship with injuries can be observed in 3. Depression appears in 6 of the studies and in 5 of them it appears together with anxiety, which leads us to understand the relationship between the two and their great relevance. Also, stress and sleep quality are very important indicators to consider, since they are closely related to sports injuries. The studies that consider these indicators affirm that we must bear in mind that mental health interferes in athletes and to avoid this, their indicators (anxiety, stress, sleep quality and depression) must be observed and evaluated, since they provide useful information to prevent and intervene in their appearance or reduce the aggravation of the sports injury.[58,59] If an athlete is injured, these factors increase, since it has been demonstrated that mental health plays a very important role in the response, rehabilitation and recovery of the athlete's injury.[31] Data indicates that identifying stressors early can decrease the rate of injury and illness.[60]

In turn, in many publications it has been possible to determine how the terms "mental health", "anxiety", "sleep quality", "depression" and "stress" are mentioned by athletes, coaches and family members in the sports environment and in relation to the discomfort of the athlete at the psychological and physical level.[35,61] Another fundamental aspect in which both concepts must be contextualized is in the athlete's retirement, as there is high quality evidence to support that a high athletic identity contributes to an increase in mental health symptoms after retirement.[62]

On the other hand, it has been possible to detect how studies have investigated some of its indicators separately (stress and injuries, anxiety and injuries, sleep quality and injuries, depression and injuries) but not as a whole. It is necessary to observe mental health as a whole and analyse its indicators, since stress leads to anxiety, anxiety can end in depression and all this leads to a bad rest and incorrect recovery due to the lack of sleep quality due to the state of restlessness that the athlete may manifest.

Likewise, the results regarding the objective of determining the relationship between mental health indicators and the vulnerability to injury of the athlete indicate that the prevalence of mental health symptoms and disorders (stress, anxiety, depression, sleep) predisposes the athlete to injury.[63]

The importance of mental health among athletes is increasingly recognized and appreciated. In Rogers' study[64] conclusive results were obtained stating that sports injuries have a negative impact on the mental health of athletes and that mental health can influence and influences sports performance, which is closely linked to the risk of sports injuries, thus creating a complex cycle with an inability to separate physical and mental health. If we allow these disorders to develop, the athlete's vulnerability will be greater, and the athlete will have a greater predisposition to develop the problem.

Similarly, the trend towards early sports specialization is associated with an increased risk of injury and burnout, which have significant implications for mental health.[65] The importance of the mental health of athletes cannot be underestimated, so we must work from a multidimensional approach, starting by recognizing that both mental and physical health are related, and that this implication will be reflected in performance, in the number of injuries of the athlete and in his or her recovery in the case of suffering them.

Finally, the results regarding the objective of determining the relationship between the injury suffered and its rehabilitation process with the mental health indicators of the injured athlete indicate that sports injuries and mental health have a bidirectional relationship in the rehabilitation process. Stress is the major indicator in rehabilitation and recovery from injury along with anxiety and depression. It should also be added that the number of injuries increases if these indicators are not addressed in time.

Along the same lines, analysing current studies related to the promotion of mental health, it was observed how emotional distress due to pressure and injury can cause some participants to experience negative results, therefore, mental health guidelines should be considered as an urgent call to action by experts.[66] It is paramount that the athlete knows how to manage his or her mental health and has all the necessary information to be able to cope with an injury, not only physically but also psychologically.

It has even been specifically shown that injured athletes have higher rates of anxiety and depression compared to the general population[67] and are therefore more at risk of worsening their mental health and worsening their recovery. Consequently, psychological interventions can lead to a reduction of negative thoughts and moods and prevent all this continuous stress from ending up in a state of depression in the athlete.

Table 2
Included review studies.

Quote	Year	Country	Target	Type of study	Data collection system	Sample	Statistical test	Main findings
Daley et al.	2023	USA	Interpret the existing evidence on the psychological aspects of sport specialization within the developmental context.	Literature review	Not reported	Not reported	Not reported	The increasing trend toward early sports specialization is associated with an increased risk of injury and burnout, both of which have significant implications for mental health
Haugen, E.	2022	USA	Present the literature related to athlete mental health and address how sports injuries can contribute to athletes' mental health, well-being and psychological readiness to return to sport	Systematic review	Not reported	Not reported	Not reported	Sports injuries and mental health appear to have a bidirectional relationship, and the sports injury and rehabilitation process is associated with a wide variety of psychological and mental health problems.
Gouttebarge et al.	2021	Various countries	Develop an assessment and recognition tool to identify elite athletes at risk for mental health symptoms and disorders.	Narrative Review	On-line questionnaire	Active and retired elite athletes *N* = 360	None	The SMHAT-1 and SMHRT −1 allow to know the symptoms and mental health disorders in elite athletes. This will facilitate the diagnosis of athletes suffering from any symptom or mental health disorder and, consequently, a rapid intervention can be made.
Chang et al.	2020	USA	To provide a document of best practices in the detection, treatment and prevention of mental health problems in competitive athletes.	Literature review	PubMed, SportDiscus and Cochrane were searched.	Athletes, actively involved in research and demonstrated leadership	None	Stress consistently demonstrates a relationship with injury risk, as well as the ability to rehabilitate from injury and return to sport.
Gouttebarge et al.	2019	Several countries	To present an overview of the existing epidemiological evidence regarding the occurrence of mental health symptoms and disorders among current and former elite athletes.	Systematic review and meta-analysis according to the PRISMA guideline	We searched 5 databases: PubMed (MEDLINE), SportDiscus via EBSCO, PSycINFO via ProQuest, Scopus and Cochrane.	Comprises 2895 to 5555 current elite athletes and 1579 to 1686 retired elite athletes.	Random effects models, pooled estimates with 95 % confidence intervals and Cochran's Q test.	The prevalence of mental health symptoms and disorders ranged from 19 % for alcohol abuse to 34 % for anxiety/depression for current elite athletes, and from 16 % for distress to 26 % for anxiety/depression in retired elite athletes
Reardon et al.	2019	Several countries	Promoting a more standardized and evidence-based approach to mental health symptoms and disorders in elite athletes, a consensus working group of the international Olympic committee critically assessed the current state of the science and provided recommendations	Systematic review	The databases PubMed, SportDiscus, PSycINFO, Scopus, Cochrane and any additional databases considered relevant were used.	Panel of experts, composed of 23 people from 13 countries with experience in the mental health of elite athletes.	None	The current state of the science of mental health in elite athletes suggests: that there is a lack of access to mental health services; further research and subsequent recommendations are needed for expanded mental health screening of elite athletes. In this context, the impact of sleep on recovery and optimal preparation should be considered; further prevention strategies for mental health symptoms and disorders
Rice et al.	2019	Several countries	To identify and quantify the determinants of anxiety symptoms and disorders experienced by elite athletes.	Systematic review and meta-analysis according to the PRISMA guideline	Systematic search strategy The search was carried out in PubMed, SportDiscus, PsycINFO, Scopus and Cochrane databases.	Sixty-one studies were included in the systematic review and 27 of them were suitable for meta-analysis.	Raw data (mean, SD and n) were obtained for the determinants of anxiety. Effect size data (r, OR, t, β, and F values) were used. Overall effect sizes were estimated using the standardized difference of means.	The determinants of anxiety in elite populations broadly mirror those experienced by the general population. Clinicians should be aware of these general and specific determinants of anxiety among elite athletes

(*continued on next page*)

Table 2 (*Continued*)

Quote	Year	Country	Target	Type of study	Data collection system	Sample	Statistical test	Main findings
Rice et al.	2018	Australia	To assess the evidence base regarding the association between sport-related concussion and mental health outcomes in athletes competing at professional and elite levels.	Systematic review according to PRISMA guidelines	We searched 6 databases: PubMed, EMBASE, SportDiscus, PSycINFO, Cochrane and Cinahí.	27 studies	None	Current evidence suggests a link between sports-related concussion and depressive symptoms in elite athletes. Causality cannot be determined at this stage of research due to the lack of well-designed prospective studies. More research is needed that considers a range of mental health outcomes in diverse samples of elite athletes/ sportspeople
Souter et al.	2018	UK	To explore issues affecting men and mental health in the context of elite sport.	Literature review	Not reported	Review of areas: injury, stress, depression, anxiety, overtraining, eating disorders	None	Major negative life events, including injuries, can increase the risk of mental health problems in elite athletes. When men suffer emotionally it can increase the risk of injury. And as the literature suggests, injuries can increase the risk of mental health problems and adverse behaviors.
Ford et al.	2017	USA	To provide current information on sport-related anxiety.	Literature review	Not reported	Models developed by authors	None	Sport-related anxiety can; 1) have a negative impact on sports performance during practice and competitions, 2) lead to an increased risk of injury occurrence, 3) delaying and obstructing the injury rehabilitation and return-to-sport process, and 4) increasing subsequent risk of re-injury during practice and post-rehabilitation competitions.
White et al.	2017	Australia	Evidencing the relationship between physical activity and mental health so that interventions and policy guidelines can be tailored to maximize positive effects.	Systematic review and meta-analysis according to the PRISMA guideline	Four databases were used: Scopus, PubMed, PsychINFO and SportDiscus.	98 studies published between 1988 and 2015.	Pearson correlation, regression coefficient (Beta). Omnibus ANOVA test. Rosenthal's publication bias test, Egger's regression asymmetry test.	The context in which physical activity occurs influences the relationship between physical activity and mental health and, therefore, should be taken into account when developing interventions, treatment programs, and policy guidelines
Putukian M.	2016	United States	Know the current state of knowledge about the psychological response to an injury in order to direct the injured athlete to a mental health care provider, if appropriate	Narrative review	Not reported	Elite athletes from 16 to 23 years of age	None	The psychological response to injury can trigger more serious mental health problems, such as depression, anxiety, eating disorders, and substance use. There are barriers to treating mental health problems in athletes, and athletic trainers, team physicians, and other health care providers play a critical role in recognizing and identifying athletes at risk for mental health issues

Table 3
Empirical studies.

Quote	Year	Country	Target	Type of study	Collection system of data	Sample	Statistical test	Main findings
Olmedilla et al.	2022	Spain Portugal	Extend Andersen and Williams' stress and injury model to other "negative" psychological variables, such as anxiety and depression, encompassed in Olmedilla and García-Mas' conceptual model.	Correlational, longitudinal and descriptive design.	Soccer and indoor soccer teams that met the requirements for convenience sampling were recruited. Players signed an informed consent form. The evaluations were conducted on an individual basis	455 soccer and futsal players, average age 21.66 years (±4.46)	Bayesian network analysis	From the results obtained, it can be affirmed that stress is not only found in the framework of psychological variables traditionally considered "negative", and that these have different degrees of severity and complexity for players. Furthermore, it is affirmed that stress is not the only factor in the classic and repeatedly contrasted model that relates it to sports injuries.
Olmedilla et al.	2022	Spain	To determine the relationship between perfectionism, mental health indicators (depression, anxiety and stress) and sports injuries in female soccer players.	Cross-sectional descriptive study	An agreement was reached with the federation and the soccer clubs of the Region of Murcia. The players signed the informed consent form and the players who did not want to take part in the study were excluded. The other players were administered the different questionnaires.	74 female soccer players with a mean age of 19.6 ± 4.7 years old.	Cross-sectional descriptive analysis SPSS, SEM and MANOBA	The relationship between maladaptive perfectionism and stress, anxiety and depression was positive. Likewise, stress, anxiety and depression were positively related to the number of injuries in the last two years. Thus, a higher level of maladaptive perfectionism leads to higher levels of these symptoms.
Garit et al.	2021	Spain Cuba	To determine the relationship between psychological variables associated with athlete performance and injuries suffered.	Cross-sectional-correlational study	Authorization and informed consent were obtained from the athletes under study The instruments were applied at the beginning of the preparatory stage for both national series, always before each training session.	48 pitchers	Descriptive and correlational statistics	The results show a high prevalence of injuries, which occur more frequently in competition. Most of the psychological variables are related to the experience and number of injuries suffered, and the negative effect of injuries on anxiety, self-confidence, negative coping control, attention control, and visual and imaginative control is also estimated.
Mousavi et al.	2021	Netherlands Iran	To investigate the epidemiology of running-related injuries (RRI) in recreational runners and the association of mental, sleep and other potential factors with RRI	Cross-sectional study	The company was contacted through social networks and the evaluation was carried out through an online survey.	804 runners	Descriptive analysis, Univariate logistic regression analysis, Multivariate analysis	Mental aspects and sleep quality explain 15 % of the variance in running-related injuries (RRI). Therefore, it is recommended that in addition to the common risk factors for RRI, mental aspects and sleep be incorporated into advice on RRI prevention and management.

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Table 3 (*Continued*)

Quote	Year	Country	Target	Type of study	Collection system of data	Sample	Statistical test	Main findings
Catalá & Peñacoba	2020	Spain	To analyse the association between certain psychological characteristics of athletes and the occurrence of injuries in a third division soccer team.	Prospective case study	2 evaluation moments. 1st moment - evaluation protocol and 2nd moment at 6 months. Then, the number of lesions and their location were counted. They were also classified according to their level of severity	a third division soccer team (n = 22)	Descriptive analysis (Cronbach's Alpha). Non-parametric Mann-Whitney U test.	Certain psychological variables are related to the absence of sports injuries, which recommends their evaluation and the development of psychological intervention programs for their prevention.
Charest, J., & Grandner, M. A.	2020	USA and Canada	Highlight the prevalence of poor sleep, describe its impacts, and address the issue of the sports culture surrounding healthy sleep	Not reported	Not reported	Not reported	None	Sleep disorders among athletes have adverse impacts on physical performance, mental performance, injury risk and recovery, medical health and mental health.
Stavrou et al.	2020	Greece	To investigate whether oxygen uptake and resting HR, in Greek professional soccer players, are affected by recent injuries, as well as how sleep quality is affected.	Not reported	Anthropometric and morphological characteristics, body surface area, pulmonary function test and sleep quality (Pittsburgh Sleep Quality Index (PSQI) questionnaire) were recorded.	42 male professional soccer players were included in the study.	Descriptive analysis, Kolmogorov-Smirnov, Mann-Whitney U test, bivariate correlation analysis	Oxygen consumption and resting heart rate are affected by systemic adaptations due to injury. These pathophysiological changes are probably related to overactivation of the sympathetic system for restoration of the injured area As a result, oxygen supply is improved, while effects of training withdrawal, such as altered chronobiology and circadian rhythm, as well as sleep deprivation-induced muscle damage are reversed
Breslin et al.	2019	Several countries	Make a consensus statement to aid effective awareness of mental health in sport and guide program implementation in this area.	Not reported	The AGREE reporting checklist was followed and 2 online surveys were conducted.	Experts from 10 countries and over 39 organizations	None	This article presents a consensus statement on recommended psychosocial and policy-related approaches to mental health awareness programs in sport.
Foskett, R. L., & Longstaff, F.	2018	UK	To investigate the prevalence of signs of anxiety/depression and distress among a sample of elite sportsmen and women and to identify variables	Cross-sectional study	The sports organizations were contacted by e-mail. They forwarded the study information and the link to the online survey to their athletes.	143 elite athletes	Chi-square tests, biserial point correlation and logistic regression tests	Results indicate that screening for career dissatisfaction in elite athletes can support early detection of signs of anxiety/depression and/or distress
Granados & Urrea	2018	Spain	Describe the benefits of the influence of sport with respect to physical and mental health status.	Qualitative, descriptive approach	The following databases were used: Web of Science, Scopus, ProQuest, Psicodoc, Ovid, Visibility and Bibliotheca Virtual in Salud.	55 studies meet the inclusion criteria	None	The practice of sport and physical activity as a healthy habit can favour progress at a therapeutic and preventive level based on the promotion of healthy lifestyles.

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Table 3 (*Continued*)

Quote	Year	Country	Target	Type of study	Collection system of data	Sample	Statistical test	Main findings
Mohammed et al.	2018	Great Britain	To investigate the role of Mindfulness practice in decreasing anxiety/stress. An additional objective was to increase positive mood and decrease negative mood in injured athletes.	Cross-sectional study	At weeks zero and nine of the study, (CPT). During weeks one through eight, participants in the intervention group completed three questionnaires (MAAS, DASS and POMS). Injured athletes in the control group also completed the CPT at week zero and week 9.	Twenty athletes (males = 14; females = 6; age range = 21−36 years) with severe injuries.	Descriptive analysis (mean and standard deviation), two-factor and three-factor mixed-effects ANOVA	Injured athletes can benefit from the use of mindfulness as part of the sports rehabilitation process to increase their pain tolerance and awareness.
Olmedilla et al.	2018	Spain	to determine the differences in stress levels between injured and non-injured female soccer and futsal players	Descriptive correlational	Those teams were selected that met the requirements for convenience sampling: geographic feasibility and contact feasibility. Subsequently, the objectives of the study were explained.	102 federated players between the ages of 12 and 37 years old	Student's *t*-test was performed	11-a-side soccer and futsal players report lower levels of stress when injured than when not injured and that players with severe injuries had higher stress levels than players with less severe injuries.
Gouttebarge et al.	2015	Amsterdam Netherlands Japan	To investigate the prevalence of symptoms related to common mental disorders in professional soccer players from five European countries.	Cross-sectional study	National players' unions sent information about the study by e-mail. Participants completed an online questionnaire	3174 professional soccer players from 5 European countries	Descriptive analysis, Wald method Univariate logistic regression analysis	The original contribution made in this study is that it is the only international study presenting the prevalence of CMD-related symptoms among professional soccer players from five European countries. Results showed that prevalence rates ranged from 10 % for distress to 26 % for anxiety/depression and adverse nutritional behaviours in addition to sleep disorders (among others).

Finally, tools must be used to recognize the mental health of athletes and facilitate early detection of their symptoms and address them in a loquacious manner. It is highly recommended to treat and work on the injury from a multidisciplinary approach with a good mental health awareness.

Practical and professional implications

The findings of the present study help to increase awareness of mental health in athletes, more specifically, it gives visibility and importance to several of its indicators to show how it affects and/or impacts injuries. The fact that an athlete develops one or more indicators of mental health (anxiety, depression, stress and sleep quality) leads to a higher prevalence of injury and in the case that it has occurred these interfere in their recovery. Therefore, the data obtained should be relevant in the field for Sports Science professionals, whether they are coaches and trainers or physical trainers, with the advice of psychologists, to be able to act accordingly, both from a preventive perspective and from a perspective of detection of possible mental disorders, and therefore to intervene on them. In addition, there are obstacles to the treatment of mental health problems in athletes, since medical and psychological care play an essential role in the recognition and identification of athletes at risk of mental health problems. It is important to have a comprehensive plan to detect and manage athletes with problematic response to injury. Various positive coping mechanisms and interventions can help the athlete manage the response to injury. Understanding available mental health resources, making timely referrals, and providing support for help-seeking behaviours are essential for the sports medicine team.

Limitations of the study

The main limitations of the studies included in our systematic review are that many of the articles included one or two mental health indicators, but few of the articles discuss mental health and its impact on sports injuries in general. Mental health symptoms and disorders were assessed with different scales and from different indicators. The studies included in our review focus on mental health symptoms and their relationship to sports injuries, but it is strongly suggested that future studies also focus on clinical mental health disorders. The scales used in the included studies to measure mental health symptoms were generally different across studies. In addition, the studies largely focused on male soccer players in team sports. Consequently, it may be more complex to make valid comparisons across sports (e.g., individual vs. team sports), countries and culture (e.g., Asian vs. African athletes), genders, and other demographic variables. There is a lack of intervention-based research on the psychological well-being of athletes, and there are virtually no systematic reviews that synthesize the impact of musculoskeletal injuries on the mental health of adult athletes regardless of their sport specialty.

In conclusion, it is considered very relevant to continue to carry out studies relating mental health and sports injuries, given the scarce scientific production in this field.

Future lines of research

Our study justifies a multidisciplinary approach to the care of athletes that could allow detection and care at an early stage of different mental health indicators. Symptoms that could otherwise develop into serious mental health disorders in the long term and that a sports injury occurs and/or is influenced by it for recovery. A rigorous evidence-based implementation of mental health awareness programs is required and this predisposes the athlete to injury, therefore, future work should consider the importance of these and be able to implement them with a work in multidisciplinary between sports psychologists, sports technicians and some specialists (sleep and nutrition, among others), in order to develop and implement preventive and supportive measures.

Conclusions

This systematic review shows how mental health indicators significantly affect sports injuries, and how their relationship can lead the athlete to an improper recovery or be more exposed to suffer it. Mental health is paramount to the proper development of the athlete and is vital to their performance.

Conflicts of interest

The authors of this article declare that they have no conflicts of interest.

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