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Sleep Disturbances and Sports Injury Risk: A Narrative Review

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Abstract

Background. Sleep is a fundamental physiological process that supports recovery, cognitive function and the proper functioning of the neuromuscular system. Growing scientific evidence indicates that sleep disturbances, including insufficient sleep duration and poor sleep quality, are associated with an increased risk of sports injury.

Aim. The aim of this narrative review was to summarize and synthesize the current evidence regarding the relationship between sleep disturbances and sports injury risk, with particular emphasis on physiological, neurocognitive and training-related mechanisms.

Material and methods. The narrative review was based on an analysis of 28 peer-reviewed studies identified through searches of the PubMed and Google Scholar databases. The included literature comprised systematic reviews, meta-analyses, cohort studies and cross-sectional studies examining associations between sleep parameters and the risk of sports injuries among athletes across different sports and age groups.

Results. The reviewed evidence indicates that sleep disturbances, such as reduced sleep duration and poor sleep quality, are associated with an increased risk of sports injuries in a wide range of athletic settings. From a physiological perspective, sleep disruption is linked to impaired neuromuscular control, decreased reaction time, altered hormonal regulation, and reduced recovery capacity. Furthermore, studies suggest that sleep interacts with training load, psychological stress and fatigue, which may contribute to cumulative injury risk.

Conclusions. Sleep plays an important role in injury prevention in athletic populations. The available evidence suggests that regular sleep assessment and the promotion of healthy sleep habits may represent valuable components of comprehensive athlete health management aimed at optimizing recovery and reducing injury risk. Sleep should be considered an integral component of athlete recovery and injury prevention strategies.

Keywords: sleep, sports injuries, injury prevention, athletes, recovery

1.Introduction

Sports injuries are one of the most significant challenges in both recreational and elite athletic populations, contributing to a decline in performance and interruptions in training and competition. Despite advances in training methodology, the incidence of musculoskeletal injuries remains high in many sports disciplines.

Among modifiable risk factors, sleep has become an important component of athletes' health and performance. Sleep is widely recognized as a fundamental biological process that supports physical recovery and cognitive function. Adequate sleep facilitates metabolic restoration, neuromuscular repair, immune system regulation, and optimal central nervous system functioning. These processes are essential for maintaining performance capacity and reducing injury susceptibility [1,11,24].

In recent years, increasing attention has been directed toward the relationship between sleep and sports injuries. Epidemiological evidence suggests that athletes with shorter sleep duration or poorer sleep quality experience a higher incidence of musculoskeletal injuries across different sports, competitive levels, and age groups [2,9,10,14]. This association has been observed in adolescent, collegiate, professional populations, indicating that the connection between sleep and injury risk may be consistent across different groups of athletes [7,8,16].

Insufficient sleep has a negative impact on many areas related to injury risk. Neurocognitively, sleep deprivation impairs reaction time, attention, executive function, and decision-making, which may increase susceptibility to acute injuries during dynamic sport situations [11,24]. From a physiological perspective, inadequate sleep is associated with hormonal dysregulation, elevated inflammatory responses, and impaired muscle and connective tissue recovery, which may contribute to reduced tissue resilience and increased susceptibility to overuse injuries [1,24]. In addition, sleep restriction may exacerbate perceived fatigue and reduce neuromuscular control, which further increases the risk of injury during high-intensity training and repetitive loading.

Despite growing scientific interest in this topic, the existing literature is characterized by substantial heterogeneity in study designs, populations, injury definitions, and sleep assessment methods. This variability limits direct comparison between studies and complicates the establishment of clear causal inferences. Moreover, many studies rely on self-reported sleep measures, which may introduce measurement bias and reduce the comparability of findings across studies.

Therefore, a comprehensive narrative synthesis is warranted to integrate current evidence on the relationship between sleep characteristics and sports injury risk. Such synthesis is essential for clarifying existing findings, identifying consistent patterns across different studies, and better understanding the physiological mechanisms linking sleep to injury susceptibility in athletic populations.

The aim of this narrative review was to summarize and synthesize the available evidence regarding the association between sleep disturbances and sports injury risk, with particular emphasis on sleep duration, sleep quality, potential underlying mechanisms, modifying factors, and implications for injury prevention.

2. Materials and methods

This study was conducted as a narrative review aimed at summarizing and synthesizing the current evidence regarding the relationship between sleep characteristics and the risk of sports injuries in athletic populations. The review included original research articles, systematic reviews and meta-analyses published in English that investigated the association between sleep characteristics and sports injury occurrence.

The literature search was performed using the PubMed and Google Scholar databases. The search strategy combined keywords related to sleep and sports injuries, including: „sleep”, „sleep duration”, „sleep quality”, „sleep deprivation”, „sports injury”, „injury risk”, and „athletes”.

Studies were included if they examined athletes of any age, sex, competitive level, or sport discipline and evaluated the link between sleep disturbances and the occurrence of sports injuries. Articles addressing physiological and neurocognitive mechanisms linking inadequate sleep with injury risk, as well as studies investigating sleep monitoring or interventions relevant to injury prevention, were also considered.

Ultimately, 28 publications meeting the predefined criteria were included in the narrative synthesis.

3. Research results

3.1. Sleep duration and sports injury risk

Sleep duration is one of the most frequently studied sleep-related factors associated with sports injury risk. Across the included studies, short sleep duration was repeatedly linked to a higher incidence of musculoskeletal injuries in athletes of different ages, competitive levels, and sports disciplines. Although the definition of insufficient sleep varied between studies, most

authors identified sleeping fewer than 7-8 hours per night as the threshold associated with an increased likelihood of injury [2,9,10,15,27].

Prospective studies provided the strongest evidence supporting this association. Athletes who reported chronic sleep restriction experienced a higher incidence of sports injuries during subsequent training and competition than those who slept longer [10,15]. This relationship was observed not only among adolescent athletes but also among collegiate and elite competitors, suggesting that insufficient sleep is a common modifiable risk factor [2,10,18].

The relationship between sleep duration and injury risk appeared to be dose-dependent in several studies. Athletes with progressively shorter habitual sleep demonstrated a gradual increase in injury occurrence, indicating that even modest reductions in nightly sleep may adversely affect musculoskeletal health over time [2,9,10].

Several studies also emphasized that chronic sleep restriction, rather than isolated nights of insufficient sleep, was more strongly associated with injury occurrence [3,10,12]. Repeated sleep loss may impair physiological recovery between training sessions, reduce tissue repair capacity, and compromise readiness for subsequent physical activity, increasing susceptibility to cumulative injuries during the competitive season [1,5,28].

Despite the consistency of these findings, the magnitude of the association varied between studies. Differences in athlete characteristics, injury definitions, methods used to assess sleep duration, and follow-up periods likely contributed to this variability [5,12,17]. Moreover, many investigations relied on self-reported sleep duration, which may be susceptible to recall bias and subjective estimation. Nevertheless, studies employing objective sleep monitoring methods generally supported the observed association between insufficient sleep and increased injury risk [17,19].

Although methodological heterogeneity limits direct comparisons between studies, the overall findings support adequate sleep duration as an important and potentially modifiable component of injury prevention strategies in sport [1,2,5,9,10,15,18,27].

3.2. Sleep quality and injury occurrence

In addition to sleep duration, sleep quality has also been identified as an important factor influencing the risk of sports injuries. The reviewed literature indicates that athletes reporting poor sleep quality are more prone to musculoskeletal injuries than those with restorative and uninterrupted sleep, regardless of the total number of hours slept [3,5,6,11,13,17,18]. These findings suggest that sleep quality represents an independent component of recovery that should be considered when evaluating injury susceptibility.

Several studies assessed sleep quality using validated questionnaires, most commonly the Pittsburgh Sleep Quality Index (PSQI), while others evaluated subjective sleep disturbances or symptoms of insomnia [5,6,13,17]. In all of these studies, poorer sleep quality was associated with a higher incidence of sports injuries, prolonged recovery times, and increased perceptions of fatigue [5,6,11,13].

Sleep fragmentation, frequent nocturnal awakenings, difficulty initiating or maintaining sleep, and reduced subjective sleep satisfaction were among the most commonly reported disturbances associated with sports injuries[3,6,13,18]. Such disturbances may compromise the essential functions of sleep, leading to incomplete physiological and psychological recovery between training sessions. Consequently, athletes experiencing persistent sleep problems may demonstrate reduced readiness for training and competition, which increases their susceptibility to injuries [1,5,28].

The mechanisms linking poor sleep quality with risk of injury appear to be multifactorial. Beyond its effects on physical recovery, inadequate sleep quality is associated with increased daytime sleepiness, impaired concentration, mood disturbances, and greater perceived fatigue. All of these factors may adversely affect athletic performance and increase the likelihood of injury during training or competition [3,6,11,18]. These findings suggest that sleep quality influences both physiological recovery and cognitive processes essential for safe sports participation.

Despite the generally consistent findings, several studies noted that sleep quality is often influenced by factors unrelated to training itself, including psychological stress, academic or work demands, travel, and competition schedules [5,13,17]. Therefore, the observed relationship between poor sleep quality and sports injuries is likely the result of multiple interacting factors rather than representing a simple cause and effect association. Nevertheless, the available evidence consistently identifies poor sleep quality as an important and potentially modifiable predictor of injury risk across different athletic populations [3,5,6,11,13,17,18].

3.3. Physiological and neurocognitive mechanisms linking sleep disturbances with injury risk

The association between sleep disturbances and sports injury risk is likely the result of a combination of physiological and neurocognitive mechanisms. Although the reviewed studies differed in their methodological approaches, they all indicated that insufficient or poor sleep quality adversely affects many processes essential for achieving athletic performance and preventing injuries [1,3,5,6,18,28].

One of the most frequently proposed mechanisms is impaired physical recovery. Sleep plays a fundamental role in tissue repair, protein synthesis, hormonal regulation, and immune function, all of which are essential for restoring physiological homeostasis following training and competition [1,5,28].

Chronic sleep deprivation can disrupt these recovery processes, leading to cumulative fatigue, delayed muscle repair, and reduced tolerance to repeated training loads. Consequently, athletes experiencing persistent inadequate sleep may be more vulnerable to both acute and overuse injuries [1,5,18].

In addition to physiological effects, inadequate sleep has been associated with impaired neurocognitive function. Several studies reported that sleep disturbances contribute to slower reaction times, reduced attention, impaired decision-making, and decreased executive function, which may negatively affect an athlete's ability to respond appropriately to rapidly changing situations during training and competition [3,6,18]. These cognitive impairments may increase the likelihood of technical errors, delayed motor responses, and inappropriate movement patterns, thereby elevating injury risk.

Neuromuscular control may also be adversely affected by insufficient sleep. The available evidence suggests that sleep loss contributes to balance disorders, reduced postural stability, impaired coordination, and altered movement control, all of which are recognized risk factors for sports injuries [6,18,28]. Although the exact physiological mechanisms remain incompletely understood, these findings support the hypothesis that inadequate sleep impair the integration of sensory information and motor responses necessary for safe participation in sports.

Overall, the reviewed evidence indicates that the relationship between inadequate sleep and sports injury risk is multifactorial. Rather than acting through a single mechanism, inadequate sleep appears to impair recovery, cognitive function, neuromuscular performance, creating conditions that increase the likelihood of injury in athletes [1,3,5,6,18,28].

3.4. Factors modifying the relationship between sleep disturbances and sports injury risk

The link between sleep disturbances and sports injury risk is influenced by many factors specific to the individual athlete and the sport discipline. The reviewed literature indicates that the impact of insufficient or poor-quality sleep on injury occurrence is not uniform across athletic populations but is modified by training characteristics, individual athlete profiles, and external demands [1,4,8,13,16,18,21].

Training load emerged as one of the most important factors influencing this relationship. Several studies reported that periods of intensified training, congested competition schedules, and inadequate recovery between training sessions were associated with both poorer sleep and an increased incidence of sports injuries [4,8,13,18]. High training loads may amplify the negative consequences of insufficient sleep by limiting the athlete's ability to achieve complete physiological recovery, thereby increasing cumulative fatigue and injury susceptibility [5,18]. Individual athlete characteristics also appear to modify the association between sleep disturbances and injury risk. Age, competitive level, previous injury history, and sex have been identified as factors that may influence both sleep patterns and vulnerability to sports injury [10,13,16,21]. For example, teenage athletes often experience insufficient sleep due to school obligations and early training hours, while elite athletes may be additionally affected by frequent travel, competition-related stress, and irregular training schedules [10,16].

External factors unrelated to sport participation may further contribute to poor sleep and indirectly increase injury risk. Academic and occupational demands, psychological stress, travel across time zones, and competition schedules are associated with poorer sleep quality and reduced recovery opportunities [5,13,16,17]. These factors often coexist, making it difficult to isolate the independent effect of sleep disturbances on injury incidence.

Although the influence of individual modifying factors varied between studies, the available evidence consistently indicates that sleep disturbances should not be considered in isolation from other factors. Instead, sleep disturbances interact with training demands, individual characteristics, and environmental stressors, collectively shaping an athlete's susceptibility to sports injuries [4,8,13,16,18,21].

3.5. Sleep monitoring and intervention strategies in injury prevention

Recent studies increasingly emphasize the importance of sleep monitoring as part of comprehensive athlete health management and injury prevention programs. Both subjective and objective methods were used to assess sleep characteristics, allowing the early identification of athletes experiencing insufficient sleep duration, poor sleep quality, or other sleep disturbances associated with an increased risk of injury [5,6,17,19,22].

Subjective assessment tools, including sleep diaries and validated questionnaires such as the Pittsburgh Sleep Quality Index (PSQI), were the most commonly applied methods because of their simplicity, accessibility, and low cost [5,6,13,17]. However, several studies have highlighted the limitations of self-reported sleep measures, particularly their susceptibility to recall bias and subjective interpretation [17,19]. Objective monitoring techniques, including

actigraphy and wearable sleep monitoring devices, have gained increasing attention as complementary methods for evaluating athletes' sleep patterns in both scientific research and in sports practice [19,26].

Several studies also investigated interventions aimed at improving sleep and reducing the risk of injury. The most frequently reported strategies included sleep hygiene education, optimization of training and competition schedules, management of travel-related sleep disruption, and individualized recovery planning [4,17,23,26]. Although the evidence regarding the direct effect of these interventions on reducing the risk of sports injuries remains limited, the implementation of structured programs focused on sleep has been associated with improvements in sleep duration, sleep quality, and recovery [17,23,26].

The reviewed evidence suggests that integrating regular sleep assessment into athlete monitoring systems may facilitate the early identification of individuals at increased risk of inadequate recovery and subsequent injuries [5,17,19,26]. Rather than serving as a standalone preventive measure, sleep monitoring appears to be most effective when combined with the evaluation of training load, fatigue, and other risk factors specific to the individual athlete. Such a multidimensional approach may improve decision-making regarding training adjustments and recovery strategies, thereby contributing to more effective injury prevention in athletic populations [4,19,26].

4. Discussion

The present narrative review synthesized evidence regarding the relationship between sleep disturbances and sports injury risk across athletes of different ages, competitive levels, and sporting disciplines. The reviewed studies indicate that insufficient sleep duration and poor sleep quality are associated with a greater likelihood of sports injuries. The strength of this association varied between studies because of differences in study design, athlete characteristics, and methods used to assess sleep and injuries, but the overall findings support sleep as an important component of athlete health and injury prevention.

One of the most important observations emerging from this review is that sleep duration alone does not fully explain injury susceptibility. While sleeping fewer than the recommended number of hours was repeatedly associated with a higher incidence of injuries, several studies demonstrated that athletes reporting poor sleep quality also experienced an elevated injury risk despite obtaining an apparently sufficient amount of sleep [2,3,5,6,9,10,13,15]. This suggests that the restorative value of sleep may be as important as its duration. Consequently, evaluating athlete recovery solely on the basis of sleep quantity may underestimate the impact of disturbed

sleep on injury susceptibility. A multidimensional assessment including both sleep duration and sleep quality may therefore provide a more comprehensive evaluation of recovery status. The reviewed evidence also indicates that the interplay between inadequate sleep and injury occurrence is multifactorial. Rather than representing a direct cause of injury, inadequate sleep appears to influence several physiological and neurocognitive processes that collectively increase injury susceptibility. Sleep restriction has been associated with impaired tissue recovery, altered hormonal regulation, reduced immune function, diminished neuromuscular control, slower reaction time, impaired attention, and decreased decision-making ability. These changes may compromise both physical readiness and cognitive performance during training and competition, thereby increasing the likelihood of technical errors and inappropriate movement patterns that predispose athletes to injury [1,3,5,6,18,28]. However, the reviewed literature also emphasizes that these mechanisms remain incompletely understood, and further studies are required to clarify their relative contribution to injury development.

An additional finding of this review is that the link between sleep disturbances and injury risk is modified by numerous athlete-specific and environmental factors. Training load, competition schedules, travel, academic or occupational demands, previous injury history, and competitive level all appear to influence both sleep characteristics and injury occurrence [4,8,13,16,18,21]. Athletes exposed to multiple recovery challenges may therefore require individualized monitoring strategies that account for the interaction between sleep, workload, and other stressors.

The increasing interest in sleep monitoring observed across the reviewed studies reflects a growing recognition of sleep as a practical component of athlete management. Although evidence demonstrating that sleep-focused interventions directly reduce injury incidence remains limited, regular monitoring of sleep duration and sleep quality may facilitate early identification of athletes experiencing inadequate recovery. Integrating sleep assessment with other indicators of athlete readiness may therefore improve decision-making regarding training modification and recovery planning.

This narrative review integrates recent evidence from diverse athletic populations and sporting disciplines while considering multiple dimensions of sleep, including duration, quality, physiological mechanisms, modifying factors, and practical monitoring strategies. It provides a broader understanding of the relationship between sleep disturbances and sports injury risk than studies focusing on a single sleep parameter. Nevertheless, several limitations should also be acknowledged. The reviewed studies demonstrated considerable methodological heterogeneity with respect to study design, sleep assessment methods, injury definitions,

follow-up periods, and athlete characteristics. Many investigations relied primarily on self-reported sleep measures, which are susceptible to recall bias and subjective interpretation. Furthermore, the observational nature of most included studies limits the ability to establish causal relationships between disturbances and sports injuries.

Future research should prioritize well-designed prospective studies using standardized definitions of inadequate sleep and sports injuries together with validated objective sleep assessment methods. Particular attention should be given to the interaction between sleep, training load, psychological stress, and recovery processes.

Taken together, the findings of the present review support the inclusion of sleep assessment as an integral component of athlete health monitoring. While sleep should not be viewed as the sole determinant of injury risk, maintaining adequate sleep duration and high sleep quality appears to contribute substantially to recovery, athletic readiness, and injury prevention. Incorporating sleep into comprehensive athlete management programmes may therefore represent an important step toward reducing sports injuries and optimizing long-term athletic performance.

5. Conclusions

This narrative review demonstrates that sleep disturbances, including insufficient sleep duration and poor sleep quality, are associated with an increased risk of sports injuries across diverse athletic populations. The available evidence suggests that sleep influences injury susceptibility through multiple interacting physiological and neurocognitive mechanisms and should therefore be considered an essential component of athlete recovery rather than an isolated health behaviour.

The findings of this review also highlight the importance of considering sleep together with other factors affecting injury risk, including training load, fatigue, psychological stress, and competition demands. Regular assessment of sleep characteristics may facilitate the early identification of athletes at increased risk of inadequate recovery and contribute to more individualized athlete management.

Although further high-quality prospective studies are needed to strengthen the current evidence base, promoting healthy sleep habits and incorporating sleep monitoring into comprehensive athlete care may represent practical and potentially valuable strategies for reducing injury risk and supporting long-term athletic health and performance.

Disclosure

All authors have read and agreed to the published version of the manuscript.

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Conflicts of Interest

The authors declare no conflict of interest.

Declaration of the use of generative AI and AI assisted technologies in the writing proces

All AI tools were used strictly as assistive instruments under human supervision. The selection of studies, interpretation of findings, and all conclusions represent the sole intellectual contribution of the authors. AI was used to enhance efficiency in manuscript preparation and linguistic refinement, and did not replace human judgment at any stage of the research proces.

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