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The Impact of Sleep on the Risk of Sports Injuries and Athletes' Body Regeneration – A Literature Review

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Abstract

Introduction: Sleep is one of the basic biological processes that determine the proper functioning of the body. It is of particular relevance in sport due to its impact on the body's regeneration, training adaptation, cognitive functions and the health of athletes. For those reasons, in recent years the relationship between the quality and length of sleep and the risk of sports injuries is given more attention.

Aim of the study: The aim of the study is to present the current state of knowledge regarding the impact of sleep on the body's regenerative processes and the risk of injury among athletes, with particular emphasis on recommendations for sleep hygiene.

Material and methods: A literature review of publications on sleep, recovery and sports injuries published mainly between 2008 and 2025.

Results: Available studies indicate that chronic sleep deprivation is associated with a deterioration in physical and psychomotor performance, an increase in fatigue, an increase in inflammatory processes and an increased risk of injury. At the same time, the right amount and quality of sleep promotes muscle regeneration, rebuilding energy resources and optimizing cognitive functions.

Conclusions: Sleep should be treated as an integral part of the training process and injury prevention. Monitoring sleep parameters can be an important tool to support the care of athletes.

Keywords: sleep, recovery, sports injuries, sports medicine, athletes

1. Introduction

Contemporary competitive sport places ever-increasing demands on athletes. Intense training, high frequency of competitions and pressure to achieve high results make the body constantly exposed to physiological strain. Under such circumstances, proper regeneration becomes an essential part of the training process, which enables the body to rebuild after exercise and

adapt better to subsequent loads, while also making it less susceptible to fatigue and injuries [1–3].

Sleep is one of the most important factors affecting regeneration, during which various processes necessary for the proper functioning of the body occur, such as tissue reconstruction, regulation of hormone secretion, strengthening of immunity and regeneration of the nervous system. Getting enough sleep also helps consolidate motor skills, improve concentration and support the ability to make quick decisions, which is of particular importance in sports [2–4].

Despite awareness campaigns on the importance of sleep, many athletes do not get enough sleep. This is influenced by many factors related to the specifics of the sport, such as training sessions that take place late in the evening, frequent trips to competitions, changes of time zones or stress accompanying competition. In addition, the use of phones and other electronic devices immediately before bedtime has an increasing impact on sleep quality, which can make it difficult to fall asleep and shorten the time of night's rest [1,2].

The results of studies from recent years show that even a minor but regular sleep deprivation can negatively affect the functioning of an athlete. There is a deterioration in physical performance, slower reaction time, difficulty concentrating and impaired regeneration after exercise. More and more authors draw attention to the relationship between too little sleep and a higher risk of sports injuries. For this reason, assessing the length and quality of sleep is considered an important part of monitoring the training process and actions aimed at reducing the number of injuries [2–5].

The aim of this study is to present current knowledge on the impact of sleep on the regeneration of the athlete's body and its importance in reducing the risk of sports injuries.

2. Sleep Physiology

Sleep is a natural state of the body that allows it to rebuild after a day of activity. Although for many years it was treated mainly as a period of rest, it is now known that many processes necessary to maintain the proper functioning of the body take place during sleep. Two interacting mechanisms are responsible for its course – the circadian rhythm, regulated by the biological clock, and the homeostatic mechanism, which increases the need for sleep along with the increase in wakefulness [1,6].

Proper sleep consists of two main phases: NREM (non-rapid eye movement) and REM (rapid eye movement). The NREM phase includes three stages, of which deep sleep is the most important for recovery. During this time, the activity of the sympathetic system decreases, heart function slows down, blood pressure decreases, and the body goes into a state conducive

to tissue reconstruction. This is when the greatest secretion of growth hormone occurs. This hormone participates in the repair of damaged structures and the synthesis of muscle proteins [1,6].

The REM phase, on the other hand, plays an important role in the regeneration of the nervous system. During it memory is consolidated, information is organized and connections between neurons are strengthened. In athletes, these processes are of particular importance because they affect learning new movement patterns, coordination and decision-making during training and competitions [6,10].

During sleep, the body's hormonal activity also changes. In the first part of the night, the secretion of growth hormone, melatonin and prolactin increases, while the concentration of cortisol remains low. Such conditions promote anabolic processes, limit protein breakdown and enable more effective post-workout regeneration [1,6].

2.1 Importance of Sleep for Skeletal Muscle Recovery

Every intense workout leads to micro-damage to muscle fibers. It is a physiological element of the body's adaptation to exercise, but for this to happen, appropriate regeneration conditions are needed. During deep sleep, the secretion of growth hormone increases, which stimulates protein synthesis and supports the reconstruction of damaged muscle fibers. As a result, the body adapts faster to training loads, and the risk of chronic fatigue is reduced [1,7]. More and more studies indicate that limiting sleep time disrupts the balance between anabolic and catabolic processes. In such conditions, the concentration of cortisol increases, while the body's ability to regenerate decreases. As a consequence, the muscles need more time to rebuild, the athlete may feel more fatigue and return to full fitness more slowly after training [6].

Review studies also indicate that sleep deprivation can negatively affect physical performance, reaction time, and the ability to perform repetitive, high-intensity efforts [1,7]. The influence of sleep on the body's energy management also plays an important role. The right length and quality of sleep are conducive to rebuilding glycogen stores and controlling the correct metabolic regulation of glucose. Shortening the sleep time can disrupt these processes, which translates into faster fatigue during subsequent training units [8].

2.2 Sleep and the Immune System and Inflammatory Processes

The impact of sleep is not limited to muscle regeneration. Equally important is its importance for the proper functioning of the immune system. During proper sleep, the body regulates the activity of immune system cells and controls the course of inflammatory reactions. Thanks to

this, the healing process of micro-damage caused during exercise is more efficient, and the body is better prepared for subsequent loads [1,9].

Chronic sleep deprivation, on the other hand, is associated with increased secretion of pro-inflammatory cytokines, including interleukin 6 (IL-6) and tumor necrosis factor alpha (TNF- α). Persistent inflammation can prolong recovery, increase susceptibility to overload, and impair the body's ability to adapt to training [1,9].

2.3 Sleep and Central Nervous System Regeneration

In many sports, the efficiency of the nervous system determines the speed of reaction, precision of movements and making the right decisions. During sleep, movement memory is consolidated and information acquired during training is organized. These processes are necessary for improving technique and learning new movement elements [6,10].

Sleep deprivation worsens concentration and, consequently, increases the number of mistakes made. Sleep-deprived athletes are more likely to have difficulty maintaining attention and assessing the situation during competition, which can translate into both a worse sports result and a higher risk of injury [6,10].

3. Sleep and the Risk of Sports Injuries

Sleep is increasingly treated as an important factor affecting the risk of injuries in sports. For a long time, in injury prevention, attention has been paid to such factors as training load, history of previous injuries or the level of training of the player. Nowadays, it is increasingly emphasized that nighttime regeneration, and in particular the length and quality of sleep, plays an equally important role [11].

Available research indicates that reduced sleep time is associated with an increased risk of sports injuries. Literature reviews have observed that athletes who sleep less are more likely to be injured than those who maintain adequate sleep [11]. Importantly, this does not apply only to extreme cases of sleep deprivation. Many studies point out that the risk may increase with chronic sleep of less than 7–8 hours a night [13].

In the study by Milewski et al. it was shown that young athletes who slept less than eight hours a night were significantly more likely to suffer from injuries than their peers who slept longer. Importantly, sleep remained an independent risk factor even after other variables such as activity levels and previous injuries were taken into account [12].

The relationship between sleep and the risk of injury is gradual. This implies that as sleep time shortens and its quality deteriorates, the risk of injury systematically increases. Rather than an abrupt threshold effect, this relationship reflects the cumulative impact of recovery

deficits over time [13]. Conversely, in scenarios where athletes extended their sleep duration, improvements in both physical and cognitive functioning were observed. Although most of these studies did not directly analyze injuries, it can be assumed that improving these parameters indirectly affects their reduction [13].

The mechanism of the relationship between sleep and trauma is multifactorial. Sleep deprivation leads to cognitive deterioration, slowed reaction time and decreased neuromuscular control. In effect, this means a higher risk of technical errors, which are often a direct factor in injury in sport [14]. In addition, shortened sleep affects regenerative processes. Micro-damage caused during training may not be fully rebuilt, leading to a gradual accumulation of tissue fatigue. In such conditions, even standard training loads can exceed the body's adaptive capacity [15].

A review of studies on athletes found that people who regularly slept less than eight hours were not only more likely to suffer injuries, but also felt the effects of fatigue longer and recovered more slowly [15]. It should be noted, however, that the available studies do not provide conclusive evidence of how much faster specific injuries heal in athletes who sleep the appropriate number of hours. The current state of knowledge indicates that adequate sleep duration creates more favorable conditions for regeneration by increasing protein synthesis, reducing inflammatory processes and improving the functioning of the immune system. Chronic sleep deprivation, on the other hand, disrupts these mechanisms, which can prolong the process of returning to full fitness and increase the risk of injury recurrence [15].

4. Practical Significance of Research Results for Sports Medicine Physicians, Coaches and Athletes

4.1 Practical Significance for Sports Medicine Physicians

For sports medicine physicians, sleep monitoring can be a valuable component to a standard assessment of an athlete's health. Many symptoms, such as chronic fatigue, decreased performance, decreased concentration, and more frequent musculoskeletal overloads, can result from improperly selected training loads, as well as from chronic sleep deprivation [15,16].

From a practical point of view, during periodic examinations of athletes, it is worth taking into account not only the number of hours of sleep, but also its quality, the number of nighttime awakenings, the regularity of the circadian rhythm, the occurrence of daytime sleepiness and the impact of frequent travel and competitions on sleep. These parameters can

provide information about the degree of regeneration of the body and help in finding players who are particularly vulnerable to overload or injury [16,18].

Standardized screening tools such as the Pittsburgh Sleep Quality Index (PSQI), the Epworth Sleepiness Scale (ESS) and the Athlete Sleep Screening Questionnaire (ASSQ) are increasingly being used in everyday clinical practice [4,18]. Their application is relatively simple, does not require expensive equipment, and the results obtained can be the basis for further diagnostics or implementation of measures to improve sleep hygiene. For athletes returning to training after injuries, sleep monitoring can also help assess the effectiveness of the recovery process and tolerance to increasing training loads [18].

4.2 Practical Significance for Coaches

Equally important is the role of coaches, who have a direct impact on the organization of training [19]. Current research indicates that proper load planning should take into account not only the volume and intensity of training, but also the athlete's regenerative capabilities. If an athlete sleeps too little for several consecutive days or reports a deterioration in sleep quality, their ability to rebuild muscle microdamage and adapt to exercise may be lower than usual. In these situations, maintaining high training loads increases the risk of overloads and subsequent injuries [16].

More and more sports clubs are monitoring players' sleep using sleep diaries, actigraphy or wearable devices. The data obtained are analyzed together with the assessment of fatigue, perceived effort and training parameters. This approach allows you to detect the symptoms of insufficient recovery earlier and modify the training plan accordingly before a decline in form occurs [16,18]. This is particularly important during periods of intense starting calendar, during competitions held in the evening and during travel between time zones, which may disturb the athlete's circadian rhythm [16].

4.3 Practical Significance for Athletes

Based on current recommendations, most adult athletes should sleep about 7–9 hours a night, while during periods of very intense training or competition, the need for sleep may be higher [20,24]. It is also beneficial to maintain regular bedtime and wake times, limit exposure to light emitted by electronic devices before bedtime, avoid caffeine in the evening, and create appropriate environmental conditions conducive to falling asleep [16,21].

Although these measures seem simple, numerous studies indicate that their systematic use can improve the quality of regeneration, reduce the build-up of fatigue and support the maintenance of high athletic disposition [16,17]. To sum up, the results of modern research suggest that sleep monitoring should be treated as one of the elements of injury prevention

and optimization of the training process [15,16]. Incorporating sleep assessment into your athlete care routine can help you detect recovery disorders early, support decision-making about training loads, and improve the safety and effectiveness of the recovery process from injuries [16,18].

Table 1. Recommendations for optimizing sleep in athletes

Recommendation	Scientific Justification
Regularly monitor sleep quality (PSQI, ASSQ [22], actigraphy, sleep diary)	Early detection of deterioration in sleep quality allows for overload reduction and reduces the risk of injury
Do not use alcohol as a "sleeping pill"	Alcohol may aid in falling asleep; however, it impairs sleep architecture and elevates the incidence of awakenings throughout the night
Sleep at least 7–9 hours a night (in young athletes, often 8–10 hours)	Adequate sleep duration improves muscle regeneration, cognitive function and growth hormone secretion
Maintain consistent hours of falling asleep and waking up	A regular circadian rhythm improves the quality of sleep and facilitates recovery after exercise
Limit the use of phones, tablets and computers 30–60 minutes before bed	Blue light inhibits melatonin secretion, increases the time required to fall asleep and worsens the quality of sleep [23]
Avoid caffeine in the evening (at least 6–8 hours before bedtime)	Caffeine increases the time required to fall asleep and reduces the amount of deep sleep
Plan your workouts to avoid very late intense sessions	Intense exercise late in the evening can make it difficult to fall asleep by increasing body temperature and sympathetic activity
During periods of intense training, consider increasing your sleep time	Sleep prolongation improves motor skills and focus in athletes

5. Conclusions

Sleep plays a crucial role in the regeneration of the athlete's body and is one of the basic factors that improve adaptation to physical exertion. Current research indicates that adequate length and quality of sleep are conducive to muscle reconstruction, proper hormonal regulation, efficient functioning of the immune system and regeneration of the central nervous

system. These processes have a direct impact on the body's ability to take on subsequent training loads and maintain high physical and mental fitness.

The available data also suggest that chronic sleep deprivation may increase the risk of sports injuries. Deterioration of concentration, increased reaction time, disorders of neuromuscular control and less effective regeneration after exercise can promote the occurrence of overloads and injuries. Although this relationship has been reported in many studies, further work is still needed to better determine the impact of sleep duration and quality on the incidence of injuries in different sports.

From a practical perspective, sleep assessment should be part of the training plan. Regular analysis of sleep duration and quality can help identify insufficient recovery, support training load planning, and improve player safety. Educating athletes on sleep hygiene principles is equally critical, as simple interventions—such as maintaining consistent sleep schedules and limiting pre-sleep electronic device use—can significantly enhance physiological recovery.

Despite the growing number of publications, the current state of knowledge is still based mainly on observational research. Further, well-designed studies involving athletes from different disciplines are needed to better determine the role of sleep in injury prevention and to develop recommendations based on reliable scientific evidence.

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