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THE IMPORTANCE OF SLEEP FOR ATHLETIC PERFORMANCE – A SYSTEMATIC REVIEW

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Abstract

Introduction

Sleep influences the well-being of every person, but it is especially important for athletes [1]. This review analyses the impact that quality and duration of sleep has on physical and cognitive performance in athletes. It also examines the strategies for optimizing sleep, such as extending the duration of sleep, adding naps during the day and educating athletes about sleep hygiene.

Results

Research conclusively states that insufficient sleep impairs physical endurance and strength, reduces coordination and increases injury risk [2–5]. It impacts cognitive processes – decreases focus, diminishes strategic thinking and slows reaction times[6].

Evidence reveals that sleep interventions such as prolonging sleep duration, napping during the day and blue-enriched light exposure lead to improving sleep in athletes[7].

Summary

By integrating findings from a range of studies, this review emphasizes the role of sleep as an indispensable pillar of sports performance optimization. It offers practical implications and limitations to the analyzed studies.

Key words: sleep; athletic performance; sleep interventions; systematic review.

Introduction

Sleep is a necessary factor of health for humans. It influences both physical recovery and cognitive functions [2,8–10]. In the fast-paced world of our time, it is not always prioritized enough. Sleep impacts positively decision-making, concentration, motivation and mental resilience [11]. These psychological factors could make or break a champion. They are as important in sport performance as physical fitness. Sleep is also crucial for physical recovery process, as it decreases injury risk. [12] In light of these facts, coaches and athletes should pay special attention to the quality and duration of sleep.

Despite the importance of quality sleep in athletes, its role is often underestimated. For some, its importance pales in comparison to long hours of hard training. As research shows, they could not be more wrong. Due to unique challenges that their occupation entails, athletes often struggle with maintaining optimal sleep [12, 10]. While the recommendation for general population is to obtain 7 to 9 hours of sleep, elite athletes frequently sleep less than 7 h. [7] The professional athletes' lifestyles often entail a lot of irregular training schedules, competition stress and travel resulting in jet lag. All of those disturb the circadian rhythm and decrease the quality of sleep, bringing all the problems that insufficient sleep causes. [11].

Insufficient sleep impairs cognitive functions, such as reaction-time, concentration, motor coordination, cognitive decision-making and emotional regulation, which are essential in competitive sports. These factors influence the abilities of adapting to change and facing new challenges that are vital in athletics. Chronic sleep insufficiency has also been associated with an increased risk of injury, making it not only a performance issue but also a matter of athlete's safety.[4]

Analyzing the negative influence of insufficient sleep on the performance of humans' body and mind, one must wonder if better quality and extended sleep might maximize the

athlete's assets in sport. Research indeed shows that extending sleep might be a new performance-enhancing strategy. It improves reaction-time and daytime sleepiness, sprint performance and endurance[13]. Applying this theory to life is limited in the competitive setting by factors in athletes' lifestyles that make it hard to keep a consistent sleep schedule and achieve quality sleep.

This review aims to provide a comprehensive understanding of the relationship between sleep an athletic performance. It collects conclusions from existing evidence on the effects of quality and duration of sleep on athletic outcomes and presents future possibilities of incorporating the sleep interventions into athletes' lifestyle and preparation to competition.

Methods

Search strategy

The research consisted of articles found on PubMed using keywords such as "sleep", "sleep deprivation", "sport", "athletic performance" and "sleep interventions". All the included articles were systematic reviews, randomized controlled trials and meta-analyses that were published between 2011 and 2024. In addition, a literature review was conducted to further identify studies that met the inclusion criteria.

Inclusion criteria

The PECO (Population, Exposure, Comparator, Outcome) for this systematic review was defined as follows: (P): athletes from any level of competition, age group and sex, E: sleep insufficiency and sleep interventions, C: regular sleep, O: athletic performance, cognitive performance, injury risk and recovery metrics. [14]

This review employs the PECO framework to structure the research question. The PECO framework is a methodological adaptation of the PICO framework (Population, Intervention, Comparator, Outcome), originally developed in evidence-based medicine to evaluate clinical interventions. In this context, the framework has been tailored to suit sports science research by focusing on exposure.

Exclusion criteria:

Studies focused on non-athletic populations, populations with sleep disorders other than sleep deprivation or sleep loss, studies with no registered performance outcomes, published in non peer-reviewed sources.

Results

Study selection included 28 articles that met the inclusion criteria. Four additional articles identified through the included studies' reference lists were included. 32 articles therefore were eligible for review.

Role of sleep in athletes' cognitive and physical functioning

Research shows that sleep improves physiological recovery through enhancing muscle repair [15–17] and enhances cognitive function. Sleep is also an important protective factor in injury prevention as sleep deprivation causes athletes to have slower reflexes and impaired neuromuscular coordination. [10,11,16] As per the recommendations of The National Sleep Foundation, the average time of sufficient sleep for adults varies between 7 and 9 hours, and athletes may benefit from extending this range to support athletes' physical and cognitive demands [18]. Insufficient sleep negatively affects reaction times, decision-making and strategic thinking in athletes [19,20]. Acute sleep deprivation proved to impact negatively endurance and reaction time which lead to reduced cognitive and physical output during competition. [21]

Quality of sleep and its benefits

Aside from duration, quality of sleep plays a pivotal role in athletic recovery and performance. High-quality sleep is characterized by adequate time spent in slow-wave sleep (SWS) and rapid eye movement (REM) sleep, minimal interruptions or awakenings during the night and percentage of time asleep relative to time in bed above 85%. REM phase is the time when most recovery processes occur in human body. [2] This phase is critical for muscle recovery, hormonal regulation, and memory consolidation.[22]

Studies that used polysomnography to register quality of sleep indicate that athletes who experience disruptions in SWS or REM sleep exhibit slower recovery times and diminished ability to acquire new motor skills. [22] This fact is particularly relevant for skill-based sports such as gymnastics and basketball since these are the sports where motor learning is crucial. There are also external factors that could disrupt sleep linked to athletes'

lifestyles. They include competition stress, irregular schedules and jet lag after time zone transportation. Addressing these factors through behavioral and environmental interventions, such as cognitive behavioral therapy for insomnia (CBT-I) or optimizing sleep environments, can significantly enhance athletes' performance outcomes. [23]

Athletes with higher quality of sleep show to have better performance metrics, particularly in tasks of high intensity. [24] As for the chronotype, athletes with morning preferences had better sleep efficiency and performance consistency.[24,25] Improved sleep was consistently linked with better cognition performance which consisted of improved reaction times, decision-making and reduced mental fatigue. [20,26] Those factors were especially important in precision sports such as archery and shooting.[13,19]

Better quality sleep also resulted in improved physical outcomes such as increased strength, endurance and faster recovery times, especially with interventions of extended sleep duration or napping. [13,15,20]

Effects of sleep interventions

1. Extended sleep duration.

Athletes are a special population that due to heightened physical and mental demands of sports requires longer duration of sleep than general population.[4,9,11,27,28] As the study of Mah et al. (2011)[13] showed, extending nightly sleep in collegiate basketball players to 9-10 hours improves sprint speed, shooting accuracy and reaction times. Players who prolonged their sleep also reported improved mood.

Sleep extension to 9-10 has been consistently reported as a factor improving physical performance, including sprint times, endurance, recovery rates and motor skill accuracy.[7,18]

Extended sleep replenishes glycogen stores and supports muscle recovery. This process is essential for athletes engaging in high-intensity or endurance sports. [3,5,17]

2. Sleep hygiene education

Educating athletes on sleep hygiene provided mixed results, mostly dependent on adherence levels. [15,29]

3. Napping

Napping during the day for 20 to 90 min has shown to counteract sleep deficits, resulting in improvements in sprint performance and cognitive tasks. [13,19,30]

4. Practicing mindfulness

Mindfulness techniques such as yoga or meditating require further research on effects on performance as they show potential to reduce anxiety and shorten sleep onset latency. [15,31,32]

5. Blue-enriched light therapy

Exposure to blue-enriched light as a tool to manage jet-lag was shown to realign circadian rhythm. Athletes who underwent light therapy presented better sleep efficiency and cognitive focus.[11,12]

6. Cognitive Behavioral Therapy for Insomnia (CBT-I)

CBT-I might be a useful tool to develop successful strategies of behavior and changing thought patterns which aim to improve initiating and maintaining night's sleep. [33,34]

Discussion

Synthesis of findings

This review aims to affirm that the quality and duration of sleep are crucial factors in athletic performance. Sleep influences recovery, it has an important effect on physical and cognitive functioning. Optimal sleep improves endurance and strength while reducing injury risk. Conversely, studies show that disruptions to sleep have significant consequences to sport performance.

Practical implications

Since sleep reveals to be of such importance for athletic performance, there is a message for athletes and coaches to prioritize sleep as part of training structure. In practice, athletes could try researched sleep interventions such as implementing pre-sleep routines, managing travels in a way to minimize the jet-lag effect and start incorporating relaxation techniques that could help them manage stress better. And, if night sleep is disturbed, it may be beneficial to install naps of 20 to 90 min that could reverse the negative effect of

insufficient sleep. All of those lead to better sleep, which proved to be key to achieve peak performance.

Limitations

Most studies focus on male athletes that perform individual sports. There is limited research on the effects of better sleep on team sport players. The influence of sleep in the group of female athletes and their challenges in maintaining quality sleep are also not researched enough. The intervention studies have small sample sizes which may influence the results of the research. There might be additional influence of factors not included in the studies of sleep and sleep interventions, such a dietary choices and individual stress of an athlete's which could disrupt the analyzed studies.

Conclusions

This systematic review focuses on the fundamental role of sleep in enhancing athletic performance. Sleep is as vital as training and nutrition for athletic success. Optimal sleep accelerates recovery, reduces injury risk and improves endurance, strength and reaction times. Sleep deprivation on the other hand results in impaired physical and cognitive functions of athletes, making it harder to perform well in sport competitions. Prioritizing sleep and incorporating sleep interventions may be of help for athletes to achieve better sleep quality and therefore improving their performance.

There is a need for future research to address the overlooked group of female athletes and team sports athletes. There is a field of dietary choices and cultural factors influencing sleep patterns that needs further research. Integrating sleep optimization into training plan might open a new direction for significant performance gains, while also supporting competitors' general well-being.

Future research should focus on individualized sleep interventions and their impact across diverse sports disciplines. These studies could lead athletes to achieving new records and maximizing their performance.

In this review it is highlighted that sleep is an active contributor to athletic excellence and should be treated as such, not just as a passive recovery process that could be overlooked in the name of more training hours. It is important that coaches and sports medicine

physicians prioritize sleep hygiene education and strategies to ensure athletes' adequate sleep. It might just be the missing piece to achieving individual peak performance.

Disclosure

Author's contribution

Conceptualization, Julia Białeta and Katarzyna Rowińska; methodology, Michalina Jurkiewicz; software, Agnieszka Napieralska; check, Wiktoria Pysiewicz, Wiktor Garbarczyk and Alicja Cernohorska; formal analysis, Albert Kapla; investigation, Daria Bednarczyk; resources, Michalina Jurkiewicz; data curation, Agnieszka Napieralska; writing - rough preparation, Julia Białeta; writing - review and editing, Julia Białeta, Karolina Siembab; visualization, Katarzyna Rowińska; supervision, Julia Białeta; project administration, Karolina Siembab.

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