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Review Article

The Effect of Exercise on Sleep – A Literature Review

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ABSTRACT

Background: Sleep is essential for physical recovery, cognitive function, emotional regulation, and cardiometabolic health. Poor sleep quality and insufficient sleep are increasingly common and are associated with sedentary behavior, stress, obesity, chronic disease, and impaired wellbeing. Exercise is a promising non-pharmacological strategy for improving sleep, but evidence varies by exercise type, intensity, timing, and population. Objective: This narrative review aimed to synthesize evidence on the effects of exercise on sleep quality, sleep duration, sleep onset, sleep architecture, and sleep-related symptoms across healthy and clinical populations. Methods: A narrative literature review was conducted using studies examining physical activity, aerobic exercise, resistance training, aquatic exercise, Nordic walking, yoga, Tai Chi, Baduanjin, and combined exercise programs in relation to sleep outcomes. Evidence was synthesized thematically according to exercise modality, population characteristics, physiological mechanisms, and sleep-related outcomes. No meta-analysis was performed because of heterogeneity in study designs, interventions, and outcome measures. Results: The reviewed evidence suggests that regular exercise is generally associated with improved sleep quality, longer sleep duration, reduced sleep latency, and favorable changes in sleep architecture. Aerobic and endurance exercise improved sleep continuity, resistance training enhanced subjective sleep quality, and aquatic and mind-body exercises appeared beneficial for older adults and individuals with physical limitations. Exercise also showed positive effects in anxiety patients, breast cancer patients, overweight or obese individuals, and people undergoing tobacco withdrawal. Conclusion: Exercise is a safe and clinically relevant non-pharmacological approach for improving sleep. However, further controlled studies are needed to define optimal exercise type, timing, intensity, and dose for specific populations. Keywords: Exercise; Sleep Quality; Physical Activity; Insomnia; Aerobic Exercise; Resistance Training; Sleep Architecture; Narrative Review.

INTRODUCTION

Sleep is a fundamental physiological process required for physical recovery, cognitive function, emotional regulation, metabolic stability, immune competence, and overall health. Adequate sleep allows the body to restore homeostasis, consolidate memory, regulate neuroendocrine activity, and maintain cardiovascular and psychological wellbeing. In contrast, insufficient or poor-quality sleep is associated with fatigue, impaired concentration, mood disturbance, reduced physical performance, cardiometabolic dysfunction, and increased risk of chronic disease. Although sleep duration is commonly emphasized, sleep quality, continuity, latency, efficiency, and sleep architecture are equally important indicators of restorative sleep.

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In recent decades, sleep disturbance has become increasingly common because of sedentary lifestyles, psychosocial stress, excessive screen exposure, irregular work schedules, poor dietary patterns, and reduced physical activity. Pharmacological sleep aids may provide short-term symptom relief, but their use is limited by cost, adverse effects, dependence risk, and concerns regarding long-term safety. Therefore, non-pharmacological interventions that are safe, accessible, and sustainable have gained increasing attention in sleep health promotion. Among these approaches, exercise is particularly important because it improves multiple physiological systems simultaneously, including cardiovascular fitness, autonomic regulation, metabolic control, musculoskeletal function, mood, and stress modulation.

Exercise may influence sleep through several interconnected mechanisms. Regular physical activity can increase total energy expenditure, improve thermoregulation, reduce anxiety and depressive symptoms, enhance circadian rhythm stability, and support autonomic balance. It may also promote deeper sleep by increasing homeostatic sleep pressure and improving physical fatigue in a controlled and adaptive manner. Different forms of exercise, including aerobic training, resistance exercise, aquatic exercise, yoga, Tai Chi, Baduanjin, Nordic walking, and combined exercise programs, have been investigated in relation to sleep outcomes across healthy adults, older adults, overweight and obese individuals, patients with anxiety, women with breast cancer, postmenopausal women, and individuals undergoing tobacco withdrawal.

Despite the expanding evidence base, findings remain heterogeneous because studies differ in exercise type, intensity, timing, frequency, population characteristics, sleep assessment tools, and duration of follow-up. Some studies suggest that moderate and vigorous exercise improve sleep quality and duration, whereas others indicate limited effects on sleep latency, night waking, or specific sleep architecture parameters. Moreover, the influence of exercise timing remains clinically relevant, as morning or daytime exercise may support sleep regulation, while vigorous late-night activity may disturb autonomic and thermoregulatory recovery in some individuals. These variations make it necessary to synthesize the available literature in a structured narrative form.

This narrative review therefore aims to synthesize existing evidence on the effects of exercise on sleep quality, sleep duration, sleep architecture, and sleep-related symptoms across healthy and clinical populations. It also examines how different exercise modalities, intensity levels, timing patterns, and population characteristics may influence sleep outcomes. By integrating physiological mechanisms with clinical evidence, this review seeks to clarify the role of exercise as a practical, non-pharmacological strategy for improving sleep health.

MATERIALS AND METHODS

This article was designed as a narrative literature review to synthesize evidence on the relationship between exercise and sleep. A narrative approach was considered appropriate because the topic includes diverse exercise modalities, heterogeneous populations, varied sleep outcomes, and different study designs, making conceptual and thematic synthesis more suitable than pooled quantitative analysis. The review focused on studies examining the influence of physical activity, structured exercise, aerobic training, resistance exercise, aquatic exercise, mind-body exercise, and lifestyle-based activity on sleep quality, sleep duration, sleep latency, sleep efficiency, sleep architecture, insomnia symptoms, and sleep-related wellbeing.

Relevant literature was identified through searches of major biomedical and academic databases, including PubMed/MEDLINE, Google Scholar, ScienceDirect, and other accessible journal sources. Search terms were developed around three core concepts: exercise, sleep, and target populations. Keywords included “exercise,” “physical activity,” “aerobic exercise,” “resistance training,” “aquatic exercise,” “yoga,” “Tai Chi,” “Baduanjin,” “Nordic walking,” “sleep quality,” “sleep duration,” “sleep

architecture," "sleep latency," "insomnia," "older adults," "obesity," "anxiety," "breast cancer," and "tobacco withdrawal." Reference lists of relevant articles were also reviewed to identify additional studies.

Studies were considered relevant if they examined the relationship between exercise or physical activity and sleep-related outcomes in healthy individuals or clinical populations. Randomized controlled trials, observational studies, pilot studies, systematic reviews, and relevant narrative reviews were included where they contributed clinically meaningful evidence to the topic. Articles were prioritized when they reported specific exercise characteristics, sleep outcomes, population details, and measurable findings. Studies focusing exclusively on pharmacological sleep interventions, unrelated lifestyle exposures, or populations without exercise-related outcomes were not emphasized.

The selected literature was synthesized thematically rather than statistically. Evidence was organized according to major conceptual areas, including sleep physiology, central nervous system responses to exercise, endurance and strength training, aquatic exercise, resistance training, exercise intensity, aerobic and anaerobic exercise, mind-body exercise, exercise timing, diet-exercise interactions, and clinical populations such as older adults, individuals with anxiety, breast cancer patients, overweight or obese adults, and people undergoing tobacco withdrawal. Because this was a narrative review, no formal meta-analysis, pooled effect estimation, or risk-of-bias scoring was performed. However, greater interpretive weight was given to randomized trials, systematic reviews, and studies with clearly defined exercise protocols and sleep outcomes.

The synthesis was developed to distinguish consistent findings from areas of uncertainty. Claims were interpreted cautiously where evidence came from small samples, short intervention periods, subjective sleep measures, or heterogeneous exercise protocols. The review also considered potential mechanisms linking exercise to sleep, including improved autonomic regulation, thermoregulation, psychological stress reduction, circadian rhythm stabilization, enhanced physical conditioning, and improved metabolic function. Final interpretation focused on clinical relevance, practical implications, and evidence gaps requiring further controlled research.

RESULTS

The reviewed literature shows a generally positive association between exercise and sleep outcomes across healthy adults, older adults, overweight or obese individuals, anxiety patients, breast cancer patients, adolescents, and individuals undergoing tobacco withdrawal. Because the included studies varied in design, population, exercise modality, intervention duration, and sleep assessment method, the findings were synthesized narratively rather than statistically. Overall, regular physical activity, aerobic exercise, resistance training, aquatic exercise, Nordic walking, and combined exercise programs were associated with improvements in sleep quality, sleep duration, sleep onset, or sleep architecture.

This evidence suggests that exercise timing and intensity may influence sleep outcomes. Daytime and morning exercise appeared more favorable for improving sleep architecture and overall sleep quality, while vigorous late-night exercise may produce less consistent effects because of physiological arousal, increased heart rate, and altered body temperature regulation. Both aerobic and anaerobic exercise improved sleep quality in non-athlete men, while moderate-to-vigorous exercise was associated with more regular sleep patterns among overweight and obese individuals. Resistance training also demonstrated beneficial effects, particularly among inactive individuals and those with sleep disturbance linked to anxiety or depression.

Low-impact and mind-body exercise interventions were particularly relevant for older adults and populations with physical limitations. Aquatic exercise improved sleep quality and duration in older adults with mild sleep impairment, likely because it enables safe movement with reduced joint loading and lower fear of falling. Nordic walking and sleep education improved sleep complaints among adults,

and studies on yoga, Tai Chi, and Baduanjin also suggest potential benefits for sleep quality through combined effects on physical activity, relaxation, breathing control, and autonomic regulation.

Clinical populations also benefited from exercise-based approaches. Among breast cancer patients, higher-dose aerobic exercise showed better sleep-related effects than standard aerobic exercise, while exercise during radiotherapy was reported to reduce pain-related sleep problems. In anxiety patients, both aerobic and resistance exercise were associated with improved sleep and fewer night-time awakenings. Exercise also improved sleep onset among individuals undergoing tobacco withdrawal, suggesting a role for physical activity in behavioral support and rehabilitation programs.

Diet and body composition appeared to interact with sleep outcomes. Studies included in the review indicated that short sleep duration, high caloric intake, fat consumption, obesity, and low physical activity may be interrelated. However, the direction of this relationship remains uncertain because poor sleep may influence eating behavior, while diet, obesity, and inactivity may also worsen sleep. Therefore, exercise should be interpreted as one component of a broader lifestyle approach to sleep improvement.

Table 1. Chronological Summary of Studies on Exercise and Sleep

Researcher Name	Year	Research Type	Topic	Research Sample Size	RESULTS
Walker et al.	1978	Quantitative	Effects of exercise on sleep	10 runners	Exercise was associated with reduced rapid eye movement sleep in runners compared with non-runners.
Youngstedt et al.	1997	Quantitative synthesis	Effects of acute exercise on sleep	401 subjects	Acute exercise produced small-to-moderate effects on REM sleep, total sleep time, and slow-wave sleep.
Sherrill, Kotchou, and Quan	1998	Quantitative	Association between physical activity and sleep disorders	319 men and 403 women	Regular exercise was reported to be useful for therapeutic management of sleep problems.
Grove, Wilkinson, Dawson, Eastwood, and Heard	2006	Quantitative	Effects of exercise on sleep during tobacco withdrawal	Females	Exercise improved sleep onset among individuals undergoing tobacco withdrawal.
Guo et al.	2010	Quantitative	Relationship between dietary intake and sleep	459 females	Total fat intake was negatively associated with sleep.
Carandente et al.	2011	Quantitative	Effect of exercise on night sleep	15 males	Exercise made it easier to fall asleep, lengthened overall sleep time, and improved sleep problems.
Fairbrother	2011	Quantitative	Effects of aerobic exercise timing on sleep architecture	13 participants; 4 males and 7 females reported in manuscript	Morning aerobic exercise was associated with better sleep patterns.
Uchida et al.	2012	Literature review	Effects of exercise on sleep physiology	Not applicable	Exercise affected sleep physiology; daytime exercise enhanced sleep timing and quality.
Awad, Drescher, Malhotra, Quan, and Breathing	2013	Quantitative	Effects of exercise and nutrition on sleep	319 children	Exercise and nutrition increased stage 2 sleep; high fat intake decreased REM sleep in girls.
Courneya et al.	2014	Quantitative	Effect of exercise on sleep in breast cancer patients	301 females	High-level aerobic exercise produced better sleep-related outcomes than combined exercise; standard aerobic exercise was less helpful.
Alley	2014	Quantitative	Effects of resistance exercise timing on sleep architecture	Pre-hypertensive non-smokers aged 18–25 years	Resistance exercise was beneficial for individuals with sleep apnea, anxiety, or depression.
Daskalaki et al.	2014	Quantitative	Effects of endurance and strength exercise on sleep quality	15 participants	Exercise improved sleep quality.

Researcher Name	Year	Research Type	Topic	Research Sample Size	RESULTS
Herring, Kline, and O'Connor	2015	Quantitative	Effect of exercise on sleep in anxiety patients	26 females	Exercise improved sleep among women with anxiety.
Erlacher, Erlacher, and Schredl	2015	Quantitative	Nordic walking and sleep quality	98 volunteers	Greater step counts were associated with better sleep quality.
Chen, Fox, Ku, and Chang	2016	Quantitative	Effects of aquatic exercise on sleep in older adults	67 older adults	Aquatic exercise had a noteworthy positive effect on sleep quality and duration.
Kianian, Navidia, Aghamohamadi, and Saber	2017	Quantitative	Comparison of aerobic and anaerobic exercise for sleep quality	90 non-athlete men	Aerobic and anaerobic exercise were both helpful for improving sleep quality.
Quist et al.	2019	Quantitative	Effects of exercise domain and intensity on sleep in overweight and obese individuals	130 overweight and grade 1 obese participants	Sleep cycles were more regular and normal among participants performing moderate-to-vigorous exercise.
Polito et al.	2019	Quantitative	Effects of resistance training on sleep quality	30 participants	Resistance training improved sleep quality.

Taken together, the results indicate that exercise is a clinically relevant and low-risk non-pharmacological strategy for improving sleep. The strongest and most consistent benefits were observed when exercise was performed regularly, adapted to the individual's physical capacity, and incorporated into a broader healthy lifestyle pattern. However, because the reviewed literature includes heterogeneous populations, small sample sizes in several studies, varied intervention protocols, and mostly narrative or subjective sleep outcomes, the findings should be interpreted cautiously. Future studies should use standardized sleep assessment tools, clearly defined exercise prescriptions, longer follow-up periods, and population-specific intervention protocols to determine the optimal exercise type, intensity, timing, and dose for sleep improvement.

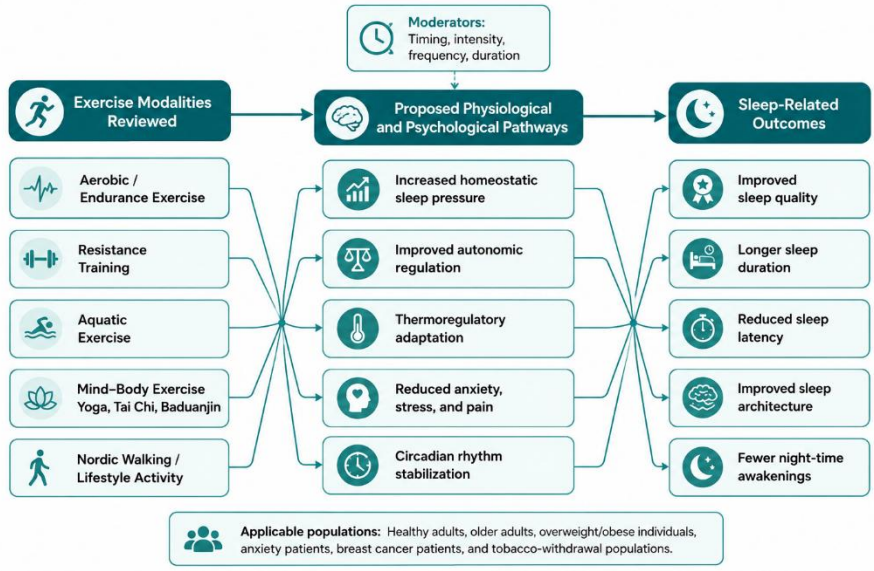

Figure 1. Conceptual synthesis of exercise-related pathways influencing sleep outcomes in the narrative review.

The figure illustrates the relationship between different exercise modalities and sleep-related outcomes through proposed physiological and psychological mechanisms. Aerobic and endurance exercise, resistance training, aquatic exercise, mind-body exercise, and Nordic walking/lifestyle activity are shown as the primary exercise approaches identified in the reviewed literature. These modalities may influence sleep through several interconnected pathways, including increased homeostatic sleep pressure, improved autonomic regulation, thermoregulatory adaptation, reduction of anxiety and pain, and stabilization of circadian rhythm. These mechanisms collectively contribute to improved sleep quality, longer sleep duration, reduced sleep latency, improved sleep architecture, and fewer night-time awakenings. The figure also highlights important moderating factors such as exercise timing, intensity, frequency, and duration, which may alter the magnitude of sleep-related effects. The conceptual

framework demonstrates that exercise-based interventions may be beneficial across diverse populations, including healthy adults, older adults, overweight or obese individuals, anxiety patients, breast cancer patients, and individuals undergoing tobacco withdrawal.

DISCUSSION

This narrative review synthesized evidence on the relationship between exercise and sleep across healthy individuals and clinical populations. Overall, the reviewed studies suggest that regular physical activity and structured exercise are generally associated with improvements in sleep quality, sleep duration, sleep onset, and selected aspects of sleep architecture. The evidence was most consistent for aerobic exercise, resistance training, aquatic exercise, Nordic walking, and mind-body approaches such as yoga, Tai Chi, and Baduanjin. These benefits appear to occur through multiple interacting mechanisms, including increased homeostatic sleep pressure, improved autonomic regulation, thermoregulatory adaptation, reduction of anxiety and pain, and stabilization of circadian rhythm.

The findings support exercise as a practical non-pharmacological approach for sleep improvement, particularly because it may address both physiological and psychological contributors to poor sleep. Aerobic and endurance-based exercise showed beneficial effects on sleep continuity and total sleep time, while resistance training was associated with improved subjective sleep quality among inactive individuals and those with anxiety-related sleep complaints. Low-impact interventions, including aquatic exercise and Nordic walking, appeared especially relevant for older adults because they offer safer modes of activity while still supporting sleep-related benefits. In breast cancer patients, exercise may contribute to better sleep by reducing pain, fatigue, and treatment-related distress, while in tobacco withdrawal populations it may improve sleep onset and reduce withdrawal-associated restlessness.

However, the evidence should be interpreted cautiously because the reviewed studies varied substantially in exercise mode, frequency, intensity, intervention duration, participant characteristics, and sleep outcome measurement. Some studies used subjective sleep quality scales, whereas others examined physiological sleep architecture, making direct comparison difficult. The timing of exercise also remains an important unresolved issue. Although morning and daytime exercise appear more consistently beneficial, vigorous late-night exercise may increase physiological arousal in some individuals and could interfere with sleep onset. Therefore, exercise prescriptions for sleep improvement should be individualized according to age, health status, baseline fitness, comorbidities, and tolerance.

This review has several limitations. As a narrative review, it did not use formal systematic screening, risk-of-bias scoring, or pooled statistical synthesis. Therefore, selection bias and evidence heterogeneity may influence interpretation. Several included studies had small sample sizes, short follow-up periods, or limited reporting of exercise dose and adherence. In addition, the available evidence does not clearly establish the optimal exercise type, timing, intensity, or duration for specific sleep problems. Future studies should use standardized sleep assessment tools, clearly defined exercise protocols, longer follow-up periods, and population-specific intervention designs. Comparative trials evaluating aerobic exercise, resistance training, mind-body exercise, and combined programs would be especially useful for developing clinically applicable exercise prescriptions for sleep health.

CONCLUSION

Exercise appears to be a safe, accessible, and clinically meaningful non-pharmacological strategy for improving sleep quality, sleep duration, sleep onset, and selected aspects of sleep architecture. The reviewed evidence suggests that aerobic exercise, resistance training, aquatic exercise, Nordic walking, and mind-body exercises may benefit both healthy and clinical populations when performed regularly and adapted to individual capacity. Although findings are generally favorable, heterogeneity across studies limits definitive conclusions regarding the optimal exercise dose, timing, and modality. Future

high-quality controlled studies are needed to develop precise, population-specific exercise recommendations for sleep improvement.

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