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# EFFECTS OF DIFFERENT TYPES OF PHYSICAL EXERCISE ON SLEEP QUALITY OF DIFFERENT INDIVIDUALS: A LITERATURE REVIEW

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## ABSTRACT

**Research objectives:** Sleep disturbances, including insomnia, are unfortunately a common occurrence among adults, negatively impacting various aspects of their physical and mental health. Available pharmacotherapy is restricted by adverse effects and limited safety of long-term usage. Consequently, interest in non-pharmacological approach including physical exercise intervention has increased. This work aims to review research published since 2018 on the topic of effects of physical exercise on sleep quality in adults.

**Methods:** PubMed, ResearchGate, MDPI, and Google Scholar were searched for RCTs, reviews, systematic reviews or meta-analyses in English, published between 2018 and 2025. Studies on children, with small populations or lacking interventions were excluded.

**Key findings:** Regular physical exercise, particularly aerobic exercise or resistance training, improved subjective sleep quality and reduced insomnia severity, among its other positive effects. Physical exercise of moderate intensity, with the duration of 30-60 minutes, conducted 3-5 times a week for 8-12 weeks proved to be most effective in the context of improving sleep quality. Moreover, some of other types of physical exercise were more beneficial for specific populations and resulted in additional health benefits.

**Conclusions:** Current evidence supports regular physical exercise as safe, easily accessible, and effective intervention for improving sleep quality in adult population. Future research should focus on broader utilization of objective methods of sleep quality measures, standardizing exercise protocol for the best effect, further exploration of indirect pathways of interaction between sleep quality and physical activity, effects of different combinations of approaches in treating insomnia, and long-term follow up of the interventions.

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## KEYWORDS

Sleep Quality, Insomnia, Exercise, Physical Activity, PSQI, Sleep

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### Introduction:

Sleep quality is one of the key factors necessary to optimal physical and psychological functioning. Generally, inadequate sleep quantity and/or poor sleep quality can impair multiple physiological processes in human body leading to diseases and poor health outcomes [1]. Unfortunately, sleep disturbances, including insomnia, are prevalent in adult population and contribute to decrease in overall life quality [2], as well as increased risk of hypertension, metabolic dysregulation, cardiovascular disease, impaired glucose tolerance, cognitive decline, obesity and depression [3]. Chronic insomnia affects up to one third of adults, whereas more transient sleep disturbances occur in about half of the population [2,4].

Short-term symptom reduction is effective and made possible by available pharmacological treatments that involve numerous different medications. However, this approach is bound by the considerable limitations, namely adverse effects of the medications, buildup of tolerance, risk of developing dependence and addiction to prescribed medication. Consequently, strategies that involve non-pharmacological approaches are becoming increasingly more recommended as first-line interventions.

Non-pharmacological strategies involve, among others, cognitive behavioral therapy, mindfulness-based stress reduction, both of which are believed to improve quality of sleep indirectly, by improving mental health first [5], sleep hygiene education [6], and of course physical exercise intervention, that can be recommended as a separate approach or in addition to a different one, working in combination to improve quality of sleep [5]. Physical exercise is becoming one of the more promising strategies. Regular physical activity has been linked to improvement in the terms of quality of sleep, reduced sleep latency, greater sleep

efficiency and a decreased daytime sleepiness [5,7], in addition to general physical health related benefits, typically associated with physical activity.

The main objective of this review is to research studies published from 2018 to 2025, covering the topic of effects of physical exercise intervention on quality of sleep in various adult populations. It further seeks to outline main physiological mechanisms and identify the limitations and gaps of current available literature.

### Review Methods:

This review was conducted by browsing PubMed, ResearchGate, MDPI, and Google Scholar databases. The search window covered literature published during and after 2018 up to December 2025. Keywords, that were used in the search, consisted of following terms: “exercise”, “physical activity”, “physical exercise”, “sleep quality”, “quality of sleep”, “insomnia”, “PSQI”, “ISI”, “ESS”, “sleep efficiency”, “sleep latency”, “meta-analysis”, “RCT”, “polysomnography”, “actigraphy”, as well as their combinations using Boolean operators.

Primary inclusion criteria, that were applied, were as follows: publication type of randomized controlled trial, review, systematic review or meta-analysis, with adult participants. Only publications in English language were included. Studies were excluded if they involved only children or adolescents, lacked an physical exercise intervention or involved very narrow clinical populations, limiting their generalizability.

### Description of the State of Knowledge:

Sleep is fundamental biological process, and in adequate quantity and good quality is known to promote important, neurological processes such as consolidation of memory or acquired knowledge, while simultaneously allowing the physical body to regenerate [3]. Sleep quality can be defined as an individual’s self-satisfaction with all the aspects of their sleep experience. Four attributes of sleep quality are: sleep efficiency, sleep latency, sleep duration, and wake after sleep onset [1]. Sleep quality is one of the most significant predictors of sleep status as a whole. Sleep disorders disrupt normal sleep pattern, affect sleep quality, and may cause daytime impairments. Table 1. summarizes common sleep disorders/issues, and corresponding features, that the broad umbrella term “Difficulty Sleeping” encompasses.

**Table 1.** Sleep Disorders That Cause or May Present as “Difficulty Sleeping” [4].

Disorder/Issue	Common features
Isolated symptoms/Normal variants	
Short sleeper (needs <6 h of sleep)	Sleep time is routinely short Feels rested during the day
Excessive time in bed	Spends time awake in bed trying to sleep Feels rested during the day
Insomnia disorder	
Chronic insomnia disorder	Difficulty initiating/maintaining sleep in favorable sleep conditions Daytime impairment Not better explained by another diagnosis Can coexist with medical and psychiatric conditions as well as with other sleep disorders
Short-term insomnia disorder	
Other insomnia disorder	
Sleep disorders	
Circadian rhythm sleep-wake disorders, including: Jet lag Delayed sleep-wake phase disorder - “night owl” Advanced sleep-wake phase disorder - “early bird” Shift work disorder Non-24 sleep-wake disorder Irregular sleep-wake rhythm disorder	Mismatch between actual sleep time and socially acceptable/desired sleep times Difficulty falling/being asleep at desired times, but can sleep at other times Excessive daytime sleepiness

Obstructive sleep apnea	Short sleep latency Unrefreshing sleep and/or repeated short awakenings Nocturia Loud or habitual snoring Gasping or choking during sleep Dry mouth and/or headache upon awakening Daytime sleepiness or fatigue
Movement disorders	
Restless legs syndrome	Urge to move the limbs (usually legs) Usually accompanied by or attributed to uncomfortable and unpleasant sensations in the affected limbs Occurs or is predominant in the evening or night Occurs or worsens with inactivity Improves with movement Not better explained by another diagnosis
Periodic limb movement disorder	Repetitive movement of limbs (usually legs) during sleep Not associated with another sleep disorder on polysomnography
Narcolepsy	Unrefreshing or disrupted sleep Excessive daytime sleepiness; unplanned sleep Cataplexy Hypnagogic and/or hypnopompic hallucinations Sleep paralysis

Insomnia, which is described as chronic decrease in quality of sleep and/or its quantity, persistent issues with falling asleep, waking up too early in the morning, or sleep fragmentation [2], a situation when frequent repeated awakenings during the night make phases of deep, regenerative sleep inaccessible. Insomnia is the most common problem with sleep quality [3], and is even more widespread among populations of the elderly, women, and individuals already burdened with mental or physical health conditions [2]. Moreover, sleep may be disturbed by many underlying medical or psychiatric conditions [4]. Table 2. presents conditions that may disturb sleep and affect sleep quality along with organ system that is affected. It is important to rule out any potentially treatable conditions that disturb sleep, as with their treatment, poor sleep quality, which in those cases is secondary to said conditions, may also improve.

**Table 2.** Conditions potentially disturbing sleep [4].

Affected Organ System	Exemplary conditions
Cardiac	Arrhythmias Congestive heart failure
Pulmonary	Asthma Chronic obstructive lung disease Neuromuscular diseases of chest wall and/or diaphragm
Gastrointestinal	Gastroesophageal reflux disease* Hepatic encephalopathy
Musculoskeletal	Arthritis Fibromyalgia* Nocturnal leg cramps
Neurologic	Dementia Epilepsy* Migraine and other headache disorders* Neurodegenerative diseases

Psychiatric*	Anxiety disorders Bipolar disorders (manic phase) Depressive disorders Posttraumatic stress disorder
Endocrine	Hyperthyroidism Menopause
Dermatologic	Pruritic skin conditions Medical conditions causing pruritus
Urologic	Benign prostatic hypertrophy Overactive bladder

Physical activity can be defined as body movement of any form that requires muscle contractions. Physical health improves when the energy expenditure during the physical activity exceeds energy expenditure during resting time [3]. Physical activity, including exercises, influences sleep in multitude of different ways. There are multiple proposed explanations of the mechanisms, that allow this relationship between physical activity and quality of sleep to exist. Some suggest that insomnia can be exacerbated by an increase in levels of pro-inflammatory cytokines [6]. Physical exercise helps to restore stable circadian rhythm by increasing the production of melatonin [8], hormone that regulates it. Consequently, proper and stable circadian rhythm decreases elevated levels of those cytokines [6]. Furthermore, increased production of melatonin, the result of physical activity, can assist in shortening sleep latency, that is the time it takes to fall asleep after completely truing the lights off [2]. Another proposed mechanism associates physical activity with sunlight exposure, which may improve metabolic capacity, alleviate stress and anxiety [6], factors that are contributing to poor sleep quality. Physical exercise is also thought to improve sleep quality by increasing energy expenditure, increasing endorphin production [2,9], which can translate to lower stress and anxiety, resulting in subsequent relaxation and better sleep quality [2], stimulating release of serotonin and norepinephrine, neurotransmitters involved in mood regulation, relaxation, possibly improving sleep latency [2], and helping to regulate body temperature changes [2,6]. Furthermore, sweating after the physical exercise may decrease appetite peptide levels, the role of which is to maintain arousal and participate in the immune response. Thus, decreased levels of appetite peptides may translate to decreased arousal, sleep promotion and anti-insomnia effects [9]. While moderate intensity of physical activity has a positive effect on sleep quality, high-intensity physical activities were mainly found to negatively impact quality of sleep and making falling asleep harder [2]. Which indicates that intensity is an important factor influencing the effects of physical activity on sleep quality [2]. The time of exercise also plays a role in influencing its outcomes, nighttime activity, especially high-intensity interval training conducted within three hours before bedtime, can decrease quality of sleep [2]. However, this aspect additionally depends on the degree of endurance that body is used to, duration of exercise, and its type [2]. Some individuals might even benefit from certain evening exercises depending on combination of specific conditions and personal traits [2], so a more tailored and personal approach should be preferred, as not every physical exercise influences every individual the same.

Stress can severely impair the quality of sleep, make falling asleep harder/longer or lead to sleep fragmentation [2]. Physical activity by itself can also prove helpful in reducing stress, controlling depression and anxiety, increasing serotonin levels in central nervous system, and improving general systemic immunity [3], indirectly increasing the quality of sleep in through those pathways [2], as quality of sleep and mental health are deemed inseparable [5,10].

Xie and coauthors conducted a systematic review and meta-analysis of 22 randomized controlled trial studies concerning the effects of physical exercise on sleep quality and insomnia, with numerous participants of adult age across various age groups and genders. Physical exercise interventions consisted of aerobic exercises, resistance training and mind-body practices of varying durations. The study revealed a pooled reduction in Pittsburgh Sleep Quality Index (PSQI) scores, which was accompanied by improvement in Insomnia Severity Index (ISI) and reduction of daytime sleepiness on Epworth Sleepiness Scale (ESS). Improvements were most visible in participants suffering from insomnia, and those with poor sleep quality. While the improvements were evident in subjective measures, physiological sleep quality evaluated objectively by actigraphy, did not show significant improvement of physiological parameters of sleep [7]. The authors report that validated questionnaires, that are used to measure sleep quality take into account additional

important factors that contribute to sleep quality as a whole, one example of such factor might be daytime impairment. Exercise intervention could potentially exert its positive influence on sleep quality through these additional factors, rather than impacting sleep parameters, that are measured by objective methods. Conflicting results between subjective and objective methods of sleep evaluation might be an effect of those “hidden” factors [7], which are not taken into account in objective measurement methods. Both physical exercise, as well as mind-body exercise could lead to an improvement of sleep quality. However it is proposed that mind-body exercise might influence sleep in different or additional ways not yet fully known, compared to “traditional” physical exercise, while also requiring relatively longer intervention time to increase sleep quality. Subgroup analyses shown that short term exercise intervention with the duration of three months or less seemed more effective in the betterment of sleep disturbances compared to interventions of longer durations, but given the variability of exercise types and their characteristics, it could not have been determined, that short-term exercise is more beneficial to sleep in general. Proposed physical exercise regimen performed on a regular basis, three to five times a week, with a certain set duration each time, is shown to be the most optimal choice in the terms of overall sleep quality improvements. According to a published trial, which was mentioned by authors, one day of moderate-to-vigorous exercise in comparison to a day without physical exercise at all, did not alter sleep parameters in any significant way [7]. That fact could lead to an assumption, that the changes physical exercise evokes in the human body in the context of sleep quality, do not happen immediately but occur with time and regular exercise regimen [7].

Amiri with colleagues analyzed 32 randomized controlled trial studies with participants of various ages and genders, excluding children, and found similar, positive effects of physical exercise intervention on sleep disturbances. Physical exercise significantly improved subjective quality of sleep, daytime sleepiness, lessened obstructive sleep apnea and restless legs syndrome symptoms severity, and is an effective intervention in the context of reducing severity of insomnia [5]. Authors propose that exercise improves sleep quality in multiple, various ways. They suggest that interventions such as cognitive behavioral therapy or mindfulness-based stress reduction approach, both of which are non-pharmacological therapies widely used in treatment of insomnia, are effective in improving sleep quality indirectly, and do so by improving mental health first [5]. Numerous studies have demonstrated that mental health is closely tied to sleep quality and this relationship can be reciprocal [5,10]. The positive effects of physical activity on sleep quality can indirectly lead to an improvement of mental health and further mutual positive influence. Moreover, physical activity is linked to improvements in many various, common and problematic aspects of general health, including life quality, lower back pain, depression, and anxiety [5]. Mentioned aspects can negatively impact good quality of sleep. Therefore, physical exercise intervention that is well attuned to individual needs, targeting particular, present, problematic aspects of given individual can further improve their sleep quality on a greater scale, by addressing multiple factors contributing to their poor quality of sleep [5]. Another finding of the study is that the duration of physical exercise intervention and its correlation with positive effects exerted on sleep quality varies and depends on the type of underlying sleep disorder [5].

In the population of obese individuals physical exercise intervention produces other, additional positive effects regarding daytime sleepiness, obstructive sleep apnea, and can help in reducing abnormal bodyweight of obese individuals, simultaneously targeting many different issues, potentially impeding sleep quality, that they may experience. Besides, obesity alone is associated with increased risk of sleepiness, obstructive sleep apnea, and insomnia itself [5].

Ka with others conducted systematic review and meta-analysis of randomized controlled trial studies, regarding the effects of physical exercise intervention on sleep quality and weight reduction in obese individuals. Indicating, that physical activity of moderate to high-intensity, particularly consisting of aerobic exercise regimen and resistance training, has resulted in the most pronounced positive effect on quality of sleep in obese population, when compared to other exercise types. In regards of other characteristics of intervention, physical exercise regimen with duration of at least thirty minutes, three to five times a week for twelve or more weeks, yielded the greatest benefits in the terms of sleep quality improvement in obese adults [11]. Additional positive effect of physical exercise intervention observed in obese population, is weight reduction, which can further improve quality of sleep. Study also found that interventions including nordic walking, with combined aerobic exercise and resistance training contributed the most to weight reduction in individuals with obesity [11].

Obstructive sleep apnea is regarded as a common comorbidity among obese individuals [12]. Adequate physical exercise intervention could reduce weight of obese individuals and thus might alleviate the symptoms accompanying obstructive sleep apnea in less severe cases [5]. Weight gain is considered an important factor in the pathogenesis of obstructive sleep apnea, because of associated worsened upper airway collapsibility

[12]. Furthermore, obesity itself is associated with higher risk of insomnia and daytime sleepiness [5]. Therefore, physical exercise intervention has strong potential in improving sleep quality, especially in adult individuals with obesity, by positively influencing quality of sleep directly and in more indirect way through weight reduction and improvement of obstructive sleep apnea symptoms, factors that may be contributing to poor sleep quality [5].

Gao and others concluded a network meta-analysis that compared different types of physical exercise and their effect on sleep quality in the population of middle-aged and older individuals. Aerobic exercise has been considered the most effective in improving sleep quality and sleep continuity in this population. Particularly, this type of exercise is the most effective in improving total PSQI score, latency of sleep and in diminishing the need to use sleep medication [9]. Exercise regimen recommended by authors, as most effective in overall, consists of eight to twelve weeks of aerobic exercise (such as walking, cycling, dancing) for the duration of thirty to sixty minutes, three to six days a week [9]. It is also worth mentioning that physical exercise intervention can serve as a standalone alternative or additional complementary approach to other therapy strategies that target poor sleep quality, however the topic of combined effects of different approaches and their outcomes on sleep quality requires more research. Secondly, in population of individuals already struggling with sleep disorders, yoga practice was found to be the most effective physical exercise intervention in the terms of improving given sleep disorder, increasing sleep efficiency, sleep duration and reducing daytime dysfunction. Yoga practice improves sleep disorder symptoms by concurrently increasing melatonin levels, decreasing hyperarousal that makes falling asleep harder, and targeting breathing and heart abnormalities associated with stress. Breathing methods used in yoga practice stimulate vagal nerve activity, normalize the activity of sympathetic nervous system, and increase parasympathetic nervous system tone, which manifests as increase in heart rate variability. Many of the poses (asanas) that are performed during yoga include elements of stretching that can reduce the tension accumulated in the body, this pathway of influence may mirror the technique of progressive muscle relaxation, one of non-pharmacological treatments useful in treatment of chronic insomnia [9]. All this combined with other positive characteristics of yoga, namely great accessibility, high safety, many different styles of yoga to choose from, and small space required to practice, paint yoga as an especially helpful approach in treating insomnia in the older population. This knowledge implies that perhaps a more tailored approach may be needed. Treating specific sleep complains with suitable exercise types, may yield even better results in the betterment of sleep quality [9].

Sleep disorders may emerge or worsen with advanced age [6]. Changes that occur in brains of elderly individuals with age can exacerbate preexisting issues with sleep quality or provoke new sleep disorders. Advanced age is linked to change in the sleep patterns, increased duration of more superficial phases of sleep, and decreased duration of deep sleep and REM phases. The production of melatonin, one of important sleep regulators is also decreased [13]. All those changes make the sleep less restorative for elderly adults compared to the other age groups. Additionally, older individuals suffer from various systemic diseases impacting sleep quality more frequently, that too can lead to worsened sleep quality in this population [6]. Mood disorders and physical illnesses are considered strong predictors of poor sleep quality in the elderly [7]. Prolonged or chronic sleep disturbances can accelerate physiological and pathological aging of the brain and increase risk of many neurological illnesses [7]. Additionally, the correlation between insomnia and the decrease in quality of life is most notable in the elderly age group [14]. Systematic and regular regimen of physical exercise is shown to improve perceived subjective quality of sleep in the elderly. Some propose that the effects of physical exercise intervention on daytime sleepiness of older adults depends on the time of day that the exercise took place, with the best time for physical activity being morning [6]. Physical exercise on regular basis, in the morning or early afternoon hours, elevates body temperature by a few degrees, and when the body regains its usual, lower temperature in the evening, drowsiness may occur, promoting sleep initiation [2,15]. Additionally, the brains cerebral cortex is presumed to be in somewhat inhibited state right after awakening in the morning. In this context, early morning physical exercise intervention can reduce this inhibition, making cerebral cortex more excitable and responsive, which helps in reducing daytime sleepiness in population consisting of older adult people [6].

The strength of influence that exercise exerts on insomnia is thought not to be determined by age, and thus physical exercise might be a viable method of alleviating insomnia symptoms in general population regardless of age [6]. Conversely, some postulate that the people of advanced age may be more susceptible to physical exercise intervention regarding quality of sleep, because of its mood-relief affects [7]. Which demonstrates that this issue requires more, in-depth research. Physical activity intervention is known to be beneficial to older adult individuals struggling with insomnia as well as those who do not. Moreover, physical

exercise increases total sleep time and decreases total time spent awake after initially falling asleep in the older individuals [9]. Therefore, physical exercise can be regarded as one of many tools used to enhance poor quality of sleep and the general health of elder population [14]. Another factor that may be taken into the consideration regarding physical exercise intervention, is that the baseline physical activity level of older individuals is an important variable influencing the effect of intervention [6], with older sedentary individuals achieving greater improvements compared to older individuals with higher baseline activity level [6]. However, research of this correlation is currently very limited and certainly needs expanding in the future works.

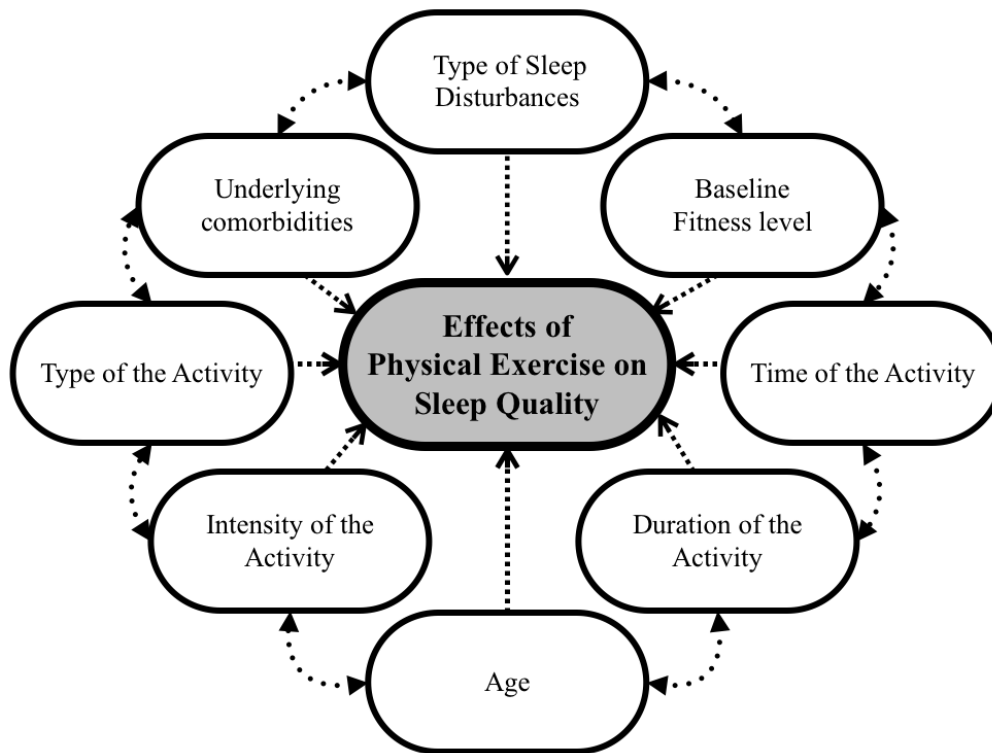
**Discussion:**

Overall, objective measures of sleep such as actigraphy or polysomnography were reported with lesser frequency and revealed weaker positive effect of physical exercise on sleep quality. This highlights the need for more trials that involve objective assessment of sleep. Actigraphy using various, available types of accelerometers can be used alternatively in objective physiological measurement of sleep quality in place of polysomnography as second-best option with seemingly better availability and lower cost and lower difficulty of implementation. Nevertheless, regular physical exercise regimen should be recommended as safe, low-cost, highly accessible, non-pharmacological intervention for adult individuals experiencing decreased quality of sleep or struggling with insomnia. It can be recommended as standalone intervention or alongside one of other interventions for the betterment of sleep quality. Future research on this topic should focus on more standardized exercise regimens, targeting specific underlying disorders and comorbidities with best suited exercise type, increase involvement of objective sleep measurement methods, assess long-term effects of physical exercise interventions, and finally explore indirect pathways of interaction between sleep and physical activity, as it can be helpful in achieving even better results of physical exercise intervention on sleep quality.

**Conclusion:**

Evidence demonstrates that regular physical exercise is healthy habit, which in addition to its more widely known benefits to general health and fitness, among many other positive effects, does certainly improve subjective quality of sleep in adults across all modalities, age groups and populations. In the cases of individuals struggling with insomnia, an adequate physical exercise intervention can reduce its severity.

Exercise type, intensity, and duration, among other factors, do influence the outcome of physical exercise intervention on quality of sleep. Additionally, underlying cause of sleep disorder and individual comorbidities also should play an important part in the decision of which type of physical exercise is the best suited for most optimal effects on sleep quality and general health improvements. For example, yoga could be recommended to older individuals struggling with poor sleep quality associated with stress and tension they experience as the most optimal exercise choice, given their specific situation. Exercise involving nordic walking may prove to be the more beneficial for obese individuals, and in cases like this, physical exercise intervention could lead to additional positive effects on general health of obese population through weight reduction. In the general population of adult people, regular moderate-intensity aerobic exercise, resistance training or mind-body practices performed for thirty to sixty minutes, three to five times a week, for at least eight to twelve weeks is the most optimal choice, that improved subjective sleep quality.



*Fig. 1. Factors that influence the effects of physical exercise on sleep quality.*

Mechanisms behind network of interactions between exercise and sleep are multifactorial and include psychological, thermoregulatory, endocrine, neurological, and metabolic pathways. Numerous different indirect pathways of influence that exercise exerts on sleep quality, seem to be dependent on the type, place, duration, and the time of exercise, and should be the target of future research into this topic.

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