REVIEW ARTICLE

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Physical Activity for Prevention and Management of Sleep Disturbances

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Physical activity can have both positive and negative effects on sleep depending on how it is practiced. Regular exercise and vigorous physical activity aid in maintaining a healthy life and preventing chronic diseases. Rather than looking for a specific exercise type to help fall asleep, it is better to encourage patients to find exercises that they can practice regularly in their daily lives. However, exercise guidelines for sleep disturbances based on clear evidence are still insufficient. Therefore, it is necessary to gain information on the correct physical activity methods for prevention/management of mild sleep disturbances. It is expected that many people can maintain physical, mental, and social health as well as prevent/manage mild sleep disturbances through regular exercise and vigorous physical activity.
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Sleep is an essential requirement for maintaining health and a high quality of life [1]. A condition in which a person does not get proper sleep, stays drowsy during the day despite sufficient sleep, or faces difficulties during sleep or while awake due to a disturbed sleep rhythm is called "sleep disturbance" [2]. Lifestyle factors that contribute to "unhealthy sleep" include overeating, caffeine intake, stress, smoking, drinking, and excessive physical activity [3-5]. Physical activity can have both positive and negative effects on sleep depending on how it is practiced; therefore, it is necessary to know the correct physical activity methods for prevention/management of mild sleep disturbances.

EFFECTS OF EXERCISE ON SLEEP

Sleep and physical activity interact physiologically and psychologically through multiple complex interactions. In general, physical activity is known to be beneficial for sleep health, but can be influenced by factors such as sex, age, fitness level, and exercise characteristics. Conversely, sleep disturbances can decrease exercise activity and increase the risk of exercise-related injuries [6].

Effects of Acute Exercise on Sleep

Regarding the effect of acute exercise on sleep, unlike chronic exercise, there were negative results on sleep depending on the time and intensity of the exercise. For example, exercise performed four to eight hours before bedtime has a negative effect on sleep [7-9]. However, recent studies have reported that moderate-to-high intensity exercise performed two to three hours

before bedtime does not adversely affect sleep and improves sleep onset latency (SOL) [10,11]. These results contradict existing sleep hygiene practices, which advise patients not to exercise for up to several hours before bedtime. Recently, the National Sleep Foundation's sleep hygiene recommendations have suggested that exercise at any time of the day is irrelevant to sleep [12]. Core body temperature decreases before bedtime, which promotes sleep [13]. It is known that when exercising, the core body temperature rises up to 2°C before sleep and then rapidly decreases, promoting sleep [13,14].

Effects of Chronic Exercise on Sleep

Regular exercise has been suggested as a non-pharmacological method for people with sleep disturbances [15]. In a meta-analysis study, regular exercise usually increased slow wave sleep and total sleep time and decreased rapid eye movement sleep, SOL, and wake time after sleep onset [7]. In addition, in adults and older adults with sleep problems, exercise has a positive effect on sleep quality and time to sleep [16,17]. Physical activity guidelines from the United States (US) Department of Health and Human Services also suggest that regular exercise and vigorous physical activity can advance the time of sleep and help improve sleep efficiency [18].

EFFECTS OF EXERCISE ON SLEEP DISORDERS

Insomnia

Insomnia is a condition involving symptoms such as difficulty falling asleep, waking up frequently during sleep, or waking up too early [19]. In general, exercise therapy is recommended as a method of treating insomnia [6]. In a study, insomnia was reduced in 64% of subjects when diet and exercise-related lifestyle management programs were provided for 10 hours per week for 4 weeks [20]. A meta-analysis of people with insomnia showed that the group exercising for an average of 10 to 16 weeks showed a positive Pittsburgh Sleep Quality Index compared to the control group, and the time to sleep and dose of sleep-related drugs were significantly reduced [16]. The US Department of Health and Human Services guidelines for physical activity also suggest that regular exercise can improve sleep health and reduce the use of sleep aids in people with insomnia [18].

Sleep Apnea

Sleep apnea refers to the repetition of a phenomenon in which breathing stops or decreases during sleep [21]. It is more common and has a more serious effect among men and people who are overweight or obese [22]. It has not been clarified whether exercise affects sleep apnea [6]. However, it is well known that regular exercise can help patients lose weight and reducing weight can improve sleep apnea [23]. The US Department of Health and Human Services guidelines also suggest that regular exercise may reduce the risk of excessive weight gain and positively affect the development of sleep apnea [18].

EFFECTS OF SLEEP ON PHYSICAL ACTIVITY AND EXERCISE

One study reported a negative correlation between insomnia symptoms and cardiopulmonary physical function [24]. This means that sleep disturbances and low physical function are related [25]. Adults with insomnia had less activity and lower cardiopulmonary physical function due to drowsiness or fatigue during the day than adults without insomnia [26].

People who sleep well feel less tired during the day and can participate in regular exercise [27]. Conversely, sleep disturbances increase fatigue throughout the day, reducing the likelihood of participating in exercise [24]. Athletes often suffer from sleep deprivation due to pre-match anxiety, demanding training levels, and international competition schedules, which can have a negative impact on athletic performance [28,29]. Insufficient sleep may impair the body's ability to recover and regain maximum power after strength training, and enough sleep can improve exercise-related factors such as coordination, response time, and speed [12].

As awareness of the importance of sleep increases, many studies have been conducted on the relationship between sleep and exercise. Although the exact mechanism has not been found, regular exercise and vigorous physical activity have been proved to help the amount and quality of sleep, and have a positive effect on people with sleep disturbances. However, exercise guidelines for sleep disturbances based on clear evidence are still insufficient. Therefore, in the future, studies with a large sample population considering age and health status and additional research using various exercise intervention methods are essential. It is expected that many people can maintain physical, mental, and social health as well as prevent/manage mild sleep disturbances through regular exercise and vigorous physical activity.

PHYSICAL ACTIVITY TO PREVENT AND IMPROVE SLEEP DISTURBANCES

Clear, consistent, evidence-based exercise guidelines for preventing and improving sleep disturbances have not yet been proposed. The US Department of Health and Human Services [18] and Korea Centers for Disease Control and Prevention [30] recommend a method of promoting physical activity for those who have difficulty exercising regularly owing to work characteristics or time constraints [31,32]. If it is impossible to exercise for 30 minutes, abandoning exercise completely is not advised. In this case, it is recommended that individuals increase time

spent on vigorous physical activity such as climbing stairs and walking in everyday life. In addition, medical staff should be trained to advise people to reduce sitting time and increase physical activity during the day. The sleep quality of people who sit for less than 8 hours a day is higher than those who sit for longer durations. If it is difficult for an individual to sit for less than 8 hours a day owing to the nature of his/her work, it is beneficial to educate staff about taking breaks to get up and move during work. If a person complaining of sleep disturbances does not engage in regular exercise, he/she should be trained to start light exercise, that is, walking for 10 minutes a day [33]. This can increase their chances of improving sleep. Starting with this small change, they may be able to help improve their sleep further by gradually engaging in more intense physical activities such as running and swimming.

Type of Exercise

Both aerobics and strength training have been shown to improve sleep [12]. Rather than looking for a specific exercise type to help to fall asleep, it is better to find an exercise that patients can practice regularly in their daily life. In other words, any exercise, such as walking, running, weight training, yoga, or pilates, can help them sleep consistently and regularly.

Amount of Exercise

In the past, exercise programs were set up by dividing exercise time, intensity, and frequency, but recently, these factors have been combined into one and used as the basis for the "exercise amount" considered [34]. The amount of exercise for preventing and improving sleep disturbances may vary depending on age and fitness level; therefore, a specific magic number has not been suggested. In general, the recommendation for adults and older adults is to practice medium-intensity physical activity 150 minutes per week or high-intensity physical activity 75 minutes per week [34]. If it is difficult to complete the exercise amount in one slot, it can be divided into multiple slots in an attempt to achieve the goals.

Timing of Exercise

As mentioned earlier, the recent sleep hygiene recommendations of the US Sleep Foundation suggest that exercising close to bedtime does not interfere with sleep and that exercise can be done at any time of the day [35]. Thus, it would be beneficial to educate people with sleep disturbances to choose a time period for regular exercise. However, there may be individual differences in the appropriate exercise time. Therefore, if physicians think that patients are disturbing their sleep by exercising late in the day, it is advisable for them to modify their schedule and exercise in the morning or afternoon and not in the evening. A study conducted in Korea reported that afternoon exercise was associated with a much better quality of sleep than was morning exercise [36].

PHYSICAL ACTIVITY MONITORING USING INFORMATION AND COMMUNICATIONS TECHNOLOGIES

One way to monitor how regularly people with sleep disturbances are physically active is to maintain an exercise diary. Recently, with the development of information and communications technologies (ICT), it has become possible to automatically record an individual's amount of physical activity through smartphone apps and various wearable devices [37,38]. It is possible to understand users' current physical activity levels and patterns. If users utilize these ICTs well, they can expect to reap the positive benefits of physical activity. Depending on the type of smartphone, it is possible to collect basic information about a user's amount of activity such as number of steps, exercise time, and standing time. When a specific wearable device is synchronized with the smartphone, it is possible to separately record the exercise type, calorie consumption, movement distance, and exercise start and end times. Based on the information collected through the application, users' activity can be evaluated and monitored. In addition to the amount of activity, the application can monitor sleep. Users can record bedtime, wake-up time, sleep time, and so on in a diary, and they can also check sleep trends through graphs. In this way, users can check whether their sleep changes when their activity changes. By looking at whether there is a change in the amount of activity when there is a change in sleep, users can utilize that information to determine the appropriate exercise duration, intensity, and time in relation to sleep.

CONCLUSION

It is important to plan the intensity and time of exercise that can be practiced regularly rather than attempting to engage in a lot of exercise at once. Previous research [24-26] has found a negative correlation between insomnia symptoms and cardiopulmonary function. People without regular exercise habits could start walking lightly for 10 minutes each day, which may improve their sleep. Regular exercise can also be used to prevent and manage sleep apnea by lowering the risk of excessive weight gain [18]. Regular exercise and vigorous physical activity can help maintain a healthy life and prevent chronic diseases. However, a consistent and clear exercise program has not been suggested according to the type or degree of sleep disturbance; instead, the existing programs only consist of simple recommendations. In the future, it will be necessary to establish evidence-based exercise programs for healthy sleep in consideration of various situations and characteristics of sleep disturbances.

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Conflicts of Interest

The authors have no financial conflicts of interest.

Authors' Contribution

Conceptualization: Jung AR. Funding acquisition: Kim HS. Investigation: Jung AR, Park JI. Project administration: Jung AR, Park JI. Resources: Jung AR. Supervision: Kim HS. Writing—original draft: Jung AR, Park JI. Writing—review & editing: Kim HS.

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