# Aerobic exercises relieve symptoms of primary chronic insomnia

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## Abstract

**Purpose:** The aim of the study was to evaluate the effect of moderate aerobic exercises on symptoms of chronic primary insomnia.

**Participants:** Twenty insomniac patients were included (age=35±5.42 yrs) and were divided into two equal groups (study and control).

**Methods:** Sleep duration and daytime symptoms were assessed before and after treatment by using a sleep diary and the Epworth Sleepiness Scale (ESS) respectively. Both groups received cognitive/behavioral and drug therapy. Additionally, patients of the study group were enrolled in a supervised structured moderate aerobic exercise program (30 min, three times/week for four weeks).

**Results**: The findings revealed significant increase in both the total number of sleep hours and ESS mean values in the study group compared to those of the control one after treatment ($p$=0.0001). Moreover, there was significant increase in the number of sleep hours in the study group at the fourth week compared to that at the second week of the intervention ($p$=0.02).

**Conclusion**: Moderate aerobic exercise was effective in improving symptoms of chronic primary insomnia and may be prescribed as an alternative treatment to drugs in the future.

**Key words:** Aerobic exercises, Sleep diary, Epworth Sleepiness Scale, Insomnia, Sleep disorders.

## Introduction

Insomnia-a common symptom caused by medical, behavioral, or psychological conditions-is defined as difficulty falling asleep, staying asleep, or having poor-quality or non-restorative sleep. Primary insomnia, as defined refers to a persistent sleep disturbance which is not connected to a current psychiatric or physical condition. Chronic insomnia occurs for at least three nights a week for one month or more. It is estimated to affect 10–19% of all individuals[1-4]. Insomnia interrupts the natural sleep cycle, which can be hard to restore. Sufferers typically complain of being unable to keep their eyes closed for more than few minutes at a time, or of tossing and turning in bed. Some insomniacs unwittingly perpetuate their complaint by napping in the late afternoon or early evening, leading to wakefulness at bedtime and more insomnia. Chronic insomnia may cause extensive sleep deprivation with deleterious effects to physical and mental health[5]. Consequences include mood disturbances, medication habituation, memory impairment, daytime fatigue, vocational and interpersonal difficulties, increased health care utilization, impaired health status[6-8]. Notwithstanding the variety of behavioral and medical options to treat insomnia, treatments are ultimately inefficient. In the current study, it was hypothesized that aerobic exercise-known to positively affect sleep quality-might be used as an efficacious alternative to drug therapy.

## Participants and Methods

### *Participants*

Twenty consecutive patients (19 females and one male) were selected from King Abdul-Aziz University Hospital and King Abdul-Aziz Medical City in Jeddah, Kingdom of Saudi Arabia. The duration of symptoms ranged from 1–4 years.

Inclusion criteria: Age ranged from 35–45 yrs and insomnia was primary and chronic (> one month).

Exclusion criteria: Pregnant and/or lactating women; restless leg syndrome, and subjects who were unable to be enrolled in the exercise program.

Written informed consent was obtained from subjects prior to the start of the study. Patients were randomly divided into two equal groups: study and control.

## Methods

### *Assessment*

#### *Clinical history and daytime sleepiness*

All patients were personally interviewed before and after treatment at the same daytime and rated according to Epworth Sleepiness Score (ESS)[9]. A score of 0–6 was suggestive of insomnia[10].

#### *Sleep diary*

Patients were given clear verbal instructions on how to use the sleep diary on the first day of their recruitment. The sleep diary is a useful tool to diagnose sleep disorders and to monitor the success of treatment. It is a record of an individual's sleep and waking hours with related information, usually for 4 weeks duration (appendix). It is self-reported or can be recorded by a caregiver[9,11]. In the present study, the sleep diary was filled out by each patient for one week (considered as pre treatment) and then during of the 2nd week and 4th week of intervention (considered as post-treatment).

#### *Treatment*

Medical treatment: Sedatives, tranquilizers, or anxiolytics was prescribed at the discretion of a physician specialized in sleep disorders. *Behavioral therapy:* Patients were instructed to follow environmental considerations such as maintaining a quiet, dark, relatively cool, well-ventilated, comfortable sleep environment. Also, avoidance of heavy evening meals, smoking, caffeine, or fluids prior to bedtime in order to reduce the potential effect of gastric discomfort in addition to avoidance of high caloric intake, stimulants, or full bladder. Miscellaneous considerations (sleep hygiene and stimulus control): Participants were also asked to establish regular sleep and waking up hours (including weekends and vacations), use the bed for sleep only (not for other activities such as reading and watching TV), avoid naps or spending excessive time in bed trying to fall sleep, and take a warm bath about 1.5–2 hours before bedtime to help the body to relax. If awake on bed for longer than 20 min, they were instructed to get out of bed, go into another room, and do a quiet activity using dim lighting until they felt sleepy. Patients were also encouraged to write down their thoughts and emotions to allay worries[12]. Deep breathing exercises were also practiced twice daily for 10 min. to promote relaxation and achieve a significant reduction in stress-related symptoms, calm the body, promote sleep, and shorten sleep onset latency[13]. Additionally, subjects were instructed to wear loose fitting cloth, lie down on their back, and stretch out comfortably as a relaxation exercise at bedtime to reduce the symptoms of stress and anxiety. Training involved tensing particular muscle groups for 7–10 sec, followed by release for 15–20 sec. The sequence consisted of clenching the hands into fists, wrinkling the forehead, closing the eyes tightly, pressing the lips tightly, pressing the back of the head against the floor, pressing the buttocks, and clenching the thighs[14].

Treadmill training: In addition to the previously mentioned treatment programs, the study group was enrolled in a supervised treadmill aerobic exercise program. They were asked to walk for 30 min, six hours before bedtime (three days a week for four weeks) on a treadmill (CYBEX, Medway, Model 530T, Z01-20530T9034NN007, AMPS 151-PHASE, USA) in the afternoon or early evening. Each session consisted of (i) A 5-min. warm-up period performed by leaning against the wall, placing most of the weight on the rear foot, and pushing the hip down and forward while keeping the rear leg straight and the heel on the ground for 5–10 sec. (same for the other leg) to stretch the calf muscles. (ii) A 20-min. exercise period at a speed of 4–6 km/h, which was adjusted accordingly to the heart rate (HR) range by determining the maximum HR (220 - age of the patient) and the exercise HR by using the Karvonen formula (HR rest + % of intensity ´ [HRmax - HRrest], in which % of intensity was 60–70%); and finally, (iii) A cool-down period similar to the warm- up period[15].

#### *Statistical analysis*

Data were presented as means ± standard deviation. Paired and unpaired *t*-tests, Wilcoxon and Mann–Whitney tests were used to analyze data. *p*-value was <0.05. Data were analyzed using the SPSS software version 10.

## Results

### *Sleep diary*

Sleep hours in the study and control groups were significantly different at baseline (20.60 ± 6.24 and 14.05 ± 4.51, respectively, $p$=0.02) and after treatment (50.85 ± 6.32 and 13.90 ± 4.31, respectively, $p$=0.0001). The control group exhibited no significant difference between the initial and the final time of the study period ($p$=0.75). On the other hand, the number of sleep hours in the study group significantly increased after treatment compared to that before treatment ($p$=0.0001) (Figure 1).

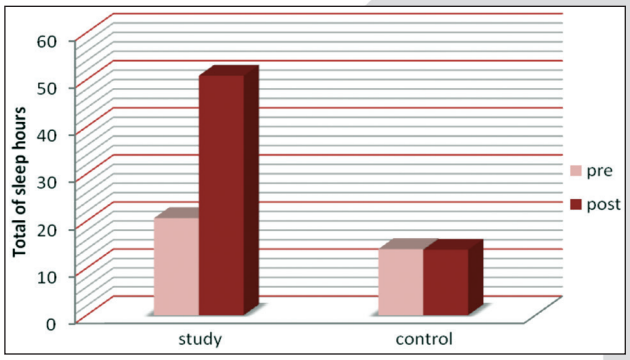


*Figure 1. Mean values of total sleep hours before and after treatment in the study and control groups*

In addition, in the study group, the number of sleep hours increased significantly by the end of 4th weeks compared to that of the 2nd week, with being 50.85 ± 6.32 and 39.90±6.38 hrs, respectively ($p$ = 0.02) (Figure 2).

### *Daytime sleepiness*

At baseline, no significant difference was found regarding ESS mean values between the study and control groups ($p$=0.94). However, after treatment, it was significantly higher in the study group ($p$=0.0001). Additionally, the ESS mean values significantly increased after treatment compared to that before treatment in the study group (($p$=0.05) (Table 1).

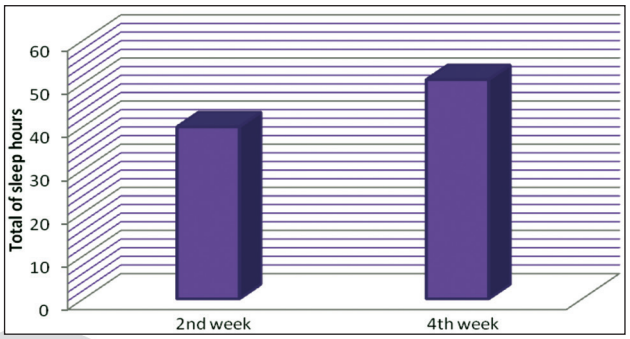


*Figure 2. Mean values of total sleep hours by the end of second and fourth week of intervention in the study group*

## Discussion

Insomnia is a common disorder characterized by insufficient or poor sleep quality associated with adverse daytime consequences in the form of tiredness, fatigue, and potential mood and cognitive impairment. The aim of the present work was to evaluate the influence of aerobic exercises on improving symptoms of insomnia. The outcomes revealed a significant increase in the total sleep hours and improvement in ESS scores. These findings are in accordance with those of Sherrill et al[16] who investigated the influence of moderate exercise on self-reported sleep disorders. They reported that regular exercises might be a useful therapeutic modality in the treatment of sleep disorders. Similarly, Tanaka et al[17] investigated the effect of a four-week exercise program on sleep quality carried out in the evening, and reported significant reduction in the wake time after sleep onset. Mental and physical health was also improved. In comparison with other treatment regimes, a number of adverse side effects of sleeping pills were reported by researchers as cognitive impairment, daytime sedation, motor in-coordination, and risk of motor vehicle accidents, slips and falls. In addition, the effectiveness and safety of such agents remain to be determined and are not recommended for long-term use[18,19]. On the other hand, behavioral/

*Table 1. Comparison between study and control groups regarding Epworth Sleepiness Scale (ESS) mean values before and after treatment*

| | ESS mean values | | |
|---|---|---|---|
| | **Study group** | **Control group** | ***p* value** |
| Before treatment | 2.8 ± 0.79 | 2.8 ± 0.92 | 0.94 |
| After treatment | 12.4 ± 3.09 | 3.4 ± 0.97 | 0.0001* |
| *p* value | 0.05* | 0.13 | |

*The data represent the mean ± standard deviation. *Statistically significant*

cognitive therapy (CBT) has proved effective not only in people with primary insomnia but also in insomnia co morbid with psychiatric and medical illness such as depression, cancer, and chronic pain[20]. But it is costly and difficult to deliver because yet, there is a woeful lack of trained providers and many large metropolitan areas may not have even a single highly-trained CBTspecialist[21]. In contrast, exercise is a healthy, safe, inexpensive, and simple means to improve sleep quality.

In the same line, Passos et al[22] divided patients with primary chronic insomnia into four groups (three experimental and one control). The experimental groups performed three different exercise programs (moderate aerobic exercises for 40 min, heavy aerobic exercises for 60 min, or moderate strengthening exercises), four days per week for four weeks. Only moderate exercise program resulted in the reduction of sleep onset latency and wake time after sleep onset by 45% and 36%, respectively, while increasing total sleep time by 21% and improving sleep efficiency by 18%. Additionally, Montgomery and Dennis[23] examined the effectiveness of moderate aerobic exercise and found significant improvement in the total sleep duration and sleep onset latency and scores on a scale of global sleep quality.

In contrast, Youngstedt and colleagues[24] found no significant difference in sleep onset latency or wakefulness after sleep onset after prolonged vigorous exercise for three hours, 30 min. before bedtime. Along the same line, Godwillas[25] examined the effect of late day exercise on insomnia and found that exercise disturbed sleep. The difference in the results between the present study and those of Youngstedt and Godwillas is most likely due to the difference in the type and time of exercise, as in the current study, patients performed moderate aerobic exercises six hours before bedtime. Other research was carried out by Tworoger et al[26] who investigated the effect of a moderate intensity treadmill walking and stationary bicycling for 45 min twice a day (morning and evening) and found no significant difference between morning and evening exercise on sleep quality.

The positive association between aerobic exercise and insomnia improvement could be explained by blood sugar and metabolism regulation. Such regulation is involved in the sleep–wake cycle. When metabolism increases during exercise, it then continues to run high even at rest. The heart beats more rapidly in order to deliver blood and oxygen to muscles so they can go through recovery process. Such process, along with the significant body exhaustion, can potentially improve insomnia[27]. The timing of exercise (late versus early evening) can also affect one's ability to fall asleep. It was proposed that exercise-induced sleep is mediated by cytokines which increase the non rapid eye movement sleep phase[28]. In addition, regular exercises improve sleep because insomniacs have increased levels of stress hormones in their blood, suggesting that they are abnormally sensitive to stress. The higher the stress hormone levels, the worse sleep is. Exercise initially increases such hormones but several hours after a workout, they decrease[29]. Such reports are in agreement with what was found in the current work where aerobic exercises were practiced afternoon or early evening several hours before bedtime thus providing enough time of stress hormones to decrease.Moreover, circadian sleep rhythm relates closely to body temperature and research implicates the involvement of the anterior hypothalamus in both heat loss and sleep mechanisms. Falling body temperature precedes the onset of sleep. In that respect, researchers have hypothesized that increasing body temperature before bedtime can activate both heat loss and associated sleep mechanisms. Notably, exercise raises body temperature more effectively than any other stimulus[30].Significant difference was also shown in the test parameters at the 2nd week compared to those at the 4th week of exercises in favor to the 4th week. This indicates that, to obtain positive effect, exercises should be performed for at least four weeks. Finally, as the study sample was small, further large scale studies are needed using various exercise maneuvers and timing in order to acknowledge aerobic exercise for insomniacs.

## Conclusion

Moderate aerobic exercise was effective in improving symptoms of chronic primary insomnia and may be prescribed as an alternative treatment to drugs in the future.

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# Appendix

***Sleep Diary***

Please shade the box to show when you slept each day and night. For example, if you slept from 2 pm until 4 pm and then again from midnight until 4am, the record would look like this:


Total hours slept: 6 hrs.

Please list all of you medications below (include herbal and over the counter (OTC) medications that you take):

Please add any notes that you feel are important to know about your sleep: / / until / /

**Monday**

Daytime Night-time


Hours slept:

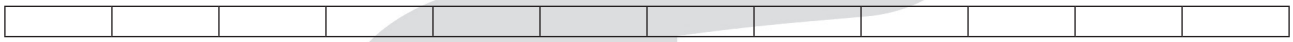
**Tuesday**

Daytime Night-time


Hours slept:

**Wednesday**

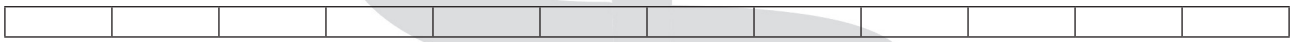
Daytime Night-time




Hours slept:

**Thursday**

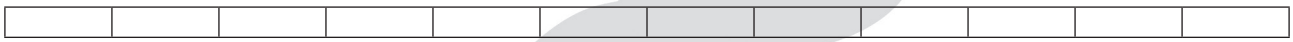
Daytime Night-time




Hours slept:

**Friday**

Daytime Night-time




Hours slept:

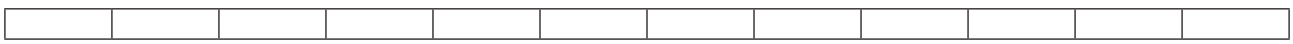
**Saturday**

Daytime Night-time


Hours slept:

**Sunday**

Daytime Night-time




Hours slept: