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Original article

The effects of exercise on self-rated sleep among adults with chronic sleep complaints

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Abstract

Purpose: The purpose of this study was to evaluate whether and to what extent the observed effects on self-rated sleep in a previous study using a combined treatment program with physical exercise and sleep education can be attributed by the physical activity (PA) component.
Methods: The present study reports supplementary analysis of an already described and published study. Data were provided by a nonclinical sample of 98 normal-active adults with chronic initiating and the maintaining of sleep complaints. The additional analysis included sleep log, exercise log, and daily pedometer data which were collected during a baseline week and 6-week of a combined intervention.
Results: The results indicate that the number of steps ($p = 0.02$) and the duration of PA ($p = 0.01$) is significantly related to the improvement in subjective sleep measures and therefore reveal an independent effect within this combined sleep program. Sleep diary data (recuperation of sleep, number of awakenings after sleep onset, and wake time after sleep onset time) improved significant (all $p < 0.01$) over the intervention program. About 50% of the participants stated that the PA had an effect on their improvement.
Conclusion: Improvements on subjective sleep quality after a combined intervention cannot be attributed to the cognitive component alone, but PA has an independent effect. Adults with chronic sleep complaints benefit from exercise. Therefore structured PA should be implemented in any sleep management programs.

Keywords: Adults; Insomnia; Non-pharmacological treatment; Physical exercise; Sleep problems

1. Introduction

Epidemiological studies suggests that physical activity (PA) might be one of the most effective daytime behaviors associate with a good night of sleep.[1] The frequently cited study by Urponen et al.[1] demonstrates nicely the notion of sleep-promoting effects due to exercise. In this survey, 1190 middle-aged adults in Finland were asked to name factors promoting and disturbing sleep. Every third respondent for both gender in all age groups listed exercise as the most sleep-promoting activity. Another epidemiological study by Loprinzi and Cardinal[2] analyzed the data of 3081 adults (age: 18–85 years) who wore an accelerometer for 7 days. Results showed an association between the objectively measured PA and self-reported sleeping-related parameters.

Furthermore, field studies have shown that physically active individuals sleep better than less active individuals do. For example, Brand et al.[3] analyzed sleep diaries from adolescent athletes ($n = 258$) with a training volume of about 18 h per week and adolescents ($n = 176$) with only about 5 h of sport per week. Results showed that frequent sporting activities related to subjectively reported shorter sleep onset, less sleep interruptions

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and a generally better mental health. For objective sleep data, a good example is the study by Edinger and colleagues[4] who showed that the sleep profile of 12 older fit men compared to inactive men of the same age revealed shorter sleep latency and shorter sleep interruptions, more deeper sleep and increased sleep efficiency. In another study, PA was measured by accelerometer for three consecutive days in 56 adolescent vocational school students.[5] Additionally, sleep was monitored for one night with a sleep electroencephalogram (sleep-EEG). Results showed that both subjectively and objectively assessed PA predicted both subjective and objective sleep among adolescents. In a study by Kalak et al.,[6] 51 healthy adolescents were randomly assigned either to a running or to a control group. The running group went running every morning for 30 min at moderate intensity during weekdays for 3 consecutive weeks. Results showed that a relative short intervention improved both subjective and objective sleep among healthy adolescents.

In contrast, Youngstedt and colleagues[7] conducted two prospective home assessment studies to investigate correlations between sleep and total daily PA. In the first study, 31 participants kept a dairy for 105 consecutive days about their total exercise duration and sleep. In the second study, 71 participants wore a wrist-mounted Actillume measuring activity and kept a sleep log for 7 consecutive days. In both studies, no correlations between PA and sleep parameters were found. From a methodological point of view, the mixed results from the studies so far might be explained by the different assessment of PA and sleep, e.g., the measure of PA ranged from not validated questionnaire items to objectively measures by pedometers and from subjective sleep data (thus assessing the psychological, but not the physiologic part of sleep) to sleep measures via actigraphy or sleep-EEG. Youngstedt[8] highlighted another important issue: in this study participants were normal sleepers with no potential to improve (ceiling effects), or the other way around: “The greater the initial impairment in sleep, the greater the potential for improvement”.

So far, experimental studies that examined the effects of PA on sleep in individuals with sleep problems are limited but show promising results. Small to moderate improvements in sleep quality were found after different exercise interventions like walking,[9] Yoga,[10] Tai Chi,[11] Baduanjin,[12] or resistance training[13] but also for worksite interventions.[14] Most of the studies focused on moderate activity respectively on the current PA health recommendation for adults and older adults worldwide.[15] In an own intervention study, we investigated the efficacy of a combined program that included physical exercise and sleep education on subjective sleep quality in adults with a long history of sleep complaints.[16] Results indicate that the combined program is effective in improving self-reported sleep quality. During the intervention, participants were required to keep a sleep and exercise log starting from a baseline week over the 6-week intervention period.

In the present study we apply supplementary analysis of the above described and published sample.[16] The aim of the present analysis was to investigate the differential effects of PA and general sleep education components on subjective sleep quality. Even though Youngstedt and colleagues[7] did not find correlations between daily PA and sleep quality in healthy young adults, we expected that in persons with sleep complaints the amount of exercise (exercise frequency, duration, intensity, number of daily steps) was positively correlated with the improvement in sleep quality. Thus far, exercise intervention studies in insomnia sufferers have not looked at those relationships.[17] The second aim of the study was to display on a descriptive level the week-to-week variability of sleep quality and PA starting from a baseline week over the 6-week intervention period. We expected an increase of PA and an improvement in sleep quality due to the intervention program. Lastly, we present the responses of the participants to indicate what they judged to be most helpful.

2. Methods

2.1. Study design and procedure

In the present study we perform supplementary analysis of the above described and published study.[16] This study used a waiting-list-controlled design. Participants were assigned either to the intervention group or a waiting-list control group. General sleep measurements were collected at baseline, after the intervention, and at follow-up after 3 months. All participants received a combined 6-week intervention consisting of sleep education and physical exercise, however, participants of the control group received the same treatment after a 6-week waiting period. The program included six weekly sessions in groups of 8−12 individuals. Each session started with 60 min sleep education followed by 60 min of instructed moderate physical exercise (Nordic walking). Twice a week, participants were instructed to engage by themselves in Nordic walking or equivalent sports (endurance sports outside). During the 6 weeks, further data provided by sleep log, exercise log as well as by pedometer were collected in a diary. For further details see Gebhart et al.[16]

Participants were recruited by advertisements in local print media. In an initial telephone interview the eligibility criteria (sleep problems, e.g., initiating sleep and/or maintaining sleep) were checked. Participation was not limited to primary insomnia symptoms, but persons with sleep problems who suffered from either coexistent physical or psychological disorders, or hypnotic medication consumption were also included.[16]

Participants provided written informed consent. The study has been carried out at the Institute for Sport and Sports Science in Heidelberg and at the Central Institute of Mental Health in Mannheim.

2.2. Participants

Overall 125 eligible participants were included in the study, whereas 81 were assigned to the intervention group and 44 to the waiting-list control group.[16] In total 27 persons (11 from the intervention and 16 from the waiting list group) did not