



Comparing the effects of music and exercise with music for older adults with insomnia ^{☆,☆☆}



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ABSTRACT

Aim: To examine the effects of a soothing music intervention before bedtime and a treadmill brisk walking exercise combined with music in the evening on sleep quality of sedentary older adults with chronic insomnia.

Background: There is evidence to support the use of complementary interventions to improve sleep. They are rarely applied in Taiwanese elderly population.

Methods: Using a crossover controlled trial, 38 participants aged 50 to 75 years were randomly assigned to a music intervention/brisk walking sequence or a brisk walking/music intervention sequence. Each participant completed two intervention sessions (separated by 1 week). Each intervention lasted 30 min. An actigraph extended with electroencephalography (EEG) and questionnaires were used to assess the sleep quality.

Results: Both interventions exhibited beneficial effects on subjective sleep quality in adults with insomnia. Also listening to soothing music before bedtime significantly shortened the wake time after sleep onset measured by EEG, compared with brisk walking in the evening.

Conclusions: The interventions applied in this study could be applied as the evidence-based nursing interventions for insomnia older adults.

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1. Introduction

Difficulty with initiating or maintaining sleep, early morning waking, or nonrestorative sleep are characteristics of insomnia, as broadly defined by sleep experts (Schutte-Rodin, Broch, Buysse, Dorsey, & Sateia, 2008). Insomnia is associated with adverse effects on quality of life and daytime functioning (Komada et al., 2012). The prevalence of insomnia worldwide is 30% (Roth, 2007). A recent study demonstrated that approximately 39.4% of the Chinese population (Wong & Fielding, 2011) and up to 60% of older adults (Almeida, Alfonso, Yeap, Hankey, & Flicker, 2011) complain of insomnia. Prescription medication is one of the remedies people with insomnia use to improve their sleep quality (Bertisch, Herzig, Winkelman, & Buettner, 2014). However, the side effects of hypnotics (DeMartinis, Kamath, & Winokur, 2009), reduction of their therapeutic effect because of long-term use, and drug tolerance and dependence (Buscemi et al., 2007; O'Malley, 2007) are frequent pharmacological management problems. Therefore, the nonpharmacological and pharmacological management of sleep should be simultaneously considered. Various nonpharmacological therapies,

such as exercise and music, have been proposed in the health care industry as alternative interventions for sleep disturbances due to their relative low cost, easily accessed, and easily self-administered.

2. Literature review

2.1. Sleep and nonpharmacological interventions

Acute reductions in sleep can alter the immune function (Besedovsky, Lange, & Born, 2012). Less than 6 hours of sleep time is associated with high mortality (Hublin, Partinen, Koskenvuo, & Kaprio, 2007), chronic inflammation (Thompson et al., 2011), diabetes (Cappuccio, D'Elia, Strazzullo, & Miller, 2010), and obesity (Cappuccio et al., 2008). Early intervention and treatment of insomnia are necessary because the symptoms of insomnia and their daytime effects are exacerbated even in mild cases (Komada et al., 2012).

2.1.1. Exercise and sleep

Few experimental studies have examined the effects of exercise on sleep in middle-aged adults and elderly people with sleep problems, and these studies have revealed small to moderate improvements in sleep quality after exercise interventions such as Nordic walking (Erlacher, Erlacher, & Schredl, 2014), aerobic exercise (Wang & Youngstedt, 2014), treadmill walking (Passos et al., 2011), and walking and stationary bicycle (Reid et al., 2010). Although exercise studies have

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consistently resulted in improvement in sleep in middle-aged and older adults, no study has been conducted to evaluate the effects of short period of time of music and exercise combined music interventions on sleep quality in this population. In clinical practice nurses, evaluating the effectiveness of a short period of time of intervention after their implementation is common, so our study design would accurately represent contemporary clinical practice.

The timing of exercise is another consideration of the effectiveness of sleep quality according to the sleep hygiene consensus. Standard sleep hygiene experts widely advise that exercise close to bedtime should be avoided. People might be unwilling to exercise when it is inconvenient to their schedule. However, [Buman, Phillips, Youngstedt, Kline, and Hirshkowitz \(2014\)](#) reported that evening exercise was beneficial rather than detrimental to sleep quality. Nonetheless, other sleep scientists have presented opposing opinions ([Horne, 2014](#)). Thus, the associations between the effects of exercise in the evening and the sleep quality are unclear, and additional studies are required.

The mechanisms by which exercise improve sleep quality are multifactorial. It has been suggested that the effects of exercise on sleep are related to antidepressant effects, anxiety reduction ([Wen et al., 2014](#)), increase in peripheral levels of beta-endorphins ([Dearman & Francis, 1983](#); [Droste, Greenlee, Schreck, & Roskamm, 1991](#)), changes in serotonin levels ([Soares, Naffah-Mazzacoratti, & Cavalheiro, 1994](#)), and a decrease in sympathetic activity ([Thoren, Floras, Hoffman, & Seals, 1990](#)). Hence, relaxation is improved, which in turn improves sleep quality.

2.1.2. Soothing music and sleep

Studies have reported that music reduces circulating noradrenaline ([Mockel et al., 1994](#); [Jiménez-Jiménez, García-Escalona, Martín-López, Vera-Vera, & Haro, 2013](#)), which is associated with sleep onset ([Irwin, Thompson, Miller, Gillin, & Ziegler, 1999](#); [Ingram, Simpson, Malone, & Florida-James, 2015](#)). Therefore, a soothing music intervention is expected to improve sleep quality. Approximately 40% to 50% of the population uses music therapy as a self-help strategy to improve sleep ([Furihata et al., 2011](#)). Researchers conducting studies using meta analysis have also demonstrated the association between a soothing music intervention and the improvement of subjective sleep quality ([de Niet, Tiemens, Lendemeijer, & Hutschemaekers, 2009](#)). Recent studies have verified the beneficial effects of music on the objective sleep quality of ICU patients ([Su et al., 2013](#)) and healthy adults with insomnia ([Chang, Lai, Chen, Hsieh, & Lee, 2012](#)). Nonetheless, results have been inconsistent ([Chang et al., 2012](#); [Lazic & Ogilvie, 2007](#); [Su et al., 2013](#)). Thus, the effects of soothing music on objective sleep quality must be examined to establish an evidence-based music intervention.

3. Purpose

In summary, previous studies of exercise interventions have not assessed the effects of short period of time of intervention on sleep outcome. Results from experimental music studies on sleep have been mixed. Listening to music and doing exercise were commonly used as interventions for sleep quality. However, which intervention that triggers sleep better is unclear. Therefore, the purpose of this randomized crossover trial was to examine the effects of a peaceful soothing music intervention before bedtime and a brisk walking exercise combined with music in the evening on the subjective and objective sleep quality of sedentary middle-aged and older adults with chronic insomnia. The current study considered the following hypotheses:

Hypothesis 1. : Participants who receive a soothing music intervention before bedtime for two nights exhibit higher sleep quality scores than no-music baseline scores.

Hypothesis 2. : Participants who perform brisk walking exercise combined with music in the evening for two nights exhibit higher sleep quality scores than no-exercise baseline scores.

Hypothesis 3. : Objective sleep quality scores do not differ between listening to soothing music and performing brisk walking exercise combined with music.

Hypothesis 4. : Subjective sleep quality scores do not differ between listening to soothing music and performing brisk walking exercise combined with music.

Except for the four hypotheses, the participants' perceptions of the interventions were also evaluated.

4. Method

4.1. Design

A randomized controlled crossover trial was conducted to compare the effectiveness of listening to soothing music before bedtime and performing a treadmill brisk walking exercise combined with music in the evening. Participants were randomly assigned to a 2-week sequence that involved (a) listening to soothing music for two consecutive days ([Chang et al., 2012](#)) in the first week, followed by brisk walking while listening to music in the next week for another two days, or (b) brisk walking combined with music for two days in the first week, followed by the soothing music intervention in the second week for two days. No adaptation night prior to the study nights was necessary because the participants were not required to sleep in unfamiliar environments. The two interventions were separated by one week ([Lai, Li, & Lee, 2012](#)).

4.2. Participants

Participants were invited for the study through the flyer advertisements. This study used purposive sampling to recruit 38 eligible participants who were community-residing older adults with chronic initiating and the maintaining of sleep complaints. To achieve a power of 0.8 at $\alpha = 0.05$, two-tailed, with a medium effect size ([de Niet et al., 2009](#); [Wang, Sun, & Zang, 2014](#)), a medium correlation among repeated measures ([Chang et al., 2012](#); [Su et al., 2013](#)), the size of each sequence was computed to be 30 ([Stevens, 1996](#)) and 25% was added for attrition. Consequently, 38 participants were recruited. To qualify for participation in the study, participants were required to: (a) have experienced insomnia >5 (Pittsburgh Sleep Quality Index; PSQI) at screening ([Buysse, Reynolds, Monk, Berman, & Kupfer, 1989](#)) for at least one month; (b) be >50 years of age; (c) exhibit normal cognitive functioning (≥ 9 correct answers on the Short Portable Mental Status Questionnaire: [Pfeiffer, 1975](#)); and (e) be sedentary (<20 min of exercise, no more than three times/week) for at least 6 months before entering the study. Exclusion criteria were as follows: (a) sleep apnea ([American Academy of Sleep Medicine, 2005](#)), (b) psychiatric or neurological problems, (c) history of alcohol or drug abuse, (d) taking sleeping pills habitually, and (e) heart disease. Over a 15-month period, 59 adults were contacted; 21 were disqualified because five exercised regularly, five disliked the selected music, and 11 were too young to participate in the study. The remaining 38 were volunteers who completed the study assessments.

4.3. Experimental intervention

Interventions alternated between listening to soothing music and performing a treadmill brisk walking exercise while listening to music and vice versa. Each intervention lasted for 30 min each day, 2 days a week, and was then alternated to another intervention for 2 days in the following week. The soothing music intervention was implemented at the homes of the participants ([Chang et al., 2012](#)), but the brisk walking exercise combined with music was implemented at our research center. No participants traveled across time zones within the 2-week study period. The two intervention sessions were conducted on the

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