Effect of music on objective sleep quality in older inpatients: A randomized controlled trial

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Research Article

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Abstract

Background: This study examined the effect of listening to music on objective sleep quality in older Japanese inpatients.

Methods: This unblinded, randomized controlled parallel trial included inpatients (age ≥ 65 years) who had symptoms associated with pneumonia or heart failure and were enrolled from April 2016 to October 2017. Patients were randomly assigned to either the music or the control group. The randomization was stratified according to sex and the use of sleeping pills at baseline. The patients in the music group listened to classical music for 30 min before nocturnal sleep. Objective sleep was assessed using Sleep Scan SL-503 for three nights after admission.

Results: A total of 43 patients were assigned to the music (n = 23) and control (n = 20) groups. The rapid eye movement sleep (REM) duration in the music group was significantly longer than that in the control group on the third night. Results of a two-way repeated analysis of variance indicated interactions between the music intervention and REM sleep duration.

Conclusions: Listening to music may prolong REM sleep duration in older patients in the early days after hospitalization. REM sleep is one of the factors contributing to the pathogenesis of dementia; therefore, listening to music potentially prevents a decline in cognitive function among hospitalized older adults. Further research is needed to confirm the effect of music on the sleep patterns of hospitalized older patients.

Trial registration: Registered with the University Hospital Medical Information Network on April 1, 2016 (http://www.umin.ac.jp/ctr/index-j.htm; ID: UMIN000021490).

Background

Older hospitalized patients experience difficulty in the initiation and maintenance of sleep because of medical care-related noise and patient factors, such as pain (1). Patients in acute care settings report deterioration in sleep quality (2), and sleep deprivation might lead to delirium (3). Major consequences of delirium include increased in-hospital (4) and 1-year mortality rates (5), as well as poor neurocognitive outcomes (6).

In order to improve quality of sleep in hospitalized adults, non-pharmacologic interventions are generally recommended as the first line of therapy (1, 7) because the risk of falls has been reported to be higher in older inpatients who use sleeping pills (8). A previous Cochrane review evaluated the use of non-pharmacological interventions, including sleep-inducing music, for the improvement of sleep in intensive care units; nevertheless, the quality of available evidence was low (9).

Several studies have investigated the effect of music on outpatient adults (10) and inpatient adolescents (11). Musical intervention has been proven to be effective in improving the sleep latency, sleep efficacy,
and daytime dysfunction of community-dwelling older adults (12). However, to the best of our knowledge, only two studies (13, 14) have investigated the effect of music on sleep quality among hospitalized older adults in general wards. In addition, no special skill and knowledge is required for this music intervention. This study aimed to examine the effect of music on objective sleep among older patients who do not require surgical management in early days after hospitalization.

**Methods**

**Design**

This study was an unblinded randomized controlled trial. Patients were randomly allocated to the music and control groups at a ratio of 1:1, using a random number table. The randomization was stratified according to sex and the usage of sleep aid medication at baseline.

This study was approved by the ethics committee of Yokohama City University School of Medicine (approval no: A151126015) in accordance with the Declaration of Helsinki, and it was registered with the University Hospital Medical Information Network on April 1, 2016 (http://www.umin.ac.jp/ctr/index-j.htm; ID: UMIN000021490). Written informed consent was obtained from the participants prior to their participation in the study.

**Participants**

A total of 67 patients were recruited from among 441 inpatients (age, 65 years and older) admitted to the general ward of a 320-bed hospital, from April 18, 2016, through October 28, 2017. The inclusion criteria were as follows: (1) patient expected to be admitted for more than three days; (2) ability to communicate in Japanese; and (3) no hearing impairments. Patients were excluded if they were diagnosed with dementia or assessed by the physicians and nurses to be incapable of participating in this study. A total of 43 patients consented to participate in this study and were subsequently randomly assigned to either the music (n = 23) or control group (n = 20), as described above.

**Intervention**

For three nights after admission, patients in the music group listened to classical music on a music player for 30 min before nocturnal sleep. The music included Ave Maria by Gounod, Meditation by Massenet, Song of India by Rimsky Korsakov, and Cantabile by Paganini (15). It is empirically known that these musical pieces indicate 1/f fluctuation and have a relationship with relaxation. The participants in the music group played the music on an mp3 player and listened to it with a set of headphones or earphones; the volume was set according to their individual preferences. The control group received no intervention.

**Outcome measures**
Objective sleep quality was assessed using Sleep Scan SL-503 (TANITA Cooperation, Tokyo, Japan) for three nights after admission. The device was placed under each patient’s mattress, and the vibration sensor detected vibrations such as body motion, pulse, and breath (16, 17). The data were used to assess distinguished awakening/sleeping of the patients, as well as light sleep (stage 1–2), deep sleep (stage 3–4), and REM sleep. In the present study, seven parameters were evaluated: (1) sleep duration (indicates the quantity of sleep between bedtime and wake time); (2) wakefulness after onset of sleep (min; indicates the quantity of wakefulness during entire sleep duration); (3) sleep latency (min; indicates the transition time between wake and sleep states); (4) rapid eye movement (REM) sleep duration (min); (5) light sleep (min); (6) deep sleep (min; indicates the sleep structure associated with polysomnography) (17); and (7) sleep efficiency (the percentage of time spent sleeping while on bed).

**Patient characteristics**

The details of the patients’ age, sex, body mass index, consciousness, and the use of sleep aid medications were obtained from their medical records. The Barthel Index (BI) was used to examine the activities of daily living (ADL) status. This scale evaluates a patient's function in terms of the level of independence or dependence when performing certain ADL. A higher BI score indicates a more independent ADL status (18). Delirium was assessed by using the Intensive Care Delirium Screening Checklist (ICDSC) every 8 h. This scale includes eight items based on the Diagnostic and Statistical Manual of Mental Disorders criteria for delirium: altered level of consciousness, inattention, disorientation, hallucination or delusion, psychomotor agitation or retardation, inappropriate mood or speech, sleep/wake cycle disturbance, and symptom fluctuation. Patients with a total score of 4 points or more were identified as delirious (19). The patients were considered delirious if they met the criteria at least one or more times during the study period.

**Statistical analysis**

In accordance with a previous study (20), we considered a difference (between intervention and control) in the primary endpoint of 60 min as clinically relevant. A sample size of 28 patients per group was determined based on this assumption, as well as the following parameters: a significance level of 5% (for a two-sided t-test), a power of 80%, and an assumed standard deviation of 80. To compensate for an expected dropout rate of approximately 20%, we planned to randomize 35 patients per group (70 in total).

An intention-to-treat analysis was performed, without imputing missing data. The t-test and chi-square test were used to compare characteristics between groups. Independent t-tests were applied to compare changes in objective sleep quality between the groups over the 3 nights of intervention. Intergroup differences were determined by two-way repeated measures analysis of variance (ANOVA) with time (1st, 2nd, and 3rd night after hospitalization), group (music group vs control group). If Mauchly's sphericity assumption was met, Mauchly's test was used; if the assumption was not met, Huynh-Feldt test was used. The data were analyzed using SPSS 23.0 for Windows (IBM Corp. Armonk, NY).
Results

A total of 441 patients were assessed for eligibility, and 374 did not meet the inclusion criteria (Fig. 1). Of the 67 patients who met the inclusion criteria, 23 declined to participate; therefore, a total of 43 patients were recruited and randomized to the music group (n = 23) and control group (n = 20). Three patients dropped out of the music group: the condition of one patient worsened, one patient recovered from illness and was discharged, and another patient did not enjoy the music and dropped out.

The patient characteristics are shown in Table 1. There were no significant differences in the body mass index or ADL; however, patients in the music group were significantly younger than those in the control group (p = .04). Before admission, sleeping pills were used by eight patients in the music group and three patients in the control group (p = .175). Three patients in the music group and one in the control group were assessed as delirious, according to the ICDSC, although there was no significant difference.

[Table 1 near here]

Objective sleep parameters

On the first and second nights, there were no significant differences in objective sleep. On the third night, the REM sleep duration was significantly longer in the music group than in the control group (Table 2). Figure 2 shows the results of comparison of changes evaluated from the sleep parameters of the two groups. There was an interaction between time and group in REM duration (F=3.518, p=.045), whereas no significant difference was observed in the main effect between the music and control groups.

[Table 2 near here]

Discussion

A previous study conducted in Japan reported that REM-like stages were observed in healthy individuals when they listened to soothing music (21). Participation in activity care programs, which include listening to music, has also been shown to increase total sleep duration among frail older adults (22). Furthermore, a previous survey conducted among a representative sample of the Japanese population found that just under half of the participants (men: 43.4%, women: 49.4%) used “reading or listening to music” as a non-pharmacological self-management practice for obtaining good sleep (23). In the present study, the REM sleep duration was found to be significantly longer in the music group than in the control group on the third night after admission. Results of the two-way repeated ANOVA confirmed a group by time interaction on REM sleep; furthermore, there were no main effects on objective sleep parameters. These results suggest that any potential influence of the music intervention on REM sleep may have been masked by several factors, such as medication use, irritation because of the intervention, and individual differences (such as music preference) (24).
Non-REM sleep decreases with aging, while REM sleep is not likely to be affected by aging (25). Although the mechanisms and functions of REM sleep are still unclear, several studies have shown that REM sleep deprivation affects learning and recall in humans (26, 27). Music intervention is potentially effective for older patients.

A 12-week music listening program was shown to improve subjective sleep quality in adults with mild memory loss (28). Additionally, a 2-week music listening program was found to affect sleep quality in pregnant women (29). A study using an even shorter (two nights) intervention reported changes in subjective sleep quality among patients in the ICU (30). Although the results of these studies suggest that music intervention can improve subjective sleep quality, the effects on objective sleep among inpatients remain unclear. Furthermore, a longer intervention period would be required to confirm the effects of music intervention among the subjects in our study.

Even though this study comprised older patients, only a few patients were considered to have delirium. Existing evidence suggests that music interventions can prevent delirium in critical care settings (31), as well as reduce stress, anxiety, and pain (32). Therefore, music interventions may be potentially used to prevent delirium among older inpatients in general wards.

A non-pharmacological approach is recommended for the management of sleep disturbances among hospitalized older adults to avoid the adverse events of polypharmacy. These approaches include relaxation techniques, sleep hygiene programs, bright light therapy, and noise reduction (1). A previous study reported that participating in music listening sessions was associated with a decreased risk of falls in patients admitted to a geriatric ward (33). In Japan, music is frequently played in the waiting room of hospitals, although it is rarely played in the ward. Listening to music potentially prevents a decline in cognitive function among hospitalized older adults.

This study has some limitations. First, the sample size was small as the study was only conducted at a single site; therefore, this may have resulted in a bias due to the higher variability in patient characteristics countrywide. Nevertheless, the randomization of patients to the intervention and control groups was stratified according to the use of sleeping medications. Second, the included patients were relatively independent (as indicated by their BI scores), and patients with dementia (who often have delirium and sleep disturbances) were excluded. Indeed, patients with dementia are more susceptible to sleep disturbances caused by changes in their environment. In the present study, the patients in the music group were younger than those in the control group; therefore, the younger patients might have adjusted to the changes in their sleep environment better than the older ones. Third, patients in the music group were provided with earphones or headphones to listen to the music; as some older inpatients may have been unfamiliar with their use, future studies should consider broadcasting the music in the entire ward. Lastly, we did not assess subjective sleep using the Oguri-Shirakawa-Azumi Sleep Inventory, Middle-age and Aged version (34), as most of the patients in our study had impaired cognitive function; therefore, they would have been unable to complete the questionnaire.
Conclusions

This study investigated the effects of listening to music on objective sleep quality in inpatient older adults. We found that the REM sleep duration was longer in the music group than in the control group on the third night. There was no significant difference in the other sleep parameters. REM sleep duration is one of the factors contributing to the pathogenesis of dementia; therefore, listening to music potentially prevents a decline in cognitive function among hospitalized older adults. Further research is needed to confirm the effect of music on the sleep patterns of older patients in the hospital environment.

Abbreviations

REM, rapid eye movement sleep
BI, Barthel Index
ADL, activities of daily living
ANOVA, analysis of variance
ICDSC, Intensive Care Delirium Screening Checklist

Declarations

Ethics approval and consent to participate

This study was approved by the ethics committee of Yokohama City University School of Medicine (approval no: A151126015) in accordance with the Declaration of Helsinki, and it was registered with the University Hospital Medical Information Network on April 1, 2016 (http://www.umin.ac.jp/ctr/index-j.htm; ID: UMIN000021490). Written informed consent was obtained from the participants prior to their participation in the study.

Consent for publication

Not applicable

Availability of data and materials

The datasets used and/or analyzed during the current study are available from the corresponding author on reasonable request.

Competing interests

The authors declare that they have no competing interests

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Author’s contributions

All authors contributed to the study conception and design. Material preparation, data collection and analysis were performed by ASO, and YK. The first draft of the manuscript was written by ASO and all authors commented on previous versions of the manuscript. All authors read and approved the final manuscript.

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References


Tables

Tables 1 and 2 are available in the Supplementary Files section

Figures
Figure 1

Study flowchart
Figure 2

Changes in objective sleep parameters

The figure illustrates the changes in objective sleep parameters between music and control groups.

¶ Huynh-Feldt test was used

REM, rapid eye movement

Supplementary Files

This is a list of supplementary files associated with this preprint. Click to download.

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