Original Article

Effects of Nature Sounds on Sleep Quality among Patients Hospitalized in Coronary Care Units: A Randomized Controlled Clinical Trial

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Abstract

Background: Sleep disorders are a source of stress for patients hospitalized in coronary care units (CCUs). **Objective:** The aim of this study was to investigate the effects of nature sounds on sleep quality among patients in CCUs. **Methods:** This randomized controlled trial was conducted on 93 patients hospitalized in the CCUs of three teaching hospitals in Tehran, Iran. Patients were randomly allocated into three groups, namely, nature sounds, silence, and control groups. Patients in the nature sounds group listened to nature sounds for 30 min in two consecutive nights while their counterparts in the silence group only wore mute headphones. Patients in the control group neither listened to nature sounds nor wore headphones. The Richards–Campbell sleep questionnaire was used for the evaluation of the patients' sleep quality two days before and during the intervention. The mean scores of sleep quality at the first two and the last two nights, respectively, were considered as the pretest and the posttest sleep quality. Cohen's *d*, one-way analysis of variance, paired-sample *t*, Chi-square, Fisher's exact, and the Scheffe *post hoc* tests were used to analyze the data. **Results:** Posttest-pretest mean differences of the sleep depth, the number of awakenings, and the returning to sleep domains of sleep quality in the control group were significantly less than nature sounds group ($P < 0.001$). Moreover, the posttest-pretest mean differences of the total sleep quality and its sleep latency and subjective sleep quality domains in the control group were significantly lower than both the nature sounds and the silence groups ($P < 0.001$). On the other hand, none of the differences between the nature sounds and the silence groups were statistically significant ($P > 0.05$). **Conclusion:** Both nature sounds and silence can significantly improve sleep quality among patients in CCUs. Nurses can use these strategies to improve the sleep quality of a patient in these units.

Keywords: *Coronary care unit, Nature sounds, Nursing, Sleep quality*

Introduction

Despite the importance of sleep and rest for the well-being and recovery of patients hospitalized in coronary care units (CCUs), these patients suffer from a wide range of sleep disorders.[1] The prevalence of low sleep quality among these patients is about 70%.[2] Sleep disorders have many adverse consequences such as physical and cognitive dysfunction, mood instability, and emotional disorders.[3] Moreover, sleep disorders can trigger epinephrine and norepinephrine release and thereby may eventually cause myocardial ischemia.[4,5]

Besides the underlying medical conditions, many other factors such as environmental lighting and noise can cause stress and sleep disorders for patients in CCUs.[6] Environmental noises, particularly telephone calls and equipment alarms, account for 17%–57% of sleep disorders in critical care units.[7,8] Consequently, effective management of environmental noise may

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improve critical care patients' sleep quality. Nurses have the responsibility of improving patient sleep in clinical settings through reducing environmental noises at sleep time and creating a quiet environment. However, environmental noise management is often difficult.[9]

There are different modalities for sleep quality improvement in a clinical setting, the most important of which are medications such as benzodiazepines. Sleeping medications are mostly associated with different side effects.[10]

Another modality for sleep quality improvement is an environmental improvement. The stress-recovery theory holds that viewing outside through a window can improve health and facilitate recovery.[11] A study also showed that hospitalization in rooms with the smell of garden, water sound, and large windows to a garden was associated with the greatest improvement in sleep quality.[12] Moreover, according to the biophilia hypothesis, humans innately love the nature.[13] The attention restoration theory also states that returning to nature can alleviate mental fatigue, stress, and anxiety.[14] Nature sounds were reported to positively affect anxiety, restlessness, and pain.[15-17] However, no study investigated the effect of nature sound on sleep quality.

Objectives

This study aimed to investigate the effects of nature sounds on sleep quality among patients in CCUs.

Methods

This randomized controlled trial was conducted from January to May 2016 in the CCUs of Shahid Rajaei, Hazrat Rassol Akram (PBUH), and Firoozgar Teaching Hospitals, Tehran, Iran. Patients were recruited consecutively according to the following selection criteria: an age of eighteen or more, hospitalization in CCU for at least 2 days, no history of sleep disorders, no hearing impairment, orientation to time, place, and person, and receiving no anesthetic or antidepressant medications during the hospital stay and no opioid drugs during the last 6 h before the study intervention. Patients were excluded if they died, developed hemodynamic instability, lost consciousness, or needed surgical operation, mechanical ventilation, or cardiopulmonary resuscitation during the study.

Considering a confidence level of 0.95%, a power of 80%, an expected sleep quality effect size of at least two points, and a sleep quality standard deviation of 2.8,[18] the sample size for each study group was estimated to be 31. Patients were assigned to nature sounds, silence, and control groups through the block randomization method with the fixed ratio of 1:1:1 [Figure 1]. Accordingly, eight cards with different permutations of three groups (i.e., A, B, and C) were placed in an opaque envelope. For every three patients, a nurse who was blind to the study drew one card from the envelope, and the order of the groups on the card was used to allocate patients to the groups.

Data collection

Data were collected through a demographic questionnaire and the Richards–Campbell sleep questionnaire (RCSQ). Demographic data were collected before the intervention

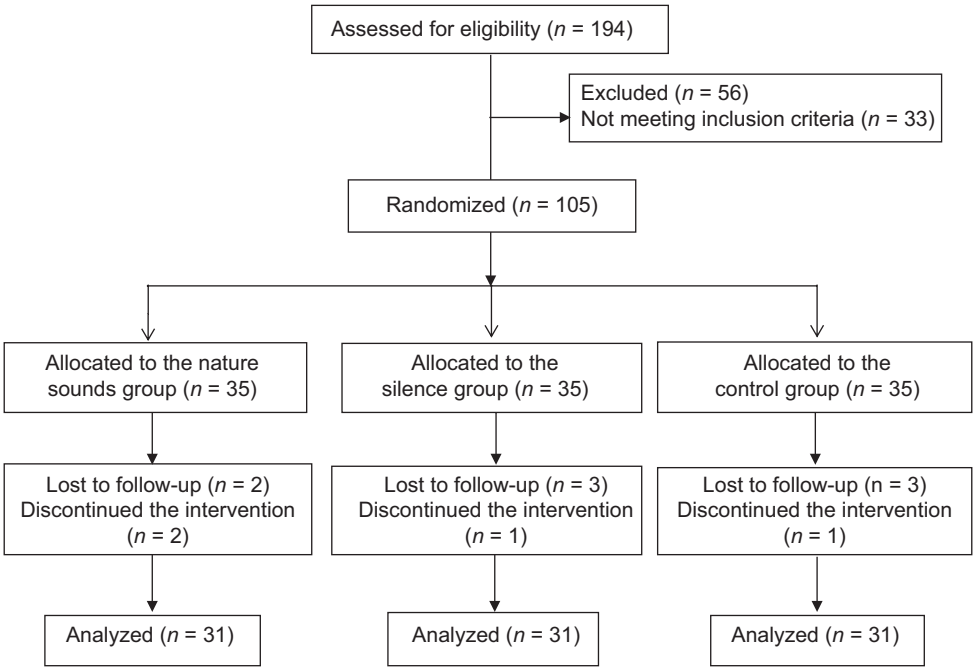

Figure 1: The study flow diagram

through interviewing patients and referring to their medical records.

RCSQ is a standard tool for sleep quality measurement.[19] It consists of five one-item domains, namely, sleep depth, sleep latency (time to fall asleep), number of awakenings, returning to sleep, and subjective sleep quality. The items are scored on a visual analog scale from 0 to 100. The total RCSQ score ranges from 0 (worst sleep quality) to 100 (best sleep quality). The questionnaire was translated into Persian through forward-backwards translation. Then, ten nursing faculties assessed and confirmed its validity. Thereafter, ten patients completed the questionnaire and their data were used for internal consistency assessment. Cronbach's alpha was 0.96.

Intervention

Each night during the study, the first author referred to the study setting, recruited eligible patients, and asked them to rate the quality of their last night sleep using RCSQ. At the two next nights, i.e., the second and the third nights, patients were initially asked to re-complete RCSQ and then they received the study intervention. Finally, on the fourth night, they were asked to re-complete RCSQ for the fourth time.

Patients in the control group only received care services routinely provided to all patients in the study setting. However, patients in nature sounds group listened to nature sounds using an MP3 player and a headphone for 30 min between 20:00 and 22:00 in two consecutive nights. The volume of the sound was adjusted at 60–70 decibels according to patients' preferences. Nature sounds included a wide variety of rain, ocean, birds, wind, forest, waterfall, and river sounds. On the other hand, patients in the silence group were asked to wear mute headphones while lying in bed for 30 min between 20:00 and 22:00 in two consecutive nights. Patients in both experimental groups also received routine care services provided to all patients in CCUs. At the beginning of the study, an educational session was held for the nurses in the study setting to inform them about the study aim and methods, secure their cooperation, and ask them to avoid disrupting the process of the interventions.

Ethical considerations

This research was approved by the Ethics Committee of Iran University of Medical Sciences, Tehran, Iran (with the code of IR.IUMS.REC.1394.9311449008). Furthermore, the study was registered in the Iranian registry of clinical trials (registration code: IRCT2015121325394N2). Patients were informed about the aim, methods, advantages, and probable disadvantages of the study. They were all assured of data confidentiality, their voluntary participation, and the rights to withdraw from the study at any point. All of them provided written informed consent for participation. The researchers were sensitive to preserve the participants' rights according to the latest version of Helsinki Ethical Declaration.

Data analysis

The mean scores of RCSQ at the first two and the last two nights respectively were considered as the pretest and the posttest sleep quality. The normality of the study variables was tested via the Kolmogorov–Smirnov test. The one-way analysis of variance, the paired-sample *t*, the Chi-square, the Fisher's exact, and the Scheffe *post hoc* tests were used for between- and within-group comparisons regarding patients' demographic characteristics and sleep quality. Cohen's *d* was used to calculate the effect size of each intervention in comparison with the control group. Data analysis was performed using the SPSS software (version 16.0; SPSS Inc., Chicago, IL, USA) at a significance level of <0.05.

Results

At baseline, study groups did not differ significantly from each other regarding patients' demographic characteristics ($P > 0.05$) [Table 1]. Besides, there were no significant differences among the groups regarding the pretest and the posttest mean scores of RCSQ and its dimensions ($P > 0.05$), except for the posttest mean score of the subjective sleep quality domain ($P = 0.039$); [Table 2]. The Scheffe *post hoc* test revealed that the posttest mean score of the subjective sleep quality in the nature sounds group was significantly greater than the control group. Moreover, groups differed significantly from each other regarding posttest-pretest mean differences of the scores of RCSQ and all its dimensions ($P < 0.05$). The Scheffe *post hoc* test revealed that the posttest-pretest mean differences of the sleep depth, number of awakenings, and returning to sleep domains in the control group were significantly less than nature sounds group ($P < 0.001$). Moreover, this test showed that the posttest-pretest mean differences of total sleep quality along with the sleep latency and the subjective sleep quality domains of RCSQ in the control group were significantly lower than both the nature sounds and the silence groups ($P < 0.001$). However, none of the differences between the nature sounds and the silence groups were statistically significant ($P > 0.05$). In addition, the effect sizes of the nature sounds (1.198, 95% confidence interval = 0.657–1.738) and the silence (0.774, 95%

Table 1: Patient's demographic characteristics

Variables	Groups[a]			*P*
	Control	Nature sounds	Silence	
Age (year)	56.60 ± 17.26	56.25 ± 14.04	54.32 ± 17.27	0.839[b]
Gender				
Male	18 (58.06)	19 (61.45)	16 (51.61)	0.744[c]
Female	13 (41.94)	12 (38.70)	15 (48.39)	
Marital status				
Single	2 (6.45)	2 (6.45)	3 (9.68)	0.978[c]
Married	23 (74.20)	21 (67.74)	23 (74.19)	
Widowed or divorced	6 (19.35)	8 (25.81)	5 (16.13)	
Educational status				
Illiterate	5 (16.13)	4 (12.90)	12 (38.71)	0.335[c]
Elementary or secondary	20 (64.52)	21 (67.74)	17 (54.84)	
University	6 (19.35)	6 (19.36)	2 (6.45)	
Income level				
Sufficient	22 (70.97)	21 (67.74)	18 (58.06)	0.884[c]
Not sufficient	9 (29.03)	10 (32.26)	13 (41.94)	
Comorbidity				
Diabetes mellitus	6 (19.40)	9 (29.00)	9 (29.00)	0.603[c]
Hypertension	13 (41.90)	14 (45.20)	12 (38.70)	0.876[c]
Heart disease	23 (74.20)	25 (80.60)	23 (74.20)	0.778[c]
Kidney disease	5 (16.10)	8 (25.80)	8 (25.80)	0.561[c]
Other	8 (25.80)	9 (29.00)	9 (29.00)	0.948[c]
Nap duration (h)				
<1	9 (29.03)	3 (9.68)	2 (6.45)	0.317[c]
1-2	15 (48.39)	20 (64.52)	25 (80.65)	
2-3	7 (22.58)	8 (25.80)	4 (12.90)	
Length of stay in CCU (days)				
2	29 (93.55)	26 (83.87)	26 (87.87)	0.612[c]
>2	2 (6.45)	5 (16.13)	5 (16.13)	

[a]Data are presented as mean±SD or *n* (%), [b]The one-way ANOVA, [c]The Chi-square test. SD: Standard deviation, CCU: Coronary Care Unit, ANOVA: Analysis of variance

confidence interval = 0.258–1.290) interventions were large and moderate, respectively.

The results of the paired-sample *t*-test for within-group comparisons illustrated no significant changes in the mean scores of RCSQ and all its domains in the control group ($P > 0.05$). However, all within-group changes in both the nature sounds and the silence groups were statistically significant ($P < 0.05$); [Table 2].

Discussion

This study aimed to investigate the effects of nature sounds on sleep quality among patients in CCUs. The study findings indicated that both nature sounds and silence interventions significantly improved sleep quality.

Findings showed that sleep quality in the domains of sleep latency and subjective sleep quality in the silence group was significantly better than the control group. Similarly, several studies reported that using earplugs and eye masks significantly improved sleep quality.[20-23] A study by Tsivian *et al*. also found that although silence produced using headphones had no significant effects on pain and anxiety, it helped maintain blood pressure stability during the transrectal prostate biopsy.[24] However, the results of the study by Le Guen *et al*., that examined the effect of earplug and eye blinders on sleep quality in patients in the postanesthetic care unit, showed that earplug decreased the number of awakening episodes and sleep apnea and increased overall sleep quality, but had no effect on the depth of sleep.[25] The inconsistency of the results can be attributed to having a pathological sleep pattern and a higher age range of samples in the Le Guen *et al*.'s study, which affects the quality and pattern of sleep.

Environmental noises are a major cause of sleep disorders in CCUs.[7] Listening to nature sounds using a headphone not only masks environmental noises and distracts patients but also may produce tranquilizing effects[13] and thereby improving sleep quality. Besides, using simple headphones without playing any sound

Table 2: The comparison of sleep quality within and between the groups

Sleep quality/time	Groups[a]			*P*[b]
	Control	Nature sounds	Silence	
Sleep depth				
Before	56.43 ± 18.29	48.59 ± 24.60	55.53 ± 20.23	0.287
After	57.30 ± 19.17	66.00 ± 23.47	65.70 ± 18.86	0.175
P[c]	0.817	<0.001	0.005	
Changes	0.87 ± 20.80	17.40 ± 20.04	10.17 ± 18.81	0.006
Sleep latency				
Before	60.64 ± 19.82	57.90 ± 21.52	56.45 ± 23.45	0.742
After	57.25 ± 20.63	68.43 ± 20.48	66.95 ± 22.36	0.084
P[c]	0.473	0.020	0.010	
Changes	−3.38 ± 25.93	10.53 ± 23.79	10.50 ± 21.26	0.033
Number of awakenings				
Before	56.12 ± 17.53	49.75 ± 17.21	54.03 ± 17.90	0.351
After	58.62 ± 16.61	68.32 ± 16.93	64.74 ± 16.67	0.076
P[c]	0.415	<0.001	<0.001	
Changes	2.50 ± 16.85	18.56 ± 12.97	10.70 ± 14.83	<0.001
Returning to sleep				
Before	57.25 ± 20.15	47.90 ± 23.70	51.20 ± 21.20	0.234
After	58.22 ± 25.02	67.17 ± 26.99	64.70 ± 17.64	0.308
P[c]	0.856	<0.001	<0.001	
Changes	0.96 ± 29.45	19.27 ± 25.41	13.50 ± 17.87	0.014
Subjective sleep quality				
Before	57.19 ± 17.49	48.61 ± 17.43	52.67 ± 19.34	0.181
After	56.88 ± 19.72	68.43 ± 19.90	66.67 ± 16.89	0.039
P[c]	0.911	<0.001	<0.001	
Changes	−0.30 ± 15.20	19.82 ± 13.24	14.00 ± 16.54	<0.001
Total sleep quality				
Before	57.53 ± 15.72	50.55 ± 16.31	53.98 ± 18.38	0.270
After	57.66 ± 17.57	67.67 ± 18.91	65.73 ± 16.26	0.065
P[c]	0.965	<0.001	<0.001	
Changes	0.12 ± 16.2	17.00 ± 11.6	11.60 ± 13.3	<0.001

[a]Data are presented as mean±SD, [b]One-way ANOVA, [c]Paired - sample *t*-test. SD: Standard deviation, ANOVA: Analysis of variance

can reduce environmental noise perception and create a favorable condition for patients to fall asleep.[26,27] Study findings also showed no significant difference between the sleep quality of patients in the nature sounds and the silence groups. However, the effect size of nature sounds intervention was larger than the silence intervention (1.198 vs. 0.744). These findings denote that both nature sounds and silence can significantly improve sleep quality probably through masking environmental noises and distracting patients. Chiang also found that both nature sounds and music caused relaxation and distraction and reduced pain and anxiety.[28] Contrary to the results of the present study, Amrollahi *et al*. showed that the average score of sleep quality in music recipient patients was not significantly different from that of the control group.[29] The reason for such a difference in findings can be differences in the nature of music because the sound of nature is rooted in human nature and may, therefore, have a greater effect on sleep quality and sedation characteristics.

We did not find any study into the effects of both nature sounds and silence. Among the study limitations were its short course and the lack of follow-up assessment due to the short stay of patients in CCUs. Moreover, the type and the dosage of sleeping medications taken by participants were not assessed. Future studies are recommended to assess the effects of nature sounds and silence after controlling the intervening effects of sleeping medications.

Conclusion

The findings of this study suggest that both nature sounds and silence can significantly improve sleep quality among patients in CCU. Nurses can use these

strategies to improve the quality of patient sleep in these units. Nursing managers and hospital authorities need to provide adequate training, equipment, and facilities to nurses to facilitate their use of such strategies.

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Conflicts of interest

There are no conflicts of interest.

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