

Original Article

The Effects of Ceiling Display and Natural Sounds on Stress and Anxiety among Cardiac Patients: A Randomized Controlled Trial

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ABSTRACT

Background: Cardiovascular disease is the most common chronic disease and the leading cause of death in the world. Stress and anxiety are among the most important risk factors of cardiovascular disease. **Objectives:** The aim of this study was to assess the effects of ceiling display and natural sounds on stress and anxiety among cardiac patients. **Methods:** This randomized controlled trial was conducted in 2018–2019 in the coronary care units (CCUs) of two teaching hospitals affiliated to Kerman University of Medical Sciences, Kerman, Iran. Participants were 220 cardiac patients randomly allocated through block randomization to four 55-person groups, namely ceiling display group, natural sounds group, combined ceiling display and natural sounds (display sound) group, and control group. The Spielberger State-Trait Anxiety Inventory and the Perceived Stress Scale were used for data collection at the beginning of the study and at the time of discharge from CCU. Data were analyzed by the Chi-square and paired-sample *t*-tests and the analysis of variance. **Results:** The mean scores of state and trait anxiety and stress significantly decreased in all intervention groups ($P < 0.05$) and did not significantly change in the control group ($P > 0.05$). There were significant differences among the groups respecting the posttest mean scores of state and trait anxiety and stress ($P < 0.05$). The posttest mean scores of state and trait anxiety in the combined display-sound group and the posttest mean scores of stress in the natural sounds group were significantly less than other groups. **Conclusion:** Ceiling display and natural sounds are effective in significantly reducing state and trait anxiety and stress among cardiac patients in CCU and their combination produces more significant effects.

KEYWORDS: Anxiety, Ceiling display, Heart disease, Sounds of nature, Stress

INTRODUCTION

Coronary artery disease and myocardial infarction are the most common chronic and life-threatening conditions.^[1,2] According to the World Health Organization, 17.3 million people worldwide die each year due to cardiovascular disease, and this rate will reach 25 million deaths by 2030.^[3]

Patients with serious cardiovascular disease are usually hospitalized in the coronary care unit (CCU). Patients in CCU have different cardiovascular problems with varying levels of severity.^[4,5] Most patients in CCU experience emotional and psychological problems such as anxiety and stress from the very beginning

hours of CCU admission. Anxiety is one of the most important complications of cardiac problems.^[6,7] Anxiety among patients can be due to a variety of factors such as hospitalization, fear over the unknown, fear over illness, process of treatment, risk of death, pain and discomfort, concerns about diagnosis and prognosis, lack of control during medical procedures, and the

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sounds of medical devices.^[8] Anxiety is associated with different complications such as ischemia, dysrhythmia, second myocardial infarction, and cardiac death. Bodily reactions to anxiety put added pressure on the heart which, in turn, can enlarge the infarcted area and lead to dysrhythmia^[9,10] and functional impairment. These problems are considered as additional risk factors for cardiac problems,^[11,12] particularly in patients with myocardial infarction. Stress, another common psychological problem among patients in CCU, also affects the cardiovascular system by altering the activity of the autonomic nervous system.^[13] By definition, stress refers to the response of the body to environmental demands that are beyond its normal capacity.^[9,14]

Given the considerable negative effects of anxiety and stress on the cardiovascular system, cardiac nurses need to employ effective strategies to reduce stress and anxiety among patients with cardiac problems.^[6,15-17] There are different pharmacological and nonpharmacological strategies for anxiety and stress management among patients with cardiac problems. Examples of these strategies are psychological therapies (such as cognitive-behavioral therapy and psychoeducational programs), guided imagery, music therapy, massage therapy, relaxation, hypnosis, progressive muscle relaxation, and distraction.^[16,18] Distraction is a technique which exposes patients to a pleasant stimulus to divert their attention from what is happening.^[19-22] Two main types of distraction are auditory distraction and visual distraction. Different studies reported that music therapy, as a distraction technique, reduces heart rate, respiratory rate, pain, and blood pressure among patients with cardiac problems. It also creates a sense of independence, facilitates coping with problems, and helps patients avoid negative emotions.^[11,23] Natural elements, such as the sounds of wind, rain, ocean, river, birds, and animals, can also be used for distraction. Human life is closely linked to nature and this connection can positively affect health.^[24-26] In addition, viewing nature scenes can elicit improvements in the recovery process following a stressor.^[27] A study reported that listening to natural sounds and looking at flowers, water droplets, and the sky can bring inner peace.^[19]

Looking at images, photos, and movies can also reduce stress and anxiety among patients by creating visual distractions.^[28] Ceiling display using natural images creates visual distraction, provides relaxation,^[29] and reduces stress among patients, their families, and health-care providers, and thereby, improves care quality.^[30] A video presentation can also be used to display natural sceneries with light music.^[19,30,31] A

study reported that natural lighting solutions and video presentation had significant positive effects on patients with burn injuries before abdominal surgery.^[32] Another study showed that simulated nature through photographic sky compositions in medical settings helped improve patient recovery.^[33] Maintaining the health of the environment is very important to the health of the patient and his family members which was first mentioned as a key factor by Florence Nightingale. The main aspects of nursing care include ventilation; the supply of fresh and clean air; light and direct sunlight; and a variety of shapes and colors. In addition, exposure to good images helps to improve patients' physical and mental health. In this regard, the nursing profession can, through small changes, improve the hospital environment, to reduce stress and help patients meet their psychological needs.^[34,35] The audio-visual aspects of the wards play an essential role in patient outcomes and make hospitals a better treatment environment for patients.^[35] Therefore, it is necessary to pay attention to this aspect of the nursing paradigms. Despite the wealth of studies into the effects of music therapy, natural sounds, and video presentation, our literature search revealed no comparative study into the effects of ceiling display and natural sounds among cardiac patients. Therefore, the present study was conducted to narrow this gap.

Objectives

The present study aimed at assessing the effects of ceiling display and natural sounds on stress and anxiety among cardiac patients.

METHODS

Design and participants

This randomized controlled trial was conducted in 2018–2019 in the CCUs of two teaching hospitals affiliated to Kerman University of Medical Sciences, Kerman, Iran. Participants were 220 cardiac patients selected based on the following inclusion criteria: age of 18–68 years, hospitalization in CCU for the first time, full consciousness, ability to speak Persian, no hearing or visual impairment, no history of known mental illness, and no intake of psychiatric medications.^[36] Exclusion criteria were significant changes in clinical conditions during the study and willingness to withdraw from the study.^[20]

Participants were randomly assigned to four groups, namely ceiling display group, natural sounds group, combined ceiling display and natural sounds (display sound) group, and control group. Randomization was performed through block randomization with 55 blocks sized 4. Groups in blocks were labeled A, B, C, and D. A nurse who was blind to the groups randomly assigned

one of these labels to each new patient recruited to the study. Participants were also blind to the groups. Therefore, the study was double blind.

The sample size was calculated to be 55 based on the findings of a previous two-group interventional study,^[19] with a confidence level of 0.95 and a power of 0.80.

$$n = \frac{(Z_{1-\alpha/2} + Z_{1-\beta})^2 (\sigma_1^2 + \sigma_2^2)}{(\mu_1 - \mu_2)^2} = \frac{(1.96 + 0.83)^2 (9.01 + 13.87)}{(1.03 - 0.77)^2} = 55$$

Data collection instruments

Data were collected using a demographic questionnaire, the Spielberger State-Trait Anxiety Inventory, and the Perceived Stress Scale. Items are scored on a 4-point Likert scale from 1 (“Not at all”) to 4 (“Very much”). The possible total score of the state and the trait anxiety dimensions is 20–80.^[29] The Cronbach’s alpha of these two dimensions was reported to be 0.87–0.90 and 0.90–0.94, respectively.^[37] The Persian version of the Cohen Perceived Stress Scale was used to assess perceived stress. It has 14 items scored on a 5-point Likert scale from 0 (“Never”) to 4 (“Very often”). The total possible score of the scale is 0–56.^[13] In the present study, the content validity of this scale was confirmed by experts in psychology and nursing and its reliability was confirmed by a Cronbach’s alpha of 0.72.

Intervention

In the ceiling display group, participants received, in addition to routine care services, a ceiling display intervention that consisted of ceiling lighting [Figure 1]. This intervention was implemented for participants twice daily at 09:00–10:00 and 18:00–20:00 and lasted throughout the patient stay in CCU.^[29] In the natural sounds group, participants received a natural sound intervention in addition to routine care services. Accordingly, they lay in the bed in a comfortable position and listened to natural sounds (i.e., a combination of rain, river, waterfall, and bird sounds) for 20 min using an MP3 player and a headphone. They could personally set the volume of the natural sounds.^[20,30] In the display-sound group, participants received, in addition to routine care services, a combination of ceiling display and natural sounds interventions. Participants in the control group just received routine care services which consisted of neither ceiling display nor natural sounds.^[38] All participants in all four groups of the study completed the study instruments at the beginning of the study and at the time of discharge from CCU.

Ethical considerations

This study was approved by the Ethics Committee of Kerman University of Medical Sciences, Kerman,

Iran (code: IR.KMU.REC.1396.2469) and was registered in the Iranian Registry of Clinical Trials (code: IRCT20160914029817N4). Participation in the study was voluntary and data were managed confidentially. All rights of participants were protected based on the Declaration of Helsinki.

Data analysis

Collected data were analyzed using the Statistical Package for the Social Sciences (SPSS) software program, version 16. (SPSS Inc., Chicago, Ill., USA). Data normality was tested using the Kolmogorov–Smirnov test and Shapiro–Wilk test which showed that the distribution of the scores of stress and anxiety in all study groups was normal. However, the Levene’s test showed the inequality of variance. Therefore, the Kruskal–Wallis test was used to analyze the scores of trait anxiety and the one-way analysis of variance was used to analyze the scores of state anxiety. Among-group comparisons respecting participants’ characteristics were performed using the one-way analysis of variance and the Chi-square and Fisher’s exact tests and within-group comparisons were performed using the paired-sample *t*-test. The level of significance was set at <0.05. Data were described using the measures of descriptive statistics, namely mean, standard deviation, and absolute and relative frequencies.

RESULTS

A total of 220 patients in four 55-person groups participated in this study [Figure 2]. Study groups did not significantly differ from each other with respect to participants’ age, gender, marital status, educational level, and employment status [$P > 0.05$; Table 1].

There was no statistically significant difference among the groups with respect to the pretest mean scores of state and trait anxiety and stress ($P > 0.05$). Within-group comparisons revealed that the mean scores of state and



Figure 1: Ceiling display

trait anxiety significantly decreased in all intervention groups ($P < 0.05$) and the greatest decrease was in the combined display-sound group ($P = 0.001$). Moreover, the mean score of stress significantly decreased in all intervention groups ($P < 0.05$). However, the mean scores of state and trait anxiety and stress did not significantly change in the control group ($P > 0.05$) [Table 2].

After the intervention, study groups significantly differed from each other respecting the mean scores of state and trait anxiety. *Post hoc* analysis through the Tukey's test showed that the mean scores of state and trait anxiety in the display-sound group were significantly less than in other groups ($P < 0.05$).

Moreover, the difference among the groups respecting the posttest mean score of stress was statistically significant ($P = 0.04$) and *post hoc* analysis through the Tukey's test showed that the mean score of stress in the natural sounds group was significantly less than in other groups ($P < 0.05$) [Table 2].

DISCUSSION

The results of this study showed that all interventions of the study, namely ceiling display, natural sounds, and combined ceiling display and natural sounds significantly decreased state and trait anxiety and stress. Moreover, compared with other interventions, combined ceiling

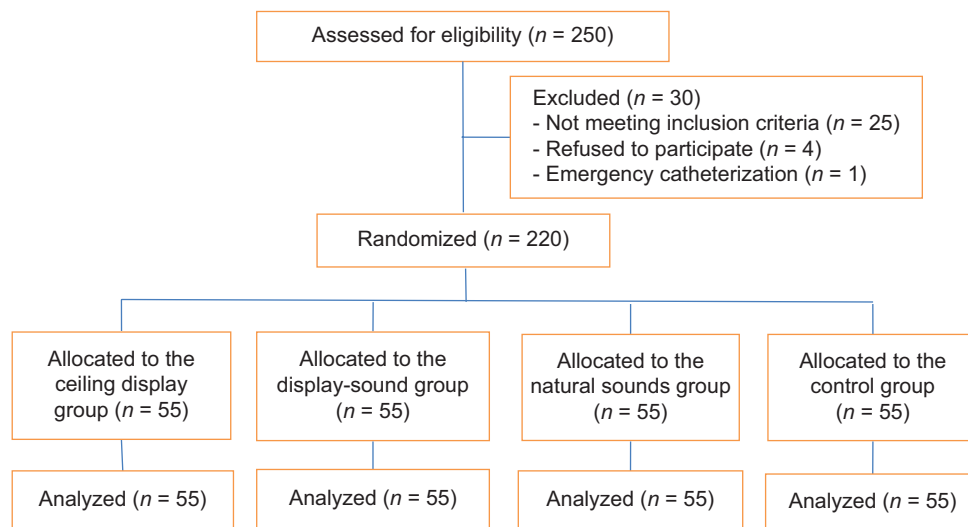


Figure 2: The flow diagram of the study

Table 1: Among- and within-group comparisons with respect to participants' characteristics

Characteristics/group	Ceiling display	Combined display-sound	Natural sounds	Control	P
Age (years)	42.9±14.5	42.12±2.5	41.12±2.9	46.1±14.4	0.26 ^a
Gender					
Male	30 (54.5)	31 (56.4)	25 (45.5)	31 (56.4)	0.61 ^b
Female	25 (54.5)	24 (43.6)	30 (54.5)	24 (43.6)	
Marital status					
Single	5 (9.1)	8 (14.5)	9 (16.4)	4 (7.3)	0.17 ^b
Married	49 (89.1)	47 (85.5)	44 (80)	51 (92.7)	
Widowed/divorced	1 (1.8)	0	2 (3.6)	0	
Education level					
Illiterate	4 (7.52)	5 (9.1)	4 (7.3)	10 (18.3)	0.09 ^b
Below diploma	3 (5.5)	4 (7.3)	9 (16.4)	6 (10.9)	
Diploma	14 (25.5)	24 (43.6)	18 (32.7)	25 (45.5)	
University	24 (43.6)	22 (40)	24 (43.6)	14 (25.4)	
Employment status					
Unemployed	4 (7.3)	5 (9.1)	5 (9.1)	1 (1.8)	0.11 ^b
Self-employed	19 (34.5)	15 (27.3)	16 (29.1)	9 (16.4)	
Employee	13 (23.6)	20 (36.30)	10 (18.2)	22 (40)	
Housewife	15 (27.3)	10 (18.23)	20 (36.3)	15 (27.3)	
Retired	4 (7.3)	5 (9.1)	4 (7.3)	8 (14.5)	

Data presented as mean±SD or n (%). ^aOne-way analysis of variance, ^bChi-square test. SD: Standard deviation

Table 2: Among- and within-group comparisons with respect to the mean scores of state and trait anxiety and stress

Outcomes	Time/group		P ^a
	Before	After	
State anxiety			
Ceiling display	22.50±0.2	21.4±0.2	0.001
Combined	25.47±0.3	17.25±0.2	0.001
Natural sounds	24.33±0.3	15.2±0.2	0.001
Control	24.49±0.2	23.45±0.2	0.5
P ^b	0.12	0.001	-
Trait anxiety			
Ceiling display	24.32±0.2	21.2±0.2	0.05
Combined	19.33±0.2	13.11±0.2	0.001
Natural sounds	24.32±0.2	15.09±0.1	0.008
Control	24.32±0.2	21.29±0.2	0.2
P ^b	0.56	0.001	-
Stress			
Ceiling display	43.3±0.2	36.27±0.2	0.002
Combined	33.21±2.2	26.13±0.2	0.002
Natural sounds	28.16±0.2	24.08±0.2	0.001
Control	43.19±2.2	43.18±2.4	0.24
P ^b	0.06	0.04	-

Data presented as mean±SD or n (%). ^aPaired-sample *t* test,

^bOne-way analysis of variance. SD: Standard deviation

display and natural sounds had more significant effects on state and trait anxiety, while natural sounds had more significant effects on stress. In line with our findings, several previous studies reported the significant positive effects of natural sounds or music therapy on anxiety among patients undergoing coronary artery bypass graft surgery,^[39] anxiety and restlessness among patients receiving mechanical ventilation in intensive care unit,^[40] anxiety among patients with heart failure,^[41] and stress and depression among the candidates for cardiac surgery.^[24] This contradiction is attributable to the differences among studies respecting their methods and interventions.

Study findings also showed that the combination of ceiling display and natural sounds was more effective than each ceiling display and natural sounds in creating distraction and reducing state and trait anxiety. Regarding its mechanism of action, studies show that depending on the place and time and the combination of auditory, visual, artificial, and environmental stimuli, the body exhibits different behaviors and reactions through complex sensory receptors and a large number of neurons in the nervous system.^[42,43] In agreement with our findings, a study showed that simulated nature through photographic sky compositions positively affects acute stress, anxiety, satisfaction, and diastolic blood pressure among 181 hospitalized patients and concluded that new nature-based technological methods are effective in reducing depression and anxiety and

calming patients.^[33] Another study found that using real and artificial nature elements to enhance the beauty and attractiveness of waiting rooms in hospitals reduced stress levels and improved well-being of patients.^[44] Moreover, a study found that ceiling display for patients receiving radiation therapy in computed tomography unit improved esthetic attractiveness, promoted patient relaxation and comfort, and positively affected their experience.^[29] Similarly, a study showed that ceiling display reduced stress and anxiety and improved satisfaction among patients and their family members.^[30] Another study showed that music therapy together with nature image display created audiovisual distraction and reduced anxiety among patients undergoing bronchoscopy.^[28] Therefore, it should be noted that environmental elements such as light, sound, color, and smell follow the assumptions of Florence Nightingale's theory of nursing. Unfortunately, in many hospitals, less attention is paid to the effects of these stimuli on patients' health. We faced some problems in installing and using ceiling displays and playing natural sounds. Therefore, we attempted to reduce this limitation by making arrangements with the authorities and the staff of the study setting.

CONCLUSION

This study concludes that ceiling display and natural sounds are effective in significantly reducing state and trait anxiety and stress among cardiac patients in CCU and their combination produces more significant effects. As anxiety and stress management in hospital settings is among the responsibilities of nurses, they can use ceiling display and natural sounds, as nonpharmacological methods, to reduce patient anxiety and stress. Further studies are needed to produce firmer evidence respecting the effects of ceiling display and natural sounds.

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Conflicts of interest

There are no conflicts of interest.

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