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Effect of Using two Different Auditory Stimulation on Patients Clinical Outcomes in Cardiac Intensive Care Units

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Abstract
Background: Cardiac intensive care patients often experience anxiety, depression, and sleep disturbance due to chest pain, separation, and difficulty orienting, with auditory stimulation as a nonpharmacological tension relief alternative. **Aim:** To evaluate the effect of using two different auditory stimulation on patients' clinical outcomes in cardiac intensive care units. **Research design:** A randomized controlled study with a single-blind design was used. **Setting:** The study was conducted in Cardiac intensive Care units at Tanta University Hospital. **Sample:** Eighty patients were included in this study, with forty patients equally assigned to each group. **Tools of data collection:** Four tools were used: Patient Biogeographic and Clinical Data, Richards-Campbell Sleep Questionnaire, Visual Analogue Pain Scale, and Hospital Anxiety and Depression questionnaire. **Results:** The study found no significant differences between two groups in terms of demographic data, heart rates, respiratory rates, and oxygen saturation. The Nature sound group had a higher RCSQ score (60.34±9.63), lower chest pain severity scores (1.47±0.50), and a gradual decrease in anxiety (10.17±1.7) and depression levels (9.52±1.51) in third day of observation. **Conclusion:** The study found significant improvements in peripheral oxygen saturation and vital signs after exposure to family voice messages or natural sound intervention, improved sleep quality, and reduced anxiety and depression. **Recommendation:** Additional proof that auditory stimulation has the potential to improve cardiac patients' clinical outcomes. Incorporating auditory therapies into routine care protocols may improve patient rehabilitation and quality of life. More multicenter studies, validation, comparison with a control group, and other treatments were recommended.

Keywords: Auditory Stimulation, Cardiac patients, Clinical outcomes & Cardiac intensive care units.

Introduction:
The cardiac intensive care unit (CICU) is dedicated to treating medical illnesses in cardiac patients and provides them with a controlled environment tailored to their unique needs **(Jentzer et al., 2022)**. Cardiac patients are physically isolated, monitored closely, and provided with necessary care such as anxiety, relaxation, and pain relief **(Pal et al., 2022)**. Non-pharmacological interventions aim to improve their health while nurses provide specialized care with love, empathy, and respect, ensuring a comfortable environment for each patient **(Liang, 2021; Verderber et al., 2021)**. Cardiac patients, owing to physiological alterations, face heightened risks of premature mortality, cardiac perforations, recurrent myocardial infarctions, and subsequent invasive interventions that may lead to further complications.
After critical illness, patients require psychological and emotional support that current treatments inadequately provide **(Zambrano et al., 2020)**.
Chest pain and anxiety are common issues in patients admitted to CICU, particularly those with cardiovascular diseases. Cardiac patients with a high anxiety level may feel more significant pain and be more prone to catastrophic chest pain. As a result of increased anxiety and stress caused by being in the hospital, 80% of inpatient chest pain exacerbations do not begin in or near the cardiac reason **(McCann et al., 2023)**. The critical care nurse should provide a sense of safety rather than merely alleviate chest pain.
Auditory stimulation has become a non-pharmacological alternative for decreasing stress, anxiety, and pain in the healthcare environment. The essence of care in the nursing process is integral to comprehensive nursing **(Khojeh et al., 2018; Yekefallah et al., 2021)**. Auditory stimulation must be integrated into the care plan for patients in CICU to enhance patient comfort and alleviate anxiety. Patients with chest pain under the care of a cardiologist or cardiothoracic surgeon and who are hospitalized following bypass surgery, percutaneous coronary intervention, or valve replacement typically exhibit heightened stress levels **(Kulinski et al., 2022; Mallik & Russo, 2022)**. To help patients recover quickly from their post-cardiac intervention health status, it is recommended that they practice increased mental relaxation. Patients may unknowingly hear unpleasant noises because they are typically awake in the CICU. **(Sukul et al., 2019)** Critical ill patients are most susceptible to disruptive auditory stimuli during nighttime hours. To minimize the length of stay in the CICU and hospital, it is

crucial to reduce anxiety and sleep disturbances by fostering a calming and supportive environment. Such measures can enhance cardiac output and facilitate a more rapid recovery. **(Khojeh et al., 2018; Yekefallah et al., 2021)**.

Few studies compare the effect of family voice or natural sounds on critically ill patients. Several studies investigated the impact of music or natural sounds, two examples of auditory stimuli that can be used in intensive care. These studies have identified a reduction in pain and anxiety while attempting to reduce pain medications in critical care patients when using live music, music therapy, and especially musician-preferred music. Participants' pain, anxiety, heart, and respiratory rates declined significantly while listening to music, suggesting that auditory stimuli reduce stress and discomfort **(Poulsen & Coto, 2018; Yekefallah et al., 2021; Naef et al., 2022; Adineh et al., 2022; Ahmed et al., 2023; Fatehimoghadam et al., 2023; Uysal & Vaizoğlu, 2023)**. Patients prefer music with guided imagery, rhythmic sounds, melodies, religious lyrics, or nature sounds for deep relaxation. Critical care nurses must be creative to provide comprehensive treatment. Auditory stimulation methods often assume a psychoneuroimmunological relationship between the auditory stimulus and physiological system response, causing subject stress state changes **(Qu et al., 2024; Wright et al., 2022)**.

Auditory stimulation has proven a favorable effect on reducing anxiety, fear, and pain in critically ill patients, benefiting various patient groups. There is some explanation for the effects of auditory stimuli: music results in the activation of endogenous endorphins, leading to a reduced perception of pain; it can facilitate a relaxation response; and the auditory stimuli changes attentional focus from the painful experience. These may positively impact mood and belief in its ability to achieve positive changes for cardiac patients **(Wright et al., 2022)**.

Family participation in the everyday care of critically ill patients is widely recognized to facilitate their recovery **(Burns et al., 2018)**. Family-centered care is a collaborative methodology by encompassing patients, families, and healthcare professionals in planning, executing, and assessing healthcare services. Patient and Family-Centered Care Institute defines it as cultivating advantageous collaborations among all stakeholders in patient care **(Fernández-Martínez et al., 2022)**. Family auditory stimulation refers to using familiar aural interventions, such as voice messages, to reduce feelings of anxiety or distract from current stressors **(Varghese et al., 2021)**.

Family members play a significant role in recovering patients from cardiac events. Familiar voices create a positive environment and reduce anxiety for the patient, especially when the person speaking and singing is familiar **(Ahmed et al., 2023)**. Several studies used family auditory stimulation to improve patient outcomes in traumatic brain injury patients **(Adineh et al., 2022; Ahmed et al., 2023), and critically ill patients(Naef et al., 2022; Uysal & Vaizoğlu, 2023)**.

Significance of the study:

Critical care nurses are crucial in implementing prevention measures for cardiac patients. They choose auditory stimuli based on patient preferences and biases, ensuring comfort and care. A comprehensive program for auditory intervention requires organizational support and interdisciplinary collaboration **(Poulsen & Coto, 2018)**. Therefore, we conducted this trial to examine the effect of using two different auditory stimulation on patients' clinical outcomes in cardiac intensive care units. A proficient auditory stimulation technique can enhance care while meeting the daily needs of CCU patients, and this study contributes to the expanding corpus of evidence substantiating this assertion.

Aim:

This study aimed to evaluate the effect of using two different auditory stimulation on patients' clinical outcomes in cardiac intensive care units.

Study hypothesis:

H0: Cardiac patients who experienced family voice messages had no significant differential clinical outcomes from patients who experienced natural sound auditory stimulation.

H1: Cardiac patients receiving family voice messages had significantly different clinical outcomes from those receiving natural sound auditory stimulation.

Design and Methods:

Research design: A single-blind, randomized, controlled trial design was utilized.

Setting: The study was conducted in CICUs at Tanta University Hospital in Gariba government, Egypt. This Hospital contained three CICUs, each divided into three sections, each with a total capacity of seven beds. Cardiac patients who are admitted to the emergency department are transferred to CICUs for medical interventions.

Subjects: The study's methodology was created following the SPIRIT 2013 guideline, Standard Protocol Items: Recommendations for Interventional Studies **(Zabor et al., 2020)**. CONSORT 2010 extension, which assesses therapies that do not involve pharmaceuticals, was used for the study's reporting **(Schulz et al., 2010)** (Figure 1). This study's protocol was submitted to the www.clinicalTrials.gov website (NCT06670027, registration data 31/10/2024). Two auditory stimulation interventions were used in this study.

Familiar auditory stimulation (familiar voice message) was utilized in the Family group, and nature sounds were used in the Nature sound group.

Randomization:

The allocation of each patient to their respective group was executed via the random number generator available at http://stattrek.com/statistics/random-number-generator.aspx. Participants in the study were randomly assigned to one of two groups: A or B. Data regarding the patients' assigned groups were recorded following the established research procedures. A researcher who was not directly involved in the participants' care but had access to the randomization sequence assigned patients to the interventions.

Blinding: This study utilized a single-blind strategy to guarantee that the participants were cognizant of the treatment allocations. Participants were randomly allocated to Family Group or B, with Family group assignments disguised in transparent, private cards. The cards were opened only after individuals gave informed consent and completed baseline evaluations.

Study sampling: Adult cardiac patients (aged 18 and older) were admitted to CICUs with plans for percutaneous coronary artery intervention (PCI) following admission. A simple randomized sample technique was used in this study; The entire sample size was determined using the IBM SPSS program for power analysis (version 28) (IBM Corp, 2021). The minimal sample size of 80 (40 per group) is sufficient to achieve 80% statistical power with an effect size of 0.25 at an alpha level of 0.05. to detect a difference of 20% in the proportion of reduced pain intensity between the studied group in the previous study **(Khojeh et al., 2018)**. **Inclusion criteria:** (i) Adult (aged 18 years or older); (ii) diagnosed with cardiac disease; (iii) patient with hemodynamic stability; (iv) consciousness and ability to communicate.

Exclusion criteria: (i) patients unable to comply with study interventions; (ii) patients with cognitive impairment; (iii) patients with severe unstable cardiac condition; (iv) having a history of hearing loss or the use of a hearing aid.

Pilot study: Pilot study was done to detect applicability of the tools on 10% of study participants (n=8). They did not include in the study sample. All necessary modifications were made.

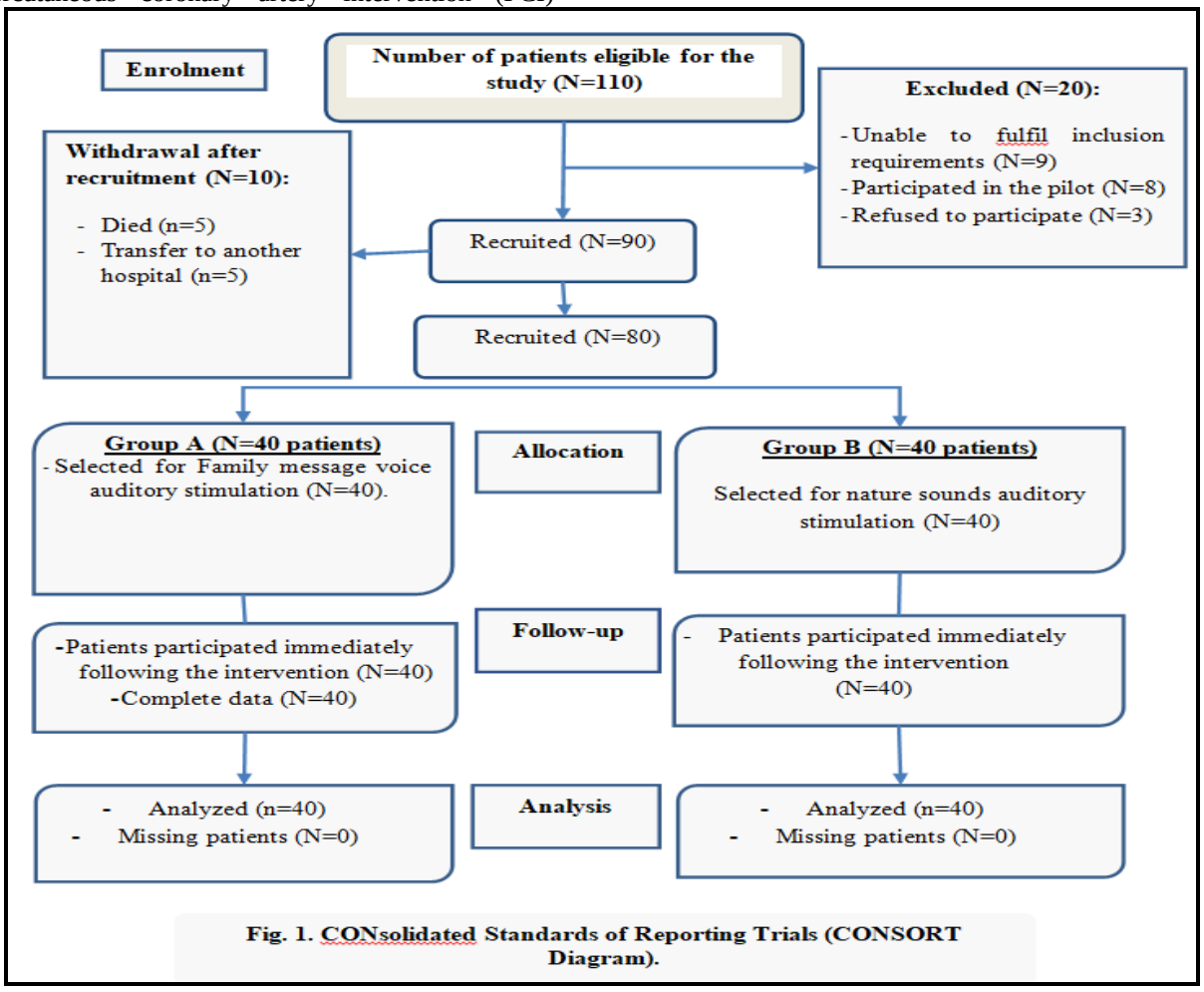

Fig. 1. CONsolidated Standards of Reporting Trials (CONSORT Diagram).

Tools of the study:

Tool one: Patient Biodemographic and Clinical Data. This tool contains patient biodemographic data, including age, gender (male, female), marital status, level of education, diagnosis, number of comorbidities, previous hospitalization, and length of stay. Vital signs parameters are also included. This part is used to assess heart rate (b/min), temperature (0C), respiratory rate (C/Min), mean arterial pressure (mm Hg), and oxygen saturation (SPO2) using a noninvasive pulse oximeter.

Tool two: Richards-Campbell Sleep Questionnaire (RCSQ). This instrument evaluated sleep quality utilizing the Richards-Campbell Sleep Questionnaire (RCSQ), established by Richards in 2000 **(Richards KC, O'Sullivan PS, 2000)**. RCSQ consisted of five items: sleep depth, latency, number of awakenings, returning to sleep, and subjective sleep quality. The RCSQ's total score ranges from zero (indicating extremely poor sleep quality) to one hundred (indicating excellent sleep quality). RCSQ was translated into Arabic language and adopted by Al-Sulami et al. The internal consistency, as measured by Cronbach's alpha, was 0.89, which is deemed acceptable **(Al-Sulami et al., 2019)**.

Tool three: Visual Analogue Pain Scale (VAS). This tool utilized the Visual Analogue Pain Scale (VAS) developed by **Hayes (1921) (Hayes & Patterson, 1921)** to determine the severity of chest discomfort. The pain scale is a straightforward 10 cm line with zero at the very least and 10 at the most severe level of pain that a person has ever felt. If a patient has trouble describing their discomfort numerically, VAS can help. A score of 0 indicates no pain, 1-3 signifies mild pain, 4-6 represents moderate to severe pain, 7-9 suggests very severe pain, and 10 indicates the greatest pain. **(Zaccagnino & Nedeljkovic, 2017)**. VAS's reliability was accepted **(Begum & Hossain, 2023)**.

- **Tool four: Hospital Anxiety and Depression (HAD) questionnaire.** This tool was utilized to evaluate the extent of anxiety and depression and was created by **Zigmond in 1981 (Zigmond & Snaith, 1983)**. This self-rate questionnaire consisted of fourteen questions: seven questions (items 1,3,5,7,9,11, and 13) were used to measure the level of anxiety (HADS-A), and another seven questions (2, 4, 6, 8, 10, 12, and 14) were used to measure the level of depression (HADS-D). Each subscale of anxiety and depression was calculated separately. A four-Likert scale was used where a score (0) means not at all, and a score (3) means very often. Two reverse items in anxiety questions and four reverse items were used in reversed scores where a score (0) means very often, and a score (3) means not at all. The cumulative score of HADS-D and HADS-A varied from 0 to 21. The scores were classified as follows: score 0-7, indicating normal; score 8-10, indicating mild; score 11-15, indicating moderate; and score 16-21, indicating severe **(Skapinakis, 2014)**. The questionnaire shown good reliability in cardiac patients, with Cronbach's alpha scores of 0.87 for the anxiety subscale (HADS-A) and 0.82 for the depression subscale (HADS-D) **(Christensen et al., 2020)**.

Methods:

- This study was approved by the Faculty of Medicine ethical committee at Tanta University (IRB approval number 36264PR749/7/24). All procedures conformed to the relevant regulations and standards specified in the Declaration of Helsinki. The study's objectives and methodologies were elucidated to the participants and signed informed consent was secured from the voluntary participants (patients and their relatives). Data confidentiality and privacy were guaranteed. The researcher informed patients of their right to either engage in or decline participation in the trial. The family audio message was erased from the recording device following the intervention.

Reliability and validity: The content validity was assessed by 5 critical care and emergency nursing professionals in the study's field. The reliability of the tool was done, and it was accepted.

- A pilot study was done on 10% of the studied patients to assess accessibility of two tool and necessary modifications were done and they excluded from total patients.

Study interventions:

- The total sample size was 80, divided into two groups. The family group contained fourteen patients who received a familiar voice message. After explaining the study's aim to the patients and their families, the researcher asked first-degree family members to record 10-minute voice messages before CICU visiting hours started. The message began by introducing a family member's identity and a brief message containing sweet and promising memories for the patient. It ended with an optimistic and encouraging statement for a forthcoming plan after discharge from the CICU and return home. These auditory messages were conducted daily before the visiting times for three consecutive days to avoid CICU congestion during visiting times. The researcher used a Digital Voice Recorder (32 GB) to record the voice message; the privacy of these messages was ensured. The patient, before bedtime, hears a voice message.
- **Example: Audio messages that the patient's family recorded**
- "Hi, My DAD. I am your daughter (name of relative). I miss you so much; I am waiting for

discharge to celebrate with you, my mother, and my brothers. After discharge, I arranged your room with your lovely things; you will stay there. Do you remember when I stayed with you and listened to your darling singer? I love you so much."

- Fourteen cardiac patients in the nature sound including singing birds, rainfall, wind, oceanic waves, river streams, and waterfalls, were selected and broadcasted for 30 minutes via headphones over three days, according to patient preference available at https://drive.google.com/drive/folders/1gaRyh50UgNgxRO5bvXbEMoHrzcQAX8?usp=sharing
- Vital signs parameters were recorded simultaneously before and after two 15-minute auditory stimulation interventions. The research avoided other stimulation, such as touch, during the intervention. The severity of chest pain was recorded before and after intervention using a visual analog scale. Sleep quality was assessed daily using the Richards-Campbell Sleep Questionnaire. The level of anxiety and depression was evaluated daily for three groups using the Hospital Anxiety and Depression scale.
- **Data collection and outcome measures:** Data was collected before (T0) and after the interventions with 15 minutes (T1) from November to December 2024. This study contained four primary outcomes, including vital signs, sleep quality, severity of chest pain, anxiety, and depression level. Secondary outcomes involve length of stay.

Ethical considerations:

This study was approved by the Faculty of Medicine ethical committee at Tanta University (IRB approval number 36264PR749/7/24). All procedures conformed to the relevant regulations and standards specified in the Declaration of Helsinki. The study's objectives and methodologies were elucidated to the participants and signed informed consent was secured from the voluntary participants (patients and their relatives). Data confidentiality and privacy were guaranteed. The researcher informed patients of their right to either engage in or decline participation in the trial. The family audio message was erased from the recording device following the intervention.

Statistical analysis:

Data was inputted and analyzed utilizing the IBP SPSS software package, version 23.0. The Shapiro-Wilk test was utilized to verify the normality of the variables' distribution. The Chi-square test (Monte Carlo or Fisher exact) is utilized for comparative analysis of groups, encompassing categorical variables. A paired student t-test was employed to compare pre-and post-test results for each group. The Mann-Whitney test was employed to compare quantitative variables between study groups. To address multiple comparisons over the three days within each group, we employed ANOVA with repeated measurements, subsequently applying the Bonferroni adjustment. A significant level of 5% was utilized for the acquired results.

Results:

Table (1): Distribution of the patients studied regarding their biodemographic data characteristics:

Sociodemographic data		Family group (n=40)		Nature Group (n=40)		χ^2	sig
		N	%	N	%		
Patient age	< 40 yrs	8	20%	7	17.5%		
	≥40yrs	33	82.5%	22	80%	0.775	^{MC}p =0.942
Gender	Male	18	45%	22	55%	1.404	0.496
	Female	22	55%	18	45%		
Marital status	Single	6	15%	7	17.5%	3.95	^{MC}p= 0.683
	Married	23	57.5%	17	42.5%		
	Divorced	8	20%	8	20%		
	Widow	3	7.5%	8	20%		
Level of education	Illiterate	15	37.5%	17	42.5%	1.717	^{MC}p= 0.944
	Primary	3	7.5%	2	5%		
	Secondary	7	17.5%	7	17.5%		
	University	15	37.5%	14	35%		
Diagnosis	Myocardial infarction	16	40%	19	47.5%	1.618	^{MC}p=0.806
	Dysrhythmia	13	32.5%	11	27.5%		
	unstable angina	11	27.5%	10	25%		
Previous hospitalization	Yes	21	52.5%	23	57.5%	2.511	^{MC}p= 0.944
	No	19	47.5%	17	42.5%		
Number of Comorbidities	1-2	12	30%	8	20%	2.693	^{MC}p= 0.610
	2-3	23	57.5%	26	65%		
	4-5	5	12.5%	6	15%		
Length of ICU stay	<7 days	23	57.5%	24	60%	-1.01	0.156
	≥7 days	17	42.5%	16	40%		
	Mean±SD	8.87(±2.35)		8.27(±2.93)			

$\chi 2$: Chi-square test MC: Monte Carlo

Table (2): Mean scores and standard deviations of vital signs parameters among studied groups at pre, post auditory intervention for three days:

Vital signs parameters	Family group (n=40)		Nature group (n=40)		Test of significance			
	T0	T1	T0	T1	U^1	P1	U^2	P2
Heart rate	Mean (SD)		Mean (SD)					
Day1	88.45±37.9	86.87±9.2	90.4±24	84.72±20	-0.241	0.809	-0.92	0.926
Day2	83.95±32.1	86.82±6.4	91.62±19	83.47±17.9	-0.639	0.523	0.215	0.830
Day3	81.15±26.8	87.97±4.4	83.87±19	77.7±13.6	0.830	0.407	-2.608	0.009*
t^1 (p)	-0.601 (0.551)		8.727(<0.001) *					
Respiratory rate								
Day1	31.02±4.14	18.62±1.3	30.65±3.2	26.025±2.5	-0.584	0.584	-7.543	<0.001*
Day2	28.8±4.17	18.07±1.1	25.97±1.9	24±2.21	-0.729	0.466	-7.66	<0.001*
Day3	26.27±7.01	17.20±0.7	23.87±2.1	21.35±2.59	-1.228	0.219	-6.712	<0.001*
t1 (p)	30.24(<0.001) *		18.88 (<0.001) *					
Temperature								
Day1	37.04±0.1	37.04±0.1	37.04±0.1	37.02±0.10	-1.163	0.245	-0.820	0.412
Day2	37.04±0.12	37.05±0.1	37.01±0.1	37.01±0.07	-1.163	0.245	-1.130	0.258
Day3	37.07±0.15	37.03±0.1	37.04±0.1	37.01±0.05	-1.074	0.283	-0.891	0.373
t1 (p)	1.557(0.123)		0.551(0.585)					
Mean arterial blood pressure.								
Day1	84.77±12.7	82.12±7.5	82.55±16	82.20±7.47	-0.746	0.455	-0.030	0.976
Day2	84.87±12.7	86±7.33	84.55±15	85.87±6.6	-0.112	0.911	-0.084	0.933
Day3	85.42±13.2	88.55±5.6	87.1±14.3	87.95±5.01	-1.356	0.175	-0.527	0.598
t1 (p)	-0.285(0.777)		-0.245(0.807)					
Oxygen saturation (SPO2)								
Day1	97.90±0.30	97.95±0.2	97.95±0.2	97.17±1.33	-0.844	0.399	-4.652	<0.001*
Day2	97.87±0.33	97.95±0.2	97.95±0.3	97.15±1.23	-1.180	0.236	-5.35	<0.001*
Day3	97.82±0.38	97.95±0.2	97.95±0.1	97.30±0.82	-1.758	0.079	-5.031	<0.001*
t1 (p)	-2.13(0.04) *		4.967(<0.001) *					

*T0: before intervention; T1, 15 min after intervention SD: Standard Deviation t=paired student t-test, U1: (pre), U2: (post), U=Mann-Whitney * Statistically significant p-value at ≤0.05.*

Table (3): Mean scores and standard deviations of Richards-Campbell Sleep Questionnaire among studied groups for three days:

Richards-Campbell Sleep Questionnaire	Family group (n=40)	Nature group (n=40)	Test of significance	
	Mean (SD)	Mean (SD)	U	p
Q1. Sleep depth				
Day1	41±9.21	59.75±20.1	-4.192	<0.001*
Day2	43.27±9.98	58.87±20.49	-3.617	<0.001*
Day3	42.65±8.86	59.75±20.59	-3.918	<0.001*
Q2. Sleep latency				
Day1	50.12±10.77	60.20±20.31	-2.511	0.012
Day2	56.50±12.5	60.75±19.53	-1.741	0.082
Day3	56.50±12.51	61.00±19.25	-1.833	0.067
Q3. Awakenings from sleep				
Day1	60.25±18.94	57.50±15.89	-0.499	0.618
Day2	55.47±13.66	60.97±19.47	-1.572	0.116
Day3	55.47±13.66	60.97±19.47	-1.572	0.116
Q4. Ability to return to sleep				
Day1	50.37±16.1	58.75±20.15	-1.775	0.076
Day2	56.62±12.6	60.35±19.74	-1.183	0.237
Day3	56.62±12.6	60.35±19.74	-1.183	0.237
Q5. Sleep Quality				
Day1	41±9.21	59.75±20.18	-4.192	<0.001*
Day2	43.25±9.97	58.75±20.59	-3.540	<0.001*
Day3	41.9±8.399	58.75±20.59	-3.823	<0.001*
6. Optional: Noise Item				
Day1	51.87±17.7	58.35±17.75	-1.572	0.116
Day2	56.62±15.86	61.25±17.23	-1.033	0.302
Day3	56.62±15.86	61.25±17.23	-1.033	0.302
Total sleep score				
Day1	48.65±8.05	59.50±11.68	-4.149	<0.001*
Day2	51.95±7.22	60.15±9.64	-3.938	<0.001*
Day3	51.62±6.88	60.34±9.63	-4.193	<0.001*

SD: Standard Deviation
U=Mann-Whitney
** Statistically significant p-value at ≤0.05*

Table (4): Mean scores and standard deviations of the severity of chest pain among studied groups at pre, post auditory intervention for three days:

Chest pain severity	Family group (n=40)		Nature group (n=40)		Test of significance			
	T0	T1	T0	T1	U^1	p	U^2	p
	Mean (SD)		Mean (SD)					
Day1	3.57±0.90	2.35±1.12	3.32±1.34	2.62±1.47	-0.997	0.319	-0.598	0.550
Day2	2.92±0.88	1.32±0.61	3.17±0.74	1.42±0.50	-1.198	0.231	-1.334	0.184
Day3	2.9±0.70	3.27±1.06	1.47±0.64	1.47±0.50	-1.581	0.114	-0.095	0.924
t^1 (p)	14.866(<0.001) *		12.139(<0.001) *					

T0: before intervention; T1, 15 min after intervention
SD: Standard Deviation
t=paired student t-test,
U1: (pre),
U2: (post),
U=Mann-Whitney
** Statistically significant p-value at ≤0.05*

Table (5): Frequency distribution of hospital and anxiety scale among studied groups for three days:

HAD Scale	Family group (n=40)						Nature group (n=40)						Test of significance
	Day 1		Day2		Day3		Day 1		Day2		Day 3		
	N	%	N	%	N	%	N	%	N	%	N	%	U (p)
Anxiety													
Normal	0	0	1	2.5	2	5	0	0	2	5	3	7.5	
Mild	2	5	5	12.5	32	80	3	7.5	8	20	24	60	
Moderate	27	67.5	33	82.5	5	12.5	25	62.5	30	75	13	32.5	
Sever	11	27.5	1	2.5	1	2.5	12	30	0	0	0	0	-0.416
Total score Mean±SD	14.62±2.1		12.2±1.89		10.25±1.75		14.30±2.2		11.7±1.9		10.17±1.7		(0.677)
F	**125.52**						**101.63**						
P	**<0.001***						**<0.001***						
η2	**0.869**						**0.843**						
Depression													-0.884
Normal	0	0	3	7.5	4	10	2	5	2	5	4	10	0.377
Mild	10	25	19	47.5	28	70	1	2.5	20	50	30	75	
Moderate	25	62.5	17	42.5	8	20	31	77.5	18	45	6	15	
Sever	5	12.5	1	2.5	0	0	6	15	0	0	0	0	
Total score Mean±SD	12.5±2.40		10.60±2.0		9.6±1.76		13.15±2.2		10.82±1.9		9.52±1.51		
F	**119.02**						**71.99**						
P	**<0.001***						**<0.001***						
η2	**0.862**						**0.791**						

SD: Standard Deviation *U=Mann-Whitne,* *F=ANOVA with repeated measures,*
η2=Partial Eta Squire ** statistically significant p-value at ≤0.05*

Table (1): The study found that most patients in the Family group (82.5%) and the Nature sound group (80%) were aged ≥40 years. Over half of the studied patients (55%) in the Family group were female and male in the Nature sound group. Married patients accounted for 57.5% of the Family group and 42.5% of the Nature sound group. About 37.5% of the Family group and 42.5% of the Nature sound group were illiterate. Myocardial infraction was the admission diagnosis for 40% of the Family group and 47.5% of the Nature sound group. Most of the patients in both groups had a previous hospitalization history and had two or three comorbidities. There was no significant difference between both groups in their length of stay (p=0.156).

Table (2): There was a significant difference between the pre-and post-intervention respiratory rates and oxygen saturation for the Family group (p <0.001, 0.04, respectively). At the same time, there is a significant difference between the pre-and post-intervention heart rates (p <0.001), respiratory rates (p <0.001), and oxygen saturation for the Nature sound group (p <0.001). The respiratory rate in the Family group's mean (SD) was lower on day 1 (18.62±1.3), day 2 (18.07±1.1), and day 3 (17.20±0.7) than in the Nature sound group (26.025±2.5,24±2.21, 21.35±2.59, respectively). Additionally, Oxygen saturation (SPO2) was improved in the Family group, with a significant difference in the Nature sound group (p<0.001).

Table (3): The mean score (SD) of RCSQ was higher in the Nature sound group on day 1 (59.50±11.68), day 2 (60.15±9.64), and day 3 (60.34±9.63) than in the Family group (48.65±8.05, 51.95±7.22, 51.62±6.88 respectively). There was a significant difference between both groups (Uday1=-4.149, p <0.001, Uday2=-3.938, p <0.001, Uday3=-4.193, p <0.001). Additionally, the mean score (SD) of sleep depth and quality was significantly improved in the Family group on day 1 (59.75±20.1, 59.75±20.18 respectively), day 2 (58.87±20.49, 58.75±20.59 respectively), and day 3 (59.75±20.59, 58.75±20.59 correspondingly). Also, no significant differences were observed between both groups regarding sleep latency, awakenings from sleep, ability to return to sleep, and noise.

Table (4): Post-intervention means scores of chest pain severity in both groups were lower than in the pre-intervention mean scores with significant differences (t Family group=14.86, P<0.001, t Nature sound group=12.139, P<0.001). There was no statistically significant difference between the reported pre- and post-intervention chest pain severity in both groups throughout three observation day

Table (5): The total mean score (SD) of anxiety level had a gradual decrease in

the family group patients over day 1 (14.62±2.1), day 2 (12.2±1.89), and day 3 (10.25±1.75) and in nature sound group had 14.30±2.2 in day 1, 11.7±1.9 in day 2, and 10.17±1.7 in day 3 with no statistical significance difference between them (p= 0.677) with large effect size in both groups (η2= 0.869, 0.843 respectively). Moreover, on day 1, the family group patients' total mean score (SD) of depression level decreased gradually to 12.5±2.40, on day 2, to 10.60±2.0, and on day 3, to 9.6±1.76. In contrast, nature sound group recorded 13.15±2.2, 10.82±1.9, and 9.52±1.51 on day 3, respectively, with no statistically significant difference between the two groups (p=0.377), and a large effect size in both groups (η2= 0.862, 0.791).

Discussion:

Cardiac patients often experience sleep deprivation, anxiety, and depression during hospitalization due to stress and isolation, which can lead to posttraumatic stress disorder (PTSD). Sensory deprivation can impair cognitive function, leading to confusion and delirium. High anxiety level correlates with cognitive dysfunction in cardiac patients, and physical consequences include increased falls and mobility restrictions, which can worsen cardiovascular outcomes **(Evbayekha et al., 2022; Makita et al., 2023)**. Immobility and sensory deprivation can promote muscle atrophy and psychological distress and increase the risk of infections, particularly ventilator-associated pneumonia, is heightened, resulting in longer stays and increased morbidity. Also, cardiac patients experience significant pathophysiological effects, including increased left and right ventricular filling pressures, impaired contractility, and increased stress. This can lead to symptoms such as dyspnea and fatigue. This creates a vicious cycle of worsening cardiac function and prolonged recovery times, necessitating comprehensive management strategies **(Evbayekha et al., 2022)**.

Meanwhile, auditory stimulation is a non-medicinal, planned, and purposeful method. A multi-sensory stimulation system was used in several studies, including using a familiar voice, a nurse's voice, music, a researcher's voice, ICU patients' and their families' video calls, Quran recitation, whistles, applause, ringing, and bird sounds. Those stimulations improve patient physiologic markers and psychological status **(Mallik & Russo, 2022; Naef et al., 2022; Uysal & Vaizoğlu, 2023)**. Both groups were matching in demographic and clinical data as more than half of both groups aged more than 40 years old, married, illiterate, diagnosed with myocardial infraction, and had no history for hospitalization. Our study revealed that using family voice messages compared to natural sounds had a similar effect on patients in both groups and that using these stimulations helps improve the health status of cardiac patients. Decreased respiratory rate and improved SpO2 were found in the family group in T1 compared to T0. While decreasing heart rate, respiratory rate, and improved SpO2 in nature sound group significantly decreased in T1 than in T0. Patients in both groups who used RCSQ reported better sleep quality on all three study days. It was noticed that nature sound group had a higher RCSQ total score than the family group on all three study days.

Regarding the severity of chest pain, patients in both groups reported a decrease in the severity of chest pain on all three study days, with no significant difference between them. Also, both groups gradually decreased their level of anxiety and depression using the HAS scale throughout three observation days. Also, both groups had no significant differences regarding their length of stay. Reducing anxiety, alleviating stress, and improving psychological status might explain the beneficial effects of auditory stimulation. Reducing levels of stress hormones such as cortisol, which can hinder recovery, may be possible when exposed to familiar voices or natural sounds since they elicit feelings of safety and comfort. Important physiological markers for recovery include blood pressure and heart rate, and this variety of aural stimulation can increase patient engagement and relaxation **(Khojeh et al., 2018; Li L; Lin Y; Wu H; Huang T; Guo C and Lin C, 2024; Nasari et al., 2018; Yekefallah et al., 2021)**. A shorter hospital stay may be possible if auditory stimulation helps create a soothing atmosphere, which speeds up healing. The aural stimulation calming effect can enhance parasympathetic nervous system activity and improve cardiovascular function **(Araç & Çıtlık Sarıtaş, 2022)**.

In addition to lowering stress-induced hyperventilation and improving general respiratory function, the relaxing effects of music can increase oxygen saturation levels. Auditory stimulation reduces stress-mediated respiratory drive by activating the parasympathetic nervous system, lowering sympathetic tone. This autonomic regulation makes better alveolar gas exchange possible, encouraging ideal breathing patterns with reduced respiratory rate and increased tidal volume **(Kobus et al., 2022)**. This agreed with a mixed study conducted by **Thorn et al. (2024)** on 27 cardiac patients, who indicated that the heart and respiratory rates were significantly reduced after the intervention with live music **(Thorn et al., 2024)**. **Uysal & Vaizoğlu (2023)** also assessed the effect of video calls with family members on the physiological parameters in the ICU. They found that

in the intervention group, heart rate significantly decreased after the intervention **(Uysal & Vaizoğlu, 2023)**. **Ghezeljeh et al. (2018)** reported a similar finding in CCU. They noted significant decreases in heart rate before and after the intervention in the patient group that listened to natural sounds for 30 minutes. **(Nasari et al., 2018)**.

Nevertheless, **Sarita's et al. (2016)** conducted quasi-experimental research on the impact of music therapy on the vital signs of patients in a surgical ICU. Their findings indicated that music therapy increased oxygen saturation levels in patients **(Araç & Çıtlık Sarıtaş, 2022)**. Similarly, **Ahmed et al. (2023)** stated that familial auditory stimulation significantly reduced respiratory rates and elevated SPO2 levels **(Ahmed et al., 2023)**. **Uysal et al. (2023)** observed that the respiratory rate in critically ill patients considerably decreased following video contact with family members compared to before the call. **(Uysal & Vaizoğlu, 2023)**.

Our study revealed that the mean RCSQ score was higher in nature sound group over three observation days than in the family group, with no significant difference. Additionally, both groups significantly improved the mean sleep depth and quality score on the first and third days. Also, no significant differences were observed between the family and nature sound groups regarding sleep latency, awakenings from sleep, ability to return to sleep, and noise. Music has been demonstrated to alleviate anxiety and encourage relaxation by increasing the release of serotonin and decreasing cortisol levels, which can lead to improved sleep.

This may be the reason for the beneficial effects of music ensembles **(Uysal & Vaizoğlu, 2023)**. This was consistent with the findings of **Jespersen et al. (2023)**, who assessed the effect of music on sleep in hospitalized patients and suggested that listening to music can improve sleep quality **(Jespersen et al., 2023)**. Additionally, **Chen et al. (2023)** stated that music listening can improve sleep quality, anxiety, and depression in critically ill patients **(Chen et al., 2023)**. Also, **Li et al. (2022)** evaluated the effect of music therapy on anxiety, depression, and sleep quality in ICU patients. They found that music therapy improved sleep quality in ICU patients **(D. Li et al., 2022)**. In agreement with a systematic review and meta-analysis performed by **Kakar et al. (2021)** on the effect of music intervention on sleep quality in critically ill and surgical patients in ICU. They highlighted that the recorded music significantly improved subjective sleep quality in some critical care and surgical populations **(Kakar et al., 2021)**.

Also, familiar voices from family members provide emotional comfort and a sense of security, which can lower stress and create a more calming environment conducive to sleep **(Ma et al., 2024)**. In this regard, **Bagheri et al. (2024)** conducted a study on the effect of increasing the duration of family members' presence on sleep status in 90 patients with acute coronary syndrome in the cardiac care unit. They reported that the presence of family members can improve the sleep quality and quantity of acute coronary syndrome patients admitted to the cardiac care unit **(Bagheri et al., 2024)**. In the same context, **Liang et al. (2023)** evaluated the effects of a sensory stimulation intervention on the psychosocial and clinical outcomes of critically ill patients and their families. They found that sleep quality improved in response to auditory stimulation of ICU patients with additional support from family caregivers **(Liang et al., 2023)**.

In our study, post-intervention means scores of chest pain severity were lower in the family and nature sound groups than in the pre-intervention mean scores with significant differences (pre-post intervention). There was no statistically significant difference between the reported chest pain severity in the family and music groups throughout three observation days. The improvement observed in the natural sound group can be explained by music therapy's ability to activate the brain's reward pathways, leading to increased endorphin release and reduced pain perception. **(Zaatar et al., 2024)** Similarly, **Thorn et al. (2024)** reported that music significantly reduced the adult intensive care patient's pain perception **(Thorn et al., 2024)**.

In agreement with our results, a systematic review of the effect of music on pain in the adult ICU by **Richard-Lalonde et al. (2020)** observed that music interventions of 20-30 minutes are efficacious in reducing pain in adult ICU patients **(Richard-Lalonde et al., 2020)**. Furthermore, the influence of familiar voices can be attributed to their capacity to provide emotional support and foster a sense of security, which effectively mitigates anxiety and tension levels that are known to exacerbate pain perception. In addition, the presence of family members can serve as a diversion from pain, diverting attention from distress and fostering a more optimistic emotional state **(An et al., 2024)**.

A study by **Tronstad et al. (2021)** also indicated decreased pain in individuals exposed to familiar sensory stimuli, including recognizable sounds and tactile contact with family members **(Tronstad et al., 2021)**. In this respect, **Sedghi et al. (2020)** conducted a study examining the impact of auditory and tactile stimulation from a family member on the agitation levels of patients with traumatic brain injury and diminished awareness in the ICU. They revealed that family members' auditory and tactile stimulation effectively decreases the agitation of traumatic brain

injury patients **(Sedghi & Ghaljeh, 2020)**. Along the same line, **Khojeh et al. (2018)** executed a study on the impact of a sensory stimulation program conducted by family members on the consciousness and pain levels of ICU patients. They showed that auditory stimulation with family members' voices reduces the pain intensity of patients admitted to the ICU **(Khojeh et al., 2018)**.

The findings of our study showed that there was no statistical difference between using family voice messages or nature sounds to decrease the level of anxiety and depression among these patients studied. The total anxiety and depression scores were significantly improved in both groups' post-intervention compared to the pre-intervention. Research indicates that music promotes relaxation, decreases anxiety, and modulates the autonomic nervous system, leading to improved stress and depression. Additionally, music can activate the parasympathetic nervous system, leading to a decrease in cortisol levels, thereby alleviating stress responses. Music's rhythmic and melodic aspects can facilitate emotional expression and distract from pain and discomfort, enhancing overall well-being **(J. Li et al., 2023)**.

When patients hear familiar voices, they trigger the release of oxytocin and serotonin, neurotransmitters critical in mood regulation and emotional processing. These neurotransmitters directly counteract anxiety and depressive symptoms. Additionally, the psychological comfort provided by familiar voices activates the parasympathetic nervous system, promoting relaxation and reducing sympathetic nervous system overactivity, a key contributor to anxiety in critical care environments **(Hendy et al., 2023)**. Also, listening to music can improve sleep quality, anxiety, and depression in critically ill patients. Additionally, the advantage of being an inexpensive and easy-to-administer intervention is that it is unlikely to have adverse effects, in contrast to pharmacological interventions **(Chen et al., 2023)**. **Kalkan Uğurlu & Alemdar (2024)** conducted a randomized controlled trial study on 60 cardiac patients using family audio recordings, and it was noticed that significant reduction in the level of anxiety between both control and intervention groups, while no significant difference in the level of depression and pain perception **(Uğurlu & Alemdar, 2024)**.

A study by **Yildirim et al. (2023)** also examined this topic concerning heart surgery patients. Patients' anxiety levels were shown to be much lower in the group that listened to an audio recording of affirmation statements following the procedure in comparison to the control group **(Yildirim et al., 2023)**. Additionally, **Adineh et al. (2022)** evaluated the influence of a sensory stimulation program including family members on the consciousness and pain levels of ICU patients. They emphasized that participation in a sensory stimulation program facilitated by family members would alleviate perplexity and anxiety in patients, fostering a sense of optimism, vitality, and security. This can enhance the efficacy of the central nervous system and foster consciousness and alertness **(Adineh et al., 2022)**. Our finding suggests that listening to a familiar voice or natural sound stimulation may be effective in stabilizing hemodynamic stability, reducing levels of anxiety and depression and severity of chest pain, and improving sleeping cardiac patients. However, long-term studies with larger samples are needed to evaluate these findings definitively. The study was a single-center investigation with a limited sample size and did not evaluate auditory stimulation using natural sounds and recognizable voices against pharmacological therapies or a control group. The intervention's effect was evaluated both before and following the session within a 15-minute timeframe.

Conclusion:

Our study demonstrated that both nature sounds and family voice messages contributed to the stabilization of heart and respiratory rates, resulted in comparable hospital lengths of stay, and supported improvements in oxygen saturation (SPO2) among cardiac ICU patients. Additionally, both interventions were effective in alleviating anxiety, depression, and chest pain severity. Although nature sound group exhibited slightly greater improvements in sleep quality and depth, the difference was not statistically significant when compared to the family voice group. These findings highlight the potential of auditory stimulation as a valuable non-pharmacological approach to enhancing patient well-being in the ICU setting.

Recommendations:

Based on our findings, we suggest integrating auditory stimulation using familiar voices and natural sounds as a complementary therapy for patients in the cardiac ICU. To strengthen these findings, future research should prioritize larger, multicenter studies to validate the results, incorporate comparisons with control groups and alternative treatments, and investigate the long-term impact of auditory interventions on patient outcomes.

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