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Effects of Music Therapy and Deep Breathing Exercise on Anxiety and Physiological Parameters in Patients with Respiratory Support

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ABSTRACT

Aims The aim of this study was to analyze the effect of a combination of music therapy and breathing exercises on anxiety and physiological parameters in patients using mechanical ventilation.

Materials & Methods The sample of this randomized controlled trial included 70 patients assigned to a treatment group of 35 patients and a control group of 35 patients. The proposed intervention was a combination of music therapy and deep breathing exercises carried out for 30 minutes twice a day for five days at 09:00 AM and 4:00 PM. In patients receiving mechanical ventilation, the following settings were used: synchronized intermittent mechanical ventilation, adaptive support ventilation, pressure support ventilation, continuous positive airway pressure, and duo positive airway pressure. Measurement of anxiety levels was done by the State-Trait Concern Inventory (Form Y) and assessing physiological parameters, such as blood pressure, mean arterial pressure, heart rate, respiration rate, and oxygen saturation. Data analysis was done using the paired t-test, Wilcoxon test, Mann-Whitney U test, and MANOVA at $p<0.05$.

Findings Differences were observed between the two groups in anxiety levels ($p=0.001$), heart rate ($p=0.001$), and respiration rate ($p=0.001$). There were no differences between the two groups in systolic blood pressure ($p=0.549$), diastolic blood pressure ($p=0.891$), mean arterial pressure ($p=0.571$), and oxygen saturation ($p=0.827$).

Conclusion The combination of music therapy with deep breathing exercises affects patient anxiety and physiological parameters with minimal risks.

Keywords Music Therapy; Breathing Exercise; Anxiety; Vital Signs; Noninvasive Ventilation

CITATION LINKS

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Introduction

Anxiety occurs in every human being in a natural way when the individual feels afraid or loses self-confidence due to stressors originating from within themselves and their environment. Anxiety is a feeling of fear that is not clear and is not supported by the situation [1, 2]. Patients who are hospitalized because of a major illness that is severe enough to use a breathing stone device and require close observation must be treated in an intensive care room. Often the intensive care environment gives its own anxiety to patients, the noise produced by monitors, and ventilators can be one of the stressors that make patients anxious in the intensive care room, especially patients with a compos mentis level of consciousness or fully conscious. Psychological changes due to ineffective patient coping with changes in illness conditions, installation of breathing apparatus (mechanical ventilation), changes in medical treatment, and treatment received are stressors for patients treated in intensive care rooms. Thus, the stressor that is felt and perceived by the patient is a threat and discomfort that can cause anxiety.

It is estimated that approximately 70-87% of critically ill patients experience anxiety [3]. Anxiety can result in physiological changes, including increased blood pressure and heart rate (HR), breathing problems, agitation, increased muscle activity/movement, and fear [4]. In a review of 26 studies, Hetland *et al.* [5] noted that between 30% and 100% of patients studied could remember all or part of their stay in the intensive care unit (ICU). Although many patients remember negative feelings, they can also remember positive and neutral feelings, negative experiences can be associated with fear, anxiety sleep disturbances, and discomfort.

The findings of a study by Saadatmand *et al.* [6] on ICU patients revealed that 7-9 patients were aware of the high-risk factors associated with anxiety. Around 10-25% of patients found it difficult to cease using the machine because of anxiety. During the mechanical ventilation procedure, patients may experience fear, anxiety, discomfort, immobility, breathing difficulties, disorientation, communication difficulties, and a lack of communication [7]. A preliminary survey was conducted at the intensive observation room (IOR) of RSUP Dr. Kariadi Hospital on 236 patients (surgical cases and internal cases) who were treated using ventilators and required close observation from March to August 2022. Patients who were treated using mechanical ventilation (ventilator) experienced a rapid increase in consciousness and were at risk of experiencing confusion and discomfort with the conditions they were experiencing. The patient's anxiety is shown by the patient not being calm. The ventilator often sounds an alarm and the unconscious patients can take actions that endanger themselves, such as removing the endotracheal tube or medical device that is attached so that the patient must be restrained. How much anxiety is felt by patients with mechanical ventilation who are treated in the IOR of RSUP Dr. Kariadi Hospital is not yet known.

Anxiety might impede recovery and ventilator support if it is not properly managed. The sympathetic nervous system can get activated as a result of anxiety, and this can result in fast heartbeat, rapid breathing, elevated blood pressure, constricted airways, and fatigue [1]. The anxiety felt by the patient can be reduced by eliminating the source of anxiety or providing supportive interventions. The findings demonstrated that using headphones to listen to natural sounds was similarly beneficial in decreasing anxiety and agitation in patients receiving mechanical breathing by lowering the risk of negative physiological reactions [7]. Music is an external stimulation intended to redirect attention and regulate emotional effects. In patients undergoing mechanical treatment, continuous music listening reduces respiratory rate (RR), systolic blood pressure (systolic), and anxiety [7].

Music therapy as a complementary therapy has not been widely used in hospitals in Indonesia. Music therapy promotes alveolar ventilation, sustains gas exchange, avoids lung collapse, and boosts cough efficacy [8,9]. According to studies on the impact of deep breathing on stress, anxiety, and tiredness in cancer patients, deep breathing exercises can be used to intervene and reduce stress, anxiety, and fatigue in cancer patients, particularly those with gynecological cancer who are receiving adjuvant chemotherapy [10]. Patients with chronic heart disease who engage in home deep breathing exercises experience less depression [11].

Deep breathing exercises and music therapy therapies are autonomous, non-pharmacological nursing acts. The impact of deep breathing exercises and music therapy on changes in physiological markers and anxiety in patients receiving mechanical ventilation is unclear. Therefore, research on the impact of music therapy and deep breathing exercises on physiological and psychological variables in patients not utilizing mechanical ventilation is important.

Materials and Methods

The sample of this randomized controlled trial was patients who were treated using a ventilator and met the criteria set by the researcher. The inclusion criteria were adult patients aged ≥18 years, patients using mechanical ventilation (ventilator) with synchronized intermittent mechanical ventilation, adaptive support ventilation, pressure support ventilation, continuous positive airway pressure, or duo positive airway pressure mode, patients with consciousness compos mentis or a minimum Glasgow coma scale (GCS) of 4-5, patients who could understand instructions both orally and in writing, and those who either did not receive any vasoactive drugs or received them in very small doses. Patients who were currently undergoing sedative treatment or other medications that depress the central nervous system (CNS), patients who had a tracheostomy, patients who have had surgery in the past, and those on a mechanical maintenance regimen for ventilation were excluded.

If the combination of music therapy and deep breathing exercises is anticipated to lower anxiety levels and enhance hemodynamic status, then, the type I error set at 5%, one-way hypothesis, and Z=1.64 can be used to calculate the study sample. Also, Z=1.28 if the type II error is set at 10%. Standard deviation (σ) was calculated from parameters in the literature [12]:

The minimum difference in the mean that is considered significant (μ1-μ2) was calculated considering the parameters in the literature: μ1=38.67 and μ2=49.67. The following formula was used to calculate the sample size:

$$n1=n2=2\left(\frac{(Z_1+Z_2)\sigma}{\mu_1-\mu_2}\right)^2$$

Based on the calculations above, the minimum sample of each group was 32 respondents. The sample size was adjusted to the calculations obtained for one group of 32 respondents and considering attrition, an additional sample of 10% of the predetermined number of respondents was added (10% of 32=3.2). Then, the total number of samples was 70 respondents (35 respondents in the treatment group and 35 respondents in the control group).

Instrument

A headphone was used to play music and the frequency of the music sound was set to the normal tuning standards of 40-60 Hz or the frequency adjusted for the patient's comfort. Recording of musical rhythms was done with a combination of natural-sounding instruments, flute, and gamelan.

The State-Trait Anxiety Inventory (STAI; Form Y) was utilized to assess participants' levels of anxiety. The STAI, which consists of two dimensions momentary anxiety (state) and basic/persistent anxiety (trait), was created by Spielberger *et al.* in 1964 [13]. However, since the anxiety analyzed was anxiety in specific situations, especially when patients were treated in the ICU using respiratory assistance (mechanical ventilation), the researchers only used the STAI. Besides, completing this questionnaire does not take much time because it uses simple language. The 20 items of this scale are scored on a single Likert scale. Ten items are favorable (positive), such as feeling secure and at ease, and the other ten are unfavorable (negative), such as worrying about impending events, being restless, worried, or tense.

Blood pressure was measured by sphygmomanometer from Indonesia, the mean arterial pressure (MAP) was measured using sphygmomanometer from Indonesia, HR was determined using an electrocardiogram from Indonesia, RR was measured by the number of breaths a person takes per minute, and SaO_2 was determined by a pulse oximeter. The blood pressure, MAP, HR, RR, and arterial oxygen saturation (SaO_2) values were recorded before and after performing music therapy along with deep breathing exercises.

Procedure

Data collection was done before the treatment in the treatment and control groups, including demographic data (age and gender), hemodynamic status (pressure blood, HR, RR, MAP, and SaO_2), and patient's anxiety levels, which was measured using a questionnaire (the researcher read and explained the questionnaire and the patient answered by showing the answers provided by the researcher with a nod of the head).

In the treatment group, after receiving treatment and medical procedures according to hospital procedures, namely oxygenation, nebulization, suctioning, mobilization, and fulfillment of basic needs, such as personal hygiene, electrolyte fluids, nutrition, and excretion, the researchers provided music therapy combined with deep breathing exercise. Before the intervention, the researcher gave an explanation of what to do; the patient was asked to listen to the music that had been prepared, and told what type of music to listen to. Then, the patient was asked to do deep breathing exercises while listening to the music.

The content of the deep breathing instructions was to inhale as much as possible, hold it, and exhale slowly. Deep breathing exercises are divided into five training stages. Each step is performed five times consecutively, interspersed with a 5-minute break in each step while listening to music (Table 1).

Table 1. Deep breathing exercise

Stage	Content
1	Inhale, hold your breath for a count of 2, and exhale
2	Inhale, hold your breath for a count of 4, and exhale
3	Inhale, hold your breath for a count of 6, and exhale
4	Inhale, hold your breath for a count of 8, and exhale
5	Inhale, hold your breath for a count of 10, and exhale

The exercise was carried out for 30 minutes two times a day for five days. The training schedule was morning at 09.00 AM and afternoon at 4.00 PM in patients treated with mechanical ventilation using the following mode settings: synchronized intermittent mechanical ventilation, adaptive support ventilation, pressure support ventilation, duo positive airway pressure, or continuous positive airway pressure. Researchers also observed the patient's ability or tolerance, general condition, and vital signs regarding the exercises given. If in the middle the patient cannot do this, he/she could give a signal code by waving his/her hand and the researcher stopped the intervention.

In the control group, patients received medical treatment and procedures according to hospital procedures, namely nebulization, suctioning, oxygenation, mobilization, and fulfillment of basic needs, such as electrolyte fluids, nutrition, excretion, and personal hygiene. However, the control group did not receive additional music therapy combined with deep breathing exercises. In the control group, only the patient's general condition and vital signs were monitored.

Data collection after the intervention was carried out in the intervention and control groups. After a combination of music therapy and deep breathing exercises for five days, the intervention and control groups were observed again by measuring hemodynamic status (blood pressure, HR, RR, MAP, and SaO_2) and the level of anxiety using a questionnaire (the researcher read and explained the questionnaire and the patient answered by showing the answers provided by the researcher). Based on the principle of fairness in research ethics, after receiving the information on the fifth day, intervention was given to the control group and the researcher explained the steps as in the intervention group.

Statistical analysis

The Kolmogorov-Smirnov test was applied to assess the normality of data. When the data were regularly distributed, parametric statistics were used, such as the paired t-test, and if they were not normally distributed, non-parametric statistics, such as the Wilcoxon test were used. In each of these tests, the independent variables for the treatment and control groups were examined both before (pre-test) and after (post-test) treatment. A homogeneity test was conducted to assess the equality of variances. We utilized the Mann-Whitney U test to compare the differences in each variable between the groups. Data analysis was done using SPPSS 23 software.

Findings

There was no significant difference between the groups in gender (Table 2). The participants in the treatment group were older, with the youngest respondent being 18 years old and the oldest respondent being 77 years old, while those in the control group were mainly in early adulthood, the youngest respondent was 21 years old and the oldest was 78 years old. According to the patient's ventilator mode at the time of data collection, nine respondents used synchronized intermittent mechanical ventilation and nine respondents used continuous positive airway pressure, which indicated the treatment group with the highest proportion of ventilator modes with similar characteristics. Also, ten responders (28.5%) in the control group used synchronized intermittent mechanical ventilation as the most common ventilator mode.

Table 2. Respondents' characteristics ($p<0.05$ for all)

Characteristics	Intervention group		Control group	
	No.	%	No.	%
Gender				
Male	19	54.3	16	45.7
Female	16	45.7	19	54.3
Age (year)				
17-25	6	17.2	5	14.2
26-35	8	22.8	11	31.4
36-45	4	11.4	6	17.2
46-55	8	22.9	5	14.3
≥56	9	25.7	8	22.9
Ventilator mode				
Synchronized intermittent mechanical ventilation	9	25.7	10	28.5
Adaptive support ventilation	4	11.4	5	14.2
Pressure support ventilation	6	17.2	6	17.2
Duo positive airway pressure	7	20	6	17.2
Continuous positive airway pressure	9	25.7	8	22.9

In the intervention group, the post-test score of anxiety decreased (moderate anxiety category) compared to the pre-test score ($p<0.05$). The control group also experienced a decrease in anxiety compared to the pre-test score ($p<0.05$). Deep breathing exercises and music therapy had no statistically significant effect on systolic blood pressure. The mean systolic blood pressure after the test was lower in the intervention group than in the control group ($p>0.05$). There was no statistically significant difference in diastolic blood pressure after music therapy and deep breathing exercises between the groups. The average post-test diastolic blood pressure value was higher in both groups ($p>0.05$). In addition, the intervention had no statistically significant effect on MAP ($p>0.05$). A statistically significant difference was seen in HR after the intervention. A significant decline was observed in the mean post-test HR value in the intervention group compared to the pre-test value ($p<0.05$); however, no significant difference was observed in the control group in this regard ($p>0.05$).

Table 3. Frequency of studied parameters between the control and intervention groups ($p<0.05$ for all)

Parameter	Intervention group		Control group	
	Pre-test	Post-test	Pre-test	Post-test
Anxiety	61.19±7.28	43.56±5.25	62.53±6.28	55.97±5.88
Systolic blood pressure	122.53±22.23	132.66±17.13	128.24±23.55	129.77 ±18.56
Diastolic blood pressure	68.41±12.42	72.23±12.26	72.53±13.59	75.09±11.48
Mean arterial pressure	88.67±12.72	91.28±12.42	91.74±16.66	95.80 ±13.54
Heart rate	119.23±15.58	92.27±7.65	115.64±22.37	105.80±19.28
Respiratory rate	21.66±6.15	17.53±1.63	18.71±5.63	22.01±6.46
Oxygen saturation (SaO_2)	98.24±1.27	98.97±0.33	98.65±1.53	98.51±0.71

In addition, there was a statistically significant difference in RR after the intervention in both groups. The average post-test RR value in the intervention group was lower compared to the pre-test ($p<0.05$), whereas its average post-test value in the control group was higher than the pre-test value. The intervention showed no statistically significant effect on SaO_2 in the groups ($p>0.05$; Table 3)

Discussion

The difference in scores between the two groups following the intervention demonstrated the impact of music therapy and deep breathing exercises on the anxiety levels of patients receiving mechanical ventilation. The findings of this study concur with those of Dorman's research [14] who compared the effect of deep breathing exercises offered to patients during the process of weaning from mechanical breathing. When compared to the control group, it was shown that listening to nature-based sounds dramatically decreased the levels of agitation and anxiety.

Listening to music (nature-based sound therapy) provides pleasurable stimuli and provides an alternative perceptual focus in mechanically ventilated patients. [6, 15]. The physiological stress response during weaning of patients from ventilators was reduced when they were given music therapy. Di Nasso *et al.* [4] found that nature-based sound therapy considerably decreased anxiety and agitation in patients undergoing mechanical ventilation. Music can trigger the release of endorphins from the CNS, which can reduce anxiety and fear by lowering blood pressure, HR, and RR as well as by offering a pleasant environment. In addition, music may boost a person's mood and promote happiness, which naturally enhances clinical self-development skills, such as pain and anxiety management [6, 16]. Deep breathing relaxation techniques, on the other hand, can help to relieve tension throughout the body while also promoting a peaceful, comfortable sensation [17]. Practicing deep breathing relaxation techniques helps boost blood oxygenation and lung ventilation. This is due to the fact that deep breathing requires effort during inspiration and expiration, which affects cardiopulmonary stretching [18]. Cardiopulmonary stretching can increase baroreceptors, stimulate parasympathetic nerves, and increase baroreceptors, which all help to calm the body by lowering stress and anxiety levels [19].

The variations in MAP that were experienced were still within normal ranges. Arterial blood pressure describes the condition of blood pressure that exists when blood is pumped out of the heart. Low blood pressure results in less blood supply to the tissues. Thus, oxygen and food essences are not delivered, and ultimately there can be a decrease in the body's metabolism. In this study, while the patients were being treated, all patients (100%) received a minimal dose of norepinephrine [19-24]. Treatment with norepinephrine stabilizes cardiovascular circulation and prevents the risk of shock and loss of consciousness in patients. All our patients had a good clinical condition and compos mentis awareness during data collection with a GCS of at least 4-5. During data collection, no patient experienced a decrease in consciousness in the treatment or control group. It can be concluded that since the intervention presented had no clinical effect on MAP, the change in the data between the two groups indicated the effect of deep breathing exercises and music therapy on HR in patients receiving mechanical ventilation. Di Nasso *et al.* [4] indicated that music therapy can stimulate the axons of the ascending sensory fibers that connect to the neurons of the reticular activating system. The corpus callosum, limbic system, cerebral cortex, as well as autonomic nervous and neuroendocrine systems, all are then stimulated. A relaxation response can be produced by music therapy by stimulating the sympathetic and parasympathetic nerves. Blood pressure, HR, and muscular tension all drop as a result of the relaxation response, which also causes sleep. Stress and anxiety affect the functioning of the CNS, activate the hypothalamic-pituitary-adrenal axis and the parasympathetic nervous system, and stimulate the secretion of norepinephrine and epinephrine, which act as vasoconstrictors, increasing HR and blood pressure [25-31].

Abu Youssef *et al.* [32] explained that arterial baroreflex sensitivity can be significantly increased by slow breathing. This shows that there is a relationship between increased vagal activity and decreased sympathetic nerves, which can reduce HR and blood pressure. During slow, deep breathing, it is also possible to see a drop in blood pressure and chemoreceptor responses. In addition to being a relaxation method, deep breathing exercises can modify the biochemistry of the body by, for example, boosting the release of endorphins, which are chemicals that increase calmness, and reducing the levels of adrenaline and blood acidity [33]. Since both the autonomic nervous system and the CNS are present in the human neurological system, deep breathing relaxation training makes sense. The CNS's job is to regulate desirable motions, such as those of the neck, fingers, hands, and feet. The autonomic nerve system is responsible for managing automatic bodily processes, including digestion and heartbeat. The sympathetic and parasympathetic nervous systems make up the two opposing parts of the autonomic nervous system. Sympathetic nerves act to boost stimulation or excite the body's organs, causing the peripheral blood vessels to constrict and the central arteries to widen, which in turn increases HR and breathing [34]. The body's organs operate more slowly as a result of the parasympathetic nervous system's actions, which include slowing the heartbeat, enlarging blood vessels' walls, opening up the bronchi, and raising blood pressure [35, 36].

Based on SaO_2 measurements, the combination of music therapy and deep breathing exercises had no effect on SaO_2. The findings of this study support previous research on the effectiveness of music therapy by Yin and Song [37] who revealed that there were no significant alterations in immunoglobulin A, blood glucose, or SaO_2 after the intervention. Brasher *et al.* [38] likewise revealed that deep breathing exercises did not affect SaO_2. The SaO_2 increased significantly after deep breathing exercises, according to the findings of the study by Borge *et al.* [12].

We showed that the increases and decreases in SaO_2 were still within normal limits and no significant difference was found in SaO_2 between the groups. With the additional intervention provided, it is hoped that in addition to feeling relaxed while listening to the music, the patient will also perform guided deep breathing according to the guidelines in music therapy so that the breathing rhythm becomes regular, which can affect optimal air ventilation, which ultimately can increase SaO_2 of patients. No patient experienced cyanosis. The intervention had no negative effect, evidenced by the fact that the SaO_2 value during treatment using a combination of music therapy and deep breathing exercises did not affect lowering the SaO_2 value below the normal level. Deep breathing exercises are a form of relaxation that reduces anxiety levels by strengthening the parasympathetic nervous system, reducing the stress response, and increasing the release of hormones in the endocrine nervous system that promote relaxation and mental awareness.

In music therapy interventions, only one type of music was used, i.e. natural sounds combined with gamelan sounds so that the respondent could not choose music according to their taste. The researchers could not assess whether the deep breathing exercises performed by the respondents were correct according to the instruction manual or not because the respondents listened using headphones.

Conclusion

Deep breathing exercises and music therapy lessen patient anxiety and affect physiological parameters in those who need mechanical ventilation. It is anticipated that playing music for critically ill patients may encourage the release of endorphins from the CNS, which can lower HR, blood pressure, and RR, promote a positive mood, and lessen fear and anxiety.

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Ethical Permissions: Each participant received a permission form to sign and was informed of the procedures and objectives of the study. PGRI University of Semarang Research Ethics Committee (119/EC/UPGRIS/2020) approved all research methods. Informed consent to participate in the research was obtained after explaining the intervention. Since the patients were not able to communicate verbally, the researchers explained the intervention, the purpose, duration of administration, and side effects of the intervention to the patient's family. If the patient and family agreed, the researcher asked the family to sign a consent form as respondents.

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Authors' Contribution: Widyaningrum A (First Author), Methodologist/Main Researcher/Discussion Writer/Statistical Analyst (25%); Rohmansyah NZ (Second Author), Introduction Writer/Assistant Researcher/Discussion Writer/Statistical Analyst (25%); Hakim AR (Third Author), Methodologist/Assistant Researcher/Discussion Writer (25%); Hiruntrakul A (Fourth Author), Introduction Writer/Assistant Researcher/Discussion Writer/Statistical Analyst (25%)

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