Received: 29 January 2023 | Revised: 29 June 2023 | Accepted: 5 July 2023

DOI: 10.1111/nicc.12952

RESEARCH ARTICLE

BACCN Nursing in Critical Care WILEY

The effect of listening to music during continuous positive airway pressure on agitation levels and compliance of intensive care patients with COVID-19: A randomized controlled trial

Sumeyye Bilgili MSc, RN[1] | Reva Balci Akpinar PhD[2]

[1]Elazığ Fethi Sekin City Hospital, Elazığ, Turkey

[2]Faculty of Nursing, Department of Nursing Fundamentals, Ataturk University, Erzurum, Turkey

Correspondence
Reva Balci Akpinar, Faculty of Nursing, Department of Nursing Fundamentals, Ataturk University, Erzurum, Turkey.
Email: reva@atauni.edu.tr

Funding information
TUBITAK; Ataturk University, Grant/Award Number: TYL-2021-9711

Abstract

Background: Agitation and incompliance with the treatment may be observed in patients undergoing continuous positive airway pressure (CPAP), which may cause inadequate oxygenation, sedation, termination of CPAP or intubation of the patient.

Aim: This study was conducted to determine the effect of listening to music during CPAP on the agitation levels of intensive care patients who underwent CPAP as a result of COVID-19 and their compliance with the treatment.

Study design: This study was a prospective, randomized, controlled clinical trial. Seventy-six intensive care patients with COVID-19 were included in this study and assigned to the music and control groups via the block randomization method. The study was completed with 70 patients. The patients and outcome assessors were not blinded in this study. The Richmond Agitation and Sedation Scale (RASS) level, respiratory rate, oxygen saturation (SpO_2) and mask air leakage amount were the outcome measures.

Results: The mean RASS score of the patients in the intervention group was 2.14 ± 0.69 before CPAP, 1.63 ± 064 at the 1st minute, 0.89 ± 0.58 at the 15th minute and 0.74 ± 0.61 at the 30th minute. The mean RASS score of the patients in the control group was 2.06 ± 0.53 before CPAP, 1.80 ± 0.58 at the 1st minute, 1.43 ± 0.60 at the 15th minute and 1.46 ± 0.61 at the 30th minute of CPAP. There was a statistically significant difference between the groups at the 15th and 30th minutes ($t = -3.81$, $p < .001$; $t = -4.89$, $p < .001$ respectively). The mean respiratory rate, SpO_2 and mask air leakage amount were compared between the groups. There was a statistically significant difference in favour of the intervention group at the 15th minute ($t = -2.47$, $p < .001$; $t = 2.57$, $p < .001$; $t = 2.93$, $p < .001$ respectively) and 30th minute ($t = -3.17$, $p < .001$; $t = 3.46$, $p < .001$; $t = -3.93$, $p < .001$ respectively).

Conclusions: The study results show that listening to music during CPAP reduces the agitation levels of patients and helps them comply with the treatment.

Relevance to clinical practice: Music may be a beneficial application for patients who are agitated and unable to comply with CPAP therapy. This is an easy and applicable method, which can protect patients from the adverse effects of failed CPAP.

KEYWORDS
Agitation, compliance, COVID-19, CPAP, music

1 | INTRODUCTION

COVID-19 disease, which has killed approximately 6.9 million people worldwide, leads to pneumonia characterized by fever, shortness of breath and acute respiratory symptoms.[1] According to the infection severity and the patient's clinical picture, oxygen therapy, high-flow nasal oxygen therapy, non-invasive mechanical ventilation (NIMV), or invasive mechanical ventilation (IMV) should be administered to patients who develop pneumonia. In individuals who breathe spontaneously, continuous positive airway pressure (CPAP) is a frequently used form of NIMV to keep the airways open. In this form of ventilation, air is applied to the upper respiratory tract with a constant pressure higher than atmospheric pressure. The forced air delivered helps to keep the airways patent.[2] It is asserted that CPAP is the first therapeutic option for acute respiratory distress syndrome developing because of COVID-19.[3,4] CPAP therapy increases functional residual capacity, opens collapsed alveoli, increases oxygenation, reduces the use of auxiliary respiratory muscles, rapid and superficial respiration, improves gas exchange, alleviates respiratory workload by improving lung compliance and relieves respiratory distress without intubating the patient.[4] However, its successful administration depends on patient-ventilator compliance. CPAP therapy causes psychological problems such as fear, anxiety, claustrophobia, a feeling of suffocation, panic, sleep disturbance and agitation and physical problems such as peeling of the nose and facial skin, pain, eye irritation and dry mouth, which adversely affect the patient's compliance with CPAP therapy.[5,6] During CPAP, the patient's agitation, breathing rhythm incompatible with the mask and air leakage indicates non-compliance with the therapy.[2] Air leak reduces the tidal volume applied to the patient, and the patient has difficulty triggering the ventilator. The panic caused by the patient's feeling of suffocation stimulates the sympathetic nervous system, increasing blood pressure, pulse rate and respiratory rate.[2] When patients receiving CPAP support cannot comply with the treatment, either CPAP therapy is terminated and other options are considered, or sedation is administered to these patients.[7] Therefore, the nursing care of the patient receiving CPAP therapy should aim to facilitate the patient's relaxation and compliance with CPAP. Music therapy, which is included in the Nursing Interventions Classification (NIC) with the code 4400, has been found to have pain, anxiety and stress-reducing effects, affect the patient's blood pressure, pulse, respiratory rate and oxygen saturation values, enable relaxation and increase patient comfort.[8–16]

In a systematic review update conducted by Bradt and Dileo,[17] it was stated that listening to music reduced anxiety, decreased systolic blood pressure and respiratory rate and decreased the use of sedatives and analgesics but did not improve oxygen saturation in patients receiving mechanical ventilation. In the study performed by Dallı et al.,[18] it was reported that music intervention controlled delirium, pain, need for sedation and anxiety in intensive care patients. Hence, it was proposed as a nursing intervention. The organism's response to music varies depending on an individual's perception of music and the intensity and rhythm of sounds.[14,19,20] In relaxing music, the absence of lyrics, repetitive rhythms, low sound, low tempo and harmony are important.[21] It is reported that the biological rhythms of individuals, such as respiration and pulse, are synchronized with the rhythm of the music they listen to.[22,23] Therefore, the music should have a rhythm suitable for the therapeutic purpose.

What is known about the topic

- CPAP may lead to agitation in patients, which adversely affects CPAP compliance.
- In patients who comply with CPAP therapy, oxygenation increases, lung compliance improves, respiratory workload is alleviated and the risk of intubation decreases.
- Nurses use music for therapeutic purposes to improve the problematic conditions of intensive care patients, such as pain, anxiety, delirium and sleep disturbance.

What this paper adds

- In intensive care patients with COVID-19, listening to music during CPAP effectively decreases patients' agitation levels and ensures their compliance with the treatment.
- The positive effect of music on patients' agitation and compliance with the treatment is observed at the 15th and 30th minute of the intervention.

2 | AIM

This study aimed to investigate the effect of music that intensive care patients with COVID-19 listen to while receiving CPAP on their agitation levels and compliance with CPAP. Specifically, the study aimed to test the following hypotheses:

Hypotheses:

H0: Listening to music during CPAP does not affect the agitation level and the CPAP compliance of intensive care patients with COVID-19.

H1: Listening to music during CPAP reduces the agitation level of intensive care patients with COVID-19.

H2: Listening to music during CPAP increases the CPAP compliance of intensive care patients with COVID-19.

3 | DESIGN AND METHODS

This study was conducted as a prospective, randomized controlled clinical trial. The Consolidated Standards of Reporting Trials (CONSORT) 2010 guidelines were followed in this single-centred and randomized controlled trial.[24] The ClinicalTrials.gov registration number is NCT05102084.

3.1 | Study setting

The data of this study were obtained from patients hospitalized in the COVID-19 intensive care unit of a state hospital in Turkey between September and December 2021. The intensive care unit where the study was conducted has 13 beds, and one patient is accommodated in each room. Rooms are ventilated with a negative pressure ventilation system, and their physical properties, such as temperature and lighting, are similar.

3.2 | Study participants

Patients receiving CPAP support in intensive care units were evaluated for meeting the inclusion criteria. Patients over 18 years of age, who stayed in the intensive care unit for 1 day and received CPAP at least once, who did not have a hearing impairment, did not receive sedation, were not diagnosed with any psychiatric disease, were hemodynamically stable, and had a Glasgow Coma Scale (GCS) score of 14 and above were included in the study. Patients whose clinical course worsened during the follow-up period, who were intubated, sedated and had delirium were excluded from the study.

3.3 | Sampling and randomization

The study population consisted of patients with COVID-19 who were hospitalized in the intensive care unit of the city hospital and underwent CPAP therapy. An a priori power analysis was conducted to determine the sample size of the study. It was found that 78 patients should been recruited at the 0.05 significance level for an effect in the medium-high effect size range[25] (According to Cohen, an effect size of 0.65 (0.5 + 0.8/2) corresponding to this range was selected). Ninety-three patients who underwent CPAP therapy as a result of COVID-19 were admitted to the intensive care unit between the data collection dates. Of these patients, 11 did not meet the inclusion criteria, and six refused to participate in the study. We reached 76 patients who met the inclusion criteria and agreed to participate in the study. Two patients in the intervention group gave up listening to music, and two patients did not continue CPAP therapy. In the control group, one patient was transferred from the intensive care unit to the clinic, and one patient did not continue CPAP therapy. Thus, six patients were excluded from the study during follow-up, and the study was completed with 70 patients. In the post hoc (experimental/real) power analysis performed after the study, it was determined that the study's effect size was 1.180 and the power $(1-\beta)$ was 99.8% (Mean $1 = 0.74 \pm 0.61$, Mean $2 = 1.46 \pm 0.61$), the alpha error was 0.001 and the beta error was 0.002. These values indicate that the sample size was sufficient (Figure 1).

Patients were assigned to the experimental and control groups via the block randomization. Block randomization was performed using the computer software Research Randomizer. A block size of four was established to ensure an equal chance of allocation to each group; allocation ratio 1:1. To ensure confidentiality, the randomized sequence was generated by a statistician and, in sealed envelopes, given to the researcher who performed the intervention.

The management of the hospital from which the study data were obtained allowed only one researcher to access the intensive care unit for the purpose of avoiding contamination. Therefore, a single researcher performed the intervention and outcome assessment in the study, and the outcome assessors could not be blinded. As the music intervention was not compared with any other intervention, the patients could not be blinded, which may have led to the risk of bias. However, we think this risk was low in the objective results of the study. On the other hand, the other researcher who conducted the data analysis was blinded to group coding.

3.4 | Data collection tools

Patient descriptive and follow-up form: Patients' characteristics such as age, body mass index (BMI), GCS score, tidal volume, total respiratory pressure, respiratory rate, oxygen saturation and air leak amount values evaluated during follow-up were recorded in this form. The descriptive characteristics of patients were obtained from the BMI and GCS patient files, and tidal volume, total respiratory pressure, respiratory rate, oxygen saturation and air leak amount were obtained from the ventilation monitor.

Richmond Agitation and Sedation Scale (RASS): The agitation levels of patients were monitored with the RASS. Sessler et al.[26] performed its validity and reliability studies in adult intensive care patients in 2002. The scale was adapted to Turkish.[27] The RASS was preferred because it has the highest agreement between practitioners and is easy to apply.[28] The RASS is a 10-point scale, with scores ranging from +4 to −5. Positive RASS scores refer to agitated patients, while negative RASS scores refer to sedated patients or patients in a

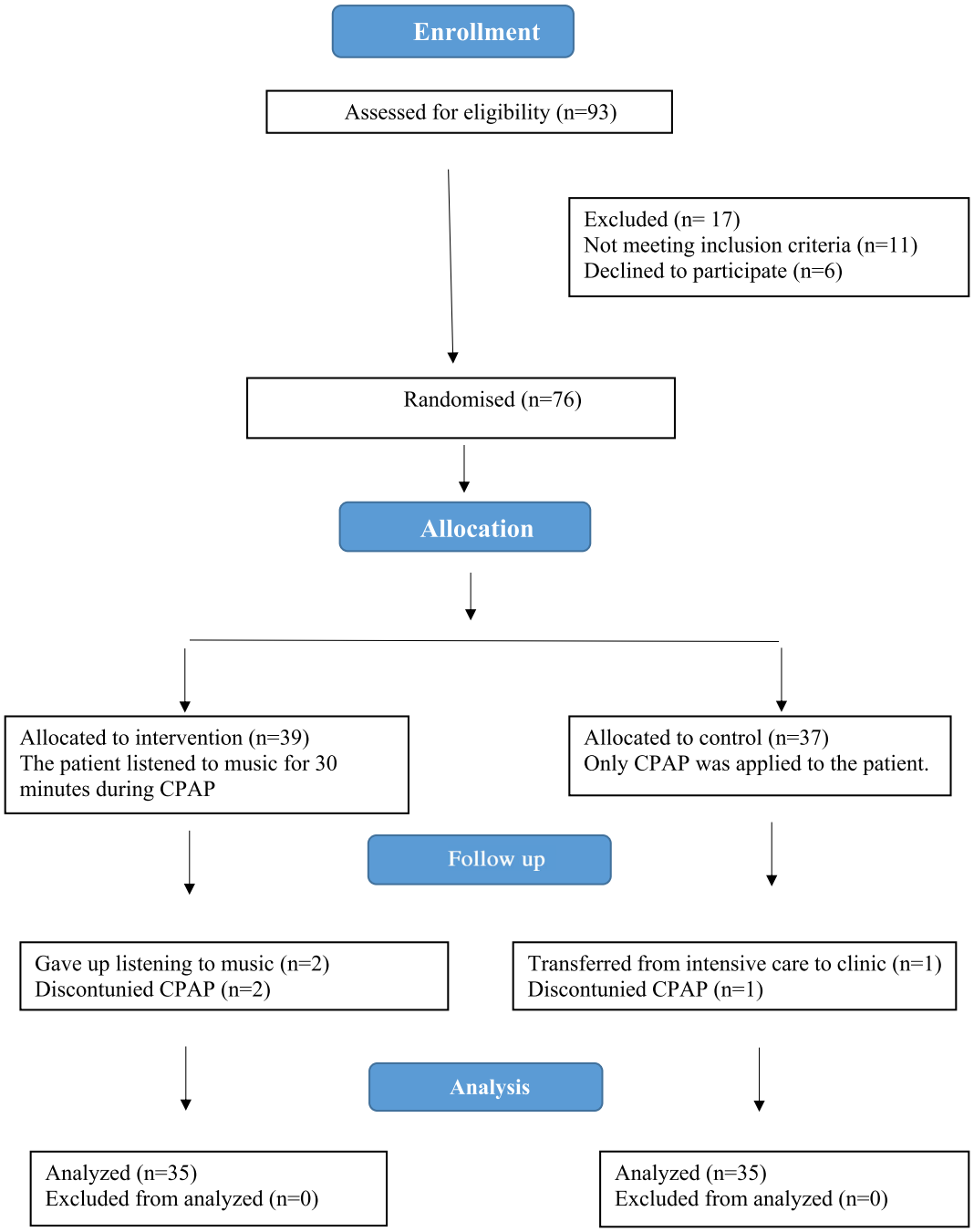

FIGURE 1 Flow diagram of the study.

coma. As sedated patients were not included in the present study, only scores between 0 and 4 were evaluated. The RASS scoring is done by observation and verbal request to the patient. The evaluation is as follows: if the patient is generally aggressive and poses a danger to the staff, +4 points are given. Pulling or removing the tube and urinary catheter or aggressive behaviours towards personnel are scored as +3 points, while repetitive aimless movements or the lack of ventilation coordination are given +2 points. Worried but no aggressive or violent movements are given +1 point, whereas alert and calm states are scored as 0 points.

Music patients listened to: Music was created by a specialist who was a music therapist and a vocal artist. Four audio recordings with relaxing and appropriate rhythms were compiled from the artist's audio archive for patients who underwent CPAP therapy, and these recordings were combined into a single 30-min audio recording. The prepared audio recording was uploaded to the MP3 player via Bluetooth, and the patient listened to it with on-ear headphones. Decontamination measures were taken.

3.5 | Outcomes

The outcome measures of the study were agitation level and compliance with CPAP. The agitation level was measured by the RASS.

CPAP compliance was evaluated according to respiratory rate, oxygen saturation and the amount of air leakage from the ventilation monitor. Measurements were made before CPAP, at the 1st, 15th and 30th minutes of CPAP.

3.6 | Study procedures

As this study took place in a setting involving patients with infectious diseases, the researcher wore protective clothing and equipment before initiating the intervention. Interventions and data collection were conducted between 18:00 and 22:00 when treatment and care practices decreased and visits were limited. After evaluating the patient's condition and obtaining his/her consent, the RASS scores were determined and recorded by observation in the intervention group before the initiation of CPAP. Respiratory rate and oxygen saturation values were taken from the ventilator monitor. Before starting CPAP, the patient wore headphones, and the MP3 player volume was set so that the patient could hear the music and would not be disturbed. After the intervention was initiated upon selecting the CPAP mask suitable for the patient's facial structure, music was also started. While the patient was listening to music during CPAP, respiratory rate (min), oxygen saturation (%) and mask air leak amount (l/min), defined as treatment compliance parameters, were taken from the ventilation monitor at the 1st, 15th and 30th minutes, and the RASS scores were determined and recorded by observation.

To compare the groups' initial characteristics, tidal volume (mL) and total respiratory pressure (cmH_20) values were recorded from the ventilation monitor at the 1st minute of CPAP. These values were determined by the doctor according to the patient's requirements and adjusted to the ventilator. Study-related observations were terminated after 30 min, and the patient continued CPAP therapy. Listening to music was continued depending on the patient's request. In the control group, CPAP and measurements were performed in the order in the intervention group, before CPAP, at the 1st, 15th and 30th minute of CPAP, but the patient did not listen to music.

3.7 | Statistical analysis

The study's statistical analysis was carried out in version 25.0 of the SPSS program. Normal distribution was evaluated with Kolmogorov–Smirnov normality test and it was determined that the parameters showed a normal distribution. In comparing the groups' characteristics, chi-square analysis was performed to assess for any significant differences in the categorical variables and the independent sample *t*-test was conducted for continuous variables. Repeated measures ANOVA was used to compare the dependent variables of the study within the group, and the independent sample *t*-test was used for intergroup comparisons. p-values lower than 0.05 were considered significant.

4 | RESULTS

Ninety-three patients were evaluated for eligibility over 122 days between September and December 2021. As 11 patients did not meet the inclusion criteria and six patients did not agree to participate in the study, they were not included in the study. Seventy-six patients were eligible for inclusion in the study and were randomized to the study groups. Four patients in the intervention group and two patients in the control group could not complete the study. The data of 70 patients who completed the study (35 patients in each group) were analysed (Figure 1).

The mean age of the patients in the intervention group was 60.06 ± 16.02 years, 46.3% were female and 50.9% were married. The mean age of the patients in the control group was 65.03 ± 15.19 years, 53.7% were female and 53.3% were single. When the mean age, sex and marital status of the intervention and control groups were compared, it was observed that the difference was not statistically significant ($t = -1.33$, $p = .187$; $\chi^2 = 0.530$, $p = .467$; $\chi^2 = 0.085$, $p = .771$ respectively). When the ventilation-related characteristics of the patients in both groups were compared between the groups, no significant difference was identified between the duration of CPAP support before the study, the mean tidal volume and total respiratory pressure ($t = 0.581$, $p = .566$; $t = 0.77$, $p = .444$; $t = 0.68$, $p = .499$ respectively), (Table 1).

Table 2 presents the intra- and inter-group comparison of the mean RASS scores of the groups according to the measurement times. The mean RASS score of the patients in the intervention group was 2.14 ± 0.69 before CPAP, 1.63 ± 064 at the 1st minute, 0.89 ± 0.58 at the 15th minute and 0.74 ± 0.61 at the 30th minute. The mean RASS score of the patients in the control group was 2.06 ± 0.53 before CPAP, 1.80 ± 0.58 at the 1st minute, 1.43 ± 0.60 at the 15th minute and 1.46 ± 0.61 at the 30th minute of CPAP. A statistically significant difference was identified between the mean RASS score of the patients in the intervention and control groups according to the measurement times ($F = 208.53$, $p < .001$; $F = 384.57$, $p < .001$ respectively). Considering the mean RASS scores between the groups, a statistically significant difference was observed between the 15th and 30th minute of CPAP ($t = -3.81$, $p < .001$; $t = -4.89$, $p < .001$ respectively), (Table 2).

Table 3 contains the intra- and inter-group comparison of the treatment compliance parameters of the intervention and control groups according to the measurement times. The mean respiratory rate of the patients in the intervention group was 32.80 ± 6.17 before CPAP and 23.60 ± 5.26 at the 30th minute. The respiratory rate of the control group patients was 31.37 ± 4.71 before CPAP and 27.94 ± 6.14 at the 30th minute of CPAP. The difference between the mean respiratory rates of the patients in the intervention and control groups was statistically significant in the intra-group comparisons ($F = 1165.11$, $p < .001$; $F = 1258.49$, $p < .001$ respectively). In the inter-group comparisons, a statistically significant difference was determined in favour of intervention group at the 15th and 30th minute of CPAP ($t = -2.47$, $p < .001$; $t = -3.17$, $p < .001$ respectively). The mean SpO_2 percentage of the patients in the intervention group was 77.86 ± 6.97 before CPAP, 87.80 ±

TABLE 1 Comparison of individual and ventilation-related characteristics of patients.

Variables	Intervention group ($n = 35$)		Control group ($n = 35$)		Test	
	n	%	*n*	%	χ^2	*p*
Sex					0.530	.467
Female	19	46.3	22	53.7		
Male	16	55.2	13	44.8		
Marital Status					0.085	.771
Married	28	50.9	27	49.1		
Single	7	46.7	8	53.3		
Educational Status					0.784	.853
Primary school	12	48.0	13	52.0		
Middle school	9	47.4	10	52.6		
High school	9	60.0	6	40.0		
College	5	45.5	6	54.5		

Variables	Intervention group ($n = 35$)	Control group ($n = 35$)	Test	
	$\overline{X}$±SS	$\overline{X}$±SS	*t*	*p*
Age (year)	60.06 ± 16.02	65.03 ± 15.19	−1.33	.187
Body mass index (kg/m^2)	27.31 ± 3.84	27.60 ± 4.98	−0.26	.789
Glasgow Coma scale score	14.20 ± 1.23	13.97 ± 1.24	0.77	.443
Duration of CPAP support (h)	12.06 ± 3.41	11.63 ± 2.72	0.581	.566
The mean tidal volume (mL)	694.0 ± 236.56	732.43 ± 176.50	0.77	.444
Total respiratory pressure (cmH_2O)	20.77 ± 3.45	20.29 ± 2.39	0.68	.499

Note: χ^2: Chi-Square. *t* = independent sample *t*-test. *p*-values lower than .05 were considered significant.

TABLE 2 Intra-group and inter-group comparison of the mean RASS scores of the intervention and control groups according to measurement times.

RASS by measurement times Groups	Before the intervention $\overline{X}$±SS	1st minute of the intervention $\overline{X}$±SS	15th minute of the intervention $\overline{X}$±SS	30th minute of the intervention $\overline{X}$±SS	Test *F*	 *p*
Intervention group	2.14 ± 0.69	1.63 ± 064	0.89 ± 0.58	0.74 ± 0.61	208.53	**.001**
Control group	2.06 ± 0.53	1.80 ± 0.58	1.43 ± 0.60	1.46 ± 0.61	384.57	**.001**
Test and *p* values	$t = 0.57$ $p = .56$	$t = -1.16$ $p = .24$	$t = -3.81$ **$p = .001$**	$t = -4.89$ **$p = .001$**		

Note: *F*: Repeated measures ANOVA. *p*-values lower than .05 were considered significant. Bold values are statistically significant.

4.81 at the 1st minute, 93.09 ± 3.14 at the 15th minute and 94.46 ± 2.97 at the 30th minute. The mean SpO_2 percentage of the control group patients was 78.20 ± 6.43 before CPAP, 86.77 ± 4.37 at the 1st minute, 90.83 ± 4.11 at the 15th minute and 91.60 ± 3.86 at the 30th minute of CPAP. The SpO_2 percentage of the patients in the intervention and control groups differed statistically significantly among the intragroup mean scores ($F = 20127.55$, $p < .001$; $F = 19559.98$, $p < .001$ respectively). In the inter-group comparisons, a statistically significant difference was found in favour of intervention group at the 15th and 30th minutes of CPAP ($t = 2.57$, $p < .001$; $t = 3.46$, $p < .001$ respectively). The amount of mask air leak in the intervention group patients was 16.54 ± 11.63 at the 1st minute, 10.77 ± 8.71 at the 15th minute and 9.00 ± 8.67 at the 30th minute of CPAP. The mean mask air leak amount of the patients in the intervention group differed statistically significantly in intra-group comparisons ($F = 66.74$, $p < .001$ respectively). The mean mask air leak amount of the patients in the control group was 18.11 ± 13.16 at the 1st minute, 18.77 ± 13.56 at the 15th minute and 20.03 ± 14.14 at the 30th minute of CPAP. The intra-group comparison revealed that the mean amount of mask air leak in the control group increased, and this increase was statistically significant ($F = 72.46$, $p < .001$ respectively). In the inter-group comparisons, the difference in the mean amount of mask air leak was found to be statistically significant in favour of intervention group at the 15th and 30th minute of CPAP ($t = -2.93$, $p < .001$; $t = -3.93$; $p < .001$ respectively), (Table 3).

TABLE 3 Intra-group and inter-group comparison of treatment compliance parameters in the intervention and control groups according to measurement times.

Compliance Parameters	Groups	Before the intervention $\overline{X}$±SS	1st minute of the intervention $\overline{X}$±SS	15th minute of the intervention $\overline{X}$±SS	30th minute of the intervention $\overline{X}$±SS	Test	
						F	*p*
The mean respiratory rate (min)	Intervention	32.80 ± 6.17	28.40 ± 5.26	25.37 ± 4.82	23.60 ± 5.26	1165.11	**.001**
	Control	31.37 ± 4.71	29.23 ± 5.52	28.46 ± 5.58	27.94 ± 6,14	1258.49	**.001**
Test		$t = 1.08$ $p = .28$	$t = -0.64$ $p = .52$	$t = -2.47$ $\mathbf{p = .001}$	$t = -3.17$ $\mathbf{p = .001}$		
SpO_2 (%)	Intervention	77.86 ± 6.97	87.80 ± 4.81	93.09 ± 3.14	94.46 ± 2.97	20127.55	**.001**
	Control	78.20 ± 6.43	86.77 ± 4.37	90.83 ± 4.11	91.60 ± 3.86	19559.98	**.001**
Test		$t = -0.211$ $p = .83$	$t = 0.93$ $p = .35$	$t = 2.57$ $\mathbf{p = .001}$	$t = 3.46$ $\mathbf{p = .001}$		
The amount of mask air leak (L/min)	Intervention	-	16.54 ± 11.63	10.77 ± 8.71	9.00 ± 8.67	66.74	**.001**
	Control	-	18.11 ± 13.16	18.77 ± 13.56	20.03 ± 14.14	72.46	**.001**
Test		-	$t = -0.52$ $p = 0.59$	$t = -2.93$ $\mathbf{p = .001}$	$t = -3.93$ $\mathbf{p = .001}$		

Note: Bold values are statistically significant.

5 | DISCUSSION

The results of an experimental study conducted to determine the effect of music on CPAP compliance and agitation levels of patients in need of respiratory support in the COVID-19 intensive care unit were discussed in light of the literature.[3,14–18,21,22,29–37]

The age, sex, education level, marital status, BMI, GCS, CPAP duration, tidal volume and respiratory pressure characteristics of the patients included in the study were similar in the intervention and control groups. The mean age of the patients varied between 60 and 65 years. It has been reported that older persons are more affected by COVID-19, and the mean age of patients hospitalized in intensive care units is 65 and above.[29] The mean BMI scores of the patients were above 25 in both groups. Studies conducted on COVID-19 cases have stated that admission to the intensive care unit, the incidence of pneumonia, the need for intubation and the length of hospital stay increase in patients with high BMI.[30] The ventilation-related characteristics of the patients determined in the initial measurements were similar in the intervention and control groups. This situation was evaluated positively in terms of associating the research results with the intervention conducted on the intervention group.

In the intervention and control groups, the mean RASS scores decreased within the group according to the measurement times. The agitation status of the group which listened to music almost disappeared at the 15th and 30th minutes. Although a significant improvement was achieved in the control group over time, the patients were still agitated at the 30th minute. The passing time is an important factor in ensuring patients' compliance with CPAP, and the improvement of oxygenation also reduces the agitation levels of patients.[3] Therefore, the decrease in the agitation levels of both groups was interpreted as an expected case. In this study, the agitation levels of the patients in the intervention group decreased, whereas the mean RASS scores did not reach the sedation limit, and the patients calmed down without sedation. While it is a positive situation that patients receiving NIMV are calm, the increased tendency to sedation is among the IMV indications. The main striking result of this study is that, in intergroup comparisons, the agitation level of the group which listened to music decreased significantly compared with the control group as of the 15th minute. Appropriately selected music is known to reduce catecholamine release, have an anxiolytic effect and help calm and relax.[17,31,32] In the multi-session music application performed by Dallı et al.,[18] the RASS scores of the patients who underwent mechanical ventilation also decreased. A systematic review carried out by Sazak et al.,[15] investigating the music intervention in intensive care patients, reported that music positively affected anxiety, sedation, pain and comfort levels in intensive care patients. It has been emphasized that music should be listened to for a minimum of 30 min for physical and psychological effects on the organism. In this research, the effect of music on agitation was observed after 15 min, and this result on the duration of effect is consistent with the literature. In the study conducted by Messika et al.,[14] it was stated that 30 min of music intervention decreased the systolic and mean arterial pressure of patients because of the relaxing and anxiolytic effects of music. In our study, the decrease in the agitation levels of the patients in the music group may be because of the relaxing and anxiolytic effects of music and the lower secretion of stress hormones in patients exposed to music.[16]

SpO_2, respiratory rate and mask air leak amount were taken as indicators of the groups' CPAP compliance.[4] The mean SpO_2 value significantly increased in an intra-group manner in the intervention and control groups. This increase is definitely associated with respiratory support and oxygen therapy provided to patients. On the other hand, it is seen that the mean SpO_2 value of the intervention group reached normal values more than the control group as of the 15th and 30th minute, which can be explained by the patient's compliance with CPAP owing to the music listened to during the intervention. A study conducted by Çiftçi and Öztunç[33] in an intensive care unit reported that music increased SpO_2 values. When the oxygen level in the tissues reaches a

sufficient level and the oxygen need decreases, the respiratory rate decreases. This fact can explain the decrease in the respiratory rate of the intervention and control groups. In the study, the decrease in the mean respiratory rate of the patients in the intervention group in favour of the intervention group at the 15th and 30th minute was associated with the calming and synchronizing effects of the music that the patients listened to. There is some evidence showing that organisms' rhythms are synchronized with the rhythm of music.[21,22] In this study, the number of beats/rhythms per minute of the music that the patients listened to was at a rhythm similar to the normal respiratory rate. We think that this situation helps patients breathe synchronously with music and hence helps reduce the respiratory rate. Many studies conducted in intensive care units in the literature have reported that listening to music positively affects respiratory rate values but does not affect SpO_2 values.[17,34,35] Yilmaz et al.[36] stated that listening to music did not affect the respiratory rate but increased SpO_2 in patients treated in the intensive care unit and under MV support. Messika et al.[14] examined patients with respiratory distress in three groups, music, sensory deprivation and control. As a result of the research, no difference was indicated between the groups in terms of respiratory distress.[14] Messika et al.[14] explained this situation by the fact that the 30-min music duration was too short to affect respiratory distress or that the patient chose the music genre and music settings. In this study, the effect of music at the 15th and 30th minute does not support the first interpretation of Messika et al.[14] In our study, music was chosen for therapeutic purposes and was not left to the patient's choice, which may be the reason for the difference in results. However, we think that more studies are needed on the effects of leaving or not leaving music choice to patients.

When the intra and inter group comparisons of the mask air leak value of the groups according to the measurement times are examined, it is observed that the mean score of the mask air leak amount of the patients in the intervention group decreased significantly and increased significantly in the control group at the 15th and 30th minute. The pain caused by the pressure on the face because of the CPAP mask and the feeling of suffocation caused by compressed air can cause the patient to move the CPAP mask, resulting in air leak from the mask. The decreased mean score of mask air leak amount of the patients in the intervention group during the intervention can be explained by the fact that the patients' attention is diverted, they are relaxed, calmed and enouraged to comply with CPAP via music.

Studies have suggested that low-pitched and calming music supports relaxation and diverts attention.[19,37] The significant increase in the amount of air leak in the control group was associated with the anxiety, agitation, claustrophobia, fear, worry and pain experienced by the patients during CPAP and the high frequency of touching the mask during the intervention.

Considering that compliance with CPAP increases the effectiveness of treatment, reduces the need for IMV and protects the patient from IMV complications, it is assumed that this study, which reveals the effects of music listened to during the intervention on the agitation levels of patients and their compliance with CPAP, significantly contributes to the literature, patients and health institutions.

6 | LIMITATIONS

The most important limitation of the present study is that the patients and outcome assessors were not blinded and the study was conducted in a single centre. Therefore, there is a risk of bias in the study. The results of this study can be generalized to intensive care patients with similar characteristics to the patients included and to the music used in our study. This study was registered retrospectively after the beginning of data collection.

7 | RECOMMENDATIONS OR IMPLICATIONS FOR PRACTICE AND/OR FURTHER RESEARCH

It is common for patients receiving CPAP to be unable to comply with the procedure and feel agitated. Music can be used as a non-pharmacological nursing intervention to facilitate the compliance of patients who need respiratory support with CPAP, manage agitation and ensure effective ventilation. To this end, it may be recommended to prefer music genres with no lyrics but a slow rhythm and calming effects and repeat the research in different patient groups receiving CPAP and in different music genres in the future.

8 | CONCLUSION

The study determined that the agitation level, respiratory rate and mask air leakage amount decreased, while oxygen saturation increased at the 15th and 30th minute in patients who listened to music during CPAP. It was concluded that listening to music during CPAP decreased the agitation level of the patients and increased their CPAP compliance.

ACKNOWLEDGEMENTS

We thank the patients included in the study, the music therapist and vocal artist Andrea Azize GÜVENÇ for the music used, and other artists involved in the performance of the music.

FUNDING INFORMATION

This study was funded by the Ataturk University Scientific Research Projects (BAP) Coordination Office (TYL-2021-9711).

CONFLICT OF INTEREST STATEMENT

The author declare no potential conflicts of interests with respect to the authorship and/or publication of this article.

DATA AVAILABILITY STATEMENT

The data that support the findings of this study are available from the corresponding author upon reasonable request.

ETHICS STATEMENT

Approval was obtained from the Ethics Committee of Ataturk University Nursing Faculty (Registered Number: 2021-1/7) before the study.

Additionally, permission was obtained from the hospital where the research data were obtained, and "COVID-19 Scientific Research Approval" was acquired from the Ministry of Health of the Republic of Turkey. Informed written consent was received from the patients themselves and their families, and the study was performed in accordance with the Declaration of Helsinki.

ORCID

Sumeyye Bilgili https://orcid.org/0000-0002-2449-3300
Reva Balci Akpinar https://orcid.org/0000-0001-8796-6497

REFERENCES

1. WHO Coronavirus Disease (COVID-19) Dashboard. https://covid19.who.int/. Accessed June 28, 2023
2. Pinto VL, Sharma S. *Continuous Positive Airway Pressure*. StatPearls Publishing; 2022:25.
3. Aliberti S, Radovanovic D, Billi F, et al. Helmet CPAP treatment in patients with COVID-19 pneumonia: a multicentre cohort study. *Eur Respir J*. 2020;56:1-5.
4. Radovanovic D, Rizzi M, Pini S, Saad M, Chiumello DA, Santus P. Helmet CPAP to treat acute hypoxemic respiratory failure in patients with COVID-19: a management strategy proposal. *J Clin Med*. 2020;9:1191.
5. Liu J, Duan J, Bai L, Zhou L. Noninvasive ventilation intolerance: characteristics, predictors, and outcomes. *Respir Care*. 2016;61:277-284.
6. Nair PR, Haritha D, Behera S, et al. Comparison of high-flow nasal cannula and noninvasive ventilation in acute hypoxemic respiratory failure due to severe COVID-19 pneumonia. *Respir Care*. 2021;66:1824-1830.
7. Altınkaya Çavuş M, Gökbulut Bektaş S, Turan S. Comparison of clinical safety and efficacy of dexmedetomidine, remifentanil, and propofol in patients who cannot tolerate non-invasive mechanical ventilation: a prospective, randomized, cohort study. *Front Med (Lausanne)*. 2022 Aug;30:9.
8. Bulechek G, Butcher H, Dochterman JM. *Nursing Interventions Classification (NIC)*. 50th ed. Mosby Elsevier; 2008:502.
9. Koelsch S, Jäncke L. Music and the heart. *Eur Heart J*. 2015;36(44):3043-3049.
10. Umbrello M, Sorrenti T, Mistraletti G, Formenti P, Chiumello D, Terzoni S. Music therapy reduces stress and anxiety in critically ill patients: a systematic review of randomized clinical trials. *Minerva Anestesiol*. 2019;85(8):886-898.
11. Miller CR, Patmon FL, Knapp H. Music to reduce stress in hospitalized patients. *Nursing*. 2021;51:62-66.
12. Chen YF, Chang MY, Chow LH, Ma WF. Effectiveness of music-based intervention in improving uncomfortable symptoms in ICU patients: an umbrella review. *Int J Environ Res Public Health*. 2021;18:11500.
13. Reidy J, MacDonald MC. Use of palliative care music therapy in a hospital setting during COVID-19. *J Palliat Med*. 2021;24:1603-1605.
14. Messika J, Martin Y, Maquigneau N, et al. A musical intervention for respiratory comfort during noninvasive ventilation in the ICU. *Eur Respir J*. 2019;53:1801873.
15. Sazak Y, Aytekin Kanadlı Y, Olgun N. Physiological and psychological effects of music application on intensive care patients: a systematic review. *Hacettepe Univ Faculty Nurs J*. 2021;8:203-212.
16. Chlan LL, Engeland WC, Savik K. Does music influence stress in mechanically ventilated patients? *Intensive Crit Care Nurs*. 2013;3:121-127.
17. Bradt J, Dileo C. Music interventions for mechanically ventilated patients. *Cochrane Database Syst Rev*. 2014;2014(12):CD006902.
18. Dallı ÖE, Yıldırım Y, Şenuzun AF, Kahveci F. The effect of music on delirium, pain, sedation and anxiety in patients receiving mechanical ventilation in the intensive care unit. *Intensive Crit Care Nurs*. 2023;75:103348.
19. Karamızrak N. Healing effects of sound and music on the organs. *Koşuyolu Heart J*. 2014;17:54-57.
20. Yazıcı D. The effects of music on human brain. *Int J Cult Soc Stud*. 2017;3:88-103.
21. Bernardi NF, Codrons E, di Leo R, et al. Increase in synchronization of autonomic rhythms between individuals when listening to music. *Front Physiol*. 2017 Oct;17(8):785.
22. Trappe HJ. Music and medicine: the effects of music on the human being. *Appl Cardiopulm Pathophysiol*. 2012;16:133-142.
23. Mollakazemi MJ, Biswal D, Elayi SC, Thyagarajan S, Evans J. Synchronization of autonomic and cerebral rhythms during listening to music: effects of tempo and cognition of songs. *Physiol Res*. 2019;68(6):1005-1019. Epub 2019 Oct 25.
24. Eldridge SM, Chan CL, Campbell MJ, et al. CONSORT 2010 statement: extension to randomised pilot and feasibility trials. *BMJ*. 2016;355:i5239.
25. Capık C. Statistical power analysis and its use in nursing studies: basic Information. *J Anatolian Nurs Health Sci*. 2014;17:268-274.
26. Sessler CN, Gosnell M, Grap MJ, et al. The Richmond agitation-sedation scale: validity and reliability in adult intensive care patients. *Am J Respir Crit Care Med*. 2002;166:1338-1344.
27. Sılay F, Akyol A. Adaptation of two measurement tools used to assess sedation-agitation and pain among patients in intensive care units into Turkish: a reliability and validity study. *J Intensive Care Nurs*. 2018;22:50-65.
28. Robinson BR, Berube M, Barr J, Riker R, Gelinas C. Psychometric analysis of subjective sedation scales in critically ill adults. *Crit Care Med*. 2013;41(9 Suppl 1):S16-S29.
29. Wu Z, McGoogan JM. Characteristics of and important lessons from the coronavirus disease 2019 (COVID-19) outbreak in China: summary of a report of 72314 cases from the Chinese Center for Disease Control and Prevention. *JAMA*. 2020;323:1239-1242.
30. Zhou Y, Chi J, Lv W, Wang Y. Obesity and diabetes as high-risk factors for severe coronavirus disease 2019 (Covid-19). *Diabetes Metab Res Rev*. 2021;37:e3377.
31. Goli R, Arad M, Mam-Qaderi M, Parizad N. Comparing the effects of geranium aromatherapy and music therapy on the anxiety level of patients undergoing inguinal hernia surgery: a clinical trial. *Explore (NY)*. 2022 Jan-Feb;18(1):57-63.
32. Su CP, Lai HL, Chang ET, Yiin LM, Perng SJ, Chen PW. A randomized controlled trial of the effects of listening to non-commercial music on quality of nocturnal sleep and relaxation indices in patients in medical intensive care unit. *J Adv Nurs*. 2013;69(6):1377-1389.
33. Çiftçi H, Öztunç G. The effect of music on comfort, anxiety and pain in the intensive care unit: a case in Turkey. *Int J Caring Sci*. 2015;8:594-602.
34. Golino AJ, Leone R, Gollenberg A, et al. Impact of an active music therapy intervention on intensive care patients. *Am J Crit Care*. 2019 Jan;28(1):48-55.
35. Liang Z, Ren D, Choi J, Happ MB, Hravnak M, Hoffman LA. Music intervention during daily weaning trials-a 6 day prospective randomized crossover trial. *Complement Ther Med*. 2016;29:72-77.
36. Yilmaz DU, Korhan EA, Baysal B, et al. The effect of music therapy on sedation levels and vital signs of patients under mechanical ventilatory support: a pilot study. *J Izmir Katip Celebi Univ Faculty Health Sci*. 2016;1:21-27.
37. Boşnak M, Kurt AH, Yaman S. Music physiology of our brain. *J KSU Faculty Med*. 2017;12:35-34.

How to cite this article: Bilgili S, Balci Akpinar R. The effect of listening to music during continuous positive airway pressure on agitation levels and compliance of intensive care patients with COVID-19: A randomized controlled trial. *Nurs Crit Care*. 2024;29(2):357-365. doi:10.1111/nicc.12952