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The effect of music to sleep quality on liver transplanted patients

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MAIN POINTS

- Listening to music significantly improved sleep quality among liver transplant recipients.
- The intervention led to notable improvements across all five dimensions of the Richards-Campbell Sleep Questionnaire (RCSQ).
- Music listening was particularly effective in reducing the frequency of awakenings and enhancing perceived sleep depth.
- The study highlights music listening as a safe, cost-effective, and non-pharmacological approach to support postoperative recovery.
- Integrating music listening into routine nursing care may enhance patient comfort and sleep outcomes after liver transplantation.

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ABSTRACT

Aim: This study aimed to evaluate the effect of music listening on sleep quality in adult liver transplant recipients. Given the limited research in this specific patient population, the study contributes to the growing body of evidence supporting non-pharmacological strategies in postoperative nursing care.

Materials and Methods: A quasi-experimental pre-test/post-test control group design was employed. A total of 88 patients were included, with 44 assigned to the experimental group and 44 to the control group. Sleep quality was assessed using the Richards-Campbell Sleep Questionnaire (RCSQ) before and after the intervention. The experimental group listened to 30 minutes of culturally familiar music each night for four consecutive days, while the control group received standard care only.

Results: Baseline RCSQ scores indicated poor sleep quality in both groups. Following the intervention, the experimental group showed a statistically significant improvement in total RCSQ scores (from 24.0 to 50.0, $p<0.001$). Subscale analysis revealed significant improvements in all five RCSQ dimensions---sleep depth, sleep latency, frequency of nighttime awakenings, wake time, and overall sleep quality ($p<0.001$). In contrast, the control group showed no meaningful change except for a slight improvement in the frequency of awakenings subscale ($p = 0.035$).

Conclusion: These findings suggest that music listening can significantly enhance sleep quality in liver transplant recipients. As a safe, inexpensive, and easy-to-apply method, music listening holds promise for integration into routine postoperative nursing care to promote patient comfort and recovery.

Keywords: Liver transplantation, Music, Sleep quality, Postoperative care, Nursing intervention, Richards-Campbell Sleep Questionnaire

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INTRODUCTION

Liver transplantation (LT) remains the most effective treatment for patients with end-stage liver failure, chronic viral hepatitis (HBV/HCV), or inherited metabolic disorders such as Wilson's disease. Other than these indications that cause chronic liver disease, LT is indicated in hepatocellular carcinoma, a primary liver tumor [1,2]. In addition to reducing liver-related mortality, transplantation allows patients to reintegrate into daily life and contributes to improvements in physical and psychological well-being [3].

However, complications during the post-transplant period have significant impact quality of life. Among these, sleep disturbances are frequently reported. Previous studies suggest that a considerable proportion of liver transplant recipients experience poor sleep quality, often linked to anxiety, depression, and limited social support [4–6]. Environmental stressors in the intensive care unit (ICU), such as sensory overload and isolation, can further worsen these disturbances [7].

In recent years, non-pharmacological and non-invasive strategies have gained prominence in addressing sleep-related problems. In particular, Music-based approaches have demonstrated benefits for post-transplant patients [8–10]. Music has been shown to influence the autonomic nervous system, lower stress levels, and facilitate the onset of sleep. In liver transplant populations, music applications have proven effective in alleviating environmental stress and improving subjec-

tive sleep quality [7, 8].

The underlying mechanisms through which music exerts these effects have also been explored. Studies suggest that these outcomes are linked to physiological changes, such as increased parasympathetic activity and reduced cortisol levels—both indicators of a relaxation response that may support sleep regulation. For instance, Ginsberg et al. reported a shift toward parasympathetic dominance, while Thoma et al. observed decreased cortisol concentrations following music listening [9, 10].

Despite these promising findings, there is still a limited number of comprehensive studies that specifically investigate the impact of music on sleep quality in adult liver transplant recipients. This gap in the literature hinders a deeper understanding of how music might be implemented in clinical practice for this patient group.

Considering these gaps, the present study investigates the impact of music on sleep quality in liver transplant patients. The findings are expected to fill a gap in the information regarding the clinical nursing practices by supporting the integration of culturally sensitive music applications into postoperative care. Clinically, the results highlight the potential of music as a safe, low-cost, and feasible approach to improve sleep regulation in immunosuppressed patients. Theoretically, this study underscores the interplay between environmental stimuli and physiological recovery, offering a multidimensional perspective on post-transplant care within the biopsychosocial framework.

MATERIALS AND METHODS

This study received ethical approval from the Non-Interventional Clinical Research Ethics Committee of Inonu University (Approval No: 2018/7-5). Institutional permission was obtained, and informed consent was secured from all participants in accordance with the principles outlined in the Declaration of Helsinki.

Study design

This study employed a quasi-experimental, pre-test/post-test control group design to examine the effects of structured music listening as a nursing intervention on sleep quality among liver transplant recipients. Random allocation was not feasible due to logistical constraints. Specifically, the researcher responsible for patient recruitment and data collection was only present in the liver transplant clinic on specific days of the week. As a result, the continuous presence required for randomization and daily monitoring could not be ensured. To maintain methodological consistency while minimizing ethical concerns and avoiding disruption of clinical routines, a quasi-experimental design with pre-scheduled intervention and control days was adopted.

Participants were assigned to either the intervention or control group using a sequential and convenience-based allocation method. Patients who met the inclusion criteria and were admitted to the hospital on days designated for the intervention were assigned to the experimental group, while those admitted on control-designated days were placed in the control group. This method ensured feasibility under real-world clinical constraints while allowing for consistency in timing and implementation.

Setting and duration

The study was conducted from May 2017 to January 2018 at a liver transplant institute in Eastern Turkey. This facility features inpatient rooms, intensive care units, and operating theaters. All inpatient rooms are single-occupancy and equipped with both acoustic and thermal insulation. Standard evening medication rounds were performed at 18:00 and 22:00. Accordingly, the music intervention was scheduled between 22:00 and 24:00 to ensure its implementation after the final medication administration, thereby facilitating a calm and uninterrupted rest period conducive to sleep.

Study population and sampling

The study population included adult patients who had undergone liver transplantation. Using a confidence interval of 95% and a 5% margin of error, the required sample size was determined to be 88 patients, with 44 in the experimental group and 44 in the control group. Participants were selected using a non-probability random sampling method. Inclusion criteria were:

- Patients without any hearing impairment and who are able to communicate verbally,
- Patients who have been hospitalized for at least one week following liver transplantation,
- Patients who are not using any medications for diagnosed sleep disorders, such as obstructive sleep apnea syndrome, insomnia, or parasomnia.

Data collection tools

Data were collected using the Patient Information Form and the Richards-Campbell Sleep Questionnaire (RCSQ).

The Patient Information Form was developed by the researchers based on literature and expert input and includes sociodemographic and clinical variables such as age, sex, marital status, education level, place of residence, transplantation reason, sleep habits, and length of hospital stay [11–13].

The RCSQ is a self-reported visual analog scale comprising five items that assess sleep depth, latency, number of awakenings, return to sleep, and overall sleep quality. The internal consistency of the original scale was high (Cronbach's $\alpha = 0.82$) [14], and the Turkish version, validated by Karaman Ozlu and Yucel (2011), reported a Cronbach's $\alpha = 0.91$ [15]. In the present study, the internal consistency of the RCSQ based on pre-test data was calculated as Cronbach's $\alpha = 0.973$.

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Data collection procedure

Data were collected through face-to-face interviews. All interviews were conducted by the same researcher, who was familiar with the study protocol, to minimize interviewer bias and ensure consistency in data collection. In the experimental group, baseline RCSQ data were recorded prior to the intervention. A 30-minute music listening session was then administered each night for four consecutive days between 22:00 and 24:00. Post-intervention RCSQ scores were recorded 24 hours after the final session. The control group did not receive any intervention; however, RCSQ assessments were conducted at equivalent time points.

Intervention protocol

The music selection was carried out in collaboration with academic experts from the Department of Music Education at a university located in Eastern Anatolia, Turkey, and TÜMATA (The Group for the Research and Promotion of Turkish Music), a renowned organization dedicated to preserving and applying traditional Turkish music in therapeutic and cultural contexts. The selected compositions reflect authentic maqam structures and performance practices consistent with culturally informed music interventions.

The intervention consisted of a 30-minute pre-recorded instrumental playlist specifically designed to promote relaxation and improve sleep quality. All compositions were performed in the Zirgüleli Hicaz maqam, which is known for its emotionally calming and soothing melodic characteristics.

This maqam was selected based not only on its cultural familiarity for the regional patient population, but also on prior research demonstrating its positive effects on sleep quality and fatigue. For instance, a systematic analysis of Turkish doctoral theses found that the Zirgüleli Hicaz maqam has been associated with improved sleep quality and emotional regulation (16).

The playlist included the following pieces:

- *Hicaz Peşrev* by Tanburi Büyük Osman Bey
- *Hicaz Peşrev* (*Zirgüleli version*) by Neyzen Osman Dede
- *Improvisational Taksim in Zirgüleli Hicaz* (instrumental, ney-based).

The pieces were performed using traditional Turkish instruments such as the ney, tanbur, and kanun. Music was selected based on established criteria for sleep-inducing compositions, including a slow and steady tempo (approximately 70–75 bpm), minimal rhythmic variation, and monotonous melodic development. These features are aligned with research by Shum et al. (2014) on the benefits of sedative, wordless music for sleep, as well as recommendations outlined by Öztürk (2020) for music intended to facilitate sleep onset [17,18].

To reduce the risk of opportunistic infections among immunosuppressed liver transplant recipients, headphones were intentionally avoided. Instead, the music was played through in-room speakers at a moderate and comfortable volume. The intervention was implemented once per evening, for four consecutive nights, using the same playlist each time to ensure consistency and control across sessions.

No healthcare personnel were present in the patient's rooms during the music sessions in order to maintain a private and natural sleep environment. Although no formal feedback instrument was used, informal verbal responses from participants were consistently positive. None of the patients reported any discomfort or adverse reactions. Several participants spontaneously stated that the music made it easier for them to fall asleep. The lack of structured qualitative feedback is acknowledged as a limitation and discussed in the relevant section of the manuscript.

Statistical analysis

Data analysis was performed using IBM SPSS Statistics Standard Concurrent User V 30 (IBM Corp., Armonk, New York, USA). Descriptive statistics were presented as frequencies (n), percentages (%), median, and interquartile range (IQR). The normality of age and pre-test–post-test score differences was assessed using the Shapiro-Wilk normality test. Group comparisons for age were conducted using the Mann-Whitney U test. Wilcoxon signed-rank test was used for comparisons of pre-test and post-test scores. Pearson chi-square, Fisher-Freeman-Halton exact test, and Yates chi-square test were employed for the comparison of categorical variables between groups. A p-value of less than 0.05 was considered statistically significant

RESULTS

Table 1 compares the sociodemographic and clinical characteristics of the experimental and control groups. No statistically significant differences were found between the groups regarding age, gender, marital status, education level, place of residence, transplant type, cause of transplant, sleep medication use, or hospitalization duration (all $p>0.05$). These results demonstrate that the groups were comparable at baseline.

Impact of music intervention on sleep quality

As presented in Table 2, the pre-test and post-test median RCSQ scores for the experimental and control groups are. In the experimental group, post-test scores increased significantly compared to pre-test scores ($p<0.001$). No significant difference was observed between pre-test and post-test scores in the control group ($p=0.431$).

Subscale analysis of RCSQ scores

As presented in Table 3, statistically significant improvements were observed in all RCSQ subscale scores from pre-test to

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Table 1. Comparison of sociodemographic and clinical characteristics between experimental and control groups.

Age, (years)	53.0 (19.7)	56.5 (19.5)	0.564	0.573[&]
Gender, n (%)				
Male	17 (38.6)	16 (36.4)	0.000	1.000[Φ]
Female	27 (61.4)	28 (63.6)		
Marital Status, n (%)				
Married	37 (84.1)	39 (88.6)	0.096	0.756 [Φ]
Single	7 (15.9)	5 (11.4)		
Education, n (%)				
Literate only	13 (29.5)	11 (25.0)		
Primary	17 (38.6)	23 (52.3)	2.844	0.415[¥]
Secondary	10 (22.7)	5 (11.4)		
Higher	4 (9.1)	5 (11.4)		
Place of Residence, n (%)				
Village	4 (9.1)	4 (9.1)		
Town / District	21 (47.7)	21 (47.7)	-	-
City Center	19 (43.2)	19 (43.2)		
Transplant Type, n (%)				
Living	38 (86.4)	42 (95.5)	-	0.266[†]
Deceased	6 (13.6)	2 (4.5)		
Cause of Transplant, n (%)				
Acute liver failure	2 (4.5)	0 (0.0)		
Chronic liver failure	30 (68.2)	33 (75.0)	3.041	0.591[¥]
Metabolic diseases	2 (4.5)	1 (2.3)		
Malignancy	5 (11.4)	7 (15.9)		
Other	5 (11.4)	3 (6.8)		
Sleep Medication Use, n (%)				
Nothing	37 (84.1)	30 (68.2)		
Resting	2 (4.5)	6 (13.6)	5.277	0.130[¥]
Painkiller	0 (0.0)	3 (6.8)		
Music/TV	5 (11.4)	5 (11.4)		
Hospitalization Duration, n (%)				
1-2 weeks	11 (25.0)	14 (31.8)		
3-4 weeks	30 (68.2)	21 (47.7)	4.498	0.084[‡]
5-6 weeks	3 (6.8)	9 (20.5)		

n: Number of patients, %: Column percentage, Age summarized as median (interquartile range). &: Mann-Whitney U test, ‡: Pearson chi-square test, ¥: Fisher-Freeman-Halton exact test, Φ: Yates chi-square test.

post-test in the experimental group (p<0.001 for all subscale areas).

Visual representation of RCSQ subscale scores

According to the findings displayed in Table 4, among the RCSQ subscales in the control group, only the "Awakening Frequency" subscale showed a statistically significant difference between pre-test and post-test scores (p=0.035), while no significant changes were noted in the other subscales (p>0.05).

Figure 1 presents a comparative boxplot of the total and subscale RCSQ scores for both control and experimental groups at pre-test and post-test measurements. As illustrated, the experimental group showed notable improvements across all sleep quality dimensions compared to the control group.

Table 2. Group-wise comparison of Pre-test and Post-test total RCSQ scores.

Group	Pre-test M (IQR)	Post-test M (IQR)	z	p
Experimental	24.0 (30.0)	50.0 (31.0)	-5.276	**<0.001**
Control	41.5 (35.0)	41.0 (35.0)	-0.788	0.431

M: Median, IQR: Interquartile range, z: Standardized test statistic for Wilcoxon signed rank test.

DISCUSSION

This study demonstrated that the music intervention significantly improved sleep quality in liver transplant recipients. Statistically significant improvements were observed across all subscales of the Richards-Campbell Sleep Questionnaire

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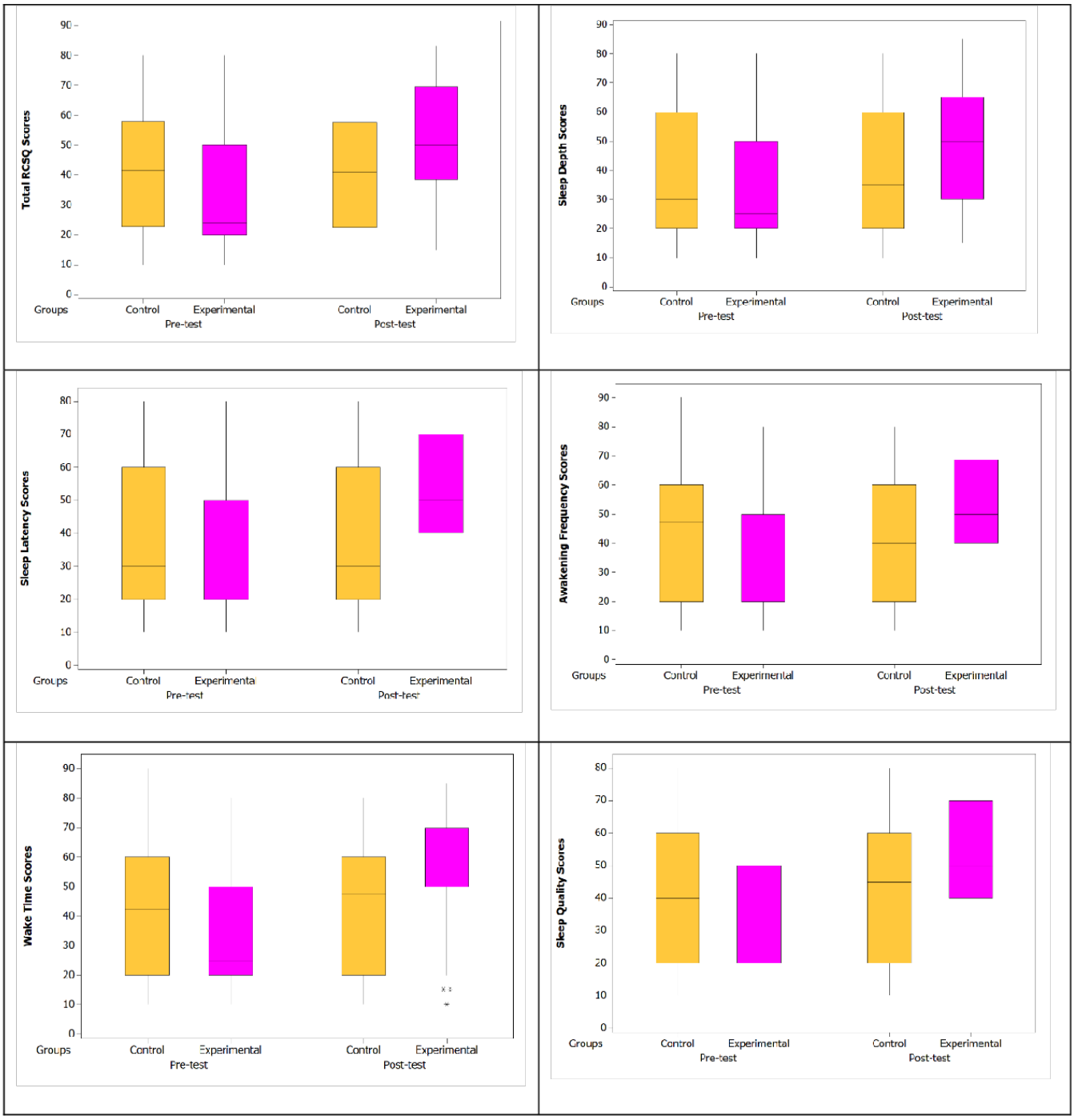

Figure 1. Boxplot comparison of RCSQ total and subscale scores between control and experimental groups at pre-test and post-test.

(RCSQ), with the most notable gains in "sleep depth" and "nighttime awakening frequency." In the intervention group, the total RCSQ score increased from a pre-test median of 24.0 (IQR 30.0) to a post-test median of 50.0 (IQR 31.0), and this difference was found to be statistically significant ($p<0.001$). No similar improvement was observed in the control group. These findings suggest that culturally adapted, non-pharmacological interventions—such as Turkish makam music—can be an effective strategy to enhance postoperative sleep quality.

Sleep disturbances are widely prevalent among liver transplant recipients. For instance, Bhat et al. reported that approximately 60% of liver transplant survivors experience significant sleep problems, such as difficulty falling asleep and frequent awakenings [2]. In a multicenter study conducted in Japan, Akahoshi et al. found that more than 50% of post-transplant patients experienced clinically relevant sleep disturbances that negatively affected their quality of life [6]. Similarly, Zhu et al. in a Chinese outpatient sample, noted a high prevalence of insomnia, nocturia, and sleep fragmentation among liver transplant recipients [3].

These sleep disturbances have been linked to factors such as

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Table 3. Comparison of RCSQ Subscale scores -- Experimental group

Subscale	Pre-test M (IQR)	Post-test M (IQR)	z	p
Sleep Depth	25.0 (30.0)	50.0 (35.0)	-5.212	**<0.001**
Sleep Latency	20.0 (30.0)	50.0 (30.0)	-5.046	**<0.001**
Awakening Frequency	22.5 (30.0)	50.0 (28.8)	-5.172	**<0.001**
Wake Time	25.0 (30.0)	50.0 (20.0)	-5.143	**<0.001**
Sleep Quality	27.5 (30.0)	50.0 (30.0)	-5.172	**<0.001**

M: Median, IQR: Interquartile range, z: Standardized test statistic for Wilcoxon signed rank test.

Table 4. Comparison of RCSQ Subscale scores -- Control group.

Subscale	Pre-test M (IQR)	Post-test M (IQR)	z	p
Sleep Depth	30.0 (40.0)	35.0 (40.0)	-0.179	0.858
Sleep Latency	30.0 (40.0)	30.0 (40.0)	-0.324	0.746
Awakening Frequency	47.5 (40.0)	40.0 (40.0)	-2.113	**0.035**
Wake Time	42.5 (40.0)	47.5 (40.0)	-0.733	0.463
Sleep Quality	40.0 (40.0)	45.0 (40.0)	-0.424	0.672

M: Median, IQR: Interquartile range, z: Standardized test statistic for Wilcoxon signed rank test.

pain, immunosuppressive therapy, environmental stress in intensive care settings, and disruptions in melatonin secretion [19-21]. Moreover, decreased melatonin levels and altered circadian rhythms are common in patients with liver cirrhosis and may persist even after transplantation, contributing to ongoing sleep difficulties [22,23].

The low pre-test sleep scores observed in our study reflect the negative impact of postoperative ICU conditions, environmental noise, psychological stress, and physiological instability on sleep quality [21]. The statistically significant pre-test difference between the intervention and control groups ($p<0.05$) may be attributed to individual stress levels or psychological variability [24].

The significant increase in sleep scores following the music intervention supports the hypothesis that music facilitates both physiological and mental relaxation. Music has been shown to regulate the autonomic nervous system and reduce cortisol levels, thereby alleviating stress responses [25,26]. Furthermore, music may ease mental tension by diverting attention from external stimuli. Compositions with slow tempo and stable melodic structures can help synchronize biological rhythms through a phenomenon known as "entrainment." Culturally familiar music can also elicit positive emotional responses that support sleep onset. As noted by Öztürk, personal beliefs and expectations regarding the therapeutic role of music may enhance its perceived effectiveness [18]. Kim et al. [22] demonstrated that music therapy not only improved RCSQ scores but also increased melatonin levels. Likewise, Herscher et al. [27] reported that nighttime music significantly improved sleep hygiene in hospitalized patients.

As shown in Table 3, significant improvements were observed in RCSQ subdimensions such as sleep latency, sleep depth, and frequency of nighttime awakenings [20,22,24]. Similar outcomes were reported by Nurhayati et al. [20], who applied a combined intervention of natural music and foot massage. Baransel and Uçar [28] also found that music positively influenced all dimensions of sleep quality in high-risk pregnancies. Additionally, Kakar et al. reported that music therapy improved subjective sleep quality by approximately 27% in surgical patients [29].

As demonstrated in Table 4, no significant difference was found between pre-test and post-test RCSQ subscale scores in the control group. This suggests that without supportive interventions, sleep quality does not improve spontaneously [27,29]. Similarly, Vinayak et al. [30] showed that both active and receptive music therapy significantly enhanced sleep quality among cancer patients undergoing chemotherapy or radiotherapy. Patchaiappan and Kripa [31] also reported that music not only improved sleep quality but also reduced anxiety and fatigue in both inpatient and outpatient oncology settings.

Limitations

This study has several limitations. First, the use of a quasi-experimental design without random assignment may have introduced selection bias, even though group comparability was statistically confirmed. Second, the sample was limited to a single transplant center in Eastern Turkey, which may restrict the generalizability of the findings. Third, although participants' verbal feedback on the music intervention was consistently positive, no formal qualitative or satisfaction data were collected. Finally, the study measured only short-term effects on sleep quality; longer-term outcomes were not assessed.

CONCLUSION

In conclusion, the findings of this study indicate that the music intervention has a positive impact on postoperative sleep quality in liver transplant recipients. Given its low cost, ease of application, and lack of side effects, music listening may represent a promising complementary strategy in nursing care for surgical patients. However, due to the limitations of this quasi-experimental, single-center study with a relatively small sample size, further randomized and multicenter trials are necessary before this intervention can be routinely recommended in clinical nursing practice.

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Ethics Committee Approval: This study was approved by the Non-Interventional Clinical Research Ethics Committee of

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Inonu University (Approval No: 2018/7-5). Informed consent was obtained from all participants.

Informed Consent: Written informed consent was obtained from the legal guardians of all participating patients.

Peer-review: Externally peer-reviewed.

Conflict of Interest: The authors declare no conflict of interest.

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