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Effect of White Noise and Benson's Relaxation Training on Sleep Quality Among Geriatric Patients Undergoing Open Heart Surgery: Aquasi- Experimental Study

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ABSTRACT:

Background: Poor sleep quality represents a highly prevalent condition among geriatric patients awaiting open heart surgery that confers a marked risk for both overall health and surgical outcomes. The integration of technology-assisted white noise therapy and Benson's relaxation technique may offer a safe and scalable non-pharmacological approach to improve preoperative sleep quality without adding medication-related risks in this vulnerable group.

Objective: This study aimed to evaluate the effect of white noise and Benson's relaxation training on sleep quality among geriatric patients undergoing open heart surgery.

Method: A quasi-experimental pre-test and post-test non-equivalent control group research design was employed. A purposive sample of 44 geriatric patients awaiting open heart surgery at the Center of Cardiothoracic and Vascular Surgery at Mansoura University was recruited (22 in the intervention and 22 in the control group). The intervention group received a combined white noise and Benson's relaxation training intervention and routine preoperative care delivered over a three-day period preoperatively, while routine preoperative care only was provided to the control group. Data were collected using a structured interview schedule and the Groningen Sleep Quality Scale at baseline and post-intervention. Statistical analysis was performed using descriptive and inferential statistics.

Results: Baseline comparisons indicated no statistically significant differences between the two groups. However, post-intervention analysis revealed a statistically significant improvement in preoperative sleep quality favoring the intervention group. Moreover, within-group analysis demonstrated a significant improvement in preoperative sleep quality among participants receiving the intervention.

Conclusion: The findings of this study highlight the value of integrating white noise and Benson's relaxation training in improving sleep quality in geriatric patients undergoing open heart surgery.

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INTRODUCTION:

Given the expanding, aging populations worldwide and the fact that cardiovascular diseases (CVDs) are the leading contributor to mortality causing around 32% of all world's deaths (WHO, 2021). Open heart surgery (OHS) emerges as the primary treatment option for increasing number of geriatric patients whose disease severity or/and anatomy exhibit no further response to conventional pharmacological or minimally invasive treatment options (Babatabar Darzi et al., 2020; Netala et al., 2024).

On a global scale, nearly 169 OHS per million population are carried out on an annual basis, encompassing different types, including coronary artery bypass graft surgery (CABG), heart transplantation, congenital heart surgery, and valvular heart surgery (VHS). In geriatric patients, the primary objective of OHS is to alleviate symptoms of CVDs, decrease the disability, optimize cardiac function, and enhance quality of life (Vervoort; 2024; WHO, 2021).

Considering that OHS is a critical life situation especially for geriatric patients who have greater vulnerability to surgical complications because they experience structural and functional changes and they also frequently present with multiple risk factors such as comorbidities and frailty (Díez-Villanueva et al., 2022; Sanders et al., 2022), the majority of them often suffer from physical and psychological disturbances including poor sleep quality, anxiety, fear, uncertainty, and irritability which can affect not only the postoperative outcomes but also the overall perioperative period (Sommer, 2023).

Hence, poor sleep quality affects up to 67% of the hospitalized patients, it is also very common in most of surgical geriatric patients for many causes (Beswick et al., 2023; Ho et al., 2017). First of all, older adults undergo changes in both the quality and quantity of sleep. Moreover, manifestations of the underling cardiovascular condition, lack of social support, and anticipation of such major surgery, anesthesia, outcomes, and pain, all of which may induce or rather exacerbate poor sleep quality (Butris et al., 2023; Chen et al., 2025).

Added to which, hospitalized geriatric patients in comparison to the patients who are admitted on the day of surgery have a greater risk for sleep disturbances that could be related to unfamiliarity with hospital environment, noise, frequent medical procedures, bright lights, shared room disturbances, and uncomfortable beds, which collectively can result in poor sleep quality and fragmented sleep (Ahmed et al., 2023; El Arab et al., 2025).

Preoperative poor sleep quality may lead to serious negative implications for both overall health and surgical outcomes as it is often associated with compromised immune function, increased sympathetic activation, and poor wound healing. It is also associated with greater risk for increased perceived pain, cognitive impairment, delirium, longer hospital stays, poor quality of recovery, poor quality of life, infection, and mortality (Chen et al., 2025).

Therefore, proper management of poor sleep quality is a key component of preoperative care and can be achieved through either pharmacological or non-pharmacological approaches. However, non-pharmacological approaches are increasingly preferred especially in geriatric patients as reliance on pharmacological treatments is associated with higher risk for adverse effects such as drowsiness, interfering with anesthetic drugs, excessive sedation, disorientation, and prolonged recovery (Tan et al., 2023).

On the other hand, non-pharmacological approaches offer sustainable, safer, and holistic benefits without the high risk of adverse effects. Under the umbrella of non-pharmacological approaches, Benson's relaxation technique (BRT) and white noise (WN) emerged as promising approaches of complementary and alternative medicine (CAM) that focus on underlying psychological and behavioral contributors to psychological abnormalities and sleep disturbances rather than merely suppressing symptoms (Abiri et al., 2024).

White noise (WN), type of sound whose intensity is equal across differential bands such as sounds of waterfalls and ocean waves, is one of the most recent background auditory stimulations in neuroscience research. Compared to music, which carries rhythmic and emotional content, WN is known to be uniform, non-structured, and non-musical sounds, that use the auditory masking theory rather than a source of cognitive or emotional engagement (Ebben et al., 2021).

It is hypothesized that the calming properties of WN can change the auditory threshold of the hospitalized patients and works as a pleasant stimulus that increases parasympathetic activity and inhibits brain stimulation which in turn promotes relaxation, improves sleep quality, reduces arousals from sleep, and reduces sleep latency (Ahmadi et al., 2022; Kutenai et al., 2023). There

are various WN generators that produce a consistent auditory stimulation including WN machines, smartphone apps, online platforms, and specialized sleep devices (Capezuti et al., 2022; Ebben et al., 2021).

Given BRT is one of the highly validated, cost-effective, and structured relaxation interventions that encompasses a series of relaxation exercises focusing on deep abdominal breathing, repetitive phrases, and muscle relaxation. BRT is hypothesized to work by modulating the sympathetic nervous system activity and regulating respiratory function, heart rate, and muscle contraction. As a result, it is widely used in managing stress, improving sleep quality, alleviating mood disorders, and decreasing body discomfort (Bagheri et al., 2021).

Considering the importance of sleep quality in geriatric patients undergoing OHS and the significant negative consequences that may result from inadequate management of poor sleep quality, it is hypothesized that combination of positive effectiveness of both WN and BRT which has been proven in different populations may cause positive synergistic effects on preoperative sleep quality by simultaneously addressing environmental disruption and autonomic arousal in geriatric patients anticipating OHS (Ahmadi et al., 2022; Kutenai et al., 2023).

Despite the growing body of evidence on non-pharmacological interventions, limited studies have targeted their effect on sleep quality in the preoperative phase, with most research focusing primarily on sleep quality and other patients' surgical issues in their postoperative phase. In addition, the combined use of non-pharmacological strategies within a single intervention protocol has gained insufficient attention (Bargnes III et al., 2024).

Therefore, the current study aimed to implement a combined training intervention consisting of WN and BRT to evaluate their synergetic effect on preoperative sleep quality in geriatric patients undergoing OHS.

AIM

This research aimed to evaluate the effect of white noise and Benson's relaxation training on sleep quality among geriatric patients undergoing open heart surgery.

This aim was achieved through the following steps:

- Assess level of sleep quality.
- Implement a combined training intervention consisting of technology-assisted WN and BRT.
- Evaluate the effect of the implemented training intervention on preoperative sleep quality in geriatric patients undergoing OHS.

Research hypothesis

To fulfill the aim of this study, the following research hypothesis was formulated:

- Geriatric patients undergoing open heart surgery who received white noise and Benson's relaxation training will show improved sleep quality than those who don't.

METHOD

This study used quasi-experimental pre-test and post-test non-equivalent control group research design. The participants were recruited by purposive sampling from geriatric patients who were awaiting open heart surgery at the adult cardiac surgery unit in the Center of Cardiothoracic and Vascular Surgery at Mansoura University, in Egypt.

The required sample size was calculated using G*power, Version 3.1.9.6. Based on the result of previous study (Moradi Mohammadi et al., 2020) where the patients' overall sleep quality was significantly better in the intervention group (7.37±3.43) than the control group (9.87±4.16). With a 95% level of confidence (error=5 %) and a study power of 80% (error=20%) in a 1: 1 ratio then the sample size was 44 geriatric patients (22 intervention group and 22 control group).

Inclusion and exclusion criteria

The inclusion criteria for participant enrollment in this study were participants aged 60 years or above of both genders, had been a candidate for any type of OHS, hospitalized for more than three days before surgery, had any type of android smartphones, accepted to participate in the study, had the ability to communicate and were oriented to time, person and place.

Exclusion criteria included participants who had a previous history of OHS or were taking any anti-anxiety or sedative drugs and those suffered from mental illnesses or bilateral hearing disability.

Tools of data collection

Data collection tools comprised a structured interview schedule that was developed by the researcher to collect data including demographic characteristics such as gender, age, level of education, marital status, and health related data such as medical history and current type of surgery.

The second tool was the Groningen Sleep Quality Scale (GSQS) which was originally developed by Mulder-Hajonides Van Der Meulen et al. (1981). The GSQS comprises 15 statements assessing the participant's sleep during the previous night, answered with true or false. The resulting total score represented the overall sleep quality during previous night.

The first question of GSQS was excluded from the total score calculation. While one mark was assigned if the answer is "True" for questions (2, 3, 4, 5, 6, 7, 9, 11, 13, 14, 15) and one mark was assigned if the answer is "False" for questions (8, 10, 12). The total scores of GSQS were summed and ranged from zero to 14. A higher score in the GSQS means poorer sleep quality of the previous night. The quality of sleep was ranged as follows: (Good: 0-5), (Fair: 6-8), and (Poor: 9-14).

Data collection

Data was collected in two phases- preparatory phase and exploratory phase.

Phase one: Preparatory phase

- An institutional ethical approval was secured and a permission to conduct the study was granted by the relevant authorities at the study setting after explaining the study's aim and procedure.
- This phase included a review of the past and current related literature and studies, developing the study tools and testing their content validity and reliability.
- The researcher translated the GSQS into the Arabic language, after which the validity of the translation was reviewed by an English language expert from the Faculty of Education at Mansoura University then a back-translation technique was used to ensure the validity of the translation.
- Content validity of the study tools was evaluated by a panel of five experts in Gerontological nursing. Then the corrective comments of the jury members were followed.
- The GSQS reliability was tested by using Cronbach's alpha coefficient test in statistical package for social science (SPSS) version 26. The Cronbach's alpha value (internal consistency) for GSQS was 0.732 which indicated high reliability.
- The researcher navigated and familiarized herself with the **Nature Sounds** application to ensure accurate and consistent implementation. It is a free highly rated android application that does not require signing up or any personal information. It is easy to install and use, with colorful and modern design, containing different natural sounds such as; soothing river, charming waterfall, lovely morning sounds and sea breeze with natural imagery. It also allows the users to select and control the sounds they are listening to by giving options to layer different types of sounds to create a unique sound and experience (Bryce, K. (2020; Drissi et al.,2020).

Phase two: Exploratory phase

- Pilot study: It was carried out at Al-Azhar University Hospital, Damietta, Egypt on 10% of the total participants' size (5) to evaluate the feasibility and practicality of the tools and determine the time required for data collection. The research did not include the geriatric patients who participated in the pilot project.
- Field work: This phase lasted four months, from the beginning of July 2025 and ended at the end of October 2025.
- The researcher attended the previously selected study setting for six hours per day, six days per week from 9 am to 3 pm. All participants were approached on their hospital admission day at their rooms in the department of cardiovascular surgeries.

- The researcher started field work by an initial assessment where all participants were screened to establish their eligibility according to the predefined inclusion criteria and free from exclusion criteria. Then the researcher introduced herself to the geriatric patients who matched sample criteria on their admission day and accepted to participate in the study; starting with providing them a brief explanation of the study's aim and the nature, followed by collecting the necessary data using all study tools after obtaining their consent to take part in the study.
- Geriatric patients were randomly allocated to the intervention group (n = 22) or to the control group (n = 22) by the researcher using the block randomization method (divided into block A and block B). By implementing this method, balanced group sizes and comparability between the two groups were ensured.

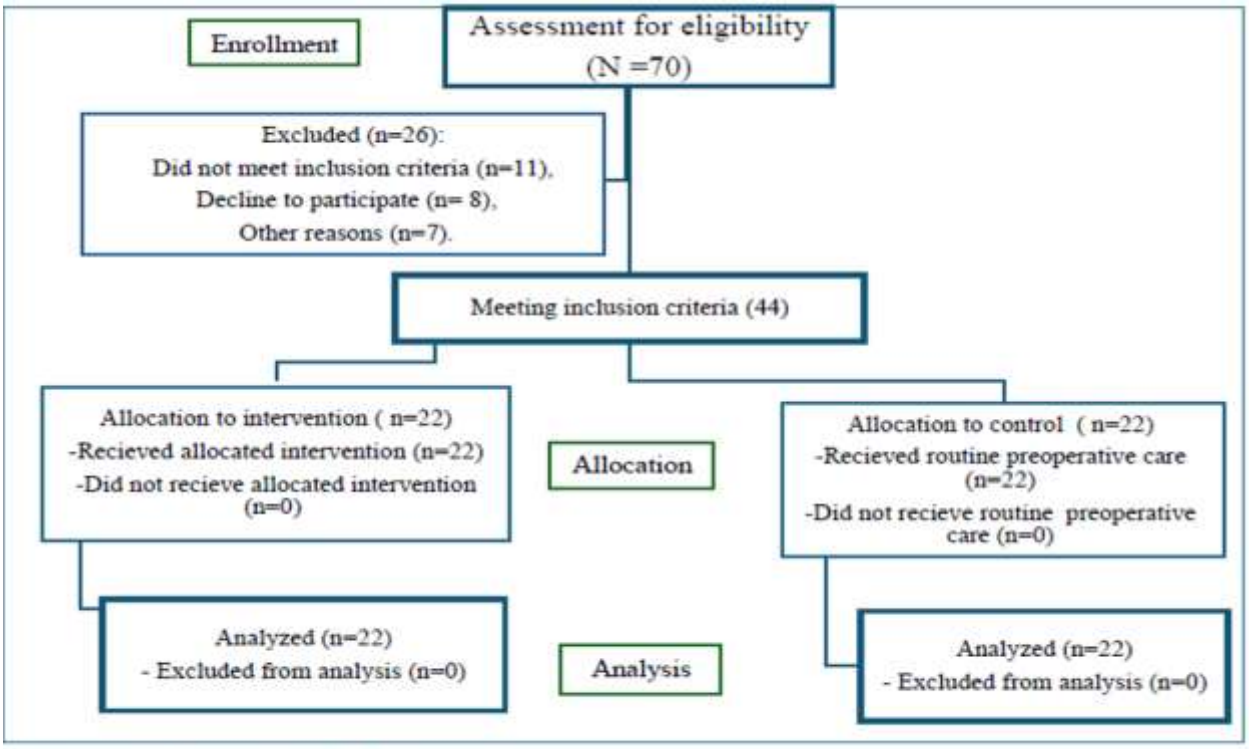

Figure 1: TREND research flow diagram

- Participants in the control group received only routine preoperative care in the cardiac surgery unit and no intervention was performed while participants in the intervention group received routine preoperative care in addition the study intervention which is an innovative combination between technology-assisted white noise therapy and Benson's relaxation technique where the patient in the preoperative stage listened to white noise on their smartphones via wired earphones while performing Benson's relaxation technique.
- For the participants of control group, each geriatric patient was interviewed individually in his room through an initial 30-minute session which involved a pre-test assessment using the study tools.
- For the participants of the intervention group, the intervention was implemented either individually or simultaneously in a controlled and structured manner that was primarily guided by patients' hospital admission timing and room allocation.
- Patients who were admitted concurrently and accommodated within the same room whether double or multi-bed rooms received the intervention simultaneously, with a maximum of two patients per session.
- In contrast, patients who were admitted to the hospital at different times or accommodated in separate rooms received the intervention individually. This approach ensured consistency in intervention conditions and minimized the risk of contamination, particularly by reducing the potential for observational learning among participants.
- The researcher started the intervention with an initial one-hour session, which was systematically divided into two distinct components: the first component involved a pre-test assessment using the study tools, while the second component comprised an individualized oral educational session, supported by a printed Arabic-language booklet that included a

general overview of OHS, followed by information about possible preoperative physiological and psychological disturbances with a brief summary about sleep and sleep quality, and an introduction to non-pharmacological interventions, including comprehensive explanation of WN and BRT.

- Additionally, in this session the researcher assisted each participant in the intervention group in installing **Nature Sounds** application on their android smartphones and familiarized them with its use. Each participant was instructed to select one preferred sound from within the application and adjusted the sound volume according to their personal comfort level.
- Furthermore, the BRT was taught to the participants whereas each participant was instructed to assume a relaxed position and close their eyes. Then, they were guided to breathe slowly and regularly (inhaling through the nose and exhaling through the mouth), while silently selecting and repeating a word in their minds that evoked a sense of peace.
- Maintaining the same position, the participants gradually relaxed their muscles from the toes and progressing to the upper body parts, until all the muscles were completely expanded and relaxed. Participants are instructed to focus their complete attention on the process of breathing, and any emerging distractions are gently ignored while repeating the selected word.
- Then, the participants were instructed to listen to WN using wired earphones alongside performing BRT for 30 minutes. Following each session, the participants were provided with a glass of water and instructed not to get out of the bed for 3 to 4 min.
- Following this initial session, participants in the intervention group proceeded with the remaining intervention sessions, which consisted of three daily 30-minute sessions (morning, afternoon, and at night) over three consecutive days. Each session involved practicing BRT while listening to WN as previously described.
- Both the morning and afternoon sessions were supervised by the researcher to ensure correct technique and adherence to intervention protocol, whereas the night sessions were performed independently by the participants to reinforce skill acquisition and promote self-regulation.
- Telephone follow-ups were conducted with the participants to remind and motivate them to complete the night session and to reduce potential attrition.
- The post-test assessment was performed on the fourth day using GSQS under the same conditions for all participants of both groups to ensure consistency with the baseline assessment. The assessment aimed to evaluate the effectiveness of the implemented intervention by comparing post-intervention outcomes between the two groups during their preoperative phase.
- After the evaluation phase, the researcher provided an oral educational session, supported by a printed Arabic-language booklet for the control group.

Data analysis

Statistical analysis was performed using statistical package for social science (SPSS) version 26. The normality of data was first tested with Shapiro-Wilk test. Appropriate Descriptive statistical tests were calculated to describe the characteristics of the participants as frequency, percentage, mean, and standard deviation. As well as inferential statistics were used; the two groups were compared with Pearson Chi-Square, Monte Carlo test, Mann Whitney test, Wilcoxon Signed Ranks test, Kruskal-Wallis H test statistic. The results were considered significant when the probability of error is less than 5% ($P < 0.05$).

Ethical considerations

- This study received an ethical approval from the Research Ethics Committee of the Faculty of Nursing, Mansoura University (***IRB***: **484**).
- A comprehensive information was provided to all participants about the nature of the study, aim, significance, benefits, risks, and compensation before signing a written informed consent. Participants were informed that their participation in the study was voluntary, and they had the right to withdraw from the study at any stage without any consequences or penalty. Privacy of the participants and confidentiality of the collected data was assured by storing offline only with a secure number and it was only used for the purpose of the study then it will be discarded after the research publication.

RESULTS

Demographic characteristics

Table (1) shows personal and demographic data of study subjects in both groups. There were 44 participants in the study, the majority of them were males in both groups. The mean age of the intervention group was 68.00±6.25, and of the control group was 69.68±5.73. While 77.3%, and 63.6% respectively of participants of both groups were married, and nearly half (45.5%) had basic or secondary education as the highest education level.

Rural residence represented 63.6% in the intervention group and 68.2% in the control group. The majority of participants of both groups were not working (81.8% and 72.7% respectively), while more than half of both groups (54.5% and 63.6%) had an insufficient monthly income and the majority of them (77.3% and 81.8%) were living with their families. The results of Chi-square and Monte Carlo test were indicative of no statistically significant difference in all the demographic data of the participants of both groups, including age, gender, marital status, educational level, monthly income, residence, and living conditions

Clinical characteristics

As presented in Table (2), a history of hypertension and correspondingly its related medications were reported by 68.2% of the intervention group and 63.6% of the control group. While, a history of diabetes and correspondingly its related medications were reported by 59.1%, and 50.0% respectively of participants of both groups. Positive family history of CVD was reported by about 63.6%, and 81.8% respectively of participants of both groups.

About 68.2% of the intervention group had a history of previous hospitalization while it represented 77.3% of the control group. In contrast, about 54.5%, and 63.6% respectively of both groups reported negative history of previous surgery. For both groups, CABG surgery predominated, accounting for 68.2%, and 63.6% of the participants of both groups respectively. Nearly 45.5% of the intervention group and 59.1% of the control group were non-smokers while 72.7% and 68.2% of them respectively reported 'no' regarding their engagement in exercise. Accordingly, there was no statistically significant difference regarding all medical history of geriatric patients in both groups, as p- value >0.05.

Sleep quality

As presented in Table (3), about 77.3% of the participants of the intervention group and 68.2% of the participants of the control group had poor sleep quality before implementing the intervention with no statistically significant difference between both groups, as p- value >0.05. While after the intervention, it was found that about 54.5% of the intervention group had fair sleep quality, and 86.4% of the control group had poor sleep quality with statistically significant difference between both groups, as p=<0.001**.

Moreover, the mean scores of sleep quality of geriatric patients in the intervention and control groups before the intervention were 9.68±2.63 and 9.77±2.33 respectively with no statistically significance difference between both groups as p=0.732. After the intervention, the mean score of sleep quality increased in the intervention group to 5.82±2.34 while it decreased in the control group to 10.55±2.52. Furthermore, there was a statistically significant difference detected between the two groups after the intervention as p=<0.001**.

As presented in Tables (4-a&b), a statistically significant relation was found between the sleep quality and demographic characteristics of geriatric patients in both groups before and after the intervention concerning; age, gender, marital status, level of education, monthly income, and residence before and after the intervention in both groups. While there was no statistically significant relation between demographic characteristics of the geriatric patients and sleep quality involving current work, and living condition as p= >0.05.

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Table (1): Demographic characteristics of the studied geriatric subjects (n=44)

Variables	Intervention group		Control group		Test of significance	
	N=22	%	N=22	%	χ^2 / Mc	P
Age						
60 to less than 75	15	68.2	17	77.3	0.458	0.498
75 to less than 85	7	31.8	5	22.7		
Mean ±SD	68.00± 6.25		69.68± 5.73			
Gender						
Male	15	68.2	13	59.1	0.393	0.531
Female	7	31.8	9	40.9		
Marital status						
Married	17	77.3	14	63.6	1.024	0.599
Widowed	4	18.2	6	27.3		
Divorced	1	4.5	2	9.1		
Educational level						
Secondary education	10	45.5	6	27.3	4.867	0.301
Basic education	5	22.7	10	45.5		
University education	3	13.6	2	9.1		
Read and write	3	13.6	1	4.5		
Illiterate	1	4.5	3	13.6		
Residence						
Rural	14	63.6	15	68.2	0.101	0.75
Urban	8	36.4	7	31.8		
Current work						
Yes	4	18.2	6	27.3	0.518	0.472
No	18	81.8	16	72.7		
Monthly income						
Enough	10	45.5	8	36.4	0.376	0.54
Not enough	12	54.5	14	63.6		
Living condition						

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With family	17	77.3	18	81.8	0.14	0.709
Alone	5	22.7	4	18.2		

Table (2): Clinical characteristics of the studied geriatric patients in both groups (n=44)

Variables	Intervention group		Control group		Test of significance	
	N=22	%	N=22	%	χ^2 / Mc	P
Chronic Diseases						
Hypertension	15	68.2	14	63.6	0.101	0.750
Diabetes Mellitus	13	59.1	11	50.0	0.367	0.545
Renal diseases	3	13.6	5	22.7	0.611	0.434
Respiratory diseases	1	4.5	2	9.1	0.358	0.550
Medication used for:						
Hypertension	15	68.2	14	63.6	0.101	0.750
Diabetes Mellitus	13	59.1	11	50.0	0.367	0.545
Renal diseases	3	13.6	5	22.7	0.611	0.434
Respiratory diseases	1	4.5	2	9.1	0.358	0.550
Family history of CVDs						
Yes	14	63.6	18	81.8	1.833	0.176
No	8	36.4	4	18.2		
Previous hospitalization						
Yes	15	68.2	17	77.3	0.458	0.498
No	7	31.8	5	22.7		
Previous Surgery						
Yes	10	45.5	8	36.4	0.376	0.750
No	12	54.5	14	63.6		
Type of current surgery						
CABG	15	68.2	14	63.6	0.489	00.783
VHS	5	22.7	6	27.3		
CABG + VHS	2	9.1	2	9.1		
Smoking						
Yes	3	13.6	5	22.7	2.814	0.245
No	10	45.5	13	59.1		
Ex smoker	9	40.9	4	18.2		

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Exercise						
No	16	72.7	15	68.2	0.109	0.741
Yes	6	27.3	7	31.8		

Data are expressed as number (n) & percentage (%), SD: standard deviation

X2: Pearson Chi-Square, Mc: Monte Carlo test

CVDs: cardiovascular diseases, CABG: Coronary artery bypass graft, VHS: Valvular heart surgery

Data are expressed as number (n) & percentage (%)

X^2: Pearson Chi-Square, Mc: Monte Carlo test

Table (3): Sleep quality of geriatric patients in both groups before and after the intervention (n=44)

Variables	**Intervention group**		**Control group**		**Test of significance**		**Cohen's d**
	N=22	%	N=22	%	χ^2	P	
Pre intervention							
Poor	17	77.3	15	68.2			
Fair	3	13.6	5	22.7	0.625	0.732	
Good	2	9.1	2	9.1			
	9.68±2.63		9.77±2.33		U=236.500	0.896	0.04
Post intervention							
Poor	3	13.6	19	86.4			
Fair	12	54.5	3	13.6	24.036	<0.001**	
Good	7	31.8	0	0.0			
	5.82±2.34		10.55±2.52		U=50.500	<0.001**	1.9
Pairwise Comparison							
Z	4.158		1.738				
P value	<0.001**		0.082				

X^2: Pearson Chi-Square, Mc: Monte Carlo test , U: Mann Whitney test, Z: Wilcoxon Signed Ranks Test

* Statistically significant at $p<0.05$, ** Statistically significant at $p<0.01$

Effect size was assessed using Cohen's d, where 0.2 indicates a small effect, 0.5 a medium effect, and 0.8 or greater a large effect.

A higher score means a more disturbance of sleep quality

As Table (5) shows, there was a statistically significant relation between medical history of the geriatric patients in both groups and their sleep quality before and after the intervention regarding previous hospitalization and previous surgery. While there was no statistically significant relation between medical history of the geriatric patients and death anxiety involving chronic diseases, taking medications, type of current surgery, smoking, and exercise as p= >0.05.

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DISCUSSION

Hence, non-pharmacological approaches provide a supportive pathway that enhances patients' overall physiological and psychological wellbeing before surgery rather than relying solely on conventional medical management with their expected adverse events. The present study included 44 geriatric patients, the majority of whom were males, aged below 75 years, married, living with their families. Most of them resided in rural areas, had only basic or secondary education, currently not working and reported insufficient monthly income. These findings are consistent with the existing epidemiological data reported by previous studies (Elhusseini et al., 2024; Goel et al., 2022; Tavangar et al., 2021; Wakefield et al., 2014). However, some discrepancies were reported by Detroyer et al., (2008) regarding age which may be attributed to differences in study settings and sample characteristics.

Regarding the clinical characteristics, the present study revealed that most participants were awaiting CABG and commonly presented with hypertension, a family history of CVDs, and a previous history of hospitalization. The majority had no previous surgical history, were non-smokers and reported no regular exercise. These findings are in agreement with earlier studies which reported similar participants' clinical characteristics (ABD ALLAH et al., 2020; Bäck et al., 2019; El-gafour et al., 2021; Elhusseini et al., 2024; Khazov et al., 2021; Ruttmann et al., 2020; Yeşiler et al., 2022).

Table (4-a): Relation between demographic characteristics of the studied geriatric patients and sleep quality

Variables	Sleep quality score			
	Intervention group		Control group	
	Pre	Post	Pre	Post
	Mean ±SD	Mean ±SD	Mean ±SD	Mean ±SD
Age				
60 to less than 75	7.71 ± 3.15	4.29 ± 2.29	7.80 ± 2.17	8.00 ± 2.83
75 to less than 85	10.60 ± 1.80	6.53 ± 2.07	10.35 ± 2.09	11.29 ± 1.93
U test (P value)	22.0 (0.029) *	23.0 (0.034) *	15.0 (0.028) *	15.5 (0.031) **
Gender				
Male	8.73 ± 2.49	4.87 ± 1.99	8.77 ± 2.49	9.38 ± 2.57
Female	11.71 ± 1.60	7.86 ± 1.68	11.22 ± 0.97	12.22 ± 1.20
U test (P value)	12.5 (0.004) **	12.0 (0.004) **	13.5 (0.003) **	16.5 (0.004) **
Marital status				
Widowed	10.47 ± 1.84	6.47 ± 1.97	10.28 ± 2.11	11.28 ± 1.90
Divorced	10.00 ± 0.00	6.00 ± 0.00	7.50 ± 3.54	8.50 ± 3.54
Married	6.25 ± 3.30	3.00 ± 2.16	7.50 ± 0.71	6.00 ± 0.00
H test (P value)	5.83 (0.050) *	6.27 (0.044) *	6.95 (0.014) *	6.12 (0.035) *
Educational level				
Illiterate	14.00 ± 0.00	10.00 ± 0.00	12.67 ± 1.15	13.67 ± 0.58
Read and write	11.33 ± 2.08	7.67 ± 2.31	12.00 ± 0.00	13.00 ± 0.00
Basic education	10.20 ± 1.92	6.20 ± 1.92	10.00 ± 1.56	11.10 ± 1.10

Secondary education	10.00 ± 0.94	5.80 ± 1.32	8.83 ± 2.14	9.17 ± 2.48
University education	4.67 ± 2.08	2.00 ± 1.00	6.00 ± 1.41	6.00 ± 0.00
H test (P value)	10.72 (0.030) *	10.75 (0.030) *	12.84 (0.012) *	13.38 (0.010) *
Current work				
Yes	9.50 ± 1.73	5.75 ± 1.26	9.83 ± 2.79	11.00 ± 2.83
No	9.72 ± 2.82	5.83 ± 2.55	9.75 ± 2.24	10.38 ± 2.47
U test (P value)	*30.5 (0.634)*	*33.0 (0.795)*	*42.0 (0.653)*	*39.0 (0.500)*

U: Mann Whitney test, H: Kruskal-Wallis H Test statistic

* Statistically significant at p<0.05, ** Statistically significant at p<0.01

A higher score means a more disturbance of sleep quality

Table (4-b): Relation between demographic characteristics of the studied geriatric patients and sleep quality

Variables	**Sleep quality score**			
	Intervention group		**Control group**	
	Pre	Post	Pre	Post
	Mean ±SD	Mean ±SD	Mean ±SD	Mean ±SD
Monthly Income				
Enough	8.20 ± 2.97	4.40 ± 2.37	8.00 ± 2.33	8.38 ± 2.62
Not enough	10.92 ± 1.51	7.00 ± 1.60	10.79 ± 1.67	11.79 ± 1.42
U test (P value)	30.5 (0.048) *	30.0 (0.044) *	18.5 (0.009) **	16.0 (0.005) **
Residence				
Rural	10.93 ± 1.44	6.93 ± 1.64	10.53 ± 2.13	11.47 ± 2.03
Urban	7.50 ± 2.88	3.88 ± 2.17	8.14 ± 1.95	8.57 ± 2.44
U test (P value)	16.0 (0.006) **	16.0 (0.005) **	18.0 (0.014) *	17.5 (0.011) *
Living condition				
Alone	10.40 ± 2.51	6.40 ± 2.51	10.00 ± 1.83	11.25 ± 1.50
With family	9.47 ± 2.70	5.65 ± 2.34	9.72 ± 2.47	10.39 ± 2.70
H test (P value)	37.5 (0.690)	37.0 (0.661)	34.0 (0.863)	33.0 (0.795)

U: Mann Whitney test, H: Kruskal-Wallis H Test statistic

* Statistically significant at p<0.05, ** Statistically significant at p<0.01

A higher score means a more disturbance of sleep quality

Despite these similarities, previous researches have yielded inconsistent findings regarding chronic health conditions (Goel et al., 2022), family history (Mohamed Elhady et al., 2025), and prior surgical history (Prado-Olivares, & Chover-Sierra, 2019).

The findings of the present study offer a meaningful perspective on the value of implementing a three-day consecutive training intervention that combine WN and BRT which can play a pivotal role in optimizing preoperative sleep quality among geriatric patients undergoing OHS. Before the intervention, most participants of both groups had poor sleep quality which could be attributed to age-related changes in elderly's sleep architecture compounded by multiple factors including cardiovascular symptoms, hospitalization, and surgery-related psychological disturbances (Butris et al., 2023). This is similarly reported by a study done in Vietnam by Vương et al. (2025), who assessed sleep quality in cardiac surgical patients and found that most of the studied patients had poor sleep quality.

After the intervention, findings of the current study revealed improvement in the mean score of sleep quality in the intervention group compared to elevated score in the control group. Additionally, a statistically significant difference detected between the both groups after the intervention. This highlights the potential positive impact of this novel training intervention on improving sleep quality.

Table (5): Relation between clinical characteristics of the geriatric patients and sleep quality

Variables	Sleep quality score			
	Intervention group		Control group	
	Pre	Post	Pre	Post
	Mean ±SD	Mean ±SD	Mean ±SD	Mean ±SD
Family history of CVDs				
Yes	10.07 ± 2.56	6.14 ± 2.45	9.72 ± 2.30	10.56 ± 2.48
No	9.00 ± 2.78	5.25 ± 2.19	10.00 ± 2.83	10.50 ± 3.11
U test (P value)	*44.0 (0.405)*	*45.0 (0.445)*	*33.5 (0.829)*	*32.5 (0.762)*
Previous hospitalization				
Yes	8.80 ± 2.54	5.0 ± 2.04	9.18 ± 2.16	9.88 ± 2.37
No	11.57 ± 1.72	7.57 ± 2.07	11.80 ± 1.79	12.80 ± 1.64
U test (P value)	18.0 (0.014) *	18.5 (0.015) *	11.0 (0.011) *	12.0 (0.015) *
Previous surgery				
Yes	8.10 ± 2.92	4.40 ± 2.32	11.63 ± 1.19	12.25 ± 1.39
No	11.00 ± 1.41	7.00 ± 1.65	8.71 ± 2.16	9.57 ± 2.53
U test (P value)	23.0 (0.013) *	23.0 (0.013) *	13.5 (0.003) **	19.0 (0.010) *
Type surgery				
CABG+ VHS	10.50 ± 0.71	7.00 ± 1.41	10.50 ± 2.12	11.00 ± 0.00
CABG	10.20 ± 2.34	6.13 ± 2.26	9.57 ± 2.68	10.00 ± 2.88
VHS	7.80 ± 3.35	4.40 ± 2.61	10.00 ± 1.67	11.67 ± 1.63
H test (P value)	*1.97 (0.373)*	*1.66 (0.437)*	*0.37 (0.830)*	*1.13 (0.570)*
Smoking				

Yes	9.33 ± 2.08	6.00 ± 2.65	8.40 ± 3.29	11.20 ± 1.30
No	10.00 ± 2.94	6.20 ± 2.49	10.46 ± 1.94	10.38 ± 2.84
Ex smoker	9.44 ± 2.65	5.33 ± 2.29	9.25 ± 1.71	10.25 ± 2.99
H test (P value)	*1.54 (0.463)*	*0.80 (0.669)*	*2.13 (0.345)*	*0.08 (0.961)*
Exercise				
No	10.06 ± 2.57	6.13 ± 2.50	10.33 ± 1.84	10.67 ± 2.72
Yes	8.67 ± 2.73	5.00 ± 1.79	8.57 ± 2.94	10.29 ± 2.21
U test (P value)	*33.5 (0.277)*	*31.0 (0.202)*	*35.0 (0.210)*	*42.5 (0.473)*

- CVDs: cardiovascular diseases, CABG: Coronary artery bypass graft, VHS: Valvular heart surgery
- U: Mann Whitney test, H: Kruskal-Wallis H Test statistic
- * Statistically significant at $p<0.05$, ** Statistically significant at $p<0.01$
- A higher score means a more disturbance of sleep quality

This finding is similar to the findings of a study carried out in Egypt by Alsayed Ahmed et al. (2023), who explored the effect of BRT on sleep quality among surgical patients and found that the sleep quality improved in BRT group. Another randomized controlled clinical trial conducted in Iran by Nasari et al. (2018), who explored the effects of nature sounds on sleep quality among patients hospitalized in coronary care units and found that the sleep quality in the nature sounds group has improved compared to control group.

To gain deeper insight, the association between sleep quality and patients' demographic and clinical characteristics was further explored. Findings from the present study reported a significant association between age and sleep quality as increasing age was associated with poorer sleep quality which may be related to age-related changes in geriatric patients' sleep pattern and architecture that leads to reduced sleep efficiency and fragmented sleep patterns which is further exacerbated with environmental changes within the hospital setting, such as ambient noise, excessive light, and frequent interruptions in routine care (Li et al., 2026; Lin et al., 2021).

The same finding was reported by Mohammad et al. (2019), while another study by Ahmed et al. (2023), revealed no association between quality of sleep of the surgical patients and their age. Moreover, females in both groups showed poorer sleep quality than males which could be a result of the negative impact of female sex hormones on sleep pattern, gathered with the fact that females are prone to a more stressful response to preoperative difficulties compared to males (Lin et al., 2021). This is also reported by Şara et al. (2022), in their earlier study conducted on surgical patients in preoperative phase.

Furthermore, married participants in both groups showed better sleep quality compared to widowed or divorced participants which highlight the role of emotional and interpersonal social support provided by spouses and families in reducing stress and anxiety, thereby promoting better sleep. This is consistent with a study conducted by Yang et al. (2024), and revealed that unmarried patients showed poorer sleep quality.

Similar to a study conducted by Yin et al. (2025), geriatric patients' educational level in this study groups showed significant association to their sleep quality as patients with lower educational levels had poorer sleep quality. This could be explained by the negative impact of lower educational attainment on health literacy, awareness of sleep hygiene, and increased vulnerability to chronic health conditions. All of which contribute to fragmented and non-restorative sleep.

Additionally, participants from rural areas suffered from poorer sleep quality when compared to those from urban areas. This may be attributed to lower awareness of sleep hygiene practices, such as maintaining regular sleep schedules and controlling environmental factors, which may further impact sleep quality in rural residents.

Furthermore, participants with a history of previous hospitalization or/and surgery showed better sleep quality when compared to those with no prior history. This may reflect the effect patients' surgical fear on perioperative sleep quality as prior exposure

to surgical procedures and medical-environment familiarity reduce surgical fear which in turn may be associated with better sleep pattern (Gacaner, & Dönmez, 2026). While the findings of the present study reported no significant association between preoperative sleep quality and current work, living conditions, chronic diseases, taking medications, type of current surgery, smoking, and exercise.

These results support the research hypothesis and emphasize the clinical relevance of the implemented intervention in improving the sleep quality among geriatric patients undergoing OHS. Furthermore, its simplicity and cost-effectiveness make it a feasible approach to be adopted by nurses and incorporated into daily nursing practice.

CONCLUSION

Based on the findings of the current study, the integration of combined technology-assisted WN and BRT represents a simple yet effective non-pharmacological approach that can be readily incorporated into perioperative nursing care as it was beneficial for geriatric patients undergoing OHS as the preoperative levels of the sleep quality had significantly improved in the intervention group, with a notable difference detected between the intervention and control groups following the intervention.

Recommendations

In the light of the study findings, the following recommendations are proposed:

- Developing standardized nursing care protocols that include WN and BRT to enhance sleep quality of geriatric patients undergoing OHS.
- Educational program for nurses about WN and BRT to enhance sleep quality of geriatric patients undergoing OHS.

Data availability

The datasets generated and/or analyzed during the current study are not publicly available due to patient privacy and confidentiality concerns. However, they are available from the corresponding author upon reasonable request.

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[Ibrahim, A., S., E.]: Conceptualization, methodology, and creating the first draft, gathering and analyzing data, reviewing relevant literature, and structuring the document. Boughdady, A., M., & Abd Elhameed, S., H.: Manuscript review and editing, validation of study tools. The final draft of the work was evaluated and approved by all of the authors. The datasets used and/or analyzed during the current study are available from the corresponding author upon reasonable request (please contact/amlsabry@mans.edu.eg). All the authors have read, commented on, reviewed and approved the final manuscript.

Conflict of interest

The authors have declared no potential conflicts of interest with respect to the research, authorship, and/or publication of this article.