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The Effect of Deep Breathing Relaxation and Lemongrass Aromatherapy on Nausea, Vomiting, and Sleep Quality in Hemodialysis Patients

Lono Wijayanti^{12*}, Nunik Purwanti², Riska Rohmawati², Siti Damawiyah², Amelia²

¹Center for Continuing Care Research (C3R), Universitas Nahdlatul Ulama Surabaya, 60243, Surabaya, East Java, Indonesia; ²Nursing Department, Faculty of Nursing and Midwifery, Universitas Nahdlatul Ulama Surabaya, 60243, Surabaya, East Java, Indonesia

ABSTRACT: Introduction: Individuals undergoing hemodialysis frequently encounter symptoms such as nausea, vomiting, and sleep disturbances, which can negatively impact their overall well-being and treatment compliance. This research investigates the impact of combining deep breathing relaxation techniques with lemongrass essential oil aromatherapy on alleviating nausea and vomiting, as well as enhancing sleep quality among hemodialysis patients. Methods: This study utilized a quasi-experimental design with a pre-post control group format. The research was conducted on hemodialysis patients at A. Yani Islamic Hospital in Surabaya, Indonesia. A total of 56 participants were selected using simple random sampling and allocated into intervention and control groups. Nausea and vomiting levels were evaluated using the INVR (Index of Nausea, Vomiting, and Retching), while sleep quality was measured through the PSQI (Pittsburgh Sleep Quality Index). Data analysis was carried out using descriptive statistics, the Wilcoxon signed-rank test, and the Mann-Whitney U test. Results: A significant reduction in nausea and vomiting was observed in the intervention group after the treatment ($p < 0.05$). Furthermore, sleep quality in the same group showed a marked improvement following the intervention ($p < 0.05$). The Mann-Whitney U test revealed a statistically significant difference in INVR and PSQI scores between the intervention and control groups ($p = 0.000$). These findings suggest that deep breathing relaxation combined with lemongrass aromatherapy is effective in minimizing nausea and vomiting, while also enhancing sleep quality in hemodialysis patients. Conclusions: The combination of deep breathing relaxation and lemongrass aromatherapy can be used as a safe and easy-to-apply complementary therapy to reduce nausea and vomiting complaints and improve sleep quality.

1. INTRODUCTION

Hemodialysis is a common renal replacement therapy for patients with end-stage chronic kidney disease. Although this procedure is essential for sustaining life, hemodialysis patients often experience various physiological and psychological side effects, one of which is nausea, vomiting, and sleep disturbances. Nausea and vomiting frequently occur during or after the dialysis process due to changes in electrolyte balance and body fluid volume [2] (Dikmen & Aslan, 2020). Meanwhile, sleep disorders can be caused by physical discomfort, anxiety, pain, or changes in the body's metabolism (Alradaideh & Bdair, 2024; Alshammari et al., 2023; Kose & Mohamed, 2024; Liu et al., 2021; Trbojević-Stanković et al., 2014). Both conditions can reduce quality of life and have a negative impact on the sustainability of therapy.

According to the World Health Organization (WHO) in 2020, the prevalence of chronic kidney disease worldwide is estimated to reach 10% of the population, but the number of chronic kidney disease patients undergoing hemodialysis is estimated to

reach 1.5 million worldwide with an annual increase of 8%. [8]. In Indonesia, chronic kidney disease affects 0.38% or 3.8 per 1,000 people, and around 60% of kidney failure patients require hemodialysis [9]. Meanwhile, according to the results of the 2023 Indonesian Health Survey, the prevalence of chronic kidney disease based on doctor's diagnosis among people aged approximately 15 years in East Java was 0.12% out of 98,738 people [9]. In previous studies, nausea and vomiting were more common, with incidence rates of 28.3% and 11.7%, respectively, during hemodialysis. Meanwhile, the average severity of nausea was 1.15 and the average severity of vomiting was 2.08 (Asgari et al., 2017). Other studies show that 21.6% have poor sleep quality.

Nausea and vomiting that occur during or after hemodialysis are generally caused by electrolyte imbalance, intradialytic hypotension, and rapid changes in fluid volume [2] (Asgari et al., 2017). Meanwhile, the sleep disturbances experienced by patients are caused by a combination of physical and psychological factors, such as anxiety, pain, and discomfort during the procedure (Alshammari et al., 2023; Liu et al., 2021). If not treated properly, these complaints can increase the risk of complications, chronic fatigue, and even depression (Adejumo et al., 2023; Masoumi et al., 2013; Şahin et al., 2023; Trbojević-Stanković et al., 2014).

Sleep disorders can disrupt circadian rhythms, which can lead to a decline in immune function in hemodialysis patients. In addition, poor sleep quality can cause anxiety and depression, which can ultimately lead to patients no longer wanting to continue hemodialysis therapy (Ismi et al., 2020). During hemodialysis, electrolyte changes cause nausea and vomiting. The nausea reflex is also caused by changes in the body's fluid levels. As a result, this condition also worsens the patient's quality of life, causing physical discomfort and increasing the risk of cardiovascular disease. If nausea and vomiting persist, it can disrupt the patient's comfort during treatment, prolong the patient's recovery time, and worsen the patient's compliance with hemodialysis (Jannah et al., 2024).

Efforts to treat nausea, vomiting, and sleep disturbances are generally pharmacological in nature, but long-term use of medications carries the risk of other side effects. Therefore, non-pharmacological interventions are an important alternative that needs to be developed, one of which is through complementary therapies such as deep breathing relaxation techniques and aromatherapy. Deep breathing relaxation is a rhythmic and controlled breathing technique that helps reduce sympathetic activity and increase relaxation. This technique has been proven to reduce stress, improve autonomic nervous system function, and enhance patients' physical and emotional comfort (Nipa et al., 2021).

On the other hand, aromatherapy with lemongrass essential oil is known to have calming and antiemetic (anti-nausea) effects, as well as helping to improve sleep quality through relaxation mechanisms and its influence on the limbic system of the brain (A'in & Norwinda, 2023; Maybodi et al., 2025; Vora et al., 2024). Lemongrass aromatherapy is applied through inhalation techniques. This method is effective because the vapor molecules from lemongrass oil easily enter the body, directly reaching the nasal cavity and interacting with the olfactory receptors, thereby providing a relaxing and calming effect. Another effect is that it can inhibit serotonin production, which can reduce abdominal muscle contractions and reduce nausea and vomiting (Setyaningrum & Setyawan, 2023; Tianto & Khayati, 2023).

2. MATERIALS AND METHODS

2.1 Materials

2.1.1 Research Design

This study is a quasi-experimental study, using a pre-test and post-test design. It was used to determine the effect of a combination of deep breathing relaxation and lemongrass aromatherapy on nausea, vomiting, and sleep quality in hemodialysis patients at A. Yani Islamic Hospital in Surabaya.

2.1.2 Setting and Samples

This study was conducted in the hemodialysis room of A. Yani Islamic Hospital in Jemursari, Surabaya. A total of 56 patients participated in this study. The selection of participants was based on predetermined criteria and was carried out by the researcher with the assistance of a nephrologist, the head of the department, and nurses. The selection of participants was based on predetermined criteria.

Inclusion criteria for this study: (1) Participants were willing to participate in the study until completion; (2) able to communicate

verbally effectively; (3) able to cooperate in the data collection process; (4) $Hb \geq 10$ g/dL; (5) undergoing routine hemodialysis twice weekly. The exclusion criteria for this study are patients with unstable hemodynamic conditions and impaired consciousness during the study.

The required sample size was determined using a paired two-proportion sample size estimation formula, yielding 25 participants per group. To account for potential dropouts, an additional 20% was added, resulting in a total of 28 participants in each group. Participants were selected through simple random sampling. The randomization process involved placing slips of paper with participant numbers into envelopes, which were then randomly drawn by an independent observer and sorted into two separate boxes representing the intervention and control groups. Participants were not informed of their group assignment (single-blind design). The following outlines the implementation process of the intervention in this study:

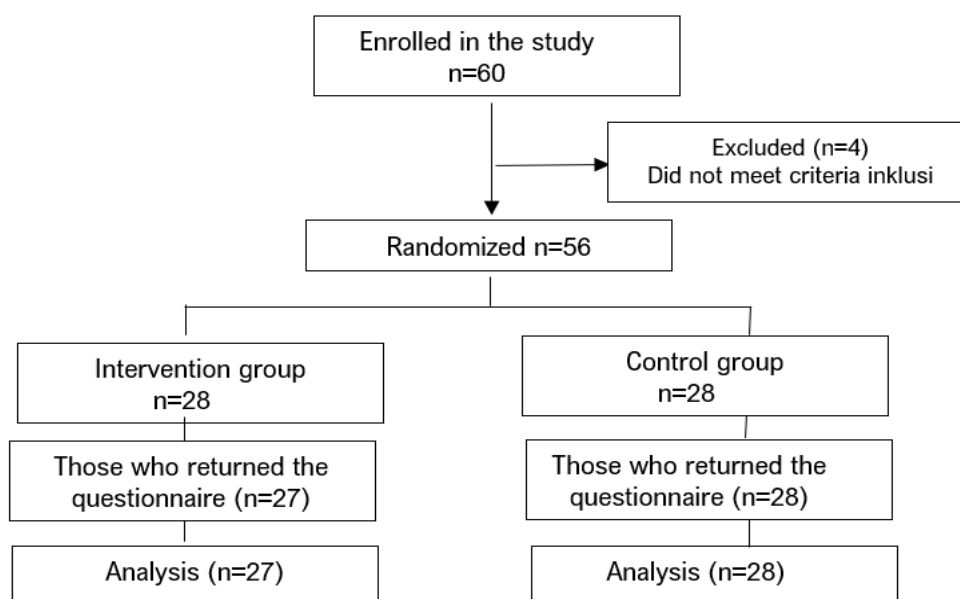


Figure 1: Partisipan Rekrutmen and Intervention Flow

Based on the registered patients, one was excluded due to shortness of breath, two were excluded due to transferring hemodialysis to a hospital closer to their homes, and one was excluded due to decreased consciousness. Each group consisted of 27 people, but in the intervention group, one respondent withdrew from continuing the study.

2.2 Data Collection Procedures

After obtaining permission from the university and hospital, the researchers, assisted by the head of the ward, determined the prospective participants according to the inclusion and exclusion criteria to prevent selection bias. This determination was based on the results of an assessment conducted by a nephrologist. Trained research assistants provided an explanation of the study's objectives and procedures and obtained informed consent. We conducted pre- and post-tests on participants in the intervention and control groups using questionnaires, including demographic data, the Index of Nausea, Vomiting, and Retching (INVR) questionnaire, and the Pittsburgh Sleep Quality Index (PSQI) questionnaire.

In the intervention group, the intervention consisted of deep breathing relaxation and aromatherapy using 5 drops of lemongrass essential oil with a diffuser, conducted twice a week for 2 weeks, with each session lasting approximately 10–25 minutes. The intervention involved deep breathing relaxation while inhaling lemongrass aromatherapy. In the control group, usual care was provided in the form of regular spiritual guidance available in the room. Spiritual guidance was provided to each patient undergoing hemodialysis for a duration of 5–10 minutes.

Demographic data consists of questions regarding age, gender, education, occupation, and duration of hemodialysis. Age is entered by writing the year, gender, education, and occupation by checking (✓) the appropriate box according to the respondent's status at the time of the interview. The nausea and vomiting instrument used the INVR (Index Nausea, Vomiting and Retching) questionnaire, which has been validated, with a validity test result of 0.871, so the questionnaire is valid for use

in research. The questionnaire consists of eight questions: three questions to measure nausea, three questions to measure vomiting, and two questions to measure retching, which are answered by patients using a 5-point Likert scale ranging from 0 to 4.

The sleep quality instrument uses the PSQI (Pittsburgh Sleep Quality Index) scale, which is a development and modification of Daniela (Daniela, 2018). The results of the reliability and validity tests of the Indonesian version of the PSQI (Pittsburgh Sleep Quality Index) scale showed a Cronbach's Alpha of 0.810. The construct validity showed a component correlation value with known group validity that was significant ($p < 0.001$) [23]. The instrument consists of seven main components: subjective assessment of sleep quality, amount of time needed to fall asleep, total sleep duration, daily sleep efficiency, sleep disturbances, use of sleep medication, and daytime activity dysfunction.

2.3 Data Analysis

For data analysis, SPSS 25 was used. Before testing the two groups, a homogeneity test was conducted. The homogeneity test used the chi-square test, while the normality test used the Kolmogorov-Smirnov test. To determine the effect of the combination of deep breathing relaxation and lemongrass aromatherapy on nausea, vomiting, and sleep quality, the Wilcoxon test was used. To determine the differences between groups, the Mann Whitney test was used.

2.4 Ethical Clearance

This research has been approved by the ethics committee of A. Yani Islamic Hospital Surabaya with number 175.EC.KEP.RSIAY.01.25

3. RESULTS AND DISCUSSION

Based on the results of respondent characteristics including gender, age, education, occupation, and duration of hemodialysis treatment, as shown in the following table:

Table 1: Frequency Distribution of Respondent Characteristics

No	Characteristics	Intervention (N=27)	Control (N=28)	P
1	Age (years)			
	26-35	1 (3,7)	0	0,788
	36-45	5 (18,5)	2 (7,1)	
	46-55	10 (37)	11 (39,3)	
	56-65	7 (26)	10 (35,7)	
	>65	4 (14,8)	5 (17,9)	
2	Gender			
	Male	16 (59,3)	18 (64,3)	0,463
	Female	11 (40,7)	10 (35,7)	
3	Duration of Hemo Dialysis (Months)			
	1-12	13 (48,1)	18 (64,3)	0,256
	13-24 Bulan	14 (51,9)	10 (35,7)	
4	Education			
	Elementary	11 (40,7)	8 (28,6)	0,272
	Secondary	7 (26)	11 (39,3)	
	Higher	9 (33,3)	9 (32,1)	

5	Occupation			
	Not working	13 (48)	20 (71,4)	0,076
	Private sector employees	8 (30)	6 (21,4)	
	Entrepreneur	6 (22)	2 (7,1)	

Table 1 shows that the results of the chi-square test for equality in terms of age, gender, duration of hemodialysis, education, and occupation yielded a p-value > 0.05, meaning that these five characteristics were homogeneous in both the treatment and control groups.

Table 2: Differences in Nausea, Vomiting, and Sleep Quality Between Groups

Variable		N	Mean	Z	p
Nausea and Vomiting	Intervention				
	Pretest	27	15,04	-4,549	0.000 ^a
	Posttest	27	7,70		
	Control				
	Pretest	28	15,86	-1,000	0,317 ^a
	Posttest	28	15,82		
Sleep Quality	Intervention	27	16,65		0,000 ^b
	Control	28	38,95		
	Intervention				
	Pretest	27	10,26	-4,564	0.000 ^a
	Posttest	27	4,48		
	Control				
	Pretest	28	10,21	0,000	1,000 ^a
	Posttest	28	10,21		
	Intervention	27	15,85		0,000 ^b
	Control	28	39,71		

^a Wilcoxon signed rank test, ^b Mann-Whitney Test

Patients undergoing hemodialysis frequently suffer from nausea and vomiting as common side effects of the procedure, which may stem from fluctuations in fluid levels, electrolyte disturbances, intradialytic hypotension, or psychological factors such as stress and anxiety (Dikmen & Aslan, 2020; Saraswati & Lestari, 2024). These symptoms significantly impact patient comfort and overall quality of life, and may disrupt the consistency of treatment. Findings from the study revealed notable differences between the intervention and control groups. Hemodialysis patients who received a combination of deep breathing relaxation and lemongrass aromatherapy showed a marked decrease in the severity of nausea and vomiting compared to those who received only standard care.

The occurrence of nausea and vomiting in patients undergoing hemodialysis due to the accumulation of uremic toxins in the blood, known as uremia, can stimulate the vomiting center in the brain. Therefore, uremic toxins affect the nerve centers in the central nervous system that regulate the nausea response. Electrolyte imbalances can disrupt gastrointestinal function and increase the risk of nausea and vomiting, as well as hemodynamic changes during the procedure that exacerbate nausea symptoms. Thus, nausea and vomiting can lead to decreased appetite and weight loss (Jannah et al., 2024).

Deep breathing relaxation performed by hemodialysis patients is carried out using a technique of slowly inhaling, then holding the breath, and finally exhaling. This relaxation is performed regularly for a duration of 10-25 minutes. This activity stimulates the parasympathetic nervous system. The parasympathetic nervous system reduces sympathetic activity, which triggers anxiety, nausea, and gastrointestinal disturbances. Relaxation of the diaphragm and digestive muscles helps reduce the gag reflex. Blood flow and oxygen supply to the brain increase, helping to stabilize the vomiting center in the medulla oblongata (Almayra et al., 2024; Nipa et al., 2021), so that nausea and vomiting are reduced. Meanwhile, lemongrass (*Cymbopogon citratus*) aromatherapy contains essential oils. These essential oils are used in aromatherapy through inhalation, which directly affects the olfactory system, sending signals to the limbic system, the part of the brain that regulates emotions and the vomiting center. It provides a calming, antidepressant, and antiemetic (anti-nausea) effect (A'in & Norwinda, 2023; Ahn et al., 2024; Hotimah & Rahmadhena, 2024; Vora et al., 2024). The fresh scent of lemongrass can inhibit the vomiting center, decrease sympathetic nerve activity, and significantly reduce feelings of nausea.

The research findings indicated a significant distinction in sleep quality between the treatment and control groups among hemodialysis patients. Those in the treatment group, who received a combination of deep breathing relaxation and lemongrass aromatherapy, experienced longer and higher-quality sleep, reduced pre-sleep anxiety, and improvements in both subjective and objective measures of sleep quality. In contrast, the control group experienced little or no meaningful change in sleep quality. This suggests that the combination of deep breathing relaxation and lemongrass aromatherapy can serve as an effective, safe, and easily applicable complementary therapy for hemodialysis patients.

Sleep activity is governed by the reticular activating system (RAS), which plays a key role in regulating all levels of central nervous system function, including states of wakefulness and sleep. The regions responsible for maintaining consciousness and sleep regulation are situated in the midbrain and pons. Moreover, the RAS is capable of transmitting stimuli such as visual, auditory, tactile, and pain signals, as well as activating the cerebral cortex through emotional and cognitive inputs. During wakefulness, RAS neurons release catecholamines such as norepinephrine. Similarly, during sleep, this is likely due to the release of serum serotonin from specialized cells located in the pons and brainstem, namely the bulbar synchronizing region (BSR), and during wakefulness, impulses received in the brain centers. Therefore, the brainstem system regulating the sleep cycle or changes is the RAS and BSR (Sarris & Byrne, 2011).

Deep breathing relaxation stimulates the parasympathetic nervous system, which can reduce hyperactive brain activity before sleep, lower heart rate, blood pressure, and cortisol levels (stress hormone), and help patients feel calmer and sleepier naturally. Meanwhile, lemongrass aromatherapy is a non-pharmacological therapy containing primarily essential oils composed of citral (neral and geranial), limonene, myrcene, geraniol, citronellal, linalool, and farnesol, which have calming, balancing, stimulating, antidepressant, and vasodilator effects, providing a warming sensation and relaxing muscles. Aromatherapy that promotes relaxation works by influencing the limbic system in the brain, enabling emotional regulation (Karadag et al., 2017). Moreover, inhalation of aromatherapy is considered safer, more comfortable, and more rapidly absorbed than oral medication, due to the quick passage through the respiratory system and the large surface area of the lung's epithelial tissue.

Previous research has indicated that aromatherapy can positively influence sleep quality in the elderly (Karadag et al., 2017). Essential oils containing compounds such as linalool and geraniol exert a soothing and calming effect on the central nervous system by stimulating the olfactory receptors. The action of aromatherapy in the human body primarily involves two physiological pathways: the olfactory system and the circulatory system. Scents have the ability to affect mood, memory, and emotional states. Inhaling pleasant, calming aromas can enhance the production of alpha brain waves, which are associated with a relaxed mental state. Alpha waves are brainwave patterns in the central nervous system that typically emerge during periods of rest or drowsiness—such as when the eyes begin to close or a person transitions from wakefulness to light sleep—indicating a relaxed yet conscious state, even if the eyes are closed (Anggraini et al., 2022; Lillehei & Halcon, 2014).

4. CONCLUSION

The group receiving the combined intervention of deep breathing relaxation and lemongrass aromatherapy demonstrated beneficial effects, with a notable decrease in both the frequency and severity of nausea and vomiting compared to the control group. Furthermore, significant enhancements in sleep quality were observed, including longer sleep duration, fewer sleep disruptions, and greater overall sleep satisfaction. This combination of non-pharmacological therapies can be recommended as a safe, easy-to-implement, and effective additional intervention to enhance patient comfort and quality of life in hemodialysis patients.

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