

Analysis of *Lavandula angustifolia* Aromatherapy Relaxation on Stress Levels and Sleep Quality in Kidney Failure Patients

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ABSTRACT

Kidney failure is a condition in which the kidneys are unable to perform essential functions, including filtering waste products, regulating fluid and electrolyte balance, and producing hormones. This study aimed to analyze the effects of relaxation combined with *Lavandula angustifolia* aromatherapy on stress levels and sleep quality in patients with kidney failure. A quantitative experimental design with a pre-test and post-test control group was employed, involving 30 respondents selected through simple random sampling. Stress levels were measured using the DASS-21, and sleep quality using the PSQI. Data were analyzed using the Mann-Whitney U test and the independent t-test, depending on the distribution of the data. Before the intervention, the mean stress score was 18.47 ± 4.21 in the control group and 17.93 ± 4.10 in the intervention group. After the intervention, the intervention group showed a significant stress reduction (mean 11.20 ± 3.45) compared to the control group (17.40 ± 3.98), as assessed by a Mann-Whitney U test ($p=0.0046$). Sleep quality also improved significantly, with pre-intervention PSQI scores of 12.33 ± 2.14 (control) and 11.87 ± 2.08 (intervention), and post-intervention scores of 8.20 ± 1.96 (intervention) versus 12.07 ± 2.11 (control), supported by a $p=0.0004$. The findings demonstrate that *Lavandula angustifolia* aromatherapy relaxation effectively reduces stress and improves sleep quality in patients with kidney failure. Lavender aromatherapy may serve as a safe, simple, and complementary non-pharmacological therapy to support clinical management in this population.



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INTRODUCTION

Patients with chronic kidney disease (CKD) often experience poor sleep quality, which can accelerate the progression of CKD and negatively affect their health-related quality of life, thereby increasing the risk of morbidity and mortality. In addition, poor sleep quality can affect the immune system, cognitive function, and emotional well-being of CKD patients and contribute to medication nonadherence and reduced participation in the overall treatment plan (Gela & Tesfaye, 2024). CKD patients are also at high risk of developing common mental disorders, which may lead to lower survival rates, poor clinical outcomes, more extended hospital stays, increased use of health services, difficulties in treatment adherence, a higher risk of requiring dialysis, as well as poor quality of life and higher mortality risk (Gela & Tesfaye, 2024).

It is estimated that around 700 million people worldwide suffer from CKD. Combined with the global burden of kidney failure (including those receiving dialysis and kidney transplants), the prevalence increases to approximately 850 million, which translates to a global prevalence of >10% (Kovesdy, 2022). Data from Indonesia's Basic Health Research (Riskesdas), conducted by the National Institute of Health Research and Development, showed that the prevalence of CKD in Indonesia was 0.38% (3.8 per 1000 population), and around 60% of kidney failure patients required hemodialysis (Kementerian Kesehatan Republik Indonesia, 2018).

Hemodialysis in CKD patients can cause complications such as anemia, weakness, sleep disturbances, muscle cramps, hypotension, and hypertension (Kamil & Setiyono, 2018). Sleep disorders in CKD patients may lead to insomnia, poor sleep quality, and a decreased quality of life,

while also affecting psychological, physiological, social, and physical well-being, and even leading to death. Poor sleep quality disrupts melatonin, a hormone that regulates sleep rhythms. Observations by researchers showed that several CKD patients experienced difficulty sleeping due to shortness of breath, itching, anxiety before dialysis, and frequent nighttime awakenings. Sleep disorders can further worsen health outcomes, including decreased quality of life, increased risk of accidents, malaise, fatigue, higher risk of falls, cognitive decline, and even death (Damayanti & Anita, 2021).

Research by Saraswati et al. (2022) found that stress levels are associated with sleep quality; in other words, stress is one factor that affects sleep in patients. A study in India by Kumar et al. (2022) reported that 78.3% of patients undergoing hemodialysis experienced stress. Stress in hemodialysis patients arises from limited physical activity, altered self-concept, economic status, and dependency levels. Patients often face financial problems, difficulty maintaining employment, loss of sexual drive and impotence, concerns about marriage, and fear of death. Lavender aromatherapy (*Lavandula angustifolia*) is an aromatic plant species widely used in aromatherapy practice because of its significant relaxation effects. Its main active compounds, such as linalool and linalyl acetate, modulate central nervous system activity through gamma-aminobutyric acid (GABA) neurotransmitter pathways, producing sedative, anxiolytic, and sleep-enhancing effects (Lari et al., 2020). Clinical studies have shown that inhalation of *Lavandula angustifolia* essential oil improves sleep quality and reduces stress. Lari et al. (2020) reported that aromatherapy with *Lavandula angustifolia* effectively enhances sleep quality, improves quality of life, and assists in metabolic regulation.

Patients with CKD often experience poor sleep quality, which can accelerate the progression of CKD and negatively affect their health-related quality of life, thereby increasing the risk of morbidity and mortality. In addition, poor sleep quality can influence the immune system, cognitive function, and emotional well-being of CKD patients, and contribute to nonadherence to medications and reduced participation in the overall treatment plan (Gela & Tesfaye, 2024). CKD patients are also at high risk of developing common mental disorders, which may lead to lower survival rates, poor clinical outcomes, more extended hospital stays, increased use of health services, difficulties in treatment adherence, a higher risk of requiring dialysis, as well as poor quality of life and higher mortality risk (Gela & Tesfaye, 2024). It is estimated that around 700 million people worldwide suffer from CKD. Combined with the global burden of kidney failure (including those receiving dialysis and kidney transplants), the prevalence increases to approximately 850 million, which translates to a global prevalence of >10% (Kovesdy, 2022). Data from Indonesia's Basic Health Research showed that the prevalence of CKD was 0.38%, and around 60% of kidney failure patients required hemodialysis (Risksdas, 2018). Hemodialysis itself may cause complications such as sleep disorders, hypotension, anemia, cramps, and psychological distress (Kamil & Setiyono, 2018).

This study is important for evaluating the effectiveness of *Lavandula angustifolia* aromatherapy as a non-pharmacological intervention to reduce stress and improve sleep quality in patients with kidney failure. The results can provide scientific evidence for the use of aromatherapy in clinical practice, thereby improving patients' quality of life by reducing stress and enhancing sleep quality. A preliminary study conducted at dr. Soehadi Prijonegoro Regional Hospital, Sragen, showed that the inpatient hemodialysis population from January to April 2025 was 290 patients, with 28 hemodialysis machines available. Most CKD patients in the inpatient hemodialysis ward reported high stress levels and poor sleep quality. Interviews with 10 hospitalized hemodialysis patients revealed that 70% experienced sleep difficulties each night. Stress among hospitalized hemodialysis patients was related to dialysis rhythms and the hospital environment, which contributed to stress and insomnia. Although the hospital has implemented non-pharmacological deep-breathing relaxation therapy, it has not been effective, as many patients continue to suffer from sleep problems and anxiety. This condition underscores the need for non-pharmacological interventions, such as *Lavandula angustifolia* aromatherapy, to help reduce stress and improve sleep quality.

METHOD

This study employed an experimental design with a pre-test and post-test control group. Patients with chronic kidney disease undergoing hemodialysis at dr. Soehadi Prijonegoro Regional

Hospital, Sragen, was divided into an intervention group that received lavender aromatherapy and a control group that did not. Both groups were assessed for stress levels and sleep quality before and after the intervention. The study population comprised 209 new CKD patients recorded between January and April 2025, of whom 30 were selected by simple random sampling. Each group comprised 15 respondents, fulfilling the minimum sample requirement for experimental research.

The instruments used were the Depression Anxiety Stress Scale (DASS-21) to measure stress levels and the Pittsburgh Sleep Quality Index (PSQI) to assess sleep quality. The Indonesian adaptation of the DASS-21 has demonstrated strong psychometric properties, with Cronbach's alphas of 0.91 for stress, 0.85 for anxiety, and 0.88 for depression, along with good construct validity and factorial stability in Indonesian populations, as validated by several Indonesian psychometric studies (Henry & Crawford, 2005). Likewise, the PSQI Bahasa Indonesia version has demonstrated acceptable internal consistency (Cronbach's $\alpha=0.79$) and has been validated for use in Indonesian clinical settings. Both instruments have been widely used in Indonesian research and are considered reliable and valid for assessing stress and sleep quality in local patient populations. Participants were instructed to inhale the aroma naturally during two consecutive days of treatment.

The duration and frequency of the intervention were extended to ensure adequate therapeutic exposure, with *Lavandula angustifolia* aromatherapy administered once daily for 7 consecutive days, as a 2-day intervention is insufficient to capture meaningful changes in sleep quality. External variables were controlled by excluding participants who used sedatives or sleep-inducing medications, standardizing hemodialysis schedules to reduce physiological variations, maintaining consistent environmental conditions in patient rooms (including lighting, noise, and temperature), and providing uniform sleep hygiene instructions to all respondents to minimize potential confounding influences.

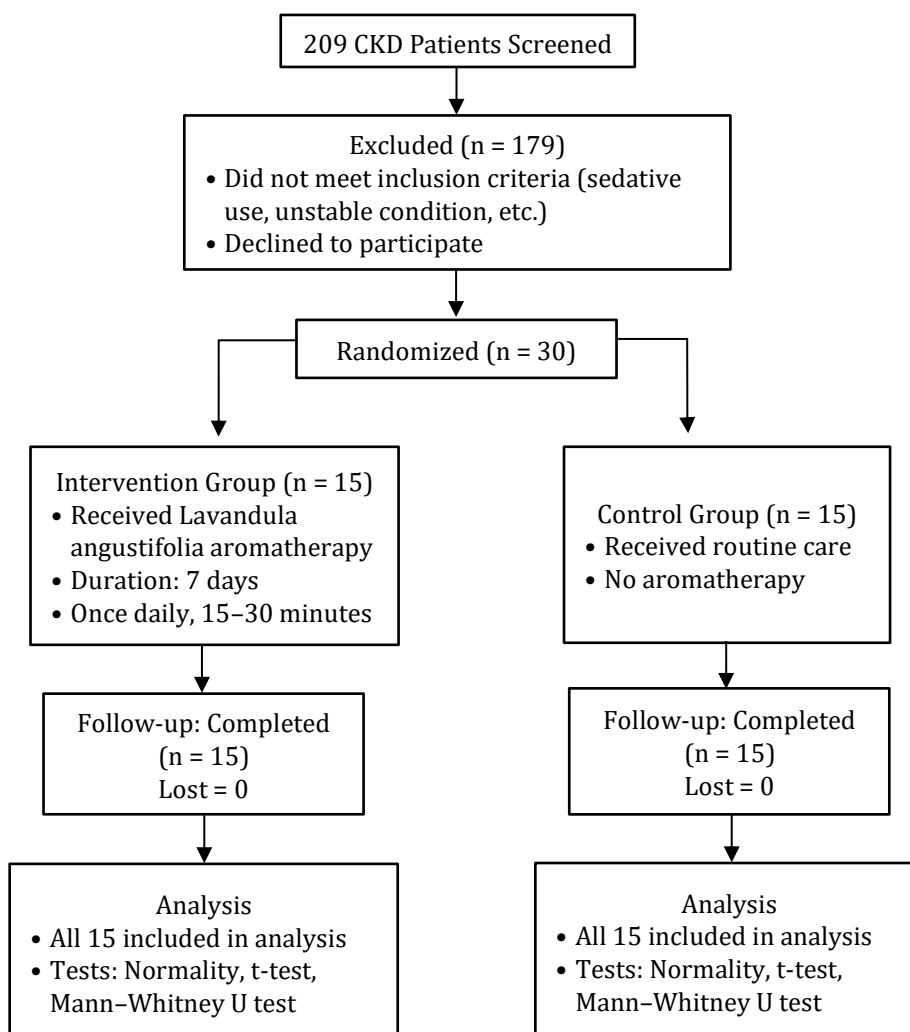


Figure 1. Consort flow diagram for lavender aromatherapy intervention in CKD patients

Data collection consisted of pre-test and post-test assessments. Statistical analysis included normality testing followed by an independent t-test for normally distributed data and the Mann-Whitney U test for non-normally distributed variables. Lavender aromatherapy was administered by diffusing 3 mL of 5% *Lavandula angustifolia* essential oil for 15-30 minutes in a closed hospital room. Participants were instructed to inhale the aroma naturally over two consecutive days of treatment. The dependent variables in this study were stress levels and sleep quality, while the independent variable was lavender aromatherapy. The study was carried out in September 2025. Ethical principles, including informed consent, anonymity, confidentiality, and risk minimization, were strictly observed. Ethical approval was obtained from the hospital's institutional review board under number 0923471/EC/KEPK/1/09/2025, and the procedures complied with the Helsinki Declaration of 2013, revised in 2020, to ensure the protection of participants' rights and safety.

RESULTS

Table 1. Distribution of central tendency of respondents' characteristics based on age and history of hemodialysis

Variable	Obs	Mean	Std. Dev.	Min	Max
Age (years)	30	47.97	10.31	29	69
HD history (yr)	30	2.87	1.33	1	6

The respondents' ages ranged from 29 to 69 years, with a mean of 47.97 ± 10.31 , and the mean duration of hemodialysis was 2.87 years (range 1–6 years). These characteristics indicate that most participants were middle-aged adults who had undergone long-term hemodialysis.

Table 2. Distribution of respondents by age category, hemodialysis duration, gender, and comorbidities

Variable Category	f	%
Age Category		
<48 years	14	46.67
≥48 years	16	53.33
Hemodialysis Duration		
<3 years	15	50.00
≥3 years	15	50.00
Gender		
Female	17	56.67
Male	13	43.33
Comorbidities		
Hypertension	15	50.00
Diabetes Mellitus	10	33.33
Heart Disease	5	16.67

More than half of respondents were aged ≥48 years (53.33%), most were female (56.67%), and hypertension was the most common comorbidity (50%). Hemodialysis duration was evenly distributed between <3 years and ≥3 years. These characteristics align with existing evidence that older age, female gender, and comorbidities such as hypertension and diabetes are closely linked to CKD progression. See Table 1 for a summary of respondent characteristics.

Table 3. Stress levels before lavender aromatherapy intervention

Group	N	Rank Sum	Expected	Z	p-value
Control	15	204.5	232.5	-1.168	0.243
Intervention	15	260.5	232.5		

Before intervention, there was no significant difference in stress levels between groups ($p=0.243$). This indicates baseline homogeneity.

Table 4. Stress levels after lavender aromatherapy intervention

Group	N	Rank Sum	Expected	Z	P-value
Control	15	300.5	232.5	2.835	0.004
Intervention	15	164.5	232.5		

After the intervention, stress levels decreased significantly in the intervention group compared with the control group ($p=0.0046$). This shows that lavender aromatherapy was effective in reducing stress.

Table 5. Sleep quality before lavender aromatherapy intervention

Group	N	Rank Sum	Expected	Z	p-value
Control	15	268	232.5	1.485	0.137
Intervention	15	197	232.5		

Before intervention, there was no significant difference in sleep quality between groups ($p=0.137$).

Table 6. Sleep quality after lavender aromatherapy intervention

Group	N	Rank Sum	Expected	Z	p-value
Control	15	318	232.5	3.566	0.0004
Intervention	15	147	232.5		

After intervention, sleep quality significantly improved in the intervention group compared to the control group ($p=0.0004$). These findings are in line with Lari et al. (2020) who reported that lavender inhalation improved sleep quality in patients with chronic illnesses.

The intervention group demonstrated a clear quantitative improvement following *Lavandula angustifolia* aromatherapy. Stress scores decreased markedly after the intervention, as reflected by a significant difference between groups ($p=0.004$), indicating that participants experienced lower stress levels than at baseline. Similarly, sleep quality scores improved substantially, with post-intervention values indicating better sleep outcomes than pre-intervention assessments ($p=0.0004$). Although the Mann-Whitney U test results are presented as ranks rather than mean differences, the consistent shift in the rank distribution indicates a meaningful reduction in stress and an improvement in sleep quality among patients receiving aromatherapy. These findings collectively support the effectiveness of lavender aromatherapy as a complementary intervention for reducing stress and improving sleep quality in hemodialysis patients. See Table 2 for a summary of stress outcomes and Table 3 for sleep quality outcomes.

DISCUSSION

The effect of lavender aromatherapy relaxation on stress levels in kidney failure patients

The findings of this study indicate that stress levels in the intervention group improved significantly after receiving lavender aromatherapy, whereas the control group did not show similar changes. This suggests that lavender aromatherapy meaningfully reduces psychological stress among hemodialysis patients. Chien et al. (2023) reported that declining kidney function and comorbid conditions often exacerbate emotional distress in hemodialysis patients.

The therapeutic effect of lavender is biologically plausible. Its main active compounds—linalool and linalyl acetate modulate GABAergic neurotransmission, producing sedative and anxiolytic effects (Chien et al., 2023; Koulivand et al., 2013). Evidence from clinical research further supports these findings. Retnaningsih et al. (2024) demonstrated that lavender aromatherapy combined with deep-breathing exercises effectively reduced anxiety levels in hemodialysis patients. Similarly, Muz & Tasci (2017) found that inhaled lavender essential oil decreased fatigue and improved psychological well-being in individuals undergoing routine dialysis. These studies collectively reinforce the role of lavender aromatherapy as a

complementary intervention that enhances emotional stability and comfort during hemodialysis and may improve adherence to treatment plans.

The effect of lavender aromatherapy relaxation on sleep quality in kidney failure patients

This study also demonstrated significant improvements in sleep quality among patients receiving lavender aromatherapy, indicating that the intervention helped regulate sleep patterns more effectively than routine care alone. These findings correspond with the work of Lari et al. (2020), who found that inhaled *Lavandula angustifolia* improved sleep quality, enhanced quality of life, and supported metabolic regulation in patients with chronic health conditions. In hemodialysis populations specifically, Chien et al. (2023) reported that lavender aromatherapy improved sleep quality and reduced sleep-related distress.

Lavender's sedative effects are attributed to the actions of linalool and linalyl acetate on central nervous system pathways, which promote relaxation and stabilize sleep rhythms (Koulivand et al., 2013). Additional evidence from Muz & Tasci (2017) shows that lavender inhalation during dialysis sessions reduces sleep disturbances and nighttime fatigue. Furthermore, Lillehei et al. (2015) demonstrated that inhaled lavender, combined with sleep hygiene practices, improves sleep outcomes in adults with chronic sleep issues.

Physiologically, lavender aromatherapy has been shown to decrease sympathetic nervous system activity, reduce cortisol levels, and stimulate parasympathetic responses, all mechanisms that support restorative sleep and emotional balance (Fung et al., 2021). These biological processes help explain the consistent improvements in sleep quality observed in the intervention group.

From a clinical perspective, the findings highlight lavender aromatherapy as a safe, simple, low-cost, and easily implementable complementary therapy for CKD patients. Integrating aromatherapy into standard nursing practice may enhance patient comfort, reduce emotional distress, and support improved overall quality of life during long-term hemodialysis treatment.

Limitations

This study has several limitations. First, the relatively small sample size limits the generalizability of the findings to a broader population. Second, external factors such as environmental conditions and noise levels could not be fully controlled and may have influenced the intervention outcomes. Third, sleep quality was assessed using subjective self-report questionnaires, which may introduce response bias.

CONCLUSION

This study concludes that lavender aromatherapy relaxation significantly reduces stress levels and improves sleep quality in patients with chronic kidney failure undergoing hemodialysis. The intervention is safe, effective, and simple to apply, making it a suitable complementary therapy to support conventional medical treatment. Further research with larger sample sizes and more rigorous designs, such as randomized controlled trials, is recommended to strengthen the evidence base and to explore the long-term impact of lavender aromatherapy on patients' psychological and physiological well-being. Based on the findings of this study, several practical recommendations can be offered for healthcare providers working with patients undergoing hemodialysis. First, nurses and physicians may consider incorporating *Lavandula angustifolia* aromatherapy as a complementary intervention to help reduce stress and improve sleep quality, particularly during or after hemodialysis sessions. Second, implementing structured relaxation practices—such as deep breathing exercises combined with aromatherapy—can enhance patient comfort and emotional well-being. Third, healthcare staff are encouraged to optimize the treatment environment by minimizing noise, ensuring adequate lighting, and providing a calm setting to support the effectiveness of non-pharmacological therapies. Finally, regular assessment of patients' psychological and sleep-related needs should be integrated into routine care to identify those who may benefit most from complementary interventions such as aromatherapy.

AUTHOR'S DECLARATION

Authors' contributions and responsibilities

TO: Writing original draft, conceptualization, visualization, data collection, funding acquisition; **JP:** writing review & editing (supporting), methodology support, funding acquisition; **PD:** supervision (lead), validation (equal), visualization (equal), review & editing (lead). All authors have read and approved the final version of the manuscript and are responsible for the integrity and accuracy of its content.

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Availability of data and materials

All data generated or analyzed during this study are available from the corresponding author upon reasonable request.

Competing interests

The authors declare no competing interests.

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