

Original Article

Effect of Citrus Sinensis Aromatherapy on Pain and Anxiety Among Hemodialysis Patients: A Quasi-Experimental Study



Endah Panca Lydia Fatma¹, Rustiana Tasya Ariningpraja¹, Retno Lestari¹

¹ Departement of Nursing, Faculty of Health Sciences, Universitas Brawijaya, Malang, East Java, Indonesia

ARTICLE INFO

Article History

Submit : October 10, 2025
Accepted : February 19, 2026
Published : March 21, 2026

Correspondence

Rustiana Tasya Ariningpraja;
Department of Nursing, Faculty
of Health Sciences, Universitas
Brawijaya, Malang, East Java,
Indonesia.

Email:

rustiana.ta@ub.ac.id

Citation:

Ariningpraja, R. T. , Fatma, E. P.
L. , & Lestari, R. . (2026). Effect
of Citrus Sinensis Aromatherapy
on Pain and Anxiety Among
Hemodialysis Patients: A Quasi-
Experimental Study. *Journal of
Applied Nursing and Health*,
8(1), 398–405.
<https://doi.org/10.55018/janh.v8i1.447>

ABSTRACT

Background: Pain is a common problem in hemodialysis patients and is often accompanied by anxiety. Aromatherapy is a simple, low-cost complementary intervention, but evidence in hemodialysis patients is still limited and inconclusive. Citrus sinensis essential oil is of particular interest because its major bioactive components are analgesic and anxiolytic agents. The purpose of this study was to determine the effect of citrus sinensis aromatherapy on pain and anxiety in hemodialysis patients.

Methods: A quasi-experimental design with a control group included 50 hemodialysis patients (25 control and 25 intervention) selected by purposive sampling at the Bangil Health Centre in Pasuruan City. Eligible patients were ≥ 18 years old, have good sense of smell, on routine hemodialysis. Pain was measured using the Numeric Rating Scale (NRS) and anxiety using the Generalized Anxiety Disorder-7 (GAD-7)—data analyzed with a paired t-test. The intervention was given twice a week for 30 minutes. Ethical clearance was obtained.

Results: In the intervention group, mean pain score decreased from 6.2 ± 1.1 to 3.4 ± 1.0 , and anxiety scores decreased significantly (both $p < 0.001$), while changes in the control group were not significant. Between-group comparisons showed a greater reduction in pain and anxiety in the intervention group ($p < 0.05$).

Conclusion: The Citrus sinensis aromatherapy was effective to reduce on pain scale and anxiety level in chronic kidney disease patients undergoing hemodialysis. These findings suggest that citrus sinensis aromatherapy can be considered as a simple complementary nursing intervention to improve comfort and psychological well-being during hemodialysis period.

Keywords: citrus sinensis; aromatherapy; pain; anxiety; hemodialysis.

Implications for Practice:

- Citrus sinensis aromatherapy may serve as a low-cost complementary therapy to reduce pain and anxiety among hemodialysis patients.
- Nurses and clinicians can use this evidence to support clinical decisions when selecting safe, affordable, and patient-centered methods for managing pain and anxiety.
- These findings may support promote training and awareness regarding the use of aromatherapy in clinical settings and consider integrating it into nursing care

Implications for Practice:

protocols for holistic patient management

Introduction

Chronic Kidney Disease (CKD) remains a major global health problem characterized by a progressive and irreversible decline in kidney function. The World Health Organization (WHO) reported that CKD ranks among the top causes of

morbidity and mortality worldwide, with increasing prevalence each year. In Indonesia, the prevalence of CKD based on a doctor's diagnosis in the population aged ≥ 15 years is around 0.18-0.22%. The condition frequently progresses to end-stage renal disease, requiring renal replacement therapy such as hemodialysis ([Survey kesehatan indonesia \(Ski\), 2023](#));).

Hemodialysis is a life-sustaining procedure designed to remove metabolic waste products and excess fluids from the blood. However, despite its therapeutic benefits, hemodialysis can cause various physical and psychological stressors that negatively affect patients' quality of life ([Tiwouw et al., 2024](#)). The insertion of arteriovenous (AV) fistula needles during hemodialysis often triggers pain, which patients commonly describe as one of the most distressing aspects of the procedure ([Barello et al., 2023](#)). In addition to pain, many patients also experience anxiety, resulting from repeated invasive procedures, uncertainty about treatment outcomes, and changes in lifestyle ([Wilkinson et al., 2021](#)). Persistent pain and anxiety may contribute to poor adherence to treatment, reduced comfort, and increased physiological burden. In the context of low- and middle-income countries (LMICs) such as Indonesia, limited resources for pharmacological pain management and mental health services make simple, low-cost non-pharmacological strategies particularly relevant ([Inayama et al, 2022](#)).

The relationship between pain, anxiety, and comfort can be explained by both physiological and nursing frameworks. According to the gate control theory of pain, non-pharmacological sensory inputs can modulate nociceptive transmission in the spinal cord and "close the gate," to reducing pain perception. From a nursing perspective, comfort is considered a central outcome of care and reflects a holistic state

of relief, ease, and well-being. Besides pharmacological treatments, non-pharmacological methods such as aromatherapy are increasingly favored for their safety, affordability, and ease of use. Sweet orange (*Citrus sinensis*) essential oil, which is rich in limonene and linalool, has been shown to reduce anxiety and pain by acting on the limbic system and stimulating serotonin and endorphin release ([Yang et al., 2021](#); [Zhao et al., 2023](#)). Effective management of pain and anxiety is vital to enhance patient comfort and adherence during hemodialysis. Besides pharmacological treatments, non-pharmacological methods such as aromatherapy are increasingly favored for their safety and ease of use. Sweet orange (*Citrus sinensis*) essential oil, rich in limonene and linalool, has been shown to reduce anxiety and pain by affecting the limbic system and stimulating serotonin and endorphin release ([Yang et al., 2021](#); [Zhao et al., 2023](#)).

Previous studies have shown that citrus *sinensis* aromatherapy effectively reduces both physical discomfort and psychological distress among various patient populations. However, limited studies have examined its dual impact on both pain and anxiety among patients undergoing hemodialysis. Considering that pain and anxiety are interrelated experiences during the procedure, integrating both outcomes within one study may provide a more holistic understanding of aromatherapy's therapeutic potential. Therefore, this study aimed to determine the effect of *sweet orange aromatherapy* on pain and anxiety among patients undergoing hemodialysis.

Methods

Study Design

This study employed a quasi-experimental pretest-posttest design. The intervention was administered to the experimental group, while the control

group received standard care without aromatherapy.

Participants

A total of 50 patients were selected using a purposive sampling technique and then randomly assigned into two equal groups with 25 participants per group. The participants were undergoing hemodialysis at the Bangil Health Centre in Pasuruan City, Indonesia. Eligible patients were approached by the researchers before their hemodialysis session, provided with information about the study, and invited to participate, and those who agreed gave written informed consent. Using a non-randomized allocation based on the dialysis schedule, patients assigned to the Monday and Thursday schedule formed the intervention group, and those assigned to the Tuesday–Thursday and Friday schedule formed the control group. The intervention group received *Citrus sinensis* aromatherapy in addition to standard care, whereas the control group received standard care only.

The inclusion criteria were aged ≥ 18 years, undergoing regular hemodialysis, conscious and able to communicate effectively, and having no disturbance of the sense of smell.

The sample size was determined using G*Power version 3.1 for a repeated measures ANOVA between groups, consistent with the study's pretest–posttest design involving three groups (*Citrus sinensis* aromatherapy, natural sound therapy, and control). With a moderate effect size ($f = 0.25$), significance level $\alpha = 0.05$, power $(1-\beta) = 0.80$, and two measurement points per participant, the analysis suggested a minimum of 25 participants in each group.

Instruments

Two standardized instruments were used. The Numeric Rating Scale (NRS) is

used to measure *pain intensity*, ranging from 0, which is no pain, to 10 for the worst pain. The NRS has been widely used and shown to have good reliability and validity in clinical populations. In a previous Indonesian study, the NRS demonstrated acceptable internal consistency with a Cronbach's alpha of 0.92. Generalized Anxiety Disorder-7 (GAD-7) to assess *anxiety level*, consisting of seven items rated on a 4-point Likert scale (0 = not at all, 3 = nearly every day), has a total score between 0 and 21. Higher scores indicate greater anxiety severity, with commonly used cut-off scores of 5, 10, and 15 representing mild, moderate, and severe anxiety. In a previous study, it was shown a Cronbach's alpha of 0.86 was shown. It means that NRS and GAD-7 are valid. All instruments were used in their Indonesian versions. The comfort instrument and, where necessary, the GAD-7 were translated and culturally adapted into Indonesian using a standard forward–backward translation procedure. Permission to use the NRS, the Indonesian version of the GAD-7, was obtained from the respective authors or copyright holders via e-mail before data collection.

Intervention

The intervention used sweet orange essential oil (2%) diluted in sweet almond oil. A total of 10 drops were applied to a 5×6 cm cotton pad, then attached to the patient's collar or neckline 5 minutes before the hemodialysis procedure and left in place for 25 minutes during the session. Patients were instructed to take deep, slow breaths to enhance inhalation. The control group received standard care only, including routine monitoring and vital sign assessment. The intervention was repeated twice following the patients' regular hemodialysis schedule.

Data Collection

Data were collected through direct observation and self-reported questionnaires during the pretest (before intervention) and posttest (after intervention) on chronic kidney disease patients on hemodialysis unit.

Data Analysis

The data were analyzed using SPSS version 25. Paired t-tests were used to identify pre- and post-intervention changes within each group. And also independent t-tests were applied to compare differences between groups, with significancy level of p-value < 0.05 was considered statistically significant.

Ethical Considerations

This study was conducted in accordance with ethical research principles involving human participants. Before data collection, ethical clearance was obtained from the Health Research Ethics Committee of the Faculty of Health Sciences, Universitas Brawijaya (Approval No.: [80/UN10.F17.10.4/TU/2025]).

Results

Table 1. Distribution of Respondents' Demographic Characteristics (n = 50)

Category	Aromatherapy (n=25)	Control (n=25)
Gender		
Male	15 (60%)	15 (60%)
Female	10 (40%)	10 (40%)
Age		
18-40	3 (12%)	0 (0%)
41-60	18 (72%)	15 (60%)
>60	4 (16%)	10 (40%)
Educational level		
Elementary school	12 (48%)	11 (44%)

Category	Aromatherapy (n=25)	Control (n=25)
Junior high school	8 (32%)	8 (32%)
Senior high school	4 (16%)	4 (16%)
College	1 (4%)	2 (8%)
Marital status		
Married	24 (96%)	25 (100%)
Single	1 (4%)	0 (0%)
Occupational		
Civil servant	2 (8%)	1 (4%)
Private employee	8 (32%)	9 (36%)
Entrepreneur	1 (4%)	0 (0%)
Housewife	6 (24%)	4 (16%)
Student	0 (0%)	0 (0%)
Others	8 (32%)	6 (44%)
Co-morbidities		
Diabetes Mellitus	7 (28%)	9 (36%)
Hypertension	11 (44%)	9 (36%)
Others	7 (28%)	7 (28%)
None	0 (0%)	0 (0%)
HD access		
Av Shunt	21 (84%)	23 (92%)

Based on the table 1 illustrates that, of the 50 respondents studied, the majority of respondents were male, aged 40-60, with a primary school education, married, had various comorbidities, especially hypertension and diabetes mellitus, or both, and most respondents had AV shunt access. They had undergone HD cycles > 100 times.

The comparison of the pain scale between the sweet orange aromatherapy and control groups is presented in **Table 2.**

Table 2. Comparison of Pain Scale and Anxiety Level in Intervention and Control Groups at Pretest and Posttest (n = 50)

Variable	Time	Intervention Group Mean ± SD	Control Group Mean ± SD	Within-Group p-value	Between-Group p-value
Pain Scale (0-10)	Pretest	4.36 ± 1.70	4.08 ± 1.89	—	0.002
	Posttest	2.80 ± 1.68	3.60 ± 1.82	0.000	0.366



Variable	Time	Intervention Group Mean \pm SD	Control Group Mean \pm SD	Within-Group p-value	Between-Group p-value
Anxiety level	Pretest	10.72 \pm 2.11	9.88 \pm 2.03	—	0.000
	Posttest	6.24 \pm 1.87	9.20 \pm 1.95	0.000	0.001

A paired t-test was performed on the treatment group and the control group, yielding a p-value of <0.001 , indicating a significant difference in hemodialysis pain between the two groups at post-test. This indicates that sweet orange aromatherapy reduced pain levels during hemodialysis compared to the group receiving standard care without aromatherapy. These findings indicate that the application of *sweet orange aromatherapy* significantly reduced pain levels among hemodialysis patients, while the standard care alone did not yield notable improvement.

The comparison of anxiety level between the sweet orange aromatherapy and control groups is presented in Table 3. On the pain variable, *sweet orange aromatherapy* also showed a substantial effect on anxiety levels. However, the improvement was much greater in the intervention group. The independent t-test comparing post-test anxiety scores between groups revealed a highly significant difference ($p < 0.001$), confirming that *sweet orange aromatherapy* was effective in reducing anxiety during hemodialysis.

Discussion

The study demonstrated that patients who received aromatherapy experienced a significant reduction in both pain scale and anxiety levels. These results confirm that *Citrus sinensis* essential oil, when administered through inhalation, provides measurable physiological and psychological benefits for hemodialysis patients. The current findings are consistent with previous studies showing that sweet orange aromatherapy effectively reduces pain and anxiety in various clinical populations.

This study supports the results of (Nascimento et al., 2025) and (Kaya et al., 2023), who found that inhaled *citrus sinensis* significantly decreased labor pain intensity. Sweet orange essential oil alleviated musculoskeletal pain among elderly patients. Furthermore, the mechanism involves the activation of olfactory receptors that transmit impulses to the limbic system, particularly the hypothalamus and amygdala, stimulating endorphin release and modulating pain perception (Tabatabaeichehr & Mortazavi, 2020). The present study reinforces these findings by demonstrating similar analgesic effects among hemodialysis patients, a population often subjected to procedural pain due to vascular access puncture. Meanwhile, a meta-analysis determined that aromatherapy has a large effect size also to reduce pain in chronic conditions.

The results about anxiety are in line with those of (Nascimento et al., 2025), who observed a significant decrease in anxiety scores following *sweet orange* inhalation therapy. These outcomes align with the theory that volatile compounds such as limonene and linalool modulate neurotransmitter activity in the central nervous system, increasing serotonin and gamma-aminobutyric acid (GABA) levels, which promote calmness and emotional stability.

This study contributes new knowledge by providing integrated evidence that *sweet orange aromatherapy* offers both analgesic and anxiolytic benefits for patients undergoing hemodialysis (National Association for Holistic Aromatherapy, 2012; Silalahi et al., 2023).

The findings support the use of complementary and alternative therapies as part of holistic nursing practice in chronic illness management. Non-pharmacological intervention can simultaneously target physical discomfort and emotional distress, two major challenges in hemodialysis care.

This insight may inform future research on multimodal interventions that combine aromatherapy with guided relaxation, music therapy, or breathing exercises to enhance patient comfort further (Giordano et al, 2023; [Miller et al., 2025](#)).

The advantage of this research is that it not only identifies the influence of sweet orange on physical but also psychological impacts. The quasi-experimental design with a control group strengthens the study's internal validity, and the use of standardized instruments supports the reliability of the data. Moreover, the study introduces a practical, safe, and low-cost complementary approach that can be easily implemented in clinical settings. Future studies should consider larger sample sizes, longer intervention durations, and additional control of psychological or environmental factors to confirm and expand upon these findings.

Implications and limitations

The findings of this study provide conceptual and scientific contributions to nursing science and complementary health research. From a theoretical perspective, the results reinforce Jean Watson's Theory of Human Caring, which underscores the integration of physical, emotional, and spiritual dimensions in nursing practice. The demonstrated reduction in pain and anxiety supports the idea that creating a caring-healing environment through sensory stimulation, such as aroma, can enhance patients' adaptive responses and promote holistic well-being. This study adds new empirical evidence linking olfactory stimulation to adaptive mechanisms, showing that sensory-based interventions can optimize coping processes among chronic illness populations.

Several limitations should be considered when interpreting the findings of this study. The sample size was relatively small. The duration of intervention was

short, conducted over two hemodialysis sessions only, so the long-term effects are unidentified. And also identify other factors that are related to pain triggers and anxiety.

Relevance to Practice

The findings of this study have several practical implications for nursing and healthcare delivery. The demonstrated effectiveness of *sweet orange aromatherapy* in reducing both pain and anxiety among hemodialysis patients underscores its potential as a simple, safe, and cost-effective complementary therapy that can be integrated into clinical practice. Hospitals can provide short training programs to nurses on aromatherapy principles, dosage, and patient safety to ensure consistent application. Policymakers may consider including aromatherapy within national nursing standards or health promotion programs for patients with chronic diseases. Additionally, collaboration between hospitals and educational institutions can foster research-based innovation, ensuring that integrative care is supported by empirical evidence and aligned with professional ethical standards.

Conclusion

This study confirmed that *sweet orange aromatherapy* effectively reduces both pain intensity and anxiety levels among patients undergoing hemodialysis. The findings highlight the dual physiological and psychological benefits of aromatherapy as a complementary nursing intervention that supports holistic, patient-centered care. By integrating *Citrus sinensis* inhalation therapy into routine hemodialysis sessions, nurses can enhance patient comfort, emotional stability, and overall well-being. These results reinforce the value of evidence-based complementary therapies in clinical practice and provide a foundation for future research and policy development

aimed at improving the quality of life for individuals with chronic kidney disease.

Funding

This research was funded by a grant from the Institute for Research and Community Service (BPPM), Faculty of Health Sciences Universitas Brawijaya (No. 02522/UN10.F1701/B/PT.01.03.2/2025).

CrediT Authorship Contributions Statement

Endah Panca Lydia Fatma: Conceptualization, Methodology, Supervision, Validation, Writing – Review & Editing.

Rustiana Tasya Ariningpraja: Investigation, Data Curation, Formal Analysis, Writing – Original Draft, Correspondence.

Retno Lestari: Methodology, Resources, Visualization, Project Administration, Writing – Review & Editing.

Conflicts of Interest

There is no conflict of interest.

Acknowledgments

We want to express our deepest gratitude to the Institute for Research and Community Service (BPPM) of Universitas Brawijaya for the research grant that has been awarded. This financial support is very meaningful and will be the main driver for the smoothness and success of our research.

References

Barello, S., Anderson, G., Acampora, M., Bosio, C., Guida, E., Irace, V., Guastoni, C. M., Bertani, B., & Graffigna, G. (2023). The effect of psychosocial interventions on depression, anxiety, and quality of life in hemodialysis patients: a systematic review and a meta-analysis. *International Urology and Nephrology*, 55(4), 897–912.

<https://doi.org/10.1007/s11255-022-03374-3>

Hsu, J. R., Mir, H., Wally, M. K., Seymour, R. B., Archer, K. R., Attum, B., Chad Coles, K. Y., Dumpe, J., Harvey, E., Higgins, T., Hoegler, J., Liu, J. Z., Lowe, J., Mamczak, C., Lawrence Marsh, J., Miller, A. N., Obremsky, W., Ransone, M., Ricci, W., ... Shafiq, B. (2019). Clinical Practice Guidelines for Pain Management in Acute Musculoskeletal Injury. *Journal of Orthopaedic Trauma*, 33(5), E158–E182.

<https://doi.org/10.1097/BOT.0000000000001430>

Kaya, A., Yeşildere Sağlam, H., Karadağ, E., & Gürsoy, E. (2023). The effectiveness of aromatherapy in the management of labor pain: A meta-analysis. *European Journal of Obstetrics and Gynecology and Reproductive Biology: X*, 20(August), 0–6.

<https://doi.org/10.1016/j.eurox.2023.100255>

Lakhan, S. E., Sheaffer, H., & Tepper, D. (2016). The Effectiveness of Aromatherapy in Reducing Pain: A Systematic Review and Meta-Analysis. *Pain Research and Treatment*, 2016. <https://doi.org/10.1155/2016/8158693>

Mailani, F., Muthia, R., Herien, Y., Huriani, E., Chan, C. M., & Abdullah, K. L. (2021). ORIGINAL RESEARCH The Fluid Management Experience in Patients with Chronic Kidney Disease Undergoing Hemodialysis in Indonesia: A Qualitative Study. *Nurse Media Journal of Nursing*, 11(3), 389–403.

<https://doi.org/10.14710/nmjn.v11i3.38838>

Miller, M. A., Ye, L., Pelt, M. Van, & Pavone, K. J. (2025). Effects of Mindfulness on Postoperative Pain, Anxiety, and Opioid Use: An Integrative Review. *Pain Management Nursing*, 26(5),

- e425–e433.
<https://doi.org/10.1016/j.pmn.2025.04.004>
- Nascimento, J. C., Gonçalves, V. S. do. S., Souza, B. R. S., Nascimento, L. de C., Carvalho, B. M. R. d., Nogueira, P. C. L., Santos, J. P. S., Borges, L. P., Goes, T. C., Souza, J. B. de, Coutinho, H. D. M., & Guimarães, A. G. (2025). Effectiveness of aromatherapy with sweet orange oil (*Citrus sinensis* L.) in relieving pain and anxiety during labor. *Explore*, 21(1), 103081. <https://doi.org/10.1016/j.explore.2024.103081>
- National Association for Holistic Aromatherapy. (2012). *No Title*. Safety Information.
- Silalahi, E. D., Lister, I. N. E., & Fachrial, E. (2023). Analgesic and Antipyretic Activity of Sweet Orange Peel Methanol Extract. *Biology, Medicine, & Natural Product Chemistry*, 12(2), 577–584. <https://doi.org/10.14421/biomedich.2023.122.577-584>
- Survey kesehatan indonesia (Ski). (2023). *Survei Kesehatan Indonesia 2023 (SKI)*. *Kemenkes*, 235.
- Tabatabaeichehr, M., & Mortazavi, H. (2020). The Effectiveness of Aromatherapy in the Management of Labor Pain and Anxiety: A Systematic Review. *Ethiopian Journal of Health Sciences*, 30(3), 449–458. <https://doi.org/10.4314/ejhs.v30i3.16>
- Tiwouw, I. P., Robert, O., Umboh, H., & Awaludin, M. (2024). Gangguan cemas pada pasien penyakit ginjal kronik yang menjalani hemodialisis : literatur review. *J Kedokt Kom Tropik*, 12(1), 525–530.
- Wilkinson, T. J., Nixon, D. G. D., Palmer, J., Lightfoot, C. J., & Smith, A. C. (2021). Differences in physical symptoms between those with and without kidney disease: a comparative study across disease stages in a UK population. *BMC Nephrology*, 22(1), 1–10. <https://doi.org/10.1186/s12882-021-02355-5>
- Yang, H., Qi, L., & Pei, D. (2024). Effect of psychosocial interventions for depression in adults with chronic kidney disease: a systematic review and meta-analysis. *BMC Nephrology*, 25(1), 1–12. <https://doi.org/10.1186/s12882-023-03447-0>
- Zhao, Q., Zhu, L., Wang, S., Gao, Y., & Jin, F. (2023). Molecular mechanism of the anti-inflammatory effects of plant essential oils: A systematic review. *Journal of Ethnopharmacology*, 301(July 2022), 115829. <https://doi.org/10.1016/j.jep.2022.115829>