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The Usage of Lavender Aromatherapy in Managing Anxiety in Patients Who Are Undergoing Hemodialysis: *A Systematic Literature Review*

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Abstract

Background: *Anxiety is a component of the quality of life for hemodialysis patients; thus, if it is not addressed promptly, it can lead to a decline in their quality of life, inhibiting and affecting the success of hemodialysis. Lavender aromatherapy serves as a relaxation therapy that can reduce anxiety levels in hemodialysis patients, characterized by its lack of side effects, safety for patients, non-invasive nature, and cost-effectiveness.*
Method: *The method employed is a Systematic Literature Review through a qualitative approach. The literature search was conducted using the databases PubMed, Cochrane Library, DOAJ, Hindawi, Healey Library, Royal College of Nursing, UIC University Library, Neliti, and Google Scholar with formulated questions and Boolean Operators. Articles were filtered using various available filters, resulting in the selection of 7 relevant articles.*
Results*: Overall, lavender oil is used in aromatherapy in the form of diluted drops, making it easy to apply. Aromatherapy was administered three times a week and the majority of aromatherapy was delivered through direct inhalation, either before or during haemodialysis. Inhalation can also be performed by breathing in cotton or gauze that has been infused with 2% concentration lavender essential oil.*
Conclusion: *A systematic literature review of seven research articles yielded consistent results that lavender aromatherapy is effective in reducing anxiety among haemodialysis patients, despite variations in population, region, lavender oil concentration, duration of aromatherapy application, and research methods.*

INTRODUCTION

Hemodialysis treatment for patients with chronic kidney failure has negative impacts, particularly on psychological aspects. The process of undergoing hemodialysis several days a week, potentially for a lifetime, triggers psychological changes in patients. Psychological aspects of patients on hemodialysis are negatively affected due to the effects of the treatment. While hemodialysis can save patients' lives, it imposes limitations on their lifestyles. Dependence on the hemodialysis machine, economic difficulties, restricted activities, changes in family and social roles, and concerns about sustaining life contribute to this strain.

The limitations on activities, accompanied by anxiety, generally lead to heightened levels of anxiety in patients undergoing hemodialysis. High levels of anxiety have been evidenced in studies (Alshelleh et al., 2023) showing a

prevalence of 83.3%, and (A. Khalil et al., 2022) reported similar findings. If anxiety is not addressed promptly, the anxiety levels in patients may continue to rise, adversely affecting their quality of life and potentially hindering the hemodialysis treatment process. Therefore, an intervention is necessary to address anxiety in hemodialysis patients.

Nursing interventions to address anxiety in hemodialysis patients can be provided through pharmacological and non-pharmacological therapies. The administration of pharmacological treatments, such as antidepressants, poses challenges for hemodialysis patients due to the risk of drug interactions with various medications they are taking (Gerogianni et al., 2019). Additionally, patients with low glomerular filtration rates are at risk of toxic metabolite accumulation in their blood since the proteins bound to antidepressants cannot be effectively eliminated during hemodialysis. Long-term use of pharmacological treatments can undoubtedly lead to patients developing dependence on these medications, resulting in complications.

Several non-pharmacological therapy options are available to help reduce anxiety in hemodialysis patients. These include cognitive behavioral therapy, group cognitive therapy, physical exercise, social support, and relaxation techniques (Gerogianni et al., 2019). As anxiety levels increase among patients undergoing hemodialysis, there is a need for effective and efficient non-pharmacological interventions. Therefore, relaxation techniques such as aromatherapy can serve as a complementary therapy to alleviate anxiety in hemodialysis patients.

Aromatherapy is a complementary therapy widely used in several countries as a holistic nursing intervention to reduce anxiety in hemodialysis patients. In recent years, aromatherapy has been integrated as an adjunct treatment in medical care. Various essential oils can be used in aromatherapy for hemodialysis patients, including orange oil, lavender oil, tea tree oil, rose oil, bitter orange oil, olive oil, sweet orange oil, and sweet almond oil. However, lavender aromatherapy is particularly easy to use, has no side effects, is non-invasive, and is cost-effective (Menekli & Çevik, 2021). Lavender flowers contain Linalyl Acetate and Linalool which have a role in producing anti-anxiety effects or as a relaxant. Lavender aromatherapy can stimulate the thalamus to release encephalin, wich then stimulates the brain to release serotonin. Serotonin can have a relaxing calming effect and reduce pain.

METHOD

Research Design

This study employs a systematic literature review design based on the PRISMA checklist.

Article Criteria

The questions used to search for articles in journals refer to the PICOT framework (P: dialysis patients, I: aromatherapy, C: control or intervention only, O: anxiety levels, T: 2019-2024) with Boolean Operators AND and OR. The formulated question for this literature search is whether the use of aromatherapy can reduce anxiety levels in patients undergoing hemodialysis?

PICOT	Description
P	Hemodialysis patients
I	Aromatherapy OR essential oil OR essence
C	-
O	Anxiety levels
T	2019-2024

Research Identification

A literature search was conducted using various databases including PubMed, Cochrane Library, DOAJ, Hindawi, Healey Library, Royal College of Nursing, UIC University Library, Neliti, and Google Scholar.

Eligibility Criteria

A total of 703,151 articles were obtained from the search process based on keywords using Boolean Operators. The results were filtered based on full text availability, open access, and the last 5 years, yielding 77,990 articles. Subsequently, the results were further narrowed down to include only research articles and related data, resulting in 28 articles. In the final stage, exclusion criteria were applied to eliminate studies that were not randomized controlled trials, quasi-experimental, or literature reviews, leading to a total of 7 relevant articles that were analyzed as the basis for the literature review. The selection process in this study is presented using the PRISMA Flow Diagram (Figure 1).

Data Extraction

In this study, the data extraction conducted for each article includes the title, authors, country, research methodology, interventions, and outcomes. The methods employed in each article were identified and analyzed systematically.

Article Quality Assessment

The assessment of the eligibility of the selected articles was performed based on the JBI Critical Appraisal Checklist, CEBMa Checklist, and Critical Appraisal for Scoping Review. The JBI Checklist for Randomized Controlled Trials contains 13 questions, which include 3 questions related to selection and allocation bias, 3 questions related to intervention bias, 3 questions related to assessment, detection, and measurement bias of outcomes, 1 question related to participant retention bias, and 3 questions related to the validity of statistical conclusions. Conversely, the JBI Checklist for Quasi-Experimental Studies consists of 9 questions, including 1 question related to temporal priority bias, 1 question related to selection and allocation bias, 1 question related to confounding factor bias, 1 question related to intervention bias, 3 questions related to assessment, detection, and measurement bias of outcomes, 1 question related to participant retention, and 1 question related to the validity of statistical conclusions. The CEBMa Checklist for Meta-Analysis or Systematic Review comprises 12 questions. Meanwhile, the Critical Appraisal Checklist for Scoping Review includes 8 questions covering 2 questions related to the relevance of the research, 1 question related to the reliability of the research, 4 questions concerning the validity of the research, and 1 question related to the application of the research to patients.

The determination of the grade and level for each article refers to the Johns Hopkins Nursing Evidence-Based Practice. Randomized controlled trial (RCT) and

systematic review with or without meta-analysis (Level I), consistent, generalizable results, sufficient sample size for the study design, adequate control, definitive conclusions, consistent recommendations based on comprehensive literature review that includes through reference to scientific evidence (High Quality). Quasi-experimental study, systematic review of a combination of RCTs and quasi-experimental or quasi-experimental studies only, with or without meta-analysis (Level II), reasonably consistent results: sufficient sample size for the study design, some control, fairly definitive conclusions, reasonably consistent recommendations based on fairly comprehensive literature review that includes some reference to scientific evidence (Good Quality).

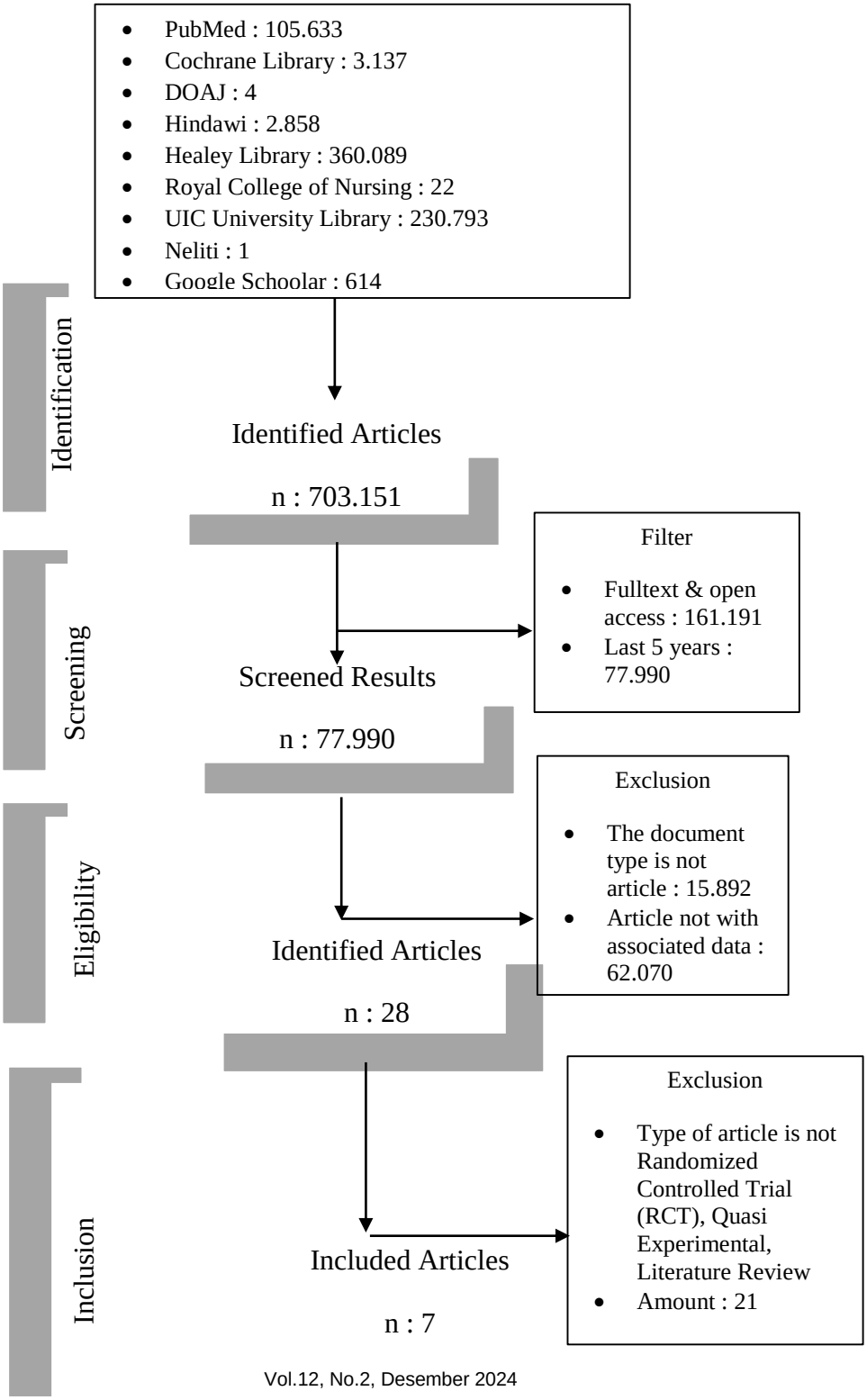

Figure 1. PRISMA Flow Diagram

Table 1. JBI Checklist for Randomized Controlled Trials

Question of Critical Appraisal	(Karadag & Baglama, 2019)	(Menekli & Çevİk, 2021)	(Şahin et al., 2021)	(Ozen et al., 2022)
Was true randomization used for assignment of participants to treatment groups?	Yes	Yes	Yes	Yes
Was allocation to treatment groups concealed?	Yes	No	No	Yes
Were treatment groups similar at the baseline?	Yes	Yes	Yes	Yes
Were participants blind to treatment assignment?	No	No	No	No
Were those delivering treatment blind to treatment assignment?	No	No	No	No
Were outcomes assessors blind to treatment assignment?	No	No	No	Yes
Were treatment groups treated identically other than the intervention of interest?	Yes	Yes	Yes	Yes
Was follow up complete and if not, were differences between groups in terms of their follow up adequately described and analyzed?	Yes	Yes	Yes	Yes
Were participants analyzed in the groups to which they were randomized?	Yes	Yes	Yes	Yes
Were outcomes measured in the same way for treatment groups?	Yes	Yes	Yes	Yes
Were outcomes measured in a reliable way?	Yes	Yes	Yes	Yes
Was appropriate statistical analysis used?	Yes	Yes	Yes	Yes
Was the trial design appropriate, and any deviations from the standard RCT design (individual randomization, parallel groups) accounted for in the conduct and analysis of the trial?	Yes	Yes	Yes	Yes

Table 2. JBI Checklist for Quasi-Experimental Studies

Question of Critical Appraisal	(Gebril Mohamed et al., 2019)
Is it clear in the study what is the ‘cause’ and what is the ‘effect’ (i.e. there is no confusion about which variable comes first)?	No
Were the participants included in any comparisons similar?	Yes
Were the participants included in any comparisons receiving similar treatment/care, other than the exposure or intervention of interest?	Yes
Was there a control group?	Yes
Were there multiple measurements of the outcome both pre and post the intervention/exposure?	Yes

Was follow up complete and if not, were differences between groups in terms of their follow up adequately described and analyzed?	Yes
Were the outcomes of participants included in any comparisons measured in the same way?	Yes
Were outcomes measured in a reliable way?	Yes
Was appropriate statistical analysis used?	Yes

Table 3. CEBMa Checklist for Meta-Analysis or Systematic Review

Question of Critical Appraisal	(Zhang et al., 2023)
Did the study address a clearly focused question?	Yes
Was a comprehensive literature search conducted using relevant research database (i.e. ABI/INFORM, Business Source Premier, PsycINFO, Web of Science, etc.)	Yes
Is the search systematic and reproducible (e.g. were searched information sources listed, were search terms provided)?	Yes
Has publication bias been prevented as far as possible (e.g. were attempts made at collecting unpublished data)?	Yes
Are the inclusion and exclusion criteria clearly defined (e.g. population, outcomes of interest, study design)	Yes
Was the methodological quality of each study assessed using predetermined quality criteria?	Yes
Are the key features (population, sample size, study design, outcome measures, effect sizes, limitations) of the included studies described?	Yes
Has the meta-analysis been conducted correctly?	Yes
Were the results similar from study to study?	Yes
Is the effect size practical relevant?	Yes
How precise is the estimate if the effect? Were confidence intervals given?	Yes
Can the results be applied to your organization?	Yes

Table 4. Critical Appraisal Checklist for Scoping Review

Question of Critical Appraisal	(Sriati et al., 2022)
Is the research method/study design appropriate for answering the research question?	Yes
Are specific inclusion/exclusion criteria used?	No
Is the effect size practically relevant? How precise is the estimate of the effect? Were confidence intervals given?	No
Were there enough subjects in the study to establish that the findings did not occur by chance?	Yes
Were subjects randomly allocated? Were the groups comparable? If not, could this have introduced bias?	Yes
Are the measurements/tools validated by other studies?	Yes
Could there be confounding factors?	No
Can the results be applied to my organization and my patient?	Yes

Table 5. Level Evidence and Quality Guides (Johns Hopkins Nursing Evidence-Based Practice)

(Author, Year)	Level Evidence	Quality Guides
(Karadag & Baglama, 2019), I/A (MenekLİ & ÇevİK, 2021), I/A (Ozen et al., 2022), I/A (Şahin et al., 2021), I/A (Sriati et al., 2022), I/A (Zhang et al., 2023), I/A	Level I Experimental study, randomized controlled trial (RCT), systematic review of RCTs with or without meta-analysis	A High Quality: Consistent, generalizable results, sufficient sample size for the study design, adequate control, definitive conclusions, consistent recommendations based on comprehensive literature review that includes through reference to scientific evidence.
(Gebril Mohamed et al., 2019), II/B	Level II Quasi-experimental study, systematic review of a combination of RCTs and quasi-experimental or quasi-experimental studies only, with or without meta-analysis	B Good Quality: Reasonably consistent results: sufficient sample size for the study design, some control, fairly definitive conclusions, reasonably consistent recommendations based on fairly comprehensive literature review that includes some reference to scientific evidence.

RESULTS

Characteristics of the Research

This systematic literature review included 7 articles derived from randomized controlled trials (RCTs), quasi-experimental studies, and literature reviews encompassing meta-analyses and scoping reviews. All articles were published between 2019 and 2024. The research was conducted in Turkey, Iran, and Egypt. The total number of respondents in this study comprised 1,942 patients undergoing hemodialysis.

Table 6. Research Characteristics

Author / Year	Country	Research Design	Mean (SD) of Age	Participant		
				Intervention	Control	Placebo
(Karadag & Baglama, 2019)	Turkey	RCT	51.10 ± 14.41	30	30	-
(Gebril Mohamed et al., 2019)	Egypt	Quasi-experimental	32.74 ± 10.29	30	30	-
(Menekli̇ & Çevi̇k, 2021)	Turkey	RCT	41	40	40	-
(Şahin et al., 2021)	Turkey	RCT	52.18 ± 14.52	36	-	38
(Ozen et al., 2022)	Turkey	RCT	59.88 ± 14.04	13	11	-
(Zhang et al., 2023)	(Iran, Turkey, China)	Meta-analysis	54.73 ± 11.40	660	664	-
(Sriati et al., 2022)	(Turkey, Iran)	Scoping Review	54.49 ± 14.18	158	162	-

Assessment of Article Quality

Based on the eligibility assessment of the articles (Table 1), there are 4 research articles rated as Randomized Controlled Trials (RCT), 1 quasi-experimental research article (Table 2), 1 meta-analysis research article (Table 3), and 1 scoping review research article (Table 4). The results of the review indicate that most articles provided explanations regarding sample randomization, research objectives, sample homogeneity, and their applicability to the local population. Additionally, an assessment of the eligibility of each article was conducted based on the strength of evidence and quality using the Johns Hopkins Nursing Evidence-Based practice criteria (Table 5). Six studies conducted by (Karadag & Baglama, 2019), (Menekli̇ & Çevi̇k, 2021), (Ozen et al., 2022), (Şahin et al., 2021), and (Zhang et al., 2023) fall under quality Level I/A (High Quality). The study conducted by (Gebril Mohamed et al., 2019) is categorized at quality Level II/B (Good Quality).

Table 7. Synthesis Grid

No.	Title	Researcher & Country	Study Design	Intervention	Result
1	The Effect of Aromatherapy on Fatigue and Anxiety in Patients Undergoing Hemodialysis Treatment: A Randomized Controlled Study	Ezgi Karadag, Sevgin Samanciouglu Baglama (Turkey)	RCTs with a sample of 60 patients were divided into intervention and control groups. The instrument used was a 4-Point Likert Self-Assessment that included 21 questions.	Patients inhaled 2% lavender oil for 20 minutes at a frequency of 2-3 times per week for up to 30 days. The intervention was administered during hemodialysis.	Significant statistical differences were found in BAI scores before and after the intervention, favoring the intervention group with a p-value < 0.05. In contrast, the control group exhibited an increase in anxiety levels by the end of the 30 days.
2	Effect of Aromatherapy on Sleep Quality, Fatigue and Anxiety among Patients Undergoing Hemodialysis	Heba Gebril Mohamed dan Marwa Khalil Hafez (Egypt)	A quasi-experimental study with a sample of 60 patients divided into intervention and control groups, the same 4-Point Likert Self-Assessment instrument consisting of 21 questions was used.	Patients inhaled 2% lavender oil at a frequency of 2-3 times per week for 30 days. The intervention was given during hemodialysis and every night before bedtime.	There were significant statistical differences in average scores with a p-value = 0.000 (p < 0.05).
3	Effect of Lavender Aromatherapy	Tugba Menekli dan Yadigar	RCTs involved 80 patients divided into	The intervention consisted of	Significant differences were observed in the

	on Pruritus, Anxiety, and Sleep Quality of Patients Undergoing Hemodialysis: A Randomized Controlled Trial	Cevik Durmaz (Turki)	intervention and control groups. The instrument used was The State Anxiety Inventory (SAI), which comprised 20 items about patients' feelings.	distilled 2% lavender oil. The first method involved massaging the pruritic area with lavender oil for 7-15 minutes. The second method involved inhalation for 30 minutes before sleep.	intervention group pre- and post-intervention, with an average SAI score ($p = 0.003$). However, there was no significant difference in the control group, with an average SAI score ($p = 0.840$).
4	Effect of Lavender Aromatherapy On Arteriovenus Fistula Puncture Pain and The Level of State and Trait Anxiety in Hemodialysis Patients: A Randomized Controlled Trial	Sevil Sahin, Bulent Tokgoz, Gokce Demir (Turki)	RCTs involving a sample of 36 patients in the intervention group and 38 patients in the placebo group was conducted. The instrument used was the State-Trait Anxiety Inventory (STAI), consisting of 40 items.	Inhalation of 5 drops of pure lavender oil diluted in 200 cc of boiled water was performed for 5 minutes.	The average STAI score of patients in the intervention group after aromatherapy was 39.12 ± 6.71 on the state anxiety subscale and 30.04 ± 1.39 on the trait anxiety subscale. There was a significant decrease in all STAI subscale scores in the intervention group at the second follow-up compared to the first follow-up ($p < 0.05$).
5	Effect of Long-Term Administration of Inhaled Lavender During Hemodialysis on Patient's Invasive Pain, Anxiety, and Comfort During Cannulation: A Single-blind Randomized Controlled Trial	Nurten Ozen, Aylin Aydin Sayilan, Elif OK, Samet Sayilan, Volkan Ozen, Clemente Neves Sousa, Ozlem Ovayolu, Tayfun Eyileten (Turki)	RCTs involved a sample of 13 patients in the intervention group and 11 patients in the control group. The instrument used was the State-Trait Anxiety Inventory (STAI), consisting of 40 items.	Participants inhaled a diluted mixture of 1:10 pure lavender oil with sweet almond oil for 3 minutes prior to hemodialysis cannulation.	The STAI scores were significantly lower ($p = 0.027$) in the intervention group compared to the control group at all time points, except at baseline.

6	Effect of Aromaterapy on Quality of Life in Maintenance Hemodialysis Patients: A Systematic Review and Meta-Analysis	Cong Zhang, Hang Mu, Yong-Fang Yang, Yong Zhang, and Wen-Jun Gou (Iran, Turki, China)	A meta-analysis included a total population of 1,324 patients, with 660 in the intervention group and 664 in the control group. The instrument used was the PRISMA Flow Diagram.	Ten studies utilized lavender oil, while 12 studies examined various aromatherapy oils.	Six studies reported a decrease in fatigue, six reported an improvement in sleep quality, six reported a reduction in pain associated with arteriovenous fistula puncture, seven reported a decrease in patient anxiety, and two studies reported a reduction in symptoms of restless legs syndrome.
7	Penggunaan Minyak Lavender dalam Menurunkan Kecemasan Pada Pasien Hemodialisis	Aat Sriati, Taty Hernawaty, Mutia Sundari, Sarah Kusumah Bakti (Turki dan Iran)	Scoping review with a total population of 320 patients. There were 158 patients in the intervention group and 162 patients in the control group. The instrument used was the PRISMA Flow Diagram.	Two studies employed the inhalation of 2% lavender oil, while one study used a concentration of 5%. Additionally, two studies utilized pure lavender with doses of 2 drops and 5 drops.	The use of lavender oil has been shown to reduce anxiety in hemodialysis patients. There are three methods of application: inhalation, application on cotton/cloth/pillow, and a combination of inhalation with gentle massage in areas of pruritus. The duration of lavender oil usage in the five studies varied from one week to six weeks. In the study that combined inhalation with massage, anxiety was not only reduced but also pruritus was alleviated, and sleep quality improved.

DISCUSSION

The use of aromatherapy is one form of complementary therapy employing non-pharmacological techniques to reduce anxiety levels in patients undergoing hemodialysis. Lavender oil is commonly used for aromatherapy due to its soothing and calming effects, which

can decrease anxiety and is considered safer compared to other aromatic oils (Karadag & Baglama, 2019). Several studies mentioned above have indicated that lavender aromatherapy is effective in lowering anxiety in the intervention group compared to both the control and placebo groups ($p < 0.05$) with varying concentrations and methods.

Overall, lavender oil is used in aromatherapy in the form of diluted drops, making it easy to apply. A 2% dilution of lavender oil administered through inhalation for 20 minutes has proven effective in reducing anxiety in hemodialysis patients (Karadag & Baglama, 2019). This study's results align with findings from (Gebril Mohamed et al., 2019) and (Menekli & Çevik, 2021), indicating that the use of 2% lavender essential oil is effective across different respondent numbers and time frames. Research by (Ilali et al., 2021) also demonstrated that using 5% lavender essential oil with different liquids is effective as a multisensory intervention for anxiety reduction. Although various liquids are used for dilution, the majority utilize plain water.

Overall, aromatherapy was administered three times a week, with the entire study conducted over a duration of four weeks. The differences in the duration of aromatherapy application showed progressively better and more effective results. This is evidenced by (Karadag & Baglama, 2019), which found that administering lavender oil aromatherapy for 20 minutes is more effective than for 5 minutes, as demonstrated by (Şahin et al., 2021)

There are three distinct methods for administering lavender aromatherapy to patients undergoing hemodialysis who experience anxiety, as stated by (Sriati et al., 2022). The majority of aromatherapy was delivered through direct inhalation, either before or during hemodialysis. Inhalation can also be performed by breathing in cotton or gauze that has been infused with 2% concentration lavender essential oil. Additionally, aromatherapy can be combined with massage for patients experiencing pruritus.

Population variation in the aforementioned studies did not affect the effectiveness of lavender aromatherapy in reducing anxiety. The populations used in (Karadag & Baglama, 2019) and (Gebril Mohamed et al., 2019) consisted of 60 patients divided into intervention and control groups. This is corroborated by the results of research conducted by (Şahin et al., 2021) which utilized a larger sample of 74 patients, and (Menekli & Çevik, 2021) which included 80 patients. A different population size was also addressed by (Ozen et al., 2022) where 24 patients demonstrated reduced anxiety through the use of lavender aromatherapy. There were variations in the regions where the studies were conducted, yet the results were consistently similar. Lavender aromatherapy interventions proved effective, as shown by (Karadag & Baglama, 2019) in Turkey, which shares the same study area as (Menekli & Çevik, 2021), (Şahin et al., 2021), and (Ozen et al., 2022). Conversely, a study in a different country was conducted by (Gebril Mohamed et al., 2019) in Egypt. The analysis of the articles reviewed by (Zhang et al., 2023) indicates similar outcomes that align with the previously analyzed studies.

Although the research was performed on different samples across various locations with differing concentrations, durations of aromatherapy application, and intervention methods, the final outcomes consistently demonstrated the effectiveness of lavender aromatherapy in lowering anxiety levels in patients undergoing hemodialysis. Therefore, the research findings can serve as Evidence-Based Nursing for diverse samples.

Psychological disorders are common among patients with chronic illnesses, including those with chronic kidney disease undergoing hemodialysis. Over the long term, psychological issues among patients can lead to suicide, hospitalization, and mortality (Kimmel et al., 2019). Anxiety levels in hemodialysis patients have been identified and analyzed by (Nagy et al., 2023) and (Kamel et al., 2021) across different populations, revealing a high prevalence. Anxiety can be triggered by the duration of hemodialysis, limitations in activities, changes in social relationships, and concerns about survival. Anxiety in hemodialysis patients is often identified through seemingly irrational and aggressive behavior (Kimmel & Cukor, 2019). The intensity

of stressors must be matched by the strength of coping mechanisms; if coping mechanisms are weak, patient anxiety will likely increase. Anxiety is a component of the quality of life for hemodialysis patients, and if not addressed promptly, it can lead to a decline in quality of life. Moreover, anxiety can obstruct and impact the effectiveness of hemodialysis.

Aromatherapy is a complementary therapy that uses essential oil extracts to produce therapeutic effects. Relaxation is a positive effect of aromatherapy with essential oils. Most aromatherapy interventions aimed at reducing anxiety in hemodialysis patients are delivered through inhalation, offering refreshing benefits and influencing the patients' mental stability. Previous review studies have indicated that inhalation aromatherapy is an effective and viable option due to its ease of application, cost-effectiveness, safety for patients, and non-invasive nature (Donelli et al., 2019). Earlier studies have shown that lavender oil is frequently used in aromatherapy.

Lavender includes several species with differing chemical characteristics. There are four main species of lavender: Lavandula angustifolia, Lavandula latifolia, Lavandula stoechas, and Lavandula x intermedia. The primary components of lavender essential oil are linalool, linalyl acetate, 1,8-cineole, ß-ocimene, terpinen-4-ol, and camphor. The two main active compounds in lavender essential oil that contribute to its calming effects are linalool and linalyl acetate. These compounds are primarily found in the Lavandula angustifolia species (Harborne & Williams, 2002)

The success of lavender aromatherapy inhalation interventions is closely linked to the olfactory sense through a complex process. When lavender oil used in aromatherapy is inhaled, some of the molecules in the oil are transferred to the limbic system of the brain. Two important areas of the brain involved in processing aromas are the amygdala and hippocampus. Once processed, the limbic system induces relaxation, resulting in a decrease in anxiety levels among hemodialysis patients (Karadag & Baglama, 2019). Furthermore, lavender oil has anxiolytic effects associated with increased serotonin levels and decreased cortisol levels (Yoo & Park, 2023). Other studies indicate that inhaling lavender aromatherapy significantly enhances alpha waves and lowers beta wave activity, indicating a state of rest and a stress-free brain (Choi et al., 2022).

CONCLUSION

Anxiety is a psychological disorder commonly found in patients undergoing hemodialysis. This condition can arise from various factors, including the duration of hemodialysis treatment, limitations in daily activities, physical changes, social relationships, dependence on hemodialysis care, and concerns about maintaining life. If anxiety is not promptly addressed, it can adversely affect a patient's quality of life and impede the hemodialysis treatment process.

Complementary therapy that can be used to reduce anxiety in hemodialysis patients is lavender aromatherapy as a non-pharmacological technique. Lavender aromatherapy is a relaxation method administered through inhalation, aimed at soothing and stabilizing the mental state of hemodialysis patients. A systematic literature review of seven research articles yielded consistent results that lavender aromatherapy is effective in reducing anxiety among hemodialysis patients, despite variations in population, region, lavender oil concentration, duration of aromatherapy application, and research methods. The limitations in sample size and duration of studies present opportunities for further development regarding the administration of lavender aromatherapy in managing anxiety in hemodialysis patients. Additionally, collaboration in providing lavender aromatherapy with other aromatherapy techniques could be

explored as an extension of this research. Therefore, the findings of this analysis can be applied to local populations experiencing similar issues.

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