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Original Article

Comparison effect of lavender oil inhalation and tea on sleep quality, fatigue, and pain in hemodialysis patients: A randomized clinical trial

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ABSTRACT

Background & Aim: The pain of needle insertion in arteriovenous fistula, fatigue, and sleep disturbances are common problems in hemodialysis patients. Using lavender products can help reduce these problems. This study aimed to compare the effects of lavender aromatherapy and lavender tea consumption on reducing pain and fatigue, as well as improving sleep quality in hemodialysis patients.

Methods & Materials: This study is an open-label trial conducted at the Dialysis Center at Tabriz University of Medical Science from May to December 2022. Random allocation was done by randomizing the moved blocks. hemodialysis patients were allocated to one of the three study groups: control (n=30), lavender inhalation (n=30), and lavender tea (n=30). At the baseline and the end of the study, Participants' sleep quality with PSQI, fatigue with FSS, and pain of needle insertion in arteriovenous fistula with Vas scale were assessed. The data analysis was performed using SPSS software The Analysis of covariance (ANCOVA) test was used to compare the mean of variables between the study groups.

Results: A comparison of the follow-up scores between 3 groups shows that participants in the lavender tea group and lavender aromatherapy group had a lower score of total score of PSQI (P<0.001), fatigue (P<0.001), and pain(P<0.001) following the intervention compared to the control group. Also, there was no statistically significant difference between the lavender tea group and the lavender aromatherapy group in terms of sleep quality scores (P=0.428), fatigue (P=0.570), and pain (P=0.997).

Conclusion: The findings of this study showed that lavender can be useful in improving the problems of dialysis patients, such as sleep quality, fatigue, and pain caused by needle insertion.

Introduction

End-stage renal disease (ESRD) is a global issue in which there is an irreversible deterioration of kidney function gradually (1). The number of people with ESRD in Iran is 320,000 and 48% of them apply for the hemodialysis (HD) plan (2). The negative effects of the disease on body systems and the bio-psychophysiological effects of hemodialysis have affected the quality of life of patients with ESRD (3).

Based on Prior research pain, fatigue, sleep disturbance, itch, and cramping are common among hemodialysis patients (4, 5). The pain of arteriovenous fistula (AVF) puncture is a main issue for patients undergoing HD treatment. AVF annulation is the cause of pain owing to the insertion of approximately 300 times per year AVF needles for vascular access (6). Moderate to severe pain has been reported in more than 60–70% of patients undergoing hemodialysis (7). Fatigue is an unpleasant, subjective symptom that may affect and reduce normal functions (8). Moreover, available data represent that 40%–85% of patients with HD

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have substantially poor sleep quality (9). Sleep disturbances include difficulty initiating sleep, frequent awakenings at night, waking up too early, or taking excessive naps during the day (10). Dialysis-related factors (such as fluid removal practices, treatment time, schedule, modality, toxin accumulation, and volume status), comorbid medical disorders (such as mood disorders, thyroid and parathyroid dysfunction, and sleep disorders), inflammation, medication side effects, nutritional condition, and muscle fatigue can contribute to poor sleep quality and fatigue (11). Therefore, reducing fatigue and pain and improving sleep quality are essential to improve the quality of life of these patients.

The use of chemical drugs to reduce itching, sleep disturbance, and anxiety has resulted in several adverse effects for patients(12). Therefore, particularly ESRD patients, usually look for non-invasive and safe complementary approaches to retrieve their health, some of which are within the scope of nursing care and can be incorporated into nursing care practice (13, 14). Lavender, a flowering plant of the Labiatae (Lamiaceae) family, is commonly consumed in traditional remedies for centuries as herbal therapy because of its analgesic, antidepressant, anticonvulsant, and antispasmodic effects (15). the analgesic effects of lavender are caused by its effect on inflammatory processes (16) Also, the cholinergic analgesic effects and the blocking effect of NMDA channels are also other mechanisms of lavender (17). Linalool and linalyl acetate in lavender have the ability to stimulate the parasympathetic system, so this plant has analgesic, sedative, and anti-spasmodic effects (18). Lavender tea contains linalyl acetate and linalool, which reduce depression and insomnia (10). The limbic system is activated when olfactory nerve cells are stimulated by the aroma of lavender herbal tea (19).

While several clinical trials have evaluated the impact of lavender oil inhalation on depression, anxiety, pain problems, and, sleep disturbance (20-23), the findings are not conclusive. Also, Iranians are more inclined to consume herbal tea compared to other forms of herbal remedies (24) but to our knowledge, no study has examined the effects of lavender tea on dialysis patients in Iran or the world. Therefore, considering the ease and popularity of consuming herbal teas compared to other herbal products and the contradictory results of lavender oils in Hemodialysis patients based on previous studies and the lack of a study that investigates the effect of lavender orally in dialysis patients, this trial aimed to comparison the effects of lavender aromatherapy and lavender tea on pain and fatigue and improving sleep quality in HD patients.

Methods

Study design

We conducted 2-week open-label, parallel-group, randomized controlled trial from May to December 2022. This research was done at the Dialysis Center, Barakat Hospital, and the Tabriz University of Medical Science for two weeks to evaluate the effect of lavender aromatherapy and lavender tea in patients with HD (Figure 1). According to the results of a systematic review, most of the aromatherapy studies were conducted in hemodialysis patients for two weeks (25).

Sample

By referring to the dialysis center, 90 patients on hemodialysis who met the inclusion criteria adhered to this study after receiving their written consent. The inclusion criteria were: undergoing hemodialysis for at least 6 months 3-5 times a week, willingness to participate in the study, age between 18-65 years old, absence of pregnancy (for women), absence of food and herbal allergies, not suffering from cancer and respiratory disease, having 5 or higher scores in Pittsburgh Sleep Quality Index (PSQI), having 4 or higher scores in Fatigue Severity Scale (FSS). The subjects with any of the following criteria were excluded; using any medications for the sleep disorder, receiving

analgesics three hours before lavender inhalation or intake of lavender tea, having a smelling problem, and having communication problems. Also; people who did not want to continue participating in the study and had not consumed lavender tea or lavender inhalation more than three times were excluded from the study. Calculation of the required sample size using the formula for comparing two mean was based on a trial by Senturk et al, which studied the effects of lavender inhalation on HD Patients' anxiety levels and sleep quality (26). Using the formula proposed for parallel clinical trials and regarding a possible drop-out rate of 10%, 30 subjects were recruited in each group. The allocation sequence was performed using the computer program called Random Allocation Software (RAS) and stratified random allocation according to age and sex. Blocking was done with block sizes of 3, 6, and 9 and with an allocation ratio of 1:1:1. Then patients were allocated to one of the three study groups: control (n=30), lavender inhalation (n=30), and lavender tea (n=30). A member of the research team who was not involved in the assessment of the study outcome was responsible for creating the allocation sequence. The present study, approved by the Medical Ethics Committee of Khalkhal University of Medical Sciences, was conducted in accordance with the Declaration of Helsinki (approval number: IR.KHALUMS.REC.1399.021). Finally, this study was registered in the Iranian Registry of Clinical Trials (IRCT registration number: IRCT20190531043778N2).

Intervention

Based on previous studies, the percentage of lavender oil was selected as 10%, and 1 gram of dried lavender flowers was used to prepare tea bags (27, 28). The lavender tea group received one teabag containing 2 g of dried lavender flowers (Golkooh Company, Iran) per day for 2 weeks. Each teabag was steeped for 10–15 minutes in 150 mL of hot water which was instructed to be consumed before sleep. Also, each subject in the lavender inhalation group inhaled diluted lavender oil (2 % lavender oil and 98% distilled water) every night before sleep. To keep the lavender oil from sunlight, it was supplied in 15-mL lightproof blue bottles. Moreover, a strict lid was applied to inhibit the release of the lavender oil into the air. Each participant or one of the caregivers was asked to drop 2 drops of lavender on the cotton balls and pin them to the collar of the patients' clothes for 30 minutes. The researcher was present at the hemodialysis center during the intervention and supervised the correct implementation of aromatherapy**.** Also, before the implementation of the intervention, the nurses were trained. The subjects were instructed to breathe in a normal way. The subjects in the tea group and inhalation group implemented the related intervention every night during the 2 weeks of study. The control group did not receive any intervention and routine procedures of the HD unit were followed. Routine measures included teaching the patient to remain motionless during needle insertion fixing the limb after needle insertion and emphasizing not to move the limb during hemodialysis. At 9:00 PM, the practice of intervention was reminded by SMS. The subjects were requested not to change their physical activity during the 2 weeks of the investigation.

Measurements

At the baseline, demographic and physical activity questionnaires were applied. The demographic questionnaire involved the subjects' sociodemographic information such as gender, age, married status, education, job, duration of HD, economic status, and some biochemical items including blood levels of creatinine (Cr), hemoglobin (Hb), and blood urea nitrogen (BUN). Moreover, weight, height, and body mass index (BMI) of patients were measured at the baseline. Weight was measured by a digital scale without shoes and with a minimum of clothes with an accuracy of 0.1 kg. Height was estimated to the nearest 0.5 cm with a tape measure in a standing position, with shoulders in a normal alignment and shoes

removed. BMI was computed by the following formula: weight (kg)/ (height)^2 (m) (29). To assess physical activity the validated short form of the International Physical Activity Questionnaire (IPAQ) was applied, and the results were reported as low, moderate, and high activity (30).

At the baseline and the end of the study, Participants' sleep quality was assessed using Pittsburgh's sleep quality index (PSQI) questionnaire. Buysse et al. have introduced this questionnaire for the evaluation of the detection of sleep disturbances and sleep quality. PSQI questionnaire has 7 subscales, including the use of sleep medication and daytime dysfunction, sleep efficiency, sleep disturbances, sleep latency, subjective, sleep quality, and sleep duration. Each subscale has a range of scores from 0 to 3, and the total score for all 7 subscales is between 0 and 21. The total PSQI score ≥ 5 is regarded as poor sleep quality (31).

In the present study, the fatigue intensity of subjects was measured by the Fatigue Severity Scale (FSS) at the baseline and the end of the study. It contains nine items: items 1–4 and 6 are about the quality of fatigue, items 5–7 and 9 consider physical and mental fatigue and their effects on the social life of individuals, and item 8 evaluates the severity of fatigue.14. Each item has a range of scores from 1 (strongly disagree) to 7 (strongly agree). The FSS score is the average score for 9 items. A score of 1 indicates the absence of fatigue, 2-4 indicates moderate fatigue, and above 4 indicates severe fatigue(32, 33). The pain at the baseline and end of the study was measured using the Visual Analog Scale (VAS). It contains a 10-cm line with two endpoints indicating 'no pain' (0 cm) and 'worst pain' (10 cm). Participants had to mark their pain by placing a mark on the line that matched their current level of pain. The validity of the instruments was confirmed by ten faculty members of Ardabil University of Medical Sciences**.** The reliability of instruments using Cronbach's alpha was 0.89 for PSQI, 0.83 for FSS, and 0.79 for VAS. The data were collected by someone other than the researcher who was unaware of the data allocation.

Statistical analysis

The results were analyzed using SPSS software (version 23, Chicago, IL, USA). The Kolmogorov-Smirnov test was applied to examine the normal distribution. A comparison of results before and after the supplementation within each group was performed using a Paired t-test and if distribution was not normal, the Wilcoxon test was used. Also, for the comparison of qualitative variables between the study groups, the Chi-square test was applied. At the beginning of the intervention, the ANOVA was used to compare quantitative variables between the 3 groups, and the Kruskal Wallis test was used if data distribution was not normal. In the adjusted model and after removing the confounders (baseline values of scores of sleep disturbances, use of sleep medication, daytime dysfunction, and total scores of PSQI), the Analysis of covariance (ANCOVA) test was used to compare the mean of variables between the study groups. The ITT approach was used to compensate for the withdrawal. The intention-to-treat (ITT) approach was applied to data analysis and all participants were included in the trial. Any events that occurred after randomization, such as misallocation and non-compliance, were ignored. Significance was regarded as a p-value less than 0.05. Data were presented as mean ± standard deviation (SD) for quantitative data and frequency (percentage) for qualitative data.

Ethical consideration

The present study, approved by the Medical Ethics Committee of Khalkhal University of Medical Sciences, was conducted in accordance with the Declaration of Helsinki (approval number: IR.KHALUMS.REC.1399.021). Finally, this study was registered in the Iranian Registry of Clinical Trials (IRCT registration number: IRCT20190531043778N2). Informed consent was obtained from all subjects.

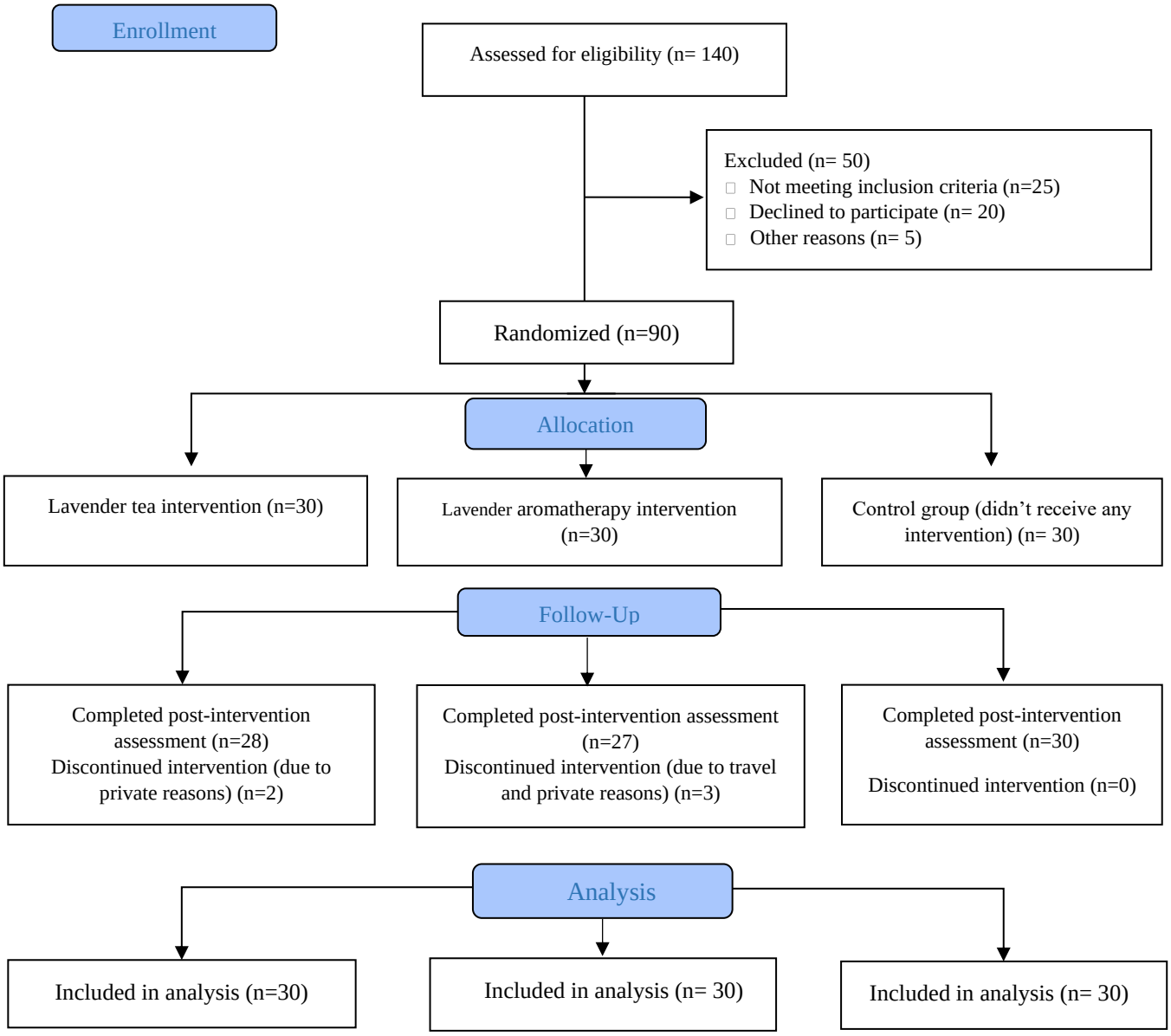

Figure 1. Sampling and intervention

Results

In the present study, 90 HD patients were enrolled, and 85 completed the 2-week intervention: 28 in the lavender tea group, 27 in the lavender aromatherapy group, and 30 in the control group. The study flow diagram (Figure 1) provides information about the reasons for the loss in the follow-up. Throughout the study, there were no reports of adverse effects or symptoms. The baseline characteristics of the participants are presented in Table 1. There were no significant differences in terms of all baseline characteristics including age, weight, height, BMI, Hb, Cr, BUN, sex, marital status, educational status, economic status, job, and physical activity of participants between the study groups (P>0.05).

After two weeks' consumption of lavender tea, scores of PSQI subscales, total score of PSQI, and score of fatigue and pain reduced significantly compared to the baseline (P<0.001). Moreover, in lavender aromatherapy group scores of PSQI subscales (except score of Use of sleep medication subscale, P=0.051), the total score of PSQI and the score of FSS and pain decreased significantly compared to the baseline (P<0.05) (Table 2).

At the baseline, there were significant differences in terms of sleep disturbances

(P<0.001), use of sleep medication (P=0.04), daytime dysfunction (P<0.001), and total score of PSQI (P<0.001) between the study groups (Table 2).

Using ANCOVA for comparison of the follow-up scores between 3 groups (Adjusted for baseline values of scores of sleep disturbances, use of sleep medication, daytime dysfunction, and total scores of PSQI), participants in the lavender tea group and lavender aromatherapy group had a lower score of subjective sleep quality (P<0.001), sleep latency, sleep duration, use of sleep medication, day time dysfunction (P for all <0.001), sleep disturbances (P=0.035), Total score of PSQI (P<0.001), fatigue (P<0.001), and pain(P<0.001) following the intervention compared to the control group (Table 2). Following the intervention, no statistically significant difference was observed between the lavender tea group and the lavender aromatherapy group regarding the scores of sleep quality (P=0.428), fatigue (P=0.570), and pain (P=0.997) (Table 2).

Table 1. Baseline characteristics of the participants in the study groups

Variable		lavender aromatherapy group (n=30)	lavender tea group (n=30)	Control group (n=30)	P- value*
		Mean ± SD	**Mean ± SD**	**Mean ± SD**	
Age (years)		54.60 ± 8.15	55.5 ± 5.48	54.36 ± 5.18	0.77
Height (cm)		167.80 ± 9.27	165.53 ± 7.65	169.26 ± 8.80	0.24
Weight (kg)		70.60 ± 11.42	71.13 ± 13.82	67.40 ± 18.37	0.57
BMI (kg/m^2)		25.16 ± 4.22	26.14 ± 5.94	23.31 ± 5.97	0.13
Hb (mg/dl)		10.79 ± 1.42	10.61 ± 1.44	10.75 ± 1.10	0.87
Cr (mg/dl)		8.50 ± 2.18	8.40 ± 1.61	8.95 ± 1.64	0.46
BUN (mg/dl)		114.20 ± 29.02	122.46 ± 29.09	124.46 ± 24.85	0.32
		N (%)	**N (%)**	**N (%)**	**P- value****
Gender					
	Male	19 (63.30)	13 (43.30)	18 (60)	0.24
	Female	11 (36.7)	17 (56.7)	12 (10)	
Married Status					
	Married	21 (70)	13 (43.3)	17 (56.7)	0.26
	Single	4 (13.3)	5 (16.7)	3 (10)	
	deceased wife	5 (16.7)	12 (4)	10 (33.3)	
Education					
	Illiterate	5 (16.70)	9 (30)	5 (16.70)	
	Guidance school	15 (50)	14 (46.70)	16 (53.30)	0.69
	diploma	8 (26.70)	7 (23.30)	8 (26.70)	
	Bachelor	2 (6.70)	0 (0)	1 (3.30)	
Economic Statues					
	good	0 (0)	0 (0)	0 (0)	0.24
	Medium	26 (86.70)	24 (80)	26 (86.70)	
	Bad	4 (13.30)	6 (20)	2 (6.70)	
Job					
	Housewife	10 (33.30)	15 (50)	10 (33.30)	
	Self Employed	14 (46.70)	9 (30)	12 (40)	0.57
	Retired	6 (20)	6 (20)	8 (26.7)	
Physical activity status					
	Low	10 (60)	2 (66.70)	18 (60)	0.35
	Medium	10 (33.30)	10 (33.30)	12 (40)	
	Favorable	2 (6.70)	0 (0)	0 (0)	

BMI: body mass index, HB: Hemoglobin, Cr: Creatinine. BUN: blood urea nitrogen
*: One-way Analysis of Variance (ANOVA) or Kruskal Wallis.
**Chi-square test.

Table 2. Comparison of the total scores of sleep quality, fatigue, and pain before and after intervention by study groups

Variable		lavender aromatherapy group (n=30)	lavender tea group (n=30)	Control group (n=30)	P-value [a,b]
Subjective sleep quality	Before	1.66 ± 0.47	1.86 ± 0.81	1.73 ± 0.44	0.433 [a]
	After	0.93 ± 0,58	1.13 ± 0.62	1.73 ± 0.44	<0.001 [b]
	P-value [c]	<0.001	<0.001	1.00	
Sleep latency	Before	2.33 ± 0.71	2.46 ± 0.73	2.26 ± 0.63	0.527[a]
	After	1.50 ± 0.68	1.53 ± 0.62	2.23 ± 0.62	<0.001 [b]
	P-value [c]	<0.001	<0.001	0.32	
Sleep duration	Before	1. 00 ± 0.90	1.60 ± 1.10	1.33 ± 0.88	0.061[a]
	After	0.13 ± 0.34	0.53 ± 0.50	1.33 ± 0.84	<0.001 [b]
	P-value [c]	<0.001	<0.001	0.89	
Sleep efficiency	Before	0.60 ± 0.96	1.13 ± 1,16	0.73 ± 1.01	0.13 [a]
	After	0.10 ± 0.40	0.06 ± 0.25	0.06 ± 0.25	0.89 [b]
	P-value [c]	0.019	<0.001	0.002	
Sleep disturbances	Before	1.20 ± 0.40	1.80 ± 0.55	1.40 ± 0.49	<0.001 [a]
	After	1.06 ± 0.25	1.26 ± 0.44	1.33 ± 0. 47	0.035 [b]
	P-value [c]	0.043	<0.001	0.07	
Use of sleep medication	Before	1.06 ± 1.08	0.93 ± 1.14	1.73 ± 0.58	0.04 [a]
	After	0.66 ± 0.60	0.53 ± 0.62	1.73 ± 0.58	<0.001 [b]
	P-value [c]	0.051	<0.001	1.00	
Day time dysfunction	Before	2.00 ± 0.37	2.46 ± 0.62	2.00 ± 0.37	<0.001[a]
	After	1.26 ± 0.44	1.40 ± 0.49	2.00 ± 0.35	<0.001 [b]
	P-value [c]	<0.001	<0.001	0.91	
Total score of PSQI	Before	9.86 ± 2.62	12.26 ± 3.93	11.20 ± 2.95	0.018 [a]
	After	5.66 ± 1.78	6.46 ± 2.51	10.43 ± 1.95	<0.001 [b]
	P-value [c]	<0.001	<0.001	0.07	
Fatigue	Before	5.77 ± 0.57	6.17 ± 1.02	5.79 ± 0.65	0.091 [a]
	After	4.14 ± 0.77	4.49 ± 0.79	5.74 ± 0.65	<0.001 [b]
	P-value [c]	<0.001	<0.001	0.92	
Pain	Before	6.66 ± 1.72	7.40 ± 2.06	7.13 ± 0.81	0.214 [a]
	After	5.20 ± 1.71	5.66 ± 1.51	7.00 ± 0.98	<0.001 [b]
	P-value [c]	<0.001	<0.001	0.16	

Values are expressed as means ± SD.

[a] One-way Analysis of Variance (ANOVA) or Kruskal Wallis was used for the comparison of the baseline scores between the 3 groups.

[b] ANCOVA for comparison of the follow-up scores between 3 groups. (Adjusted for baseline values of scores of Sleep disturbances, Use of sleep medication, Day time dysfunction, and total scores of PSQI)

[c] Paired sample t-test or Wilcoxon test was used for comparison of results before and after the supplementation within each group.

Discussion

Considering that this is the first controlled clinical trial for the effect of lavender tea in dialysis patients, its comparison with methods such as aromatherapy can confirm or deny its effectiveness. The total findings of the present study showed that lavender aromatherapy and lavender improved fatigue, sleep quality, and pain caused by needle insertion in hemodialysis patients compared to the control group. Also, the results of the study showed that there is no statistically significant difference between the two interventions of aromatherapy and lavender tea on the sleep quality, Pain and fatigue of dialysis patients. Lavender has analgesic, sedative, and antispasmodic effects by stimulating the limbic system, affecting inflammatory processes and cholinergic effects. Despite the existence of numerous studies in the field of aromatherapy with lavender on the complications of hemodialysis patients (22, 25, 34) based on our observations, no study has been conducted to investigate the effect of lavender on the complications of hemodialysis including sleep quality, fatigue, and pain when the needle is inserted. The only available study in this field is the study by Chen et al., which showed that lavender tea can reduce the severity of postpartum fatigue in women (35). The results of a systematic review study conducted in 2017 with the aim of investigating the effect of aromatherapy on the problems of hemodialysis patients showed that aromatherapy reduces pain, and fatigue and improves sleep quality, anxiety, depression, itching, and headache. Among the 22 studies examined in this systematic review, lavender was the most used scent (17 studies); two studies showed the positive effect of aromatherapy with lavender on fatigue 3 studies showed its positive effect on the pain caused by entering the needle in the fistula and 3 studies showed the positive effect of aromatherapy with lavender on the quality of sleep (27), which is consistent with the findings of the present study. Also; the results of a study in Turkey showed that aromatherapy with lavender caused a decrease of 6 points in the average score of fatigue compared to the control group and this decrease is statistically significant (36), which is consistent with the findings of the present study. The results of two clinical trials in Iran and one study in Turkey also showed that compared to the control group, aromatherapy had a statistically significant reduction in the fatigue of hemodialysis patients (22, 37, 38) which is consistent with the findings of the present study. In a study with the RFS tool, Varai et al investigated the effect of inhalation of lavender oil and massage with lavender oil, in which aromatherapy caused a significant reduction in the fatigue of hemodialysis patients after 8 and 16 weeks (39). Beerappa et al also showed by using two different tools that aromatherapy with lavender caused a significant reduction in the fatigue of hemodialysis patients compared to the control group (34). in a systematic review and meta-analysis by Yangöz et al., 9 studies conducted with the aim of investigating the effects of aromatherapy on fatigue in hemodialysis patients showed that this nursing intervention is easy and safe to reduce fatigue in these patients (25). Despite the existence of several studies that have shown the effectiveness of aromatherapy with lavender on the fatigue of dialysis patients, the results of a trial showed that aromatherapy with lavender did not significantly reduce the fatigue of patients in the second and fourth weeks (40). Despite the use of the same tools as the present study, it seems that the reasons for the difference in the results are due to the different doses of Lavender aromatherapy in the two studies, because in Bagheri Nasami et al (17) study three drops of 5% essential oil were used, while in the present study, Five drops of 10% essential oil were used. In the current study, there was no statistically significant difference between aromatherapy with lavender and lavender tea on the severity of fatigue, but despite the positive effect of lavender tea, no similar studies were found in this field.

In connection with the second objective of the study; the findings showed that both aromatherapy interventions with lavender aromatherapy and lavender tea

improved all subscales (except the score of Use of sleep medication in the aromatherapy group and the total score of the sleep quality questionnaire. in this regard, Baceer et al., study on 30 hemodialysis patients showed that aromatherapy with lavender improved the sleep quality of the PSQI questionnaire by 6 points in these patients (34). Similar results were observed in Muz et al study (37). In another study conducted by Setyaningrum et al., on 32 patients undergoing hemodialysis, the results showed that the score of sleep quality improved significantly in the aromatherapy group with lavender compared to the control group. Despite the use of the PSQI questionnaire, the scores of the subscale of the questionnaire were not analyzed in this study (20). In a trial conducted on 44 hemodialysis patients, it was shown that massage with lavender oil improved the quality of sleep in these people and a statistically significant difference was observed between the intervention and control groups ($P<0.001$). In this study, despite the use of PSQI, the score of the subscale of sleep quality was not reported, but the number of sleeping pills was significantly reduced in the group under aroma massage ($P<0.001$) (41). According to the same tool and intervention in all the mentioned studies, the results of the mentioned studies are consistent with the findings of the present study and support it. It should also be mentioned that the intervention of lavender tea has improved the sleep quality of patients by 5.8 points compared to the improvement of 4.2 points of the lavender aromatherapy intervention and no statistically significant difference was observed between the two groups **.**As stated above, it was the lack of similar studies in this field, comparison is not possible; but it seems that after conducting more studies, lavender tea can be used to improve sleep quality.

In connection with the third aim of the study, the results support the positive effect of both interventions on the pain caused by the needle entering the fistula of dialysis patients. Also, no statistically significant difference was observed between the tea and aromatherapy groups. In this regard, several studies have been conducted in the field of aromatherapy with lavender. In a study conducted by Sahin et al., aromatherapy with lavender for five minutes and three times a week for hemodialysis patients improved 3 points in pain after the first session (21), this is while in the present study; lavender aromatherapy improved the pain by about 1.5 points and lavender tea improved the pain by about 1.574 points. Despite the concordance of the results of both studies the difference in the amount of pain reduction can be attributed to the difference in the tools used. The results of another study conducted by Elhalafawy et al., to compare the effect of aromatherapy with lavender and cold therapy on the pain of dialysis children; showed that two drops of lavender scent for 15 minutes in each time of dialysis caused a significant decrease in the intensity of pain caused by needle insertion, which results support the findings of the present study (42). Also, in the studies of Ghods et al. and Bagheri Nasami et al., aromatherapy with lavender has significantly reduced pain in patients (17, 43). Therefore, according to the concordance of the results of the aforementioned studies with the present study, it seems that aromatherapy can be used as an easy, safe and accessible nursing care with the aim of reducing the pain of patients. Due to the continuous communication between nurses and hemodialysis patients, the use of pain reduction methods such as aromatherapy and herbal teas will create a positive relationship between them and increase patients' trust in nurses. Finally, patients' satisfaction and their adaptation to their disease will increase. Especially since such care is well tolerated by patients. Different doses of aromatherapy have been used in dialysis patients in different researches and its positive effect has been reported in all cases, but a meta-analysis study is needed for the final conclusion.

Study limitations

The limitations of the current study include the self-reported Scale, the influence of several factors, such as the mental condition of the patients, and the use of multiple non-

analgesic drugs by the patients, which may affect the severity of their pain. Also, due to the rotation shifts of the nurses, needle insertion was performed by different nurses. It was beyond the control of the researchers. Other limitations of the study include methodological limitations such as the impossibility of blinding the interventionist and the short duration of the study. Therefore, it is suggested that future studies with a longer intervention, different doses of lavender oil and tea, and a larger sample size should be conducted to validate these findings and explore the full breadth of lavender's applications in the dialysis population.

Conclusion

The total findings of this study showed that lavender can be useful in improving the problems of dialysis patients, such as sleep disorders, fatigue, and pain caused by needle insertion. Since reducing the complications caused by the treatments and helping to increase the feeling of comfort and adaptation to the disease is one of the main care duties of nurses; therefore, nurses can use safe doses of lavender products such as tea and aromatherapy as easily, accessible, and safe nursing care.

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Conflict of Interest

The authors declare that they have no competing interests

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References

1. Sanyaolu A, Okorie C, Annan R, Turkey H, Akhtar N, Gray F, Nwaduwa I. Epidemiology and management of chronic renal failure: a global public health problem. Biostatistics Epidemiol Int J. 2018;1(1):11-6.

2. Jager KJ, Kovesdy C, Langham R, Rosenberg M, Jha V, Zoccali C. A single number for advocacy and communication—worldwide more than 850 million individuals have kidney diseases. Nephrology Dialysis Transplantation. 2019 Nov 1;34(11):1803-5.

3. Başaran D, Altun ÖŞ, Kaban F, Ecder T. Hemodiyaliz hastalarının umutsuzluk düzeylerinin değerlendirilmesi. Nefroloji Hemşireliği Dergisi. 2016;11(1):9-16.

4. da Silva FA, Silva Martins MT, Gutiérrez-Peredo GB, Kraychete AC, Penalva CC, Lopes MB, Matos CM, Lopes AA. Mortality, health-related quality of life, and depression symptoms in younger and older men and women undergoing hemodialysis. The International Journal of Artificial Organs. 2023 Sep;46(8-9):492-7.

5. Pei M, Aguiar R, Pagels AA, Heimbürger O, Stenvinkel P, Bárány P, Medin C, Jacobson SH, Hylander B, Lindholm B, Qureshi AR. Health-related quality of life as predictor of mortality in end-stage renal disease patients: An observational study. BMC Nephrology. 2019 Dec;20:1-0.

6. Aliasgharpour M, Abbaszadeh R, Mohammadi N, Kazemnejad A. Effect of lavender aromatherapy on the pain of arteriovenous fistula puncture in patients on hemodialysis. Nursing Practice Today. 2016 Nov 19;3(1):26-30.

7. Pham PC, Khaing K, Sievers TM, Pham PM, Miller JM, Pham SV, Pham PA, Pham PT. 2017 update on pain management in patients with chronic kidney disease. Clinical Kidney Journal. 2017 Oct;10(5):688-97.

8. Usta, Y.Y. And Y. Demir, Hemodiyaliz hastalarinda yorgunluğa etki eden faktörlerin değerlendirilmesi. Anatolian Journal Of Clinical Investigation, 2014. 8(1).

9. Flythe JE, Hilliard T, Lumby E, Castillo G, Orazi J, Abdel-Rahman EM, Pai AB, Rivara MB, Peter WL, Weisbord SD, Wilkie CM. Fostering innovation in symptom management among hemodialysis patients: paths forward for insomnia, muscle cramps, and fatigue. Clinical Journal of the American Society of Nephrology. 2019 Jan 1;14(1):150-60.

10. Faydalı S, Çetinkaya F. The effect of aromatherapy on sleep quality of elderly people residing in a nursing home. Holistic Nursing Practice. 2018 Jan 1;32(1):8-16.

11. Tan LH, Chen PS, Chiang HY, King E, Yeh HC, Hsiao YL, Chang DR, Chen SH, Wu MY, Kuo CC. Insomnia and poor sleep in CKD: a systematic review and meta-analysis. Kidney Medicine. 2022 May 1;4(5):100458.

12. Lee G, Bae H. Therapeutic effects of phytochemicals and medicinal herbs on

depression. BioMed Research International. 2017;2017(1):6596241.
13. Taşan E, Ovayolu O, Ovayolu N. The effect of diluted lavender oil inhalation on pain development during vascular access among patients undergoing hemodialysis. Complementary Therapies in Clinical Practice. 2019 May 1;35:177-82.
14. Menekli̇ T, Durmaz YÇ. Effect of lavender aromatherapy on pruritus, anxiety, and sleep quality of patients undergoing hemodialysis: a randomized controlled trial. TMR Integrative Nursing. 2021 Oct 1;5(5).
15. Souri F, Rakhshan K, Erfani S, Azizi Y, Nasseri Maleki S, Aboutaleb N. Natural lavender oil (Lavandula angustifolia) exerts cardioprotective effects against myocardial infarction by targeting inflammation and oxidative stress. Inflammopharmacology. 2019 Aug 1;27:799-807.
16. Rahmati B, Khalili M, Roghani M, Ahghari P. Anti-epileptogenic and antioxidant effect of Lavandula officinalis aerial part extract against pentylenetetrazol-induced kindling in male mice. Journal of Ethnopharmacology. 2013 Jun 21;148(1):152-7.
17. Bagheri-Nesami M, Espahbodi F, Nikkhah A, Shorofi SA, Charati JY. The effects of lavender aromatherapy on pain following needle insertion into a fistula in hemodialysis patients. Complementary Therapies in Clinical Practice. 2014 Feb 1;20(1):1-4.
18. Yamada K, Mimaki Y, Sashida Y. Anticonvulsive effects of inhaling lavender oil vapour. Biological and Pharmaceutical Bulletin. 1994 Feb 15;17(2):359-60.
19. McNelis, M.A., Does Lavender Aromatherapy or Tea Improve Quality of Sleep in Women? 2018.
20. Setyaningrum N, Setyawan A, Bistara DN. The effect of lavender essential oil aromatherapy on sleep quality in hemodialysis patients. Jurnal Aisyah: Jurnal Ilmu Kesehatan. 2022 Nov 20;7(S2):155-60.
21. Şahin S, Tokgöz B, Demir G. Effect of lavender aromatherapy on arteriovenous fistula puncture pain and the level of state and trait anxiety in hemodialysis patients: a randomized controlled trial. Pain Management Nursing. 2021 Aug 1;22(4):509-15.
22. Ahmady S, Rezaei M, Khatony A. Comparing effects of aromatherapy with lavender essential oil and orange essential oil on fatigue of hemodialysis patients: A randomized trial. Complementary Therapies in Clinical Practice. 2019 Aug 1;36:64-8.
23. Kim M, Nam ES, Lee Y, Kang HJ. Effects of lavender on anxiety, depression, and physiological parameters: Systematic review and meta-analysis. Asian Nursing Research. 2021 Dec 1;15(5):279-90.
24. Bazrafshan MR, Jokar M, Shokrpour N, Delam H. The effect of lavender herbal tea on the anxiety and depression of the elderly: a randomized clinical trial. Complementary Therapies in Medicine. 2020 May 1;50:102393.
25. Yangöz ŞT, Turan Kavradım S, Özer Z. The effect of aromatherapy on fatigue in adults receiving hemodialysis treatment: A systematic review and meta-analysis of randomized controlled trials. Journal of Advanced Nursing. 2021 Nov;77(11):4371-86.
26. Şentürk A, Kartın PT. The effect of lavender oil application via inhalation pathway on hemodialysis patients' anxiety level and sleep quality. Holistic Nursing Practice. 2018 Nov 1;32(6):324-35.
27. Bouya S, Ahmadidarehsima S, Badakhsh M, Balouchi A. Effect of aromatherapy interventions on hemodialysis complications: a systematic review. Complementary Therapies in Clinical Practice. 2018 Aug 1;32:130-8.
28. Kamalifard M, Farshbaf-Khalili A, Namadian M, Ranjbar Y, Herizchi S. Comparison of the effect of lavender and bitter orange on sleep quality in postmenopausal women: a triple-blind, randomized, controlled clinical trial. Women & Health. 2018 Sep 14;58(8):851-65.
29. Haidari F, Aghamohammadi V, Mohammadshahi M, Ahmadi-Angali K, Asghari-Jafarabadi M. Whey protein supplementation reducing fasting levels of anandamide and 2-AG without weight loss in pre-menopausal women with obesity on a weight-loss diet. Trials. 2020 Dec;21:1-10.
30. Aghamohammadi V, Salmani R, Ivanbagha R, Effati daryani F, Nasiri K. Footbath as a safe, simple, and non-pharmacological method to improve sleep quality of menopausal women. Research in Nursing & Health. 2020 Dec;43(6):621-8.
31. Buysse DJ, Reynolds CF, Monk TH, Hoch CC, Yeager AL, Kupfer DJ. Quantification of subjective sleep quality in healthy elderly men and women using the Pittsburgh Sleep Quality Index (PSQI). Sleep. 1991 Aug 1;14(4):331-8.
32. A'zimian M, Fallah-Pour M, Karimlou M. Evaluation of reliability and validity of the Persian version of Fatigue Severity Scale (FSS) among persons with multiple sclerosis. Archives of Rehabilitation. 2013 Jan 10;13(4):84-91.

33. Habibzadeh H, Dalavan OW, Alilu L, Wardle J, Khalkhali H, Nozad A. Effects of foot massage on severity of fatigue and quality of life in hemodialysis patients: a randomized controlled trial. International Journal of Community Based Nursing and Midwifery. 2020 Apr;8(2):92.
34. Beerappa H, Kavana GT, Chandrababu R. The effects of inhalational lavender essential oil aromatherapy on sleep quality in hemodialysis patients: A before-and-after-intervention trial. Holistic Nursing Practice. 2023 Nov 1;37(6):356-62.
35. Chen SL, Chen CH. Effects of Lavender tea on fatigue, depression, and maternal-infant attachment in sleep-disturbed postnatal women. Worldviews on Evidence-Based Nursing. 2015 Dec;12(6):370-9.
36. Karadag E, Baglama SS. The effect of aromatherapy on fatigue and anxiety in patients undergoing hemodialysis treatment: a randomized controlled study. Holistic Nursing Practice. 2019 Jul 1;33(4):222-9.
37. Muz G, Taşcı S. Effect of aromatherapy via inhalation on the sleep quality and fatigue level in people undergoing hemodialysis. Applied Nursing Research. 2017 Oct 1;37:28-35.
38. Hassanzadeh M, Kiani F, Bouya S, Zarei M. Comparing the effects of relaxation technique and inhalation aromatherapy on fatigue in patients undergoing hemodialysis. Complementary Therapies in Clinical Practice. 2018 May 1;31:210-4.
39. Varaei S, Jalalian Z, Yekani Nejad MS, Shamsizadeh M. Comparison the effects of inhalation and massage aromatherapy with lavender and sweet orange on fatigue in hemodialysis patients: a randomized clinical trial. Journal of Complementary and Integrative Medicine. 2021 Mar 15;18(1):193-200.
40. Bagheri-Nesami M, Shorofi SA, Nikkhah A, Espahbodi F, Koolaee FS. The effects of aromatherapy with lavender essential oil on fatigue levels in hemodialysis patients: A randomized clinical trial. Complementary Therapies in Clinical Practice. 2016 Feb 1;22:33-7.
41. Arslan DE, Akça NK. The effect of aromatherapy hand massage on distress and sleep quality in hemodialysis patients: A randomized controlled trial. Complementary therapies in Clinical Practice. 2020 May 1;39:101136.
42. Elhalafawy S, Bahgat RS, Abd-Elhafez MA, Farag NH. Effect of cryotherapy versus aromatherapy on pain of arteriovenous fistula puncture for children undergoing hemodialysis. IOSR Journal of Nursing and Health Science. 2020;9(1):9-19.
43. Ghods AA, Abforosh NH, Ghorbani R, Asgari MR. The effect of topical application of lavender essential oil on the intensity of pain caused by the insertion of dialysis needles in hemodialysis patients: A randomized clinical trial. Complementary Therapies in Medicine. 2015 Jun 1;23(3):325-30.