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The Effect of Aromatherapy Massage with Bergamot on Pain, Sedation, and Anxiety in ICU Patients

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Abstract

Background: Pain, anxiety, and agitation are common complications among intensive care unit (ICU) patients undergoing mechanical ventilation, often leading to poor clinical outcomes. Complementary therapies such as aromatherapy massage may offer a non-pharmacological approach to alleviate these symptoms.

Aim: This study was conducted with aim to investigate the effects of aromatherapy massage using bergamot essential oil on pain, sedation, and anxiety levels in mechanically ventilated ICU patients.

Method: This randomized controlled trial was conducted on ICU patients with a hospital stay of more than 24 hours who were randomly assigned to one of three groups: aromatherapy massage with bergamot essential oil, massage with almond oil, and control (standard care). The interventions were administered once daily for three days per week. Pain, sedation, and anxiety levels were measured using the Critical Care Pain Observation Tool (CPOT), the Richmond Agitation-Sedation Scale (RASS), and the Facial Anxiety Scale (FAS) at baseline, and at 30 minutes and 6 hours post-intervention.

Results: Both the aromatherapy massage and massage-only groups demonstrated significant reductions in pain severity and anxiety levels compared with the control group at 30 minutes and 6 hours post-intervention ($p<0.05$). No significant differences were found in sedation levels between the groups, indicating that the interventions did not influence sedation status.

Implications for Practice: Aromatherapy massage with bergamot essential oil and regular massage may be effective and low-risk interventions for reducing pain and anxiety in mechanically ventilated ICU patients. These complementary therapies could be considered as adjuncts to routine care in critical care settings.

Keywords: Anxiety, Aromatherapy, Critical Care, Intensive Care Units, Massage, Measurement, Pain Sedation, Plant Oils, Randomized Controlled Trial

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Introduction

In the intensive care units (ICUs), patients' physical conditions are meticulously monitored to optimize survival outcomes. However, this high-stakes setting—characterized by frequent medical interventions and invasive procedures—imposes substantial psychological and emotional stress on patients (1). Mechanical ventilation, a common intervention in ICUs, often necessitates higher doses of sedatives for pain and agitation management (2). This increased sedation requirement is attributed to the stressful ICU environment, multiple invasive procedures, and the difficulty patients face in communicating with the healthcare team, all of which can exacerbate distress and anxiety (3). Indeed, anxiety and related disorders, including delirium and agitation, have been reported in up to 85% of mechanically ventilated ICU patients, with impaired psychological recovery further hindering overall physiological healing, including central nervous system plasticity (4). To improve patient comfort and quality of life, complementary therapies are increasingly integrated alongside conventional ICU care. These therapies have shown promise in alleviating or preventing ICU-related complications such as sleep disturbances, pain, and anxiety, while also reducing physiological indicators like heart rate, blood pressure, and respiratory rate (5). By engaging sensory pathways and inducing relaxation responses, they can mitigate the intense stress of the ICU experience.

Aromatherapy massage is a widely utilized complementary therapy (6), often incorporated by nurses into patient care due to its demonstrated effects in lowering blood pressure, heart rate, pain, and anxiety (7-9). Bergamot essential oil, in particular, is valued for its aromatic and medicinal properties. Its active components are rapidly absorbed through the skin, exerting sedative and anxiolytic effects (10). While previous research supports the use of aromatherapy and massage in reducing anxiety and pain across various clinical settings (11), evidence specific to mechanically ventilated ICU patients remains scarce. Studies have shown that aromatherapy can alleviate anxiety, reduce pain, and improve patient outcomes in general medical settings, but there is a lack of research focusing on the unique and stressful conditions found in ICU environments (12).

Massage therapy alleviates pain and anxiety by stimulating both sympathetic and parasympathetic nervous systems and reducing muscle tension (13). Aromatherapy, through the calming and anxiolytic properties of essential oils such as bergamot, further enhances mental well-being (14). When combined, aromatherapy massage may offer synergistic benefits, addressing both physical and psychological distress and potentially improving health outcomes (15). Despite the positive effects of aromatherapy massage, there is limited research on its impact on ICU patients, especially those requiring mechanical ventilation. Therefore, the present study was conducted with aims to investigate the effects of aromatherapy massage on physiological parameters and sedation in ICU patients.

Methods

This randomized controlled trial study was conducted on mechanically ventilated patients admitted to the ICUs of university-affiliated hospitals in Qom, Iran, between August 2022 and September 2023. The study was performed in accordance with the CONSORT guidelines for randomized trials. The sample size was determined with a 95% confidence level and 90% statistical power, based on the methodology reported by Li et al. (2019) (15). The sample size was calculated as 11 participants per group. To compensate for an anticipated 10% dropout rate and to enhance measurement precision, the recruitment target was set at 13 participants per group. During the study, two participants from the massage-only group and two from the control group withdrew due to unexpected transfers. Additionally, one extra participant who met the inclusion criteria during re-evaluation was retained in the aromatherapy massage group. Consequently, the final sample comprised 14 participants in the aromatherapy massage group, 11 in the massage-only group, and 11 in the control group (Figure 1).

The inclusion criteria were: age of 18 years or older, ICU admission with a planned stay of at least 24 hours, requirement for invasive mechanical ventilation for at least 24 hours, Glasgow Coma Scale (GCS) score greater than 8, and hemodynamic stability without the need for high-dose inotropic or vasopressor medications. The exclusion criteria were: known hearing or visual impairments, a history of psychiatric disorders, dementia, or cognitive impairment, monitoring for acute neurological injuries or substance intoxication (alcohol or drugs), pregnancy, and transfer from an external ICU. The participants were randomly assigned to groups using a web-based computer program (https://www.randomizer.org). The groups were allocated to their respective treatments through a drawing of lots from sealed envelopes, each containing the corresponding patient numbers. Although

patients under mechanical ventilation had limited olfactory perception, they were unaware of whether the applied oil contained an active ingredient. Additionally, the nurse responsible for patient assessment was blinded to the intervention group to minimize bias.

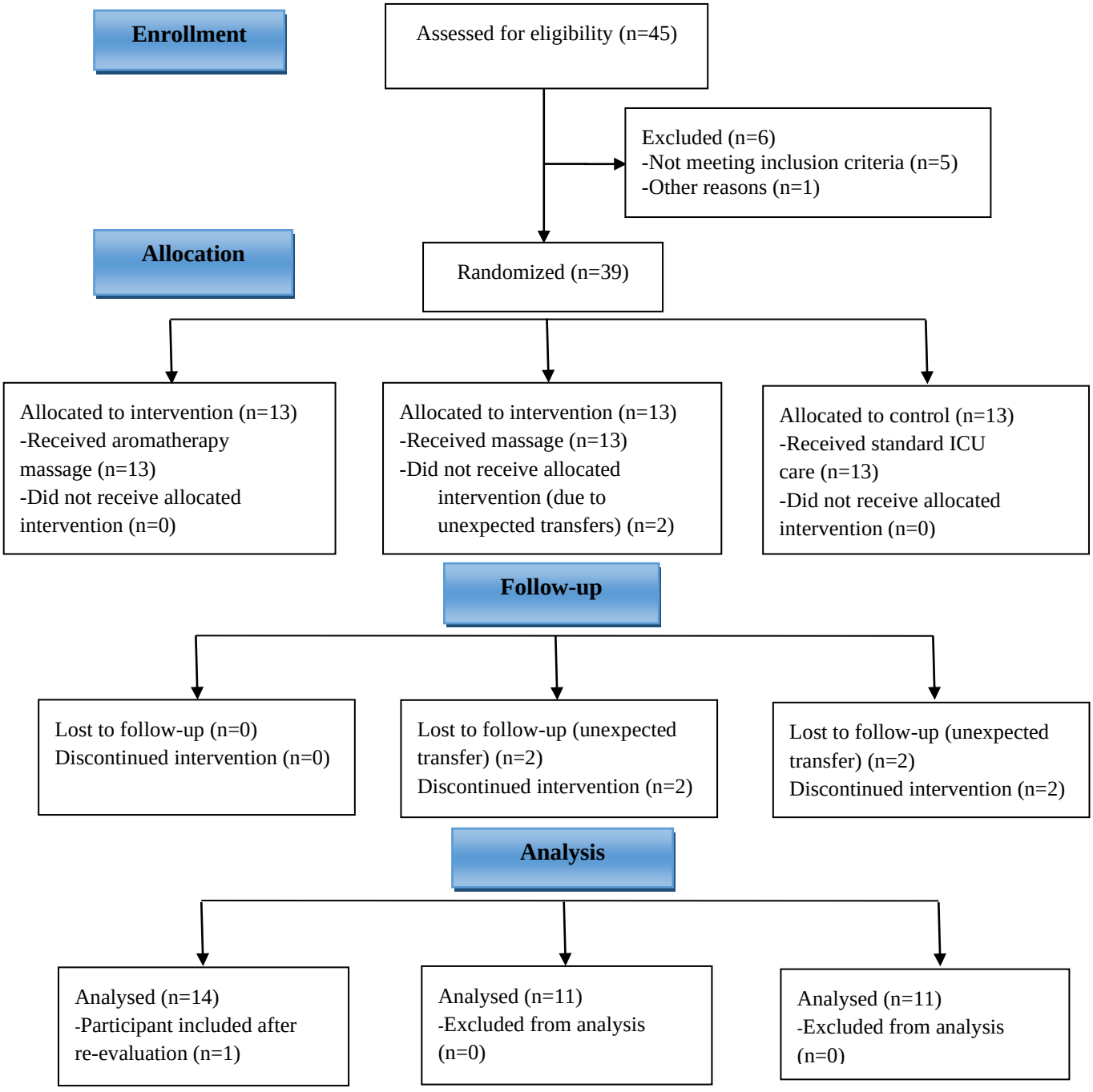

Figure 1. Flowchart of the effect of aromatherapy massage in ICU patients

The massage intervention was performed by ICU nurses trained in complementary therapies and experienced in clinical application. The massage technique consisted of gentle stroking and kneading movements applied to both hands and feet for 20 minutes per session. Interventions were conducted once daily for three days per week. In the aromatherapy massage group, a 2% dilution of bergamot essential oil was used (14). The essential oil was diluted in almond oil. In the massage group, a similar massage was performed using almond oil alone as a placebo. The patients in the control group received standard ICU care without massage intervention.

The Patient Information Form was used to collect the data on sociodemographic factors (e.g., age,

gender) and clinical characteristics (e.g., comorbidities, duration of mechanical ventilation, use of sedatives) of the patients. Pain levels were measured using the Critical Care Pain Observation Tool (CPOT), which scores pain from 0 (no pain) to 8 (severe pain). The CPOT assesses four domains: facial expressions, body movements, compliance with ventilator (or voice use for non-intubated patients), and muscle tension. The CPOT was selected due to its validity, reliability, and clinical feasibility, which was recommended by Barr et al. (2013) as its widespread endorsement by management as an effective tool for pain assessment (16, 17). Sedation levels were assessed using the Richmond Agitation-Sedation Scale (RASS), which is a 10-point scale ranging from -5 to +4. Scores from -1 to -5 represent increasing levels of sedation, beginning with "awakens to voice" and progressing to "unarousable." Scores from +1 to +4 indicate escalating levels of agitation, starting with mild apprehension and anxiety, and reaching the peak at "combative and violent." A RASS score of 0 denotes an "alert and calm" state (18). The RASS demonstrates strong validity and reliability across a range of critical care populations (19, 20).

Anxiety levels were evaluated using the Facial Anxiety Scale (FAS), which ranges from 1 (no anxiety) to 5 (severe anxiety). The FAS is a one-item scale featuring five facial expressions that depict increasing levels of fear. These expressions are presented on a card measuring 11 cm × 42 cm (21). The FAS was designed to assess anxiety through facial expressions of fear, which, despite having the same physical manifestations, may have different causes. The scale has demonstrated strong evidence of possessing the properties of interval-level measurement scales, including rank order and equality of intervals (22). A Patient Monitoring Form was developed to track and document assessments at baseline, 30 minutes, and 6 hours post-intervention.

The data analysis was conducted using SPSS software (version 27) (IBM, USA). The normality of the data was assessed using the Shapiro-Wilk test and skewness/kurtosis values. Descriptive statistics were used to summarize participants' demographic information and clinical status. Continuous variables were expressed as means and standard deviations, while categorical variables were reported as frequencies and percentages. For group comparisons, two-way analysis of variance (ANOVA) was utilized. Post-hoc comparisons were performed using Tukey’s test to adjust for multiple comparisons. To examine changes in the outcomes over time, repeated measures ANOVA was applied with time points at baseline, 30 minutes, and 6 hours. A 95% confidence interval were used for evaluating the results. $P<0.05$ was considered statistically significant.

Ethical Consideration

The study received approval from the Ethics Committee for Clinical Research at Qom University of Medical Science (ethical code: IR.MUQ.REC.1401.186), and all necessary permissions were obtained. The trial protocol was registered at the Iranian Registry of Clinical Trials (IRCT) (IRCT20221211056779N1). Informed consent was obtained from patients or their relatives in cases where the patient was unable to provide consent.

Results

The baseline characteristics of participants in the aromatherapy massage (n=13), massage (n=11), and control (n=11) groups are summarized in Table 1. The mean age of the participants varied across groups, with no significant difference among three groups (p=0.082). Females constituted 57.14% of the aromatherapy massage group, 27.3% of the massage group, and 72.7% of the control group, with no significant difference in sex distribution (p=0.098). There was no significant difference among the three groups in terms of comorbidities (p=0.550). The mean GCS score was 10.23 ± 3.45 in the aromatherapy massage group, 9.45 ± 2.98 in the massage group, and 10.00 ± 3.20 in the control group, indicating moderate levels of consciousness, with no significant differences among the three groups (p=0.742).

The repeated measures ANOVA demonstrated significant main effects of time for pain severity (p<0.001, F= 15.042, η^2_p = 0.129) and anxiety levels (p<0.001, F= 11.796, η^2_p = 0.103), whereas sedation levels did not show a significant time effect (p=0.206, F= 1.628, η^2_p = 0.016). Between-group comparisons using one-way ANOVA indicated no significant baseline differences among the three groups in mean pain severity (p=0.229) or anxiety levels (p=0.057), although baseline sedation levels differed significantly (p<0.001, F= 11.136). At 30 minutes post-intervention, pain severity differed significantly among groups (p=0.015, F= 4.349), but no difference was observed

at 6 hours (p=0.735). For anxiety, significant group differences were found at 30 minutes (p<0.001, F= 12.610) and 6 hours (p=0.004, F= 5.785), but not at baseline. Sedation levels were significantly different among the three groups at all three time points (baseline: p<0.001, F= 11.136; 30 minutes: p<0.001, F= 17.919; 6 hours: p<0.001, F= 15.225) (Table 2).

Table 1: Baseline demographic and clinical characteristics of participants in the aromatherapy massage, massage, and control groups

Characteristics	Aromatherapy massage group (N=14)	Massage group (N=11)	Control group (N=11)	P-value
Age, Mean ± SD	64.11 ± 23.80	75.81 ± 13.28	55.09 ± 23.23	0.082
Sex, N (%)				
Female	8 (57.14%)	3 (27.3%)	8 (72.7%)	0.098
Male	6 (42.85%)	8 (72.7%)	3 (27.3%)	
Comorbidities, N (%)	4 (35.7%)	6 (54.5%)	4 (36.4%)	0.550
GCS Score, Mean ± SD	10.23 ± 3.45	9.45 ± 2.98	10.00 ± 3.20	0.742
MV Days, Mean ± SD	7.20 ± 2.30	8.00 ± 3.10	7.50 ± 2.90	0.850
Use of Sedatives, N (%)	9 (64.6%)	7 (63.6%)	6 (54.5%)	0.850
Use of Analgesics, N (%)	10 (71.4%)	8 (72.7%)	8 (72.7%)	0.984
Use of Anxiolytics, N (%)	5 (35.7%)	4 (36.4%)	4 (36.4%)	0.998
HR, Mean ± SD	86.57 ± 17.32	87.84 ± 17.06	90.27 ± 19.06	0.669
RR, Mean ± SD	19.42 ± 5.78	20.30 ± 7.66	18.69 ± 2.63	0.116
BP, Mean ± SD	124/68 ± 2.5	127/81 ± 2.3	125/70 ± 2.8	0.334

Table 2: Between-group analysis of variance (ANOVA) for pain severity, sedation, and anxiety level

Variables	Time	Aromatherapy Massage Group (N=14)	Massage Group (N=11)	Control Group (N=11)	F	P-value (Between-group)
Pain Severity	Baseline	5.16± 1.02	5.62± 1.34	5.18± 1.62	1.49	0.229
	30-minute	4.53± 0.82	5.38± 1.21	4.96± 1.46	4.34	0.015
	6-hours	4.76± 1.07	5.01± 1.26	4.84± 1.41	0.31	0.735
Sedation Level	Baseline	5.90± 1.02	6.78± 2.04	5.87± 2.12	11.13	<0.001
	30-minute	5.93± 0.98	7.04± 1.96	5.91± 2.02	17.91	<0.001
	6-hours	5.93± 0.91	6.97± 1.98	6.12± 1.89	15.22	<0.001
Anxiety Level	Baseline	1.90± 0.59	2.12± 0.70	2.11± 0.72	2.94	0.057
	30-minute	1.58± 0.56	1.73± 0.59	2.30± 0.73	12.61	<0.001
	6-hours	1.61± 0.61	1.78± 0.61	2.18± 0.84	5.78	0.004

A significant time × group interaction was observed for pain severity (p=0.046, F= 2.468, η^2_p = 0.046), indicating differing temporal change patterns among the three groups. However, no significant interaction was found for anxiety (p=0.081, F= 2.148, η^2_p = 0.040) or sedation (p=0.504, F= 0.752, η^2_p = 0.015) (Table 3).

Table 3: Within-group repeated measures analysis of variance (ANOVA) for pain severity, sedation, and anxiety level

Variables	Effect	df1	df2	F	p-value	η^2
Sedation Level	Time (within)	1.284	131.013	1.628	0.206	0.016
Sedation Level	Time × Group (interaction)	2.569	131.013	0.752	0.504	0.015
Anxiety Level	Time (within)	1.881	193.754	11.796	<0.001	0.103
Anxiety Level	Time × Group (interaction)	3.762	193.754	2.148	0.081	0.04
Pain Severity	Time (within)	1.709	174.302	15.042	<0.001	0.129
Pain Severity	Time × Group (interaction)	3.418	174.302	2.468	0.056	0.046

Post-hoc analysis (Tukey's HSD) revealed that the aromatherapy massage group experienced a significantly greater reduction in pain severity compared with the control group at both 30 minutes (p=0.001) and 6 hours post-intervention (p=0.001). Specifically, pain severity in the aromatherapy group decreased by 12.2% from baseline at 30 minutes, compared with reductions of 4.3% in the simple massage group and 4.2% in the control group. For anxiety levels, a significant within-group reduction was observed in the aromatherapy group at both 30 minutes (p<0.001) and 6 hours (p<0.001) post-intervention, while the control group showed a significant increase in anxiety at 30 minutes (p<0.05).

Discussion

The findings of this study indicate that both aromatherapy massage with bergamot essential oil and massage alone significantly reduced pain and anxiety levels in ICU patients under mechanical ventilation. These results align with existing literature on the therapeutic effects of aromatherapy and massage; however, the impact on sedation levels was not significant, requiring further examination. The significant reduction in pain severity, as measured by the CPOT, suggests that bergamot essential oil has analgesic properties beyond the effects of massage alone. This finding is consistent with prior studies demonstrating that bergamot essential oil contains bioactive compounds such as linalool acetate, which exert analgesic and anti-anxiety effects (23).

The time × group interaction effect further supports the superior pain-relieving effects of aromatherapy massage compared to the control interventions. This aligns with the findings of Abbaspoor et al. (2022), who reported that patients receiving aromatherapy-based interventions experienced lower pain levels than those receiving standard care. Additionally, the analgesic effects of aromatherapy may stem from its influence on neurotransmitter activity and autonomic nervous system regulation, which contribute to pain modulation in critically ill patients (24).

The results of the present study also confirmed a significant reduction in anxiety levels, particularly in the aromatherapy and massage groups. This aligns with previous studies indicating that aromatherapy interventions can reduce anxiety in ICU settings (25). The observed anxiolytic effects of bergamot essential oil may be attributed to its ability to stimulate the parasympathetic nervous system, thereby lowering stress hormone levels and inducing relaxation (26). Furthermore, high anxiety levels in ICU patients have been associated with worsening clinical outcomes, including prolonged mechanical ventilation and increased ICU stays (Boehm et al., 2023) (3). Therefore, integrating aromatherapy-based interventions into ICU care protocols may offer a non-pharmacological strategy for mitigating stress-related complications.

In the present study, Facial Anxiety Scale (FAS) scores were significantly lower in both intervention groups, reinforcing the potential of aromatherapy and massage to alleviate stress and emotional distress in critically ill patients. These findings are consistent with studies demonstrating the efficacy of essential oils, particularly bergamot, in reducing anxiety and promoting psychological well-being (26). Contrary to expectations, aromatherapy massage did not significantly affect sedation levels across the three groups of the present study. This finding contradicts some previous research reporting increased sedation following essential oil-based interventions (27). This discrepancy may be due to variations in baseline sedation levels, differences in assessment methods (e.g., clinical scales versus physiological indicators), or individual patient responses to aromatic compounds (28). Future studies should consider using objective physiological indicators, such as EEG, to assess sedation effects more accurately.

The pain- and anxiety-reducing effects of aromatherapy massage suggest that integrating complementary therapies into ICU care may enhance patient comfort and potentially reduce the reliance on sedative medications (29). Future studies should aim to explore the long-term effects of aromatherapy massage and the optimal duration and frequency of interventions. Additionally, assessing patient preferences for different essential oils and individualizing aromatherapy treatments could further enhance their efficacy. Finally, future studies should incorporate biomarkers (e.g., cortisol levels, EEG patterns) to provide a more comprehensive assessment of sedation and relaxation effects. This study has some limitations. The small sample size may limit the generalizability of the findings. The use of subjective assessment tools (CPOT, RASS, FAS) may introduce observer bias, although different personnel conducted the intervention and outcome assessments. In addition, medication use was not experimentally controlled, but baseline drug usage was similar among the

three groups. Finally, the practical feasibility of implementing aromatherapy in ICU settings, including cost, staff training, and patient preferences, requires further exploration.

Implications for practice

Aromatherapy massage with bergamot essential oil and massage alone significantly reduced pain and anxiety levels in ICU patients undergoing mechanical ventilation, whereas no significant effect on sedation levels was observed. These findings support the therapeutic potential of aromatherapy in critical care settings, while also highlighting the need for further research to optimize its clinical application.

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Conflicts of interest

The authors state that there is no competing of interest in the present study.

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Authors' Contributions

Z.T.K contributed to conceptualization, methodology, supervision, project administration, writing—review and editing. Z.R.A and Z.A performed data collection, investigation, and writing—original draft. E.V.M participated in formal analysis, validation, writing—review and editing. All authors have read and approved the final manuscript.

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