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Review Article

Inhaled Lavender Aromatherapy for Preoperative Anxiety: A Systematic Review of Randomized Controlled Trials

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Abstract

Background: Preoperative anxiety is common among patients undergoing surgery and may adversely affect perioperative outcomes, including hemodynamic instability, increased anesthetic requirements, and delayed recovery. Lavender aromatherapy has been widely used as a complementary non-pharmacological intervention; however, its effectiveness in preoperative care remains variably reported across studies.
Objective: This review aimed to synthesize evidence from randomized controlled trials (RCTs) on the effectiveness of inhaled lavender aromatherapy in reducing preoperative anxiety among adult surgical patients.
Methods: A structured review of RCTs was conducted using Scopus, PubMed, and ScienceDirect. Studies published within the last 10 years were searched using combinations of terms related to lavender aromatherapy, inhalation, and preoperative anxiety. Eligibility criteria were defined using the PICOS framework. After duplicate removal, title and abstract screening, and full-text assessment, 11 RCTs were included in the final qualitative synthesis. Due to heterogeneity in surgical populations, intervention protocols, comparators, and anxiety measurement tools, findings were synthesized narratively.
Results: Eleven RCTs met the inclusion criteria. Most studies reported reductions in preoperative anxiety following inhaled lavender aromatherapy compared with standard care, no-aroma control, or placebo. Several trials also reported additional benefits, such as improved hemodynamic parameters, reduced cortisol levels, and lower anesthetic requirements. However, the findings were not entirely consistent, as some studies found lavender to be comparable to other non-pharmacological interventions or not significantly different from placebo.
Conclusion: Inhaled lavender aromatherapy appears to be a promising complementary intervention for reducing preoperative anxiety in adult surgical patients. Nevertheless, the evidence remains heterogeneous, and effectiveness may vary according to clinical context, comparator type, and intervention protocol. Further high-quality trials using standardized administration methods and outcome measures are needed to clarify its clinical role.

Keywords: Complementary therapy, inhalation, lavender aromatherapy, preoperative anxiety, randomized controlled trials, surgery

INTRODUCTION

Surgery is a major invasive intervention commonly associated with fear, uncertainty, pain, and concern about outcomes, all of which may contribute to preoperative anxiety (1,4). Preoperative anxiety is clinically important because it may lead to adverse perioperative consequences, including increased pain perception, nausea and vomiting, prolonged hospitalization, hemodynamic instability, and delayed postoperative recovery (3,4). In some cases, severe anxiety may even lead patients to postpone or avoid surgical procedures (2). Therefore, effective management of preoperative anxiety is essential to improve patient comfort, safety, and perioperative outcomes.

Pharmacological approaches, including sedatives and opioids, are often used to manage anxiety before surgery (5). However, these agents may cause side effects such as excessive sedation, confusion, agitation, and respiratory depression, making non-pharmacological alternatives increasingly attractive in perioperative care (6). Among these alternatives, aromatherapy has gained attention as a simple, low-cost, and minimally invasive complementary intervention (7,9).

Aromatherapy involves the therapeutic use of volatile plant-derived compounds, usually essential oils, to influence psychological and physiological responses (8,9). When administered by inhalation, aromatic molecules pass through the nasal cavity to the olfactory bulb and subsequently stimulate the limbic system, a brain region closely associated with emotion, memory, and autonomic regulation (9,10). Through this pathway, aromatherapy may modulate anxiety-related responses and promote relaxation.

Lavender (*Lavandula angustifolia*) is among the most frequently studied essential oils for anxiety reduction. It is widely recognized for its potential anxiolytic, antidepressant, antispasmodic, and relaxing properties (11). Its major components, linalool and linalyl acetate, have been proposed to influence the parasympathetic nervous system and central neurotransmitter activity, thereby promoting relaxation and reducing physiological arousal (7,12). Despite this theoretical rationale, the clinical evidence supporting lavender aromatherapy for preoperative anxiety remains mixed.

Several literature reviews have explored aromatherapy for anxiety management; however, important gaps remain. Previous reviews have often combined different essential oils, routes of administration, clinical settings, and study designs, limiting the ability to draw conclusions about inhaled lavender aromatherapy specifically in preoperative populations (2,3). In addition, not all previous reviews focused exclusively on randomized controlled trials, and some did not isolate the inhalation route, which is considered the fastest and most practical method in perioperative settings (9,10). These limitations reduce the precision of current evidence for clinical decision-making.

Therefore, this review aimed to synthesize evidence specifically from randomized controlled trials examining inhaled lavender aromatherapy for reducing preoperative anxiety in adult surgical patients. By narrowing the scope to one essential oil, one route of administration, one clinical context, and one study design, this review seeks to provide a more focused and clinically relevant understanding of the potential role of lavender aromatherapy in perioperative nursing care.

METHODS

Review Design

This study used a structured review design to summarize and interpret evidence from randomized controlled trials evaluating the effectiveness of inhaled lavender aromatherapy on preoperative anxiety. The review process was conducted using a structured approach consistent with PRISMA principles to enhance transparency in study identification, screening, eligibility assessment, and inclusion.

Research Question and Eligibility Framework

The review question was developed using the PICOS framework. Studies were selected based on the following criteria:

Table 1. PICOS Framework

Component	Description
Population (P)	Adult surgical patients (≥18 years) undergoing elective surgery
Intervention (I)	Inhaled lavender aromatherapy administered during the preoperative period
Comparison (C)	Standard care, placebo, no-aroma control, or other non-pharmacological interventions
Outcome (O)	Preoperative anxiety reduction measured using validated tools
Study Design (S)	Randomized controlled trials

Search Strategy

A literature search was conducted in Scopus, PubMed, and ScienceDirect between October and November 2025. These databases were selected to ensure broad coverage of biomedical, perioperative, nursing, and complementary therapy literature. The search strategy used combinations of the following keywords: "lavender aromatherapy" OR "lavender oil" AND "preoperative anxiety" OR "perioperative anxiety" AND "inhalation" OR "aromatherapy inhalation." The search was limited to articles published within the last 10 years and available in full text.

Inclusion Criteria

Studies were included if they involved adult surgical patients (≥18 years) in the preoperative period and evaluated inhaled lavender aromatherapy as the primary intervention. Eligible studies compared lavender aromatherapy with standard care, placebo, or other non-pharmacological interventions and reported preoperative anxiety outcomes measured using validated instruments.

Exclusion Criteria

The exclusion criteria included non-randomized studies, studies using combined or non-lavender aromatherapy interventions, studies not involving preoperative or procedural anxiety, and articles without full-text availability.

Screening and Selection Process

The study selection procedure followed the PRISMA framework. Initially, all records identified from database searches were collected, and duplicate entries were removed. The remaining studies were then screened based on titles and abstracts to identify potentially relevant articles according to the established inclusion and exclusion criteria.

Full-text articles were subsequently assessed for eligibility. Studies were excluded if they did not meet the PICOS criteria, involved non-relevant populations or interventions, or lacked sufficient methodological clarity. Importantly, studies were not excluded based on the direction or statistical significance of their findings. Finally, articles that fulfilled all eligibility criteria were included in the review, resulting in a total of eleven RCTs for qualitative synthesis.

Data Extraction

Data were extracted from each included study using a structured and standardized form. The extracted variables included study title and year of publication, sample size, type of surgical procedure, characteristics of the intervention (including delivery method and duration), comparator type, anxiety measurement tools, main outcomes, and reported adverse events. The extraction process was conducted systematically to ensure consistency across studies and to facilitate comparison of intervention characteristics and outcomes. All extracted data were tabulated to provide a comprehensive overview of study characteristics and findings.

Quality Assessment of Included Studies

The methodological quality of the included randomized controlled trials was assessed using the Cochrane Risk of Bias 2 (RoB 2) tool, which evaluates five domains: bias arising from the randomization process, deviations from intended interventions, missing outcome data, outcome measurement, and selection of reported results.

Data analysis

Given the substantial heterogeneity across the included studies in terms of surgical populations, comparator conditions, lavender delivery methods, duration of exposure, and anxiety measurement instruments, quantitative synthesis through meta-analysis was not considered appropriate. Therefore, a narrative synthesis approach was employed. The synthesis

focused on identifying overall trends in anxiety outcomes, categorizing studies based on whether they reported (1) significant reductions in anxiety, (2) comparable effects to other interventions, or (3) no significant differences compared to control or placebo. Variations in intervention protocols, comparator types, and outcome measures were also considered when interpreting the findings.

RESULTS

Study Selection

The initial database search identified 683 records, comprising Scopus (n = 546), PubMed (n = 21), and ScienceDirect (n = 116). After removal of 162 duplicates, 521 records remained for title and abstract screening. Of these, 498 were excluded because they involved ineligible populations, non-lavender or combined interventions, non-inhalation administration, or outcomes unrelated to anxiety. Twenty-three articles underwent full-text review. After full-text assessment, 12 studies were excluded due to non-randomized design, inappropriate timing of intervention, non-inhalation delivery, or insufficient methodological clarity. Ultimately, 11 randomized controlled trials were included in the qualitative synthesis.

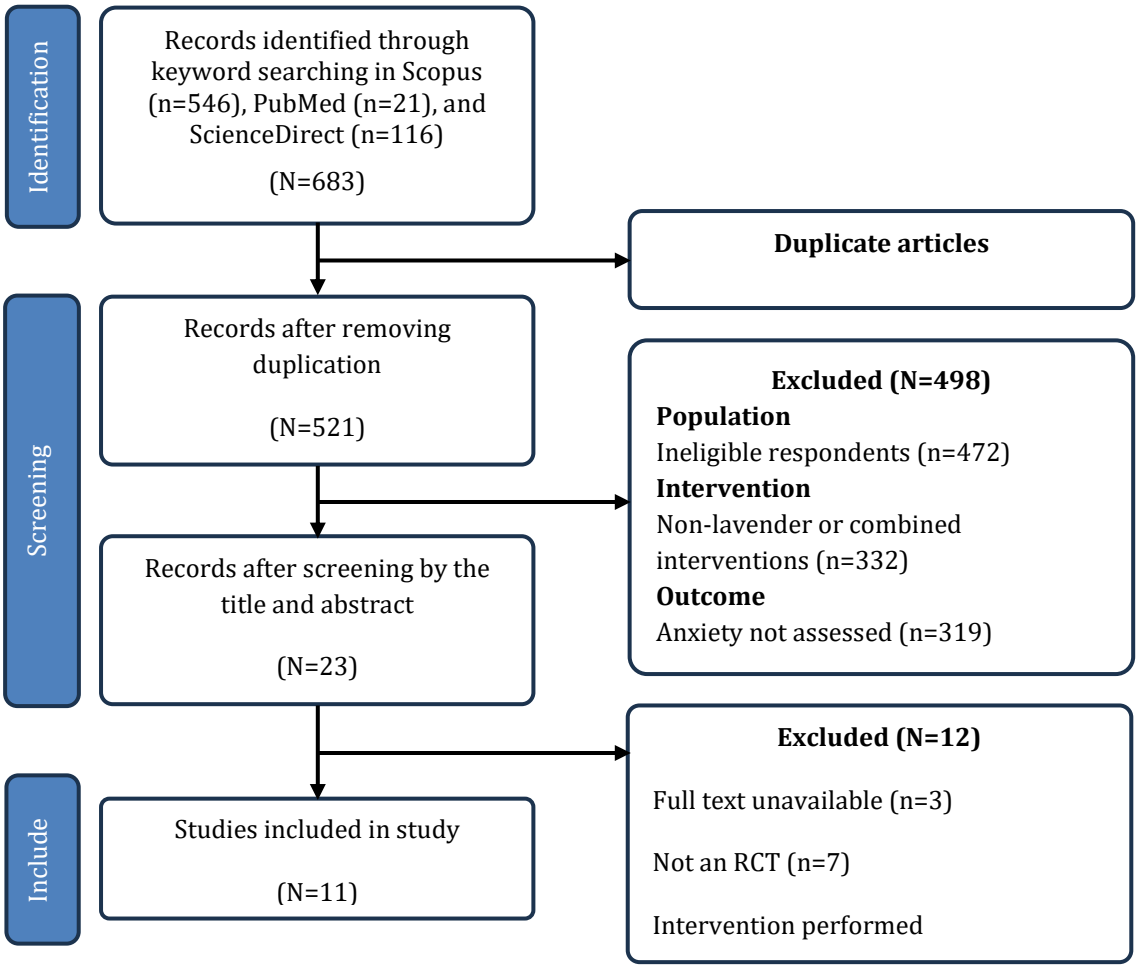

Figure 1. PRISMA Flowchart

Characteristics of Included Studies

The characteristics and principal findings of these studies are presented in Table 2. All included studies employed a RCT design and involved adult surgical patients undergoing various procedures, including cataract surgery, breast surgery, rhinoplasty, spinal anesthesia procedures, and coronary artery bypass grafting. Sample sizes ranged from small to moderate, and all studies evaluated inhaled lavender aromatherapy administered during the preoperative period. Anxiety outcomes were assessed using validated instruments, most commonly the Visual Analog Scale (VAS) and the State-Trait Anxiety Inventory (STAI). Overall, most studies reported reductions in preoperative anxiety following lavender aromatherapy; however, the findings were not entirely consistent, with some studies demonstrating comparable effects to other interventions or no significant differences compared to control or placebo groups.

Table 2. Summary of Included Studies

Title & Year	Sample Size	Type of Surgery	Intervention	Duration	Comparator	Tool	Main Outcome	Adverse Events
Stanley et al. (2019)	75	Cataract	Lavender inhalation using vaporizer	20 min	Grape seed oil (placebo)	STAI	Significant reduction in anxiety compared to placebo	No adverse events reported
Rahman et al. (2024)	105	Elective (GA)	Lavender inhalation using intranasal strip	20 min	No aroma control	VAS	Significant reduction in anxiety, reduced propofol requirement	Not reported
Shirzad et al. (2023)	68	Rhinoplasty	Lavender inhalation using cotton	20 min	No aroma control	STAI	Significant reduction in anxiety compared to control	No adverse events reported
Ebrahimi et al. (2021)	90	Mixed elective	Lavender inhalation using napkin	20 min	Citrus aurantium and control	STAI	Reduction in anxiety compared to control	Not reported
Pourmohammad et al. (2024)	120	Cataract	Lavender inhalation using cotton ball	15 min	Nature sounds and control	VAS	Greater reduction in anxiety compared to comparator	No adverse events reported
Franco et al. (2016)	88	Breast surgery	Lavender inhalation using plastic oxygen mask	10 min	Unscented oil (placebo)	STAI	Reduction in anxiety observed in both groups, with no	Not reported

							significant difference between groups	
Beyliklioğlu et al. (2018)	80	Breast surgery	Lavender inhalation using gauze	20 min	Standard care	STAI	Significant reduction in anxiety compared to control	Not reported
Hosseini et al. (2016)	90	CABG	Lavender inhalation using gauze	20 min	Distilled water	STAI	Significant reduction in anxiety compared to control, decreased cortisol levels	Not reported
Amini et al. (2024)	120	Spinal anesthesia	Lavender inhalation using gauze	20 min	PMR and control	STAI	Significant reduction in anxiety compared to both PMR and control groups	Not reported
Mousavi et al. (2024)	105	CABG	Lavender inhalation using absorbent cloth	Not specified	Benson relaxation and control	STAI	Reduction in anxiety similar to Benson relaxation, both more effective than control	Not reported
Saylam et al. (2021)	120	SWL (urology)	Lavender inhalation using nebulizer	Not specified	Placebo (saline) and frankincense arm	STAI, VAS	No significant difference in anxiety compared to placebo, no significant effect on pain	Not reported

Table 3. Risk of Bias Assessment of Included Studies (RoB 2)

Study	Randomization Process	Deviations from Intended Interventions	Missing Outcome Data	Measurement of Outcome	Selection of Reported Results	Overall Risk
Stanley et al. (2019)	Low risk	Some concerns	Low risk	Low risk	Low risk	Low risk
Rahman et al. (2024)	Low risk	Some concerns	Low risk	Some concerns	Some concerns	Some concerns
Shirzad et al. (2023)	Low risk	Some concerns	Low risk	Low risk	Low risk	Low risk
Ebrahimi et al. (2021)	Some concerns	Some concerns	Low risk	Some concerns	Some concerns	Some concerns
Pourmohammad et al. (2024)	Low risk	Some concerns	Low risk	Low risk	Low risk	Low risk
Franco et al. (2016)	Low risk	Low risk	Low risk	Low risk	Low risk	Low risk
Beyliklioğlu et al. (2018)	Some concerns	Some concerns	Low risk	Some concerns	Some concerns	Some concerns
Hosseini et al. (2016)	Some concerns	Some concerns	Low risk	Some concerns	Some concerns	Some concerns
Amini et al. (2024)	Low risk	Some concerns	Low risk	Low risk	Low risk	Low risk
Mousavi et al. (2024)	Low risk	Some concerns	Some concerns	Some concerns	Some concerns	Some concerns
Saylam et al. (2021)	Some concerns	Some concerns	Low risk	Some concerns	Some concerns	Some concerns

Quality Assessment of Included Studies

Overall, the quality of the included studies ranged from low risk to some concerns, with no studies classified as having a consistently high risk of bias across all domains. Most studies adequately reported randomization procedures; however, several limitations were identified, particularly related to blinding of participants and personnel, which is inherently challenging in aromatherapy interventions due to the recognizable scent of essential oils. In addition, some studies lacked detailed reporting on allocation concealment and adverse events, leading to potential concerns regarding reporting bias. Variability in outcome measurement tools (e.g., STAI vs. VAS) also introduced potential measurement bias across studies (Table 3).

DISCUSSION

The findings of this structured review indicate that inhaled lavender aromatherapy is frequently associated with reductions in preoperative anxiety across various surgical populations. Several randomized controlled trials demonstrated statistically significant decreases in anxiety levels following lavender inhalation compared to control conditions. For instance, studies in cataract surgery patients reported significant reductions in STAI scores compared to placebo groups (13,14). Similarly, in patients undergoing general anesthesia and rhinoplasty, lavender aromatherapy was associated with substantial decreases in anxiety scores and improved perioperative stability (1,15).

In addition to psychological outcomes, several studies reported beneficial physiological effects. Lavender inhalation was associated with improvements in hemodynamic parameters such as blood pressure and heart rate, as well as reductions in stress-related biomarkers such as cortisol (16). These findings suggest a potential interaction between psychological relaxation and physiological stress responses, supporting the hypothesis that lavender may exert its effects through modulation of the autonomic nervous system, although this mechanism remains a proposed explanation.

However, the findings across studies were not entirely consistent. Some trials demonstrated that lavender aromatherapy produced effects comparable to other non-pharmacological interventions rather than superior outcomes. For example, lavender showed similar effectiveness to Benson relaxation in reducing anxiety among patients undergoing coronary artery bypass grafting (17) and comparable or slightly greater effects than progressive muscle relaxation in patients receiving spinal anesthesia (18). These findings suggest that while lavender may be beneficial, its effects may be similar to other established relaxation-based interventions.

Furthermore, evidence from placebo-controlled studies highlights the complexity of interpreting aromatherapy effects. A study in 2016 reported significant reductions in anxiety in both lavender and unscented oil groups, with no significant difference between them, suggesting that non-specific factors such as patient expectations, therapeutic attention, or environmental influences may contribute to anxiety reduction (19). Similarly, another study found no significant difference in anxiety or pain outcomes between lavender and placebo groups during shock wave lithotripsy (10). These findings indicate that the anxiolytic effect of lavender may not be solely attributable to its pharmacological properties (20).

The variability in outcomes may be explained by several methodological and clinical factors. First, differences in comparator types, including placebo, standard care, relaxation techniques, and alternative sensory interventions such as nature sounds, may influence the observed magnitude of effect (13,17). Second, heterogeneity in surgical procedures, ranging from minor ophthalmologic surgeries to major cardiac procedures, may result in differing baseline anxiety levels and responsiveness to interventions (14,16). Third, variations in intervention protocols, including concentration of lavender oil, method of administration (vaporizer, intranasal strip, cotton, oxygen mask, gauze, inhaler, nebulizer), and duration of exposure may further contribute to inconsistencies in findings across studies.

Differences in outcome measurement instruments also represent an important source of variability. The included studies utilized a range of tools, including the STAI and VAS, each with differing sensitivity and scope. These variations may influence the detection and reporting of statistically significant changes in anxiety levels.

Despite these inconsistencies, most studies reported a general trend toward anxiety reduction following lavender inhalation. In some cases, lavender demonstrated greater reductions compared to control conditions or alternative interventions, such as nature sounds, while in others, the effects were comparable to standard relaxation techniques. Additionally, studies without a true control group still reported reductions in emotional distress following aromatherapy, although these findings should be interpreted cautiously due to the lack of comparator.

Overall, the findings of this review suggest that inhaled lavender aromatherapy may be a useful non-pharmacological option for reducing preoperative anxiety in certain clinical contexts. However, the presence of studies with non-significant findings and comparable effects to placebo or other interventions indicates that its effectiveness is not uniform. These results underscore the importance of considering contextual, methodological, and psychological factors when interpreting the evidence.

Several limitations should be acknowledged. This review did not include a formal risk of bias assessment and the synthesis was limited to qualitative analysis due to heterogeneity across studies. In addition, variations in study design, intervention protocols, and outcome measures may limit the generalizability of the findings. Therefore, the results should be interpreted as a comprehensive overview of current evidence rather than definitive conclusions regarding effectiveness.

Clinical Implications

Inhaled lavender aromatherapy may be considered as a simple, low-cost, and non-invasive complementary intervention to help reduce preoperative anxiety in clinical settings. It can be easily administered using various methods, such as gauze, inhalers, or masks, without requiring complex equipment. Given its potential benefits and relatively low risk, lavender aromatherapy may be integrated into routine preoperative care, particularly for patients experiencing mild to moderate anxiety or those who prefer non-pharmacological approaches.

However, due to variability in study findings, lavender aromatherapy should not replace

standard anxiety management strategies but rather be used as an adjunct to existing interventions. Standardization of administration methods and protocols is recommended to optimize its effectiveness in clinical practice.

Study Limitations

This review has several limitations. First, no formal risk of bias assessment was conducted, which may affect the evaluation of the methodological quality of the included studies. Second, the literature search was limited to selected databases and English-language publications, which may have resulted in incomplete retrieval of relevant studies and introduced potential language and publication bias. Third, considerable heterogeneity was observed across the included studies in terms of surgical procedures, intervention protocols, comparator types, and outcome measurement instruments, which limited the ability to perform a quantitative synthesis.

Finally, no effect size pooling or meta-analysis was performed, and the findings are based on qualitative synthesis. Therefore, the results should be interpreted as an overview of current evidence rather than definitive conclusions.

CONCLUSION

Inhaled lavender aromatherapy appears to be a potentially useful complementary intervention for reducing preoperative anxiety across various surgical settings. While most included studies reported beneficial effects, the findings were not entirely consistent, with some studies showing comparable outcomes to other interventions or no significant differences compared to placebo. These results suggest that the effectiveness of lavender aromatherapy may depend on contextual and methodological factors. Further well-designed studies with standardized protocols are needed to clarify its role in clinical practice.

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Author Contributions

GAS was responsible for the study conceptualization, literature search, study selection, data extraction, data synthesis, and manuscript preparation.

AM provided study supervision, methodological guidance, critically reviewed the manuscript for intellectual content, and approved the final version for publication.

Conflict of Interest

The authors declare that there are no conflicts of interest related to this study or its publication.

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