

Aromatherapy with Lavender Oil to Reduce Pain Intensity in Post-Cesarean Section Patients: A Study at Cirebon Hospital

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ABSTRACT

Effective pain management after cesarean section (C-section) is critical for maternal recovery and well-being. Lavender aromatherapy has been suggested as a complementary therapy to reduce postoperative pain. This study aims to evaluate the effect of lavender aromatherapy on postoperative pain in women undergoing C-section. In a randomized, double-blind, placebo-controlled trial, 120 women undergoing C-section were assigned to either a lavender aromatherapy group (n=60) or a placebo group (n=60). Baseline characteristics, including age, education, parity, and smoking status, were assessed to ensure comparability. Postoperative pain intensity was measured using a standardized pain scale. Participants were predominantly aged 20–35 years (Placebo 91.67%, Aromatherapy 88.33%) and non-smokers. Educational attainment and parity were comparable between groups. Lavender aromatherapy significantly reduced post-C-section pain compared to placebo. The results showed a statistically significant difference in pain scores ($U = 2638.5$, $p < 0.001$, $r = 0.40$). The intervention was well-tolerated and easily applied, suggesting modulation of pain through both neurophysiological and psychological pathways. Lavender aromatherapy is a safe, non-invasive, and effective adjunct for postoperative pain management after C-section. Its integration into standard postoperative care may enhance maternal comfort and satisfaction. Further multicenter studies with standardized protocols are recommended to confirm efficacy and explore long-term outcomes.

Key Messages:

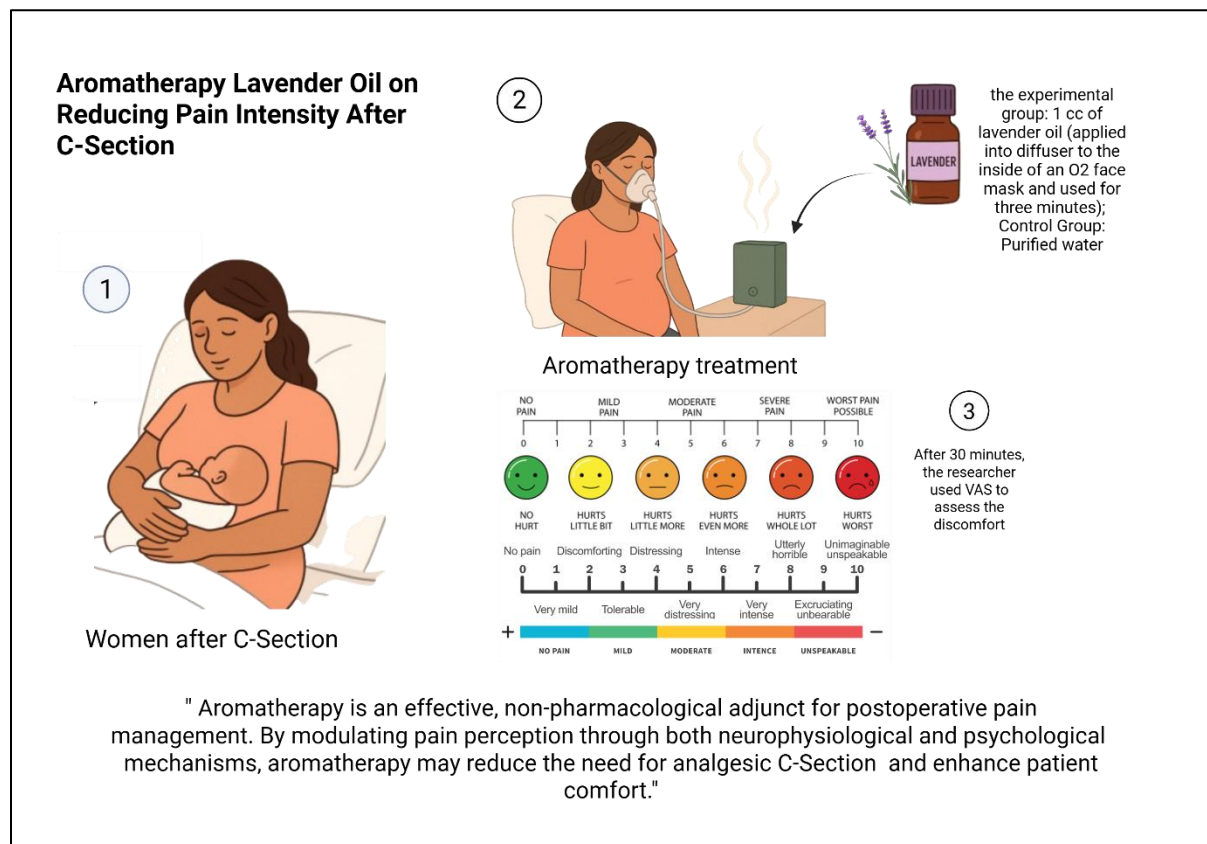
- Lavender aromatherapy is a safe, non-invasive, and effective adjunct for managing post-cesarean pain in women.
- In a randomized controlled trial, it significantly reduced pain compared to placebo, with a very large effect size ($r = 0.82$). The intervention was well-tolerated and easily implemented, making it feasible for maternity wards in Cirebon Regency.
- Integrating lavender aromatherapy into standard postoperative care in Cirebon can enhance maternal comfort, satisfaction, and recovery, supporting the region's potential as a model for innovative, patient-centered maternal health practices..

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GRAPHICAL ABSTRACT



INTRODUCTION

Cesarean section (C-section) is a common surgical procedure performed to deliver babies when vaginal birth poses risks to the mother or infant. Although generally safe, C-sections are associated with postoperative pain, which can significantly affect a mother's physical recovery, emotional well-being, and ability to care for her newborn. Managing this pain effectively is a priority in postpartum care (1).

The global prevalence of cesarean sections is currently approximately 21.1% of all births worldwide, meaning more than 1 in 5 babies are born by cesarean section. This figure has increased from approximately 7% in 1990 to more than 21% today and is projected to rise further to approximately 28.5% by 2030, with more than 38 million cesarean births expected to occur that year (2). The prevalence of cesarean sections in Indonesia in 2017 was approximately 17.6% to 17.7% of all births. This figure represents a significant increase from 1.6% in 1991 to nearly 18% in 2017, following an upward global trend(3).

While pharmacological methods such as opioids and non-steroidal anti-inflammatory drugs (NSAIDs) are commonly used, they may lead to side effects such as nausea, constipation, and sedation, and in some cases, may not provide adequate relief (4). As a result, there is growing interest in complementary therapies that are safe, effective, and supportive of holistic recovery. One such approach is aromatherapy using essential oils (5).

Aromatherapy is widely used as a treatment, especially for various ailments, although aromatherapy is intended as a supportive therapy. Lavender aromatherapy is one of the safest oils and has strong antiseptic, antiviral, and antifungal properties, as well as being able to relieve pain and headaches. (6) Aromatherapy is also commonly used in liniments, believed to accelerate the healing of skin cells from sunburn, wounds, and rashes. Because of its many benefits, lavender oil is one of the most popular oils in aromatherapy.(7)

Lavender (*Lavandula angustifolia*) is among the most widely used essential oils in aromatherapy, known for its calming, analgesic, and anti-inflammatory properties. (8) Several modest studies have shown

that lavender oil aromatherapy can reduce postoperative pain and anxiety, including those that involve women who have had cesarean sections. Few studies have looked at clinically significant outcomes, including painkiller intake, breastfeeding safety, or medium-term maternal recovery, and trials vary greatly in sample size, delivery mode, blinding, and outcome measures. Strong, standardized, placebo-controlled studies are required to ascertain if lavender aromatherapy is a safe and useful addition for pain relief following cesarean birth, given these limitations and the dearth of data from Indonesia(9). Research suggests that lavender aromatherapy may help reduce pain perception by modulating the central nervous system and promoting relaxation. Its non-invasive nature makes it a particularly appealing option for postoperative patients, including women recovering from cesarean delivery (10).

Several studies have reported that lavender oil aromatherapy can effectively reduce postoperative pain and anxiety; however, most of these investigations were conducted in different regions and under varied clinical conditions. The effectiveness of this intervention may vary depending on cultural factors, patient characteristics, and healthcare practices. In the Cirebon District, non-pharmacological approaches to pain management—especially aromatherapy—are still rarely implemented in postoperative care, and no previous studies have evaluated the use of lavender oil for pain relief among post-cesarean section patients in this setting. This lack of local evidence creates a research gap in understanding whether lavender aromatherapy can serve as an effective complementary therapy to reduce pain intensity after cesarean delivery. Therefore, this study aims to fill that gap by examining the effectiveness of lavender oil aromatherapy in reducing pain intensity among post-cesarean section patients at Cirebon Hospital. This study aims to investigate the effectiveness of Lavender aromatherapy in reducing postoperative pain among women following cesarean section. By evaluating the pain intensity before and after the intervention, the study seeks to contribute to the growing body of evidence supporting the use of non-pharmacological methods in enhancing maternal recovery.

METHODS

This study used a two-arm parallel design and was a single-center, double-blind, controlled clinical experiment. To ensure impartial representation, a randomized sampling approach was employed to select the respondents. Post-cesarean section patients who met the inclusion criteria and provided informed consent after being fully informed about the study were eligible participants. To minimize selection bias and ensure group comparability, individuals were randomly assigned to the intervention and control groups. Purposive sampling strategies were employed to collect research samples, with inclusion and exclusion criteria defined. The study was conducted from June to December 2024 at Hospital "X" in Cirebon Regency.

The Inclusion Criteria were as follows

A convenience sample of 120 post-C-section women was selected and divided into two groups: 60 mothers comprised the research group (Group I) and 60 mothers comprised the control group (Group II). The following inclusion criteria were used to choose the study and control groups. All women who underwent a cesarean section under spinal anesthesia and were aged between 18 and 45 years old, mothers on the 1st day of post-caesarean section, had full awareness, were not allergic to aromatherapy, could communicate verbally, full term, after six hours of operation, not suffering from medical and/or gynecological health problems, and were willing to be a respondent. with no history of cancer or chronic pain, nor psychiatric disorders, and no perinatal adverse events.

The Exclusion Criteria were as follows

Patients were excluded from the study if they had a history of allergy or hypersensitivity to lavender or other essential oils, or if they presented with respiratory disorders such as asthma or chronic obstructive pulmonary disease (COPD). Those who were using sedatives, analgesics, or any medications that could affect pain perception during the study period were also excluded. Additionally, patients with unstable hemodynamic conditions, postoperative complications requiring intensive care, cognitive impairments, or communication difficulties that could interfere with accurate pain assessment were not

included. Participants who refused or were unable to provide informed consent were likewise excluded from the study..

Intervention

Before data collection, the researcher informed all respondents about the study's purpose, procedures, and the voluntary nature of their participation. Confidentiality and anonymity were assured, and informed consent was obtained prior to participation. The study was conducted with respect for ethical principles, including autonomy, confidentiality, beneficence, and methodology, as well as instructions on how to use the VAS to rate their level of discomfort. After six hours (when the anesthesia had completely worn off), the lavender essential oil used in this study was obtained from a local health and aromatherapy product distributor in the Cirebon market area, Indonesia. The product was selected based on labeling and certification criteria indicating 100% pure *Lavandula angustifolia* essential oil without any synthetic additives, carrier oils, or chemical diluents. The selection process prioritized oils with clear manufacturer information, production batch numbers, and expiration dates to ensure quality and traceability. Product authenticity was confirmed through the manufacturer's documentation stating that the oil was derived from steam distillation of *Lavandula angustifolia* flowers, a process known to preserve the natural volatile compounds responsible for its therapeutic properties, including linalool and linalyl acetate. The essential oil was stored in a dark amber glass bottle at room temperature and protected from direct sunlight to maintain its stability and aromatic integrity prior to use in the intervention. a researcher gave the experimental group 1 cc of lavender oil (applied into the diffuser to the inside of an O2 face mask and used for three minutes). The mothers received the standard hospital treatment for post-C-Section pain relief. Additionally, moms in the control group received oxygen from the researcher for three minutes while wearing a face mask containing a placebo purified water instead of lavender oil. After 30 minutes, the researcher used VAS to assess the discomfort. The diffuser was positioned 10-30 cm from the patients. Before intervention, the researchers prepared the patient by positioning the patient in a relaxed and comfortable state, and could be accompanied by the family. The intervention involved spending 15 minutes to breathe and inhale lavender, and was performed 3 times (4 hours, 8 hours, and 12 hours after surgery) for 2 days. Following the coding and processing of the row data into coding sheets, the researchers conducted an analysis and interpretation of the data they had gathered. Sunday, Tuesday, and Thursday were the three days of the week designated for data collecting. The data accumulation period lasted six months, from the start of June to the end of December 2024.

Instruments

Refers to the mother's subjective pain self-report and pain observation by *Visual Analogue Scale* (VAS) was used to measure pain in this study, ranging from 0 to 10 (0-2= no pain, 2-4= Mild, 4-6= Moderate, 6-8= Intense, and 8-10 = Unbearable pain). The use of VAS is relatively easy to understand, making it easier for examiners to educate patients on its use.

Analysis

The data were analyzed using both descriptive and inferential statistics. Descriptive analysis was performed to present the frequency distribution, mean, median, and range of pain intensity scores in both the aromatherapy and placebo groups. Before inferential testing, data normality was assessed using the Shapiro-Wilk test, which indicated that the data were not normally distributed. Therefore, the Mann-Whitney U test, a non-parametric alternative to the independent *t*-test, was applied to determine differences in pain intensity between the two groups. A *p*-value of less than 0.05 was considered statistically significant, indicating a meaningful difference in pain intensity between patients who received lavender oil aromatherapy and those in the placebo group.

Ethical Considerations

Approval was obtained from the Ethics Committee of the Research and Community Service Institute of Karya Husada Kediri Health College, No. 096/EC/LPPM/STIKES/KH/VI/2024.

RESULTS

Out of the 215 women assessed for eligibility, 120 met our inclusion criteria and were accepted to be enrolled in our study. They were equally randomized into the two groups: the aromatherapy group (n = 60) and the placebo group (n = 60). All patients completed the intervention in both groups. The CONSORT 2010 flow diagram is detailed in Figure 1.

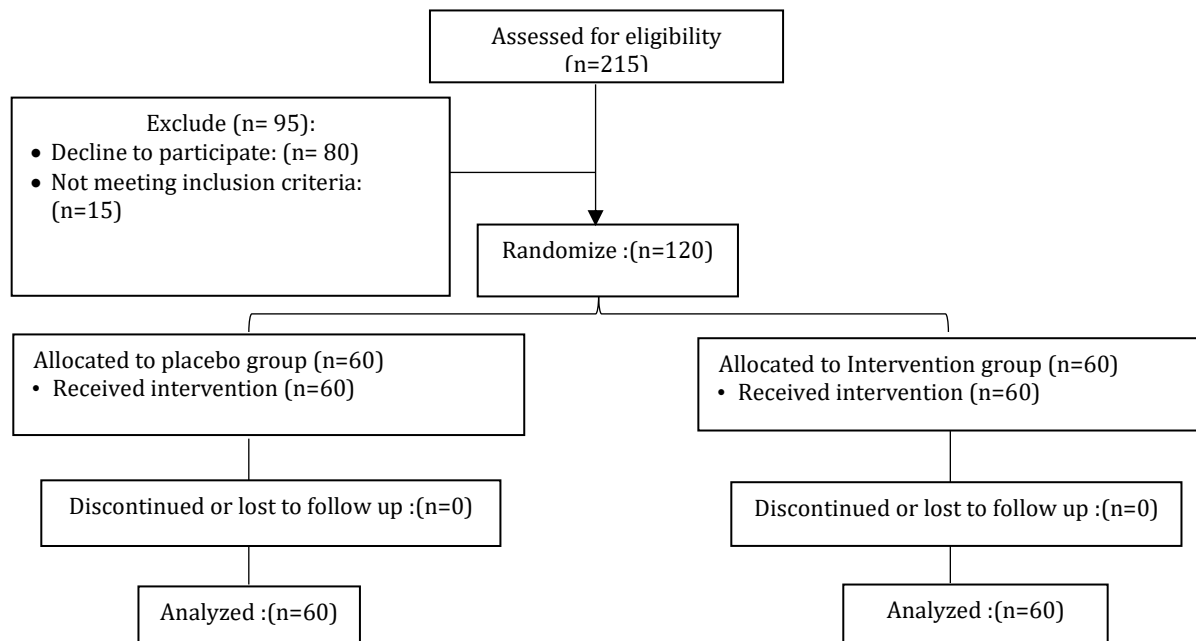


Figure 1. The CONSORT 2010 flow diagram

All participants in both groups received the assigned intervention, and there were no cases of discontinuation or loss to follow-up in either group. Ultimately, data from all 60 participants in the placebo group and all 60 participants in the intervention group were included in the final analysis, ensuring complete follow-up and contributing to the robustness of the study results. Sample characteristics are classified based on age, education, pregnancy history, knowledge about the use of herbs and aromatherapy, employment status to measure activity, and marital status. The following data were obtained in Table 1.

Table 1. Characteristics Distribution of female respondents who gave birth (N=120)

Characteristics	Placebo (%)	Aromatherapy (%)
Age		
Risk (<20 years, > 35 years)	5 (8.33)	7 (11.67)
No risk (20-35 years)	55 (91.67)	53 (88.33)
Education		
Elementary & Junior High School	14 (23.33)	6 (10)
High School	26 (43.33)	32 (53.33)
College	20 (33.34)	22 (36.67)
Parity		
Primigavida	35 (58.33)	28 (46.67)
Multigravida	20 (33.34)	25 (41.66)
GrandeMultipara	5 (8.33)	7 (11.67)
Occupation		
Unemployed	32 (53.33)	28 (53.3)
Employed	28 (46.67)	32 (46.7)
Smoking		
Yes	1 (1.67)	0(0)
No	59 (98.33)	60(100)

Characteristics	Placebo (%)	Aromatherapy (%)
Marital status		
Married	60 (100)	60 (100)
Divorce	0 (0)	0 (0)
Type of C-Section		
Schedule	53 (88.33)	54 (90)
Emergency	7 (11.67)	6 (10)
History of C-Section delivery		
Yes	18 (30)	15 (25)
No	42 (70)	45 (75)

We analyzed the association between demographic features and pre-intervention pain in the study population and the two groups. The characteristics of female respondents who underwent cesarean section (C-section) reveal several important sociodemographic and obstetric trends that can influence postoperative outcomes and the effectiveness of interventions, including complementary therapies such as aromatherapy.

Table 2. Frequency distribution of pain intensity after the Sectio Caesarea (Placebo Group)

Pain Post-SC	n (%)	Mean	Median	Min-Max
Moderate	40 (66.67)	5.75	6.00	4-9
Intense	16 (26.67)			
Unbearable	4 (6.67)			
Total	60 (100)			

Table 2 shows the frequency distribution of pain intensity among post-cesarean section patients who received lavender oil aromatherapy. The majority of respondents in this group reported *mild pain* after the intervention, while fewer experienced *moderate pain*, and none reported *intense* or *unbearable pain*. The mean pain score was notably lower compared to the placebo group, indicating a significant reduction in pain intensity following the administration of lavender oil aromatherapy. These findings suggest that lavender oil aromatherapy was effective in decreasing postoperative pain levels among cesarean section patients at Cirebon Hospital.

Table 3. Frequency distribution of pain intensity after the Section Caesarea (Aromatherapy group)

Pain Post-SC	m (%)	Mean	Median	Min-Max
No Pain	12 (20)			
Mild	44 (73.33)	3.28	3.00	1-8
Moderate	4 (6.67)			
Total	60 (100)			

Based on **Table 3**, it is known that 12 respondents (20%) no longer experienced pain, 44 respondents (73.3%) experienced mild pain, and 4 respondents (6.7%) experienced moderate pain. The results of the data analysis yielded a mean value of pain intensity after Section Caesarea following lavender aromatherapy of 3.28, with a minimum-maximum value of 1-8.

Table 4. Mann-Whitney U Test Result

Group	N	Mean±SD	Median	Mann-Whitney U Test		
			(Min-Max)	U-Value	p-Value	Effect Size (r)
Placebo	60	5.75±1.45	6(4-9)	2638.5	<0.001	0.40
Aromatherapy	60	3.28±1.92	3(1-8)			

The Mann-Whitney U test was performed to compare pain intensity after the Sectio Caesarea between the placebo group and the aromatherapy group. The results showed a statistically significant difference in pain scores (U = 2638.5, p < 0.001, r = 0.40). The median pain score in the aromatherapy

group (3.00) was lower than that in the placebo group (6.00). This finding indicates that lavender aromatherapy effectively reduced postoperative pain intensity, with a moderate-to-large effect size. These results demonstrate that lavender oil aromatherapy was effective in reducing postoperative pain intensity compared to the placebo group. The findings support the potential use of lavender aromatherapy as a complementary and non-pharmacological intervention to improve comfort and promote recovery in post-caesarean section patients at Cirebon Hospital.

DISCUSSION

This study examined the baseline characteristics of 120 women who underwent cesarean section (C-section) and participated in a trial comparing placebo and aromatherapy interventions. The distribution of demographic and obstetric factors was largely similar between groups, indicating a balanced sample suitable for evaluating the intervention's effect.

Most participants fell within the low-risk reproductive age group (20–35 years). This aligns with recommendations from the World Health Organization (11), which identifies this range as optimal for minimizing maternal and neonatal complications. Most participants in both groups fell within the 20–35-year age range (Placebo 91.67%, Aromatherapy 88.33%), which is considered optimal for pregnancy and associated with lower obstetric risks. Only a small proportion were at age-related risk (<20 years or >35 years), suggesting minimal confounding from age-related complications.

Educational attainment was slightly higher in the aromatherapy group, with 53.33% having a high school education compared to 43.33% in the placebo group. College-level education was comparable between groups. Education may influence health literacy and the ability to understand and adhere to post-C-section care instructions, potentially affecting pain perception and response to interventions. Education level has been strongly linked to maternal health behavior, including health literacy, pain management awareness, and responsiveness to non-pharmacological. This well-educated sample may show greater openness to complementary therapies like lavender aromatherapy and be more likely to report accurate perceptions of pain or stress(12).

The distribution of parity showed a predominance of primigravida women in both groups (Placebo 58.33%, Aromatherapy 46.67%), with a smaller proportion of multigravida and grand multipara women. Primigravida refers to women experiencing their first pregnancy, whereas multigravida describes those who have been pregnant more than once, and grand multipara refers to women who have had five or more pregnancies. Parity can influence pain perception and recovery following cesarean section; primigravida women often experience higher levels of anxiety and pain sensitivity during postoperative recovery, while women with previous deliveries may have different pain expectations, tolerance, and coping mechanisms (13). Notably, all participants reported non-smoking status (100%), eliminating smoking as a confounding factor in post-surgical healing or analgesic requirements. Smoking is a known risk factor for delayed wound healing, infection, and impaired recovery after cesarean section (14). Overall, the baseline characteristics indicate that the two groups were comparable, minimizing potential confounding factors. This homogeneity strengthens the internal validity of the study and supports the interpretation of differences in postoperative outcomes, such as pain relief, as likely attributable to the aromatherapy intervention rather than demographic or obstetric differences.

Pain management after cesarean section (C-section) is a critical component of postoperative care, as effective pain control can promote early mobilization, enhance maternal-infant bonding, and reduce the risk of chronic pain development.(15) In recent years, complementary therapies, particularly aromatherapy using essential oils such as lavender, have garnered interest as adjuncts to conventional analgesic methods.

Lavender (*Lavandula angustifolia*) is widely recognized for its analgesic, anxiolytic, and sedative properties. The active components of lavender essential oil, particularly linalool and linalyl acetate, are believed to interact with the limbic system through olfactory pathways, thereby influencing pain perception and emotional response(16). These compounds may exert central nervous system effects by modulating GABAergic transmission, contributing to both pain relief and relaxation.(6)

Lavender aromatherapy has been shown to reduce postoperative pain, including in women who have had cesarean sections, according to an increasing amount of research. In a randomized controlled trial conducted by Abdrabbo et al. (2024), for example, the control group's mean MJPOM pain scores (sensory, affective, and total) were all greater ($p < 0.001$). It was shown that women who inhaled lavender essential oil after cesarean delivery reported significantly lower pain scores compared to those receiving a placebo, and that primiparas had higher pain scores ($p < 0.001$) and that 68.0% of study group women said lavender was effective in reducing their post-CS pain (17)(18). Similarly, research conducted by Febrina M, *et. all* (2023) found that the results obtained that the average post-section cesarean pain before being given lavender aromatherapy was 5.63, and reduced after being given lavender aromatherapy was 3.38. It was used in the early postpartum period, leading to significant reductions in perceived pain intensity and a shorter duration of pain (19). Lavender may also enhance patient satisfaction with postoperative care. In a study by Hamdamian et al. (2018), lavender inhalation not only reduced pain but also improved overall satisfaction and mood in post-cesarean patients. These findings align with broader literature suggesting that aromatherapy can improve the holistic recovery experience through psychological and physiological mechanisms (20).

The results of this study demonstrate that lavender oil aromatherapy significantly reduced postoperative pain intensity among post-cesarean section patients. The Mann-Whitney U test revealed a statistically significant difference between the aromatherapy and placebo groups ($U = 2638.5$, $p < 0.001$, $r = 0.40$), with the median pain score notably lower in the aromatherapy group (3.00) compared to the placebo group (6.00). This finding indicates that lavender aromatherapy had a moderate-to-large effect in alleviating postoperative pain. The results are consistent with previous studies reporting the analgesic and anxiolytic effects of lavender essential oil in postoperative and obstetric populations. The pain-relieving mechanism of lavender is attributed to its active components, such as linalool and linalyl acetate, which act on the limbic system to reduce anxiety and modulate pain perception through central nervous system pathways.

Furthermore, the use of aromatherapy offers a non-invasive, safe, and low-cost complementary approach that can be easily integrated into standard postoperative nursing care. The significant reduction in pain intensity observed in this study suggests that lavender oil aromatherapy may enhance patient comfort and satisfaction during the recovery period after cesarean delivery. These findings reinforce the importance of exploring non-pharmacological interventions as adjuncts to conventional pain management, particularly in clinical settings such as Cirebon Hospital, where resource-efficient methods can contribute to better maternal care outcomes.

Despite these promising results, some limitations remain. Most studies are limited by small sample sizes, varying concentrations of essential oils, and differences in delivery methods (e.g., inhalation vs. topical use). Furthermore, aromatherapy should not replace pharmacologic analgesics C-Section but rather be considered as a complementary therapy within a multimodal pain management strategy. As additional treatment can be combined with Music treatments, which have been demonstrated to significantly reduce postoperative pain intensity, anxiety, and related stress responses (21). It activates auditory pathways that may attenuate nociceptive transmission and stimulates endogenous opioid systems. Physiological benefits of music therapy include stabilization of vital signs and reduction in markers of stress such as cortisol. Psychologically, it improves mood and reduces anxiety, which can contribute to decreased pain perception (22).

These findings suggest that aromatherapy is an effective, non-pharmacological adjunct for postoperative pain management. By modulating pain perception through both neurophysiological and psychological mechanisms, aromatherapy may reduce the need for analgesics, and enhance patient comfort. Its simplicity, safety, and high patient acceptability make it a practical addition to post-cesarean care protocols. Future multicenter studies with standardized aromatherapy interventions are warranted to confirm these effects and explore long-term outcomes.

Postoperative pain management following cesarean section (C-section) remains a critical aspect of maternal care, yet conventional pharmacologic strategies may not fully address patient comfort and satisfaction. In Cirebon Regency, where healthcare services are expanding and maternal health remains a

priority, the introduction of complementary therapies represents a promising innovation in improving postpartum care..

CONCLUSION

Lavender aromatherapy was found to significantly reduce postoperative pain intensity among women undergoing cesarean section, with a moderate-to-large effect size, indicating its effectiveness as a complementary non-pharmacological intervention. Participants receiving aromatherapy reported lower median pain scores compared to those in the placebo group, supporting the analgesic and calming effects of *Lavandula angustifolia* through its active components, linalool and linalyl acetate, which modulate pain perception via central nervous system pathways. As a safe, simple, and low-cost adjunct, lavender aromatherapy can enhance maternal comfort and satisfaction when integrated into standard postoperative care protocols. However, larger, multicenter studies are recommended to validate these findings and establish standardized guidelines for their clinical application.

CONFLICTS OF INTEREST

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

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