

The effectiveness of combining lemon aromatherapy with a digital prayer bead distraction in reducing pain in post-cesarean section patients at RSI Fatimah Cilacap

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Abstract

Background: Cesarean section (CS) is a major obstetric surgical procedure that carries a risk of postoperative pain, which can impair comfort and mobility and slow recovery. A potential nonpharmacological intervention is a combination of lemon aromatherapy and digital rosary distraction. This study aims to determine the effectiveness of this combination in reducing pain in patients following a cesarean section.

Method: A quantitative study using a quasi-experimental pre-test post-test design with a control group. A sample of 40 respondents was divided into an intervention group (n=20), which received a combination of lemon aromatherapy and digital prayer bead distraction, and a control group (n=20), which received only digital prayer bead distraction, using consecutive sampling. The intervention was administered for 15 minutes during the first 24 hours post-surgery. Pain was measured using the NRS. Data analysis utilized the paired t-test, Wilcoxon test, and Mann–Whitney U test.

Results: There was a significant reduction in pain levels before and after the intervention in both groups ($p < 0.05$). The mean pain score in the intervention group decreased from 4.40 to 2.90, while in the control group it decreased from 4.85 to 4.25. There was a significant difference between the groups ($p = 0.011$), with a lower median pain score in the intervention group (3) compared to the control group (4).

Conclusion: Both interventions were found to be effective in reducing pain, but the combination of lemon aromatherapy and digital rosary distraction was more effective than digital rosary distraction alone in patients who had undergone cesarean section surgery.

Keywords: Lemon aromatherapy; Digital prayer bead distraction; Pain management; Postoperative pain; Cesarean section.

INTRODUCTION

A cesarean section (C-section) is a major obstetric surgical procedure performed by making an incision in the uterine wall through the anterior abdominal wall to save the mother and baby when vaginal delivery is not possible (1). The prevalence of cesarean sections continues to rise globally, with more than 21% of births in 2021 performed via this procedure, including high rates in China and Latin America (2). In Indonesia, a similar trend is also evident, with an increase from 17.6% in 2018 to 25.9% in 2023 (3). That figure exceeds the World Health Organization's (WHO) recommendation of 10–15%, underscoring the importance of optimal

postoperative care, particularly in pain management (4).

Post-cesarean section pain remains a major problem, with a prevalence of about 60%, particularly in the first 24 hours after surgery, and pain intensity generally falls into the moderate-to-severe category (5). This condition can hinder early mobilization, slow recovery, and reduce patient comfort (6). In addition, pain management is often suboptimal due to mothers' concerns about the effects of analgesics on newborns, so pain is not always adequately reported (7). To date, pain management has been dominated by pharmacological therapy, even though psychological factors also influence pain perception (8,9).

Postoperative pain following a cesarean section can be managed through both pharmacological and nonpharmacological approaches. The use of opioid analgesics, which is part of pharmacological management, has been shown to be effective in reducing pain; however, it carries a risk of side effects and does not fully support patients' independence in managing their pain (6). Therefore, nonpharmacological approaches such as aromatherapy and distraction techniques are relevant alternatives. Lemon aromatherapy is known to have a relaxing effect due to its linalool and limonene content, while the digital prayer bead distraction helps divert the patient's attention from pain sensations through pain control mechanisms in the central nervous system (10,11). This intervention is relatively easy to implement, low-cost, and has a high acceptance rate (12,13).

Several previous studies have examined the combination of lemon aromatherapy and digital prayer bead distraction, including in post-cesarean section patients; however, most of these studies employed case-control and pre-experimental designs with small sample sizes, and few have utilized quasi-experimental designs with control groups in clinical settings. This situation highlights a gap in the evidence regarding the effectiveness of comprehensive nonpharmacological interventions. Therefore, this study offers a novel approach involving the use of a combination of lemon aromatherapy and digital prayer bead distraction, employing a quasi-experimental design to improve the quality of post-cesarean section pain management.

According to a preliminary survey conducted by researchers at RSI Fatimah Cilacap from May to July 2025, there were 163 cesarean sections performed over the past three months, averaging 54 cases per month. The high number of cases underscores the need for effective, evidence-based management of post-cesarean section pain in clinical settings. Therefore, this study aims to analyze the effectiveness of combining lemon aromatherapy and digital

rosary distraction in reducing pain levels in post-cesarean section patients.

METHOD

This study was conducted at RSI Fatimah Cilacap from November 19 to December 23, 2025, using a quantitative design with a quasi-experimental pretest–posttest approach with a control group to assess baseline conditions and examine differences between the intervention and control groups.

The study population consisted of all patients who had undergone a cesarean section (CS) and were experiencing pain, with an average of 54 patients per month. The sample size was determined using the G*Power calculation, taking into account the potential for dropouts. The sampling technique used was non-probability sampling with a consecutive sampling method based on inclusion criteria, resulting in 40 respondents who were divided equally into two groups (20 respondents each).

The research instrument used the Numeric Rating Scale (NRS) to measure pain intensity before and after the intervention. Data were collected via observation sheets and medical records. The intervention for the treatment group consisted of lemon aromatherapy administered via a diffuser for 15 minutes at a distance of 15–20 cm, combined with digital prayer bead distraction. Meanwhile, the control group was only given digital prayer bead distraction for the same duration.

Data processing was conducted through the stages of editing, coding, data entry, data cleaning, and tabulation. Univariate analysis was used to describe the characteristics of the respondents and the distribution of pain levels. A normality test was conducted using the Shapiro–Wilk test because the sample size was less than 50. The results showed that the data in the intervention group were normally distributed ($p > 0.05$), whereas in the control group, only the pretest data were normally distributed, while the posttest data were not ($p < 0.05$). A test of homogeneity of variances using Levene's test showed that the

variances of the two groups were homogeneous ($p > 0.05$).

Bivariate analysis was conducted to test for differences within and between groups. A paired t-test was used for the intervention group, while the Wilcoxon signed-rank test was used for the control group. Comparisons between groups were performed using the Mann–Whitney U test. This study has received ethical approval from the Health Research Ethics Committee of Harapan Bangsa University No. B. LPPMUHB/1084/10/2025. All participants provided written informed consent, and data confidentiality was maintained throughout the study.

RESULTS

Respondent Characteristics

The majority of respondents in this study were in the early adult age group (77.5%). Based on parity, the intervention group was dominated by primiparous women (55.0%), while the control group was dominated by multiparous women (55.0%). The majority of respondents had no history of cesarean section (65.0%), with a relatively similar distribution in both groups. Nearly all respondents received levobupivacaine (92.5%). The mean duration of surgery was 47.88 ± 7.72 minutes. Tests of equivalence (chi-square/Fisher's exact test for categorical data and independent t-test for numerical data) showed that all variables had $p > 0.05$, so the two groups were deemed homogeneous (Table 1).

Table 1 Frequency Distribution of Respondent Characteristics

Variable	Total (n=40)	Intervention (n=20)	Control (n=20)	P-value
Age				
Late adolescence	5 (12,5)	4 (20,0)	1 (5,0)	0,207 ^a
Early adulthood	31 (77,5)	13 (65,0)	18 (90,0)	
Late adulthood	4 (10,0)	3 (15,0)	1 (5,0)	
Parity status				
Primipara	19 (47,5)	11 (55,0)	8 (40,0)	0,525 ^a
Multipara	20 (50,0)	9 (45,0)	11 (55,0)	
Grand multipara	1 (2,5)	0 (0,0)	1 (5,0)	
SC History				
Yes	14 (35,0)	7 (35,0)	7 (35,0)	1,000 ^b
No	26 (65,0)	13 (65,0)	13 (65,0)	
Anesthetic agents				
Levobupivacaine	37 (92,5)	17 (85,0)	20 (100,0)	0,231 ^a
Bupivacaine	3 (7,5)	3 (15,0)	0 (0,0)	
	Mean±SD	Mean±SD	Mean±SD	
Duration of surgery	47.88±7.72	46.25 ± 5.51	49.50 ± 9.31	0.189 ^c

^ap-value from Fisher's Exact test, ^bp-value from Chi-square test, ^cp-value from Independent t-test

Differences in Pre-test and Post-test Pain Scores Between the Intervention Group and the Control Group

Table 2 shows the distribution of pain levels in patients following cesarean section. In the intervention group, the mean pain score decreased from 4.40 ± 1.90 (median 4.0; range 2–8) to 2.90 ± 1.80 (median 3.0; range 0–6). In the control group, the mean pain score also decreased from 4.85 ± 1.46

(median 5.0; range 3–8) to 4.25 ± 1.61 (median 4.0; range 2–8). The results of the paired t-test and Wilcoxon test showed a p-value < 0.001 in both groups, indicating a significant difference between pain levels before and after the intervention. These findings indicate that both the intervention group and the control group were equally effective in reducing pain levels in patients following a cesarean section (CS).

Table 2 Differences in Pretest and Posttest Pain Scores Between the Intervention Group and the Control Group

Variable	n	Mean±SD	Median (Minimum Maximum)	P-value
Intervention Group				
Pretest	20	4,40±1,90	4,0 (2-8)	<.001 ^a
Posttest	20	2,90±1,80	3,0 (0-6)	
Control Group				
Pretest	20	4,85±1,46	5,0 (3-8)	<.001 ^b
Posttest	20	4,25±1,61	4,0 (2-8)	

^aUji paired sample t-test, ^bUji Wilcoxon signed-rank test

Differences in Post-Test Pain Levels Between the Intervention and Control Groups

Based on Table 3, the analysis conducted to determine the difference in effectiveness between the intervention and control groups showed an Asymp. Sig. (2-tailed) value of 0.011, which is smaller than

the significance level of 0.05. These results indicate a statistically significant difference in effectiveness between the intervention and control groups, where the combination therapy of lemon aromatherapy and digital tasbeeh distraction was proven effective in reducing pain intensity in patients following a cesarean section (CS).

Table 3 Differences in Post-Test Pain Levels Between the Intervention and Control Groups

Variable	n	Median (Minimum Maximum)	Mean Rank	P-value
Intervention Group	40	3,0 (0-6)	15,95	0,011
Control Group	40	4,0 (2-8)	25,05	

DISCUSSION

The majority of respondents in this study were in their early adulthood (26–35 years old), which is the optimal reproductive age for pregnancy and childbirth. In this age group, physiological conditions are generally relatively stable compared to those at the extremes of the age spectrum (<20 years or >35 years), which are known to carry a higher risk of obstetric complications. In addition, age is also linked to pain perception. It is known that advancing age can reduce pain sensitivity due to neurophysiological changes (14). The findings of this study are consistent with previous research reporting that cesarean sections (CS) are more common among women of reproductive age (15,16).

Based on parity, the majority of respondents were multiparous (50.0%). Parity is known to influence pain intensity through both psychological and physiological mechanisms (17). In addition, multiparity is

also associated with an increased risk of cesarean section due to obstetric factors such as fetal distress, malpresentation, or obstructed labor (18,19). This finding is consistent with the study by Damanik & Zuiatna (2024), which reported that cesarean section patients were predominantly multiparous women (20). The study by Kaur et al. (2025) also shows that cesarean sections can occur in multiparous women even without a prior history of cesarean section (21). The distribution of parity across the groups showed variation, with the intervention group having a higher proportion of primiparous women (55.0%) and the control group having a higher proportion of multiparous women (55.0%). This variation is still acceptable because parity was not used as a basis for sample grouping, and therefore did not affect the analysis of the study's primary outcomes (22)

Most respondents (65.0%) had no prior history of cesarean section, indicating that primary cesarean sections predominated in this study. This finding is consistent with Nguyen et al. (2022), who reported that the proportion of primary cesarean sections remains quite high. Clinically, this condition is generally caused by acute obstetric indications such as fetal distress, malpresentation, or failure of labor to progress (23,24).

Regarding the use of anesthetic agents, nearly all respondents (92.5%) used levobupivacaine, while a small proportion used bupivacaine (7.5%). The choice of levobupivacaine aligns with the study by Paul et al. (2024), which reported that this agent has a better safety profile with more stable hemodynamic effects and fewer side effects compared to bupivacaine, without compromising the quality of analgesia (25). Pada penelitian ini, seluruh responden juga received a fentanyl adjuvant, which is known to prolong the duration of sensory block and improve the quality of postoperative analgesia. This is supported by studies by Gupta et al. (2025) and Sharma et al. (2025), which reported that the combination of levobupivacaine and fentanyl at appropriate doses provides more optimal analgesia duration and longer sensory block, reduces the dose of local anesthetic, and minimizes side effects (26,27).

The mean duration of surgery in this study was 47.88 ± 7.72 minutes, with the intervention group having a shorter duration of 46.25 ± 5.51 minutes compared to the control group's 49.50 ± 9.31 minutes. These results fall within the range of cesarean section durations reported in the literature, with a median of 53 minutes (IQR 44–64 minutes) (28). In addition, Lang Ben Nun et al. (2023) reported that prolonged surgery (>60 minutes) is associated with an increased risk of maternal complications, including bleeding, the need for transfusions, and intraoperative organ complications in certain cases (29).

The main findings of this study indicate that both the intervention group and the control group experienced a significant reduction in pain before and after the

intervention ($p < 0.000$), however, the reduction in pain was greater in the intervention group, with the mean pain score decreasing from 4.40 ± 1.903 to 2.90 ± 1.804 (median 4.0 to 3.0). Meanwhile, in the control group, the reduction in pain was relatively smaller, namely from 4.85 ± 1.461 to 4.25 ± 1.618 (median 5.0 to 4.0). Physiologically, this indicates that the combination of aromatherapy and distraction mechanisms allows for the simultaneous modulation of pain through physiological and cognitive pathways, resulting in a greater pain-reducing effect compared to the single intervention in the control group (30).

Lemon aromatherapy works through the olfactory system, whereby inhaled aroma molecules bind to receptors in the nasal epithelium and are transmitted to the limbic system, which plays a role in regulating emotions and pain perception (31). The effectiveness of this mechanism is influenced by an individual's ability to process olfactory stimuli as well as the state of their respiratory function (32). In postoperative patients, respiratory function generally remains stable, allowing for optimal aromatherapy inhalation even in the presence of pain.

These findings are supported by Ma et al. (2025), who reported that postoperative pain has a greater impact on circadian rhythm disturbances, sleep quality, fatigue, and limited mobility, without directly affecting respiratory function (33). In line with this, Trewren et al. (2025) also found that pain is more closely associated with mobility impairments, gastrointestinal symptoms, and immunosuppressive responses during treatment (34). In addition, Sudanningsih et al. (2025) reported that post-caesarean section patients are still able to perform breathing exercises, such as deep breathing relaxation techniques, to help reduce pain (35). Overall, this indicates that respiratory function remains relatively intact, allowing aromatherapy inhalation to work effectively.

The effectiveness of lemon aromatherapy is also influenced by its active compounds, such as linalyl acetate and linalool, which help reduce stress and anxiety and provide a relaxing effect. Other volatile

compounds, such as bergamot, farnesol, and limonene—which are highly volatile and rich in monoterpene hydrocarbons—can stimulate olfactory receptors in the nose, sending impulses to the central nervous system, particularly the limbic system and the hypothalamus (36). Activation of this pathway triggers the release of serotonin and endorphins, increases activity in the parasympathetic nervous system, and lowers cortisol levels. Overall, this mechanism contributes to the activation of the endogenous pain modulation system, thereby reducing pain intensity through nonpharmacological means (31,32).

Conversely, digital prayer bead distraction works through cognitive mechanisms by exploiting the limited capacity of attention to process pain stimuli and distracting stimuli simultaneously. The competition between these two stimuli causes attention to shift more toward distracting activities, thereby reducing pain perception. Neurologically, this process involves the activation of the dorsolateral prefrontal cortex (DLPFC) and the anterior cingulate cortex (ACC), which play a role in regulating attention and emotions prior to the onset of pain. Activation of these brain regions modulates pain before it reaches the pain perception center (37).

The effectiveness of distraction is highly influenced by an individual's ability to maintain focus on the distracting stimulus. In this study, the intervention was conducted in a multi-patient inpatient ward with various external stimuli, such as ambient noise and the activities of other patients. These conditions have the potential to disrupt respondents' concentration, so the effectiveness of the distraction may vary. This is consistent with Hijriana & Yusnita (2023), who state that the greater the focus of attention on the distracting stimulus, the lower the perceived pain (38).

Overall, the results of the Mann–Whitney test indicate a statistically significant difference between the intervention group and the control group in terms of postoperative pain reduction following cesarean section ($p = 0.011$; $p < 0.05$). These findings confirm the

study hypothesis that a combination of interventions is more effective than a single intervention in reducing pain. Theoretically, these findings are consistent with Shi & Wu (2023), who state that nonpharmacological pain management works through peripheral, spinal, and supraspinal mechanisms, and thus a multimodal approach is more effective than a single intervention (30).

The findings of this study are also consistent with various previous studies that have demonstrated the effectiveness of combined nonpharmacological interventions in reducing postoperative pain. Sari & Kristinawati (2025) reported that a combination of aromatherapy and digital rosary distraction was effective in reducing pain during both the preoperative and postoperative phases (39). Similar findings were also reported by Ginting et al. (2024), who showed that a combination of nonpharmacological interventions can gradually reduce pain with each day of treatment. The average decrease in pain scores on the first day was 0.41 points (from 4.33 to 3.92). Meanwhile, in this study, a single 15-minute intervention session resulted in a 1.50-point reduction in pain (from 4.40 to 2.90). Numerically, this reduction was greater than the 0.41-point reduction observed on the first day of the study by Ginting et al. (2024) (40).

The consistency of these findings is further supported by Alves et al. (2025), who reported a shift in pain categories from moderate to mild following the administration of a combination intervention (41). In line with this, this study also shows a shift in pain distribution toward milder categories following the intervention. Overall, these results confirm that a combination of nonpharmacological interventions is more effective than a single intervention in the management of postoperative pain.

The results of this study have limitations because they did not account for psychological factors such as anxiety, individual pain thresholds, and cultural factors, as well as biological factors such as stress biomarkers. These factors could theoretically have a significant impact on pain

perception. Therefore, future studies are encouraged to include these variables so that the predictive model for post-cesarean section pain becomes more comprehensive and applicable in clinical practice.

CONCLUSIONS

The majority of respondents—post-cesarean section (CS) patients—were in the early adult age group, were multiparous, had no history of CS, and received the same dose of levobupivacaine anesthesia; thus, the baseline characteristics of the two groups were considered comparable. The results showed a significant reduction in pain intensity in both groups, with a greater reduction in the group receiving the combination of lemon aromatherapy and digital rosary distraction. Thus, this combined intervention was more effective than digital rosary distraction alone in reducing pain in post-CS patients.

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