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Effectiveness of lavender and lemon aromatherapy on postpartum perineal wound pain

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ABSTRACT

Background: *The maternal mortality rate in Indonesia remains above the World Bank's estimated average. Various studies have been conducted to reduce this figure. One such study involves providing aromatherapy to postpartum mothers. Perineal pain is a frequently reported concern after childbirth, which can interfere with a mother's recovery. The use of lavender and lemon aromatherapy offers a non-pharmacological therapeutic alternative for managing this discomfort.*
Objectives: *This study aims to evaluate the effectiveness of lavender and lemon aromatherapy on postpartum perineal wound pain.*
Methods: *The research design used was a pre-experimental study involving two experimental groups. The population in this study consisted of 40 postpartum mothers. Using a purposive sampling technique, 30 women were selected as the research sample. The instrument used was a VAS questionnaire with 4 response scales. Data were analyzed using a paired t-test and Cohen's d.*
Results: *The results revealed that lavender aromatherapy was effective in reducing postpartum perineal wound pain with moderate (2 hours) and severe (4 hours) criteria. This finding was attributed to lavender aromatherapy's neuromodulatory effect, which impacted the psyche and caused mild anti-inflammatory effects on the wound. In fact, lemon aromatherapy proved effective with very severe criteria, both for the first 2 hours and the following 24 hours. These results were due to the combination of limbic neurotransmitters with peripheral anti-inflammatory effects, which helped mothers manage stress and other psychological factors during labor.*
Conclusions: *The study concluded that lemon aromatherapy was more effective than lavender because it was richer in citric acid and limonene. The study recommended that future research use a larger sample size and include several covariates to ensure broad generalizability of the findings.*

KEYWORD: *anti-inflammatory; lavender aromatherapy; lemon aromatherapy; postpartum perineal wound pain*

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INTRODUCTION

Maternal safety and health are crucial postpartum concerns (1,2). The safety and health of mothers after childbirth is also a priority because it is related to sustainable development goals (SDGs) 3.1, namely reducing maternal mortality rates (3,4). Reducing maternal mortality is also a global health target in Indonesia, but this target has not been optimally achieved due to various obstacles (5,6). Although national data indicate a decline in maternal mortality in recent years, it remains above the World Bank's estimated average (7). Global targets, as outlined in the SDGs, also expect a significant reduction by 2030 (8,9). These targets and data indicate that efforts to reduce maternal mortality are a priority and remain urgent, requiring appropriate preventative measures, including accelerated recovery by reducing postpartum pain.

Mothers experience various clinical problems during the postpartum period (10). One of these is perineal pain (11) which occurs due to tears and episiotomies. Clinically, perineal pain is defined as a tissue discontinuity that occurs during childbirth, causing pain and discomfort in the mother (12). Pain is a combination of unpleasant sensory and emotional experiences resulting from actual or potential tissue damage in the body (13). Perineal pain impacts various maternal activities, such as sleep quality, mobility, initiation and continuation of breastfeeding, willingness to touch the genital area during urination, and the mother's psychological state (14,15). Existing clinical data indicate a high level of perineal pain in mothers during the postpartum period.

Various strategies are implemented to manage this pain, one of which is aromatherapy (16). Furthermore, aromatherapy works through two physiological pathways: the olfactory and circulatory systems. Aromatherapy is considered an attractive intervention because it is relatively easy to implement, inexpensive, and has the potential to reduce analgesic use (17). Several types of essential oils are used for aromatherapy. One of these is Lavandula angustifolia (lavender) (18). Linalool and linalyl acetate are associated with analgesic and relaxation effects, thus reducing pain in women giving birth. Another type is Citrus limon (lemon) (19). Lemon aromatherapy also has the potential to provide analgesic effects, thus reducing pain. Several previous studies (20) show that lavender and lemon aromatherapy can reduce pain caused by perineal wounds in postpartum mothers.

However, little research examines the impact of these two aromatherapy treatments in the context of Indonesia, particularly West and North Lombok. Previous research (16,18,21) is limited to evaluating only one type of aromatherapy, making it difficult to definitively determine its significant impact on perineal wound pain. Furthermore, few studies investigate pain

levels before and after aromatherapy administration. Based on the foregoing, the purpose of this study is to evaluate the effectiveness of lavender and lemon aromatherapy inhalation in reducing perineal pain in postpartum mothers. The pain measurement scale used is a visual analog scale (VAS). The results of this study are expected to provide a basis for implementing standardized, easy, safe, and affordable complementary therapies that can be integrated into postpartum care procedures in clinics or hospitals. To achieve these objectives, several research questions (RQs) are formulated, including:

RQ-1. How effective is lavender aromatherapy on postpartum perineal wound pain?

RQ-2. How effective is lemon aromatherapy on postpartum perineal wound pain?

RQ-3. How does the effectiveness of lavender and lemon aromatherapy compare on postpartum perineal wound pain?

MATERIALS AND METHODS

The design used in this study was a pre-experimental design with two experimental groups (pre-post design). This design was chosen because it was relevant (22,23) to the objectives of the study. It allowed researchers to assess changes in pain levels both before and after treatment was administered to the same participants. Participants did not have to move during treatment, which made it easier to implement directly in the postpartum ward. Furthermore, the design allowed all participants in the group to benefit from the treatment, with no participants being excluded. It also tended to be efficient for observing the direct effects of aromatherapy on pain reduction within a short period of time. The research procedure is shown in **Figure 1.**

Figure 1. Research procedures

This study was conducted on postpartum mothers at two community health centers in two districts, namely West Lombok Regency and North Lombok Regency, Indonesia. The study was carried out from August to October 2025. The population in this study consisted of forty postpartum mothers at the community health centers. The sample was obtained using a purposive sampling technique, resulting in approximately thirty postpartum mothers. The inclusion criteria were willingness to participate as research subjects and unwillingness to receive painkillers and/or induction from the community health center. The exclusion criteria were having allergies to aromatherapy or to lavender and lemon essential oils.

The dependent variable in this study was perineal wound pain in postpartum mothers. The instrument used to measure this variable was a visual analog scale (VAS) questionnaire that was divided into four categories according to the measurement score (24). The categories were 0 (no pain), 1–3 (mild pain), 4–6 (moderate pain), 7–9 (severe pain), and 10 (very severe pain) (25,26). Meanwhile, the independent variables in this study were lavender and lemon aromatherapy, with categories 1 (treated) and 2 (not given). The data analysis used in this study was univariate data analysis to obtain descriptive data from the research results. The analysis (27) described the characteristics of the respondents, as well as the mean, median, standard deviation, minimum, and maximum values of the data. Furthermore, the data analysis used was bivariate data analysis. The bivariate data analysis employed was the paired t-test (28) and Cohen's d(29) because most of the data were normally distributed.

The criteria used were that when the significance value of the test was less than 0,05, it could be concluded that the aromatherapy given was effective in reducing postpartum perineal wound pain(30). The criteria for the magnitude of the effect were shown in **Table 1.**

Table 1. Effect criteria in Cohen's (31,32)

Categories	Value
Very small	0.01 - 0.19
Small	0.20 - 0.49
Medium	0.50 - 0.79
Large	0.80 - 1.19
Very large	1.20 - 1.99
Huge	$\geq$ 2.00

RESULTS AND DISCUSSION

Effectiveness of Lavender Aromatherapy in Reducing Postpartum Perineal Wound Pain

Based on the results of the data analysis of postpartum mothers who were given lavender aromatherapy, the data description was obtained as shown in **Table 2.** Based on Table 2, the information showed that there was a decrease in VAS of 7,34 at 2 hours, and after 24 hours there was a decrease of 12,67.

Table 2. Lavender aromatherapy data description

Variable	n	Mean	Median	Min	Max	SD
2-hour VAS (before)	15	74.67	80	50	90	13.02
2-hour VAS (after)	15	67.33	70	50	90	13.35
24-hour VAS (before)	15	68.00	70	50	90	13.20
24-hour VAS (after)	15	55.33	50	40	80	11.87

Table 3. Results of the normality test for lavender aromatherapy data

Variable	Shapiro-W	p-value	Decision (α=0,05)
2-hour VAS (before)	0,9033	0,1070	Normal
2-hour VAS (after)	0,8944	0,0782	Normal
24-hour VAS (before)	0,9169	0,1724	Normal
24-hour VAS (after)	0,9173	0,1750	Normal

Table 4. Results of inferential statistical analysis of lavender aromatherapy data

Variable	t (paired)	df	p (two-sided)	p (one-sided)	Cohen's d	Criteria
2-hour VAS	-24.42	14	0.0285	0.0142	-0.631	Medium
24-hour VAS	-40.12	14	0.0013	0.0006	-1.036	Large

The results of the normality test for the lavender aromatherapy data were shown in **Table 3. Table 3** indicated that all data were normally distributed because the significance value was greater than 0,05.

Furthermore, the results of the data analysis were shown in **Table 4. Table 4** indicated that in the first 2 hours, the effect of lavender aromatherapy was classified as moderate because the Cohen's d value was in the range of 0,5 to 0,79. Meanwhile, in the next 24 hours, the information showed that the aromatherapy had a large effect because the Cohen's d value was in the range of 0,8 to 1,19.

Based on the research results, it is found that lavender aromatherapy has a significant effect on reducing postpartum perineal wound pain. This reduction occurs not only in the first two hours but also throughout the following 24 hours. The reduction is also quite significant, especially during the subsequent 24-hour period. These results align with research conducted in Malaysia (33), which reveals that administering lavender aromatherapy to postpartum mothers can reduce pain caused by childbirth. These results also align with several previous studies (34,35), which show that lavender aromatherapy can reduce postpartum perineal wound pain in women giving birth.

Lavender aromatherapy is able to reduce postpartum perineal wound pain because it works through a combination of neuromodular effects that act psychologically in the brain of the mother giving birth, along with mild anti-

inflammatory effects that act locally (36,37). The lavender vapor inhaled by the mother is captured by the olfactory senses, then processed by the amygdala, and subsequently by the hippocampus and hypothalamus (38). The linalyl acetate and linalool in lavender vapor reduce anxiety and tension, which are affective components of pain (39,40). Linalool actively plays a role in increasing GABAergic activity, which produces a calming effect (41). Linalool also modulates the formation of endorphins and serotonin, which are natural analgesics that reduce pain (41,42).

Lavender aromatherapy also regulates stress in mothers giving birth (43,44). It reduces cortisol and sympathetic activity and shifts the body into a state of relaxation (parasympathetic tone) (45). This reduced stress then makes the body feel comfortable, thereby reducing pain (46,47). Lavender aromatherapy also contains terpene compounds that reduce pain mediators due to their anti-inflammatory properties (48,49). These terpene compounds also possess antimicrobial properties that reduce pain locallyl (50). Lavender aromatherapy has a positive impact on sleep quality and mood after childbirth (51). This mechanism explains why pain reduction after 24 hours has a greater effect than in the first 2 hours.

Effectiveness of Lemon Aromatherapy in Reducing Postpartum Perineal Wound Pain

The results of the analysis of the lemon aromatherapy data were shown in **Table 5. Table 5** indicated that there was a decrease in pain of 16 in the first 2-hour phase and a decrease of 13,33 in the following 24-hour phase.

Table 5. Lemon aromatherapy data description

Variable	n	Mean	Median	Min	Max	SD
2-hour VAS (before)	15	60	60	50	80	15
2-hour VAS (after)	15	44	40	30	60	15
24-hour VAS (before)	15	48	50	40	60	15
24-hour VAS (after)	15	34.67	30	20	50	15

Table 6. Results of the normality test for lemon aromatherapy data

Variable	Shapiro-W	p-value	Decision (α=0,05)
2-hour VAS (before)	0.8618	0.0257	-
2-hour VAS (after)	0.8825	0.0518	Normal
24-hour VAS (before)	0.801	0.0038	-
24-hour VAS (after)	0.8652	0.0287	-
Δ 2-hour (post?pre)	0.8818	0.0504	Normal
Δ 24-hour (post?pre)	0.7827	0.0022	-

The results of the normality test for the lemon aromatherapy data were shown in **Table 6**. Based on **Table 6**, the information indicated that the data were not normally distributed for most of the variables.

Although the data in **Table 6** showed non-normal results, some of the differences (Δ) were normally distributed. Therefore, the data analysis used the paired t-test and Cohen's d, as the t-test value was considered quite robust. The results of the data analysis were presented in **Table 7**. **Table 7** indicated that lemon aromatherapy had a very significant effect at both 2 hours and 24 hours.

Table 7. Results of inferential statistical analysis of lemon aromatherapy data

Variable	t (paired)	df	p (two-sided)	p (one-sided)	Cohen's d	Criteria
2-hour VAS	-6.808	14	0	0	-1.758	Very large
24-hour VAS	-7.135	14	0	0	-1.842	Very large

The results of **Table 7** of the study also reveal that lemon aromatherapy reduces postpartum perineal pain. In fact, the effect is quite significant in reducing pain, both in the first 2 hours and the following 24 hours. These results align with several previous studies that show that lemon aromatherapy can reduce postpartum pain (52,53). Lemon aromatherapy reduces postpartum perineal pain because it works by combining limbic neurotransmitter activity with peripheral anti-inflammatory effects, thereby autonomously regulating stress and other psychological factors (54). Lemon aromatherapy influences the olfactory pathway through the limbic system (55). It contains volatile lemon molecules such as linalool or linalyl acetate, limonene, and citral. When these volatile molecules are inhaled, they stimulate the olfactory system, which then transmits signals to the amygdala, hippocampus, and hypothalamus (20,56,57). This series of activities reduces various components of tension and anxiety, thereby increasing the pain perception threshold.

Furthermore, exposure to citrus in lemon aromatherapy increases serotonin and endorphins, which are mood-enhancing and natural analgesics, and suppresses sympathetic tone, thus reducing pain (58). Citral or limonene contained in lemon aromatherapy also suppresses the COX pathway of prostaglandins and other inflammatory mediators, thereby reducing local inflammation in the wound area (59,60). Citrus aromas also reduce cortisol and sympathetic activity, which encourage parasympathetic relaxation, thus mediating analgesia (61,62). The antimicrobial properties of lemon essential oil further improve perineal comfort in postpartum mothers (19,21).

Table 8. Comparison of the aromatherapy effects of lavender and lemon

Variable	Lavender		Lemon	
	Cohen's d	Criteria	Cohen's d	Criteria
2-hour VAS	-0.631	Medium	-1.758	Very large
24-hour VAS	-1.036	Large	-1.842	Very large

Comparison of the Effectiveness of Lavender and Lemon Aromatherapy on Postpartum Perineal Wound Pain

A comparison of the effectiveness between lavender and lemon aromatherapy was shown in **Table 8**. **Table 8** provided information that lemon aromatherapy was more effective than lavender because it had greater criteria.

Furthermore, the research results **Table 8** reveal that lemon aromatherapy tends to be more effective than lavender aromatherapy. Although no previous studies have definitively compared the two aromatherapy modalities, this finding is likely due to lemon's rich combination of citral and limonene, which promotes a faster onset of pain relief (63,64). The citrus in lemon also tends to reduce tension and increase positivity, making it easier for mothers to perceive postpartum pain, especially in the first 24 hours (65). The aroma of lemon also promotes relaxation and reduces sympathetic activity, which can increase the pain threshold, relax muscles, and reduce the sensory interpretation of pain (54,66,67). The antimicrobial and anti-inflammatory properties of citrus essential oils also tend to reduce local pain or discomfort, especially in fresh perineal wounds.

Although the research findings suggest that lemon aromatherapy is more effective than lavender, it should be noted that this conclusion is not absolute. This is due to the limited number of participants or samples in this study. The sample size is relatively small, so the findings require further confirmation with a larger sample. In addition, randomized testing that includes several controls or clinical covariates, such as parity, systemic analgesics, and type of relief, is necessary in subsequent studies.

CONCLUSION AND RECOMMENDATION

Based on the previous description, several findings can be concluded. First, lavender aromatherapy is considered effective in reducing postpartum perineal wound pain. The criteria for effectiveness are moderate during the first 2 hours and significant during the next 24 hours. This is because lavender aromatherapy provides a psychomodular effect and a mild, local anti-inflammatory effect. Second, lemon aromatherapy is also considered effective in reducing perineal wound pain. In fact, the effect is quite significant, both in the first 2 hours and in the following 24 hours. This result is due to aromatherapy working by

combining limbic neurotransmitters with peripheral anti-inflammatory mechanisms, enabling the birthing mother to regulate stress and various other psychological factors autonomously. Third, lemon aromatherapy is more effective than lavender. This result is likely due to lemon aromatherapy being richer in limonene and citral, resulting in a faster onset of effect on postpartum perineal wound pain. Despite these positive results, this study has several limitations. One of these is the relatively small sample size. Therefore, future research should use a larger sample size. In addition, future research is expected to include control variables or covariates, such as parity, systemic analgesics, and type of relief, so that the research findings obtained are more credible and can be generalized.

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