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The Effect of Inhaled Lemon Essential Oil Aromatherapy on Pain Intensity in Women During the Active Phase of the First Stage of Labor at Pesanggrahan Regional General Hospital in 2025

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Abstract

Labor pain is a subjective experience encountered by more than 90% of women worldwide, with intensity ranging from moderate to severe. At Pesanggrahan Regional General Hospital, pain management remains largely conventional and has not yet systematically incorporated complementary therapies. Lemon aromatherapy contains limonene compounds that exert analgesic and relaxation effects through stimulation of the limbic system, thereby reducing pain perception. This study aimed to determine the effect of inhaled lemon essential oil aromatherapy on pain intensity in women during the active phase of the first stage of labor at Pesanggrahan Regional General Hospital in 2025. This study employed a quasi-experimental design using a one-group pretest–posttest approach. The population consisted of women in the active phase of the first stage of labor at Pesanggrahan Regional General Hospital, with a total sample of 32 respondents selected through purposive sampling. The research instrument was an observation sheet using the Wong-Baker Faces Pain Rating Scale. Data were analyzed using the Paired Sample t-test. The results showed that prior to the intervention (pretest), the majority of respondents experienced severe pain, with a pain scale score of 8 (25.8%). After receiving inhaled lemon aromatherapy (posttest), pain intensity decreased, with most respondents reporting pain scores of 3 and 4 (each 19.4%). Statistical analysis revealed a p-value of 0.000 ($p < 0.05$), with a mean reduction in pain intensity of 3.5806. It can be concluded that inhaled lemon essential oil aromatherapy has a significant effect on reducing pain intensity in women during the active phase of the first stage of labor at Pesanggrahan Regional General Hospital in 2025. This therapy may serve as a safe and effective non-pharmacological alternative for pain management in the delivery room.

Keywords: Lemon Aromatherapy, Inhalation, Labor Pain, Active Phase of the First Stage of Labor.

INTRODUCTION

According to the International Association for the Study of Pain (IASP), more than 95% of women report experiencing pain during the labor process [5]. [13] States that more than 90% of women worldwide experience labor pain with moderate to severe intensity, particularly during the active phase of the first stage of labor. The highest prevalence has been reported in East Asia (32%), Europe (28%), and North America (25%), while Southeast Asia contributes approximately 15% of the total annual cases of severe labor pain. Of these cases, about 62% occur in primiparous women experiencing childbirth for the first time, and 38% occur in multiparous women. WHO also reports that out of every 1,000 women giving birth, approximately 720 experience severe labor pain that requires non-pharmacological pain management interventions. Physiologically, labor pain

most frequently occurs in women aged 20–35 years (71.5%), compared to those aged over 35 years (23.8%) and under 20 years (4.7%).

In Indonesia, data from the Basic Health Research Survey [16] indicate that approximately 78% of women in labor experience moderate to severe pain during the first stage of labor, while only 22% report mild pain. This figure represents an increase of about 5% compared to 2020, with most women reporting peak pain during the active phase of labor [16]. In the Special Capital Region of Jakarta, particularly South Jakarta, the prevalence of labor pain remains relatively high. Based on the annual report of the South Jakarta Health Office, approximately 82% of women in labor experience moderate to severe pain during the first stage, while only 18% report mild pain. Of these cases, around 60% occur in primiparous women and 40% in multiparous women.

Labor pain is a physiological condition experienced by women approaching childbirth. The intensity of pain varies among individuals, and even the same woman may experience different levels of pain in each labor. Pain is a subjective experience resulting from physiological changes in organ function that reflect the progress of labor through the birth canal. Labor pain is primarily caused by cervical dilation, uterine contractions, and cervical descent, which trigger the release of prostaglandin hormones that stimulate pain [1].

Pain arising from normal labor can trigger stress and lead to excessive release of stress hormones such as catecholamines and steroids. These hormones may cause vasoconstriction of smooth muscles and blood vessels, resulting in decreased uterine contractions [2].

Labor pain can be minimized through non-pharmacological or complementary therapies [27]. Complementary therapy is a non-pharmacological treatment approach used alongside conventional medical therapy to enhance therapeutic effectiveness and patient comfort. In midwifery practice, complementary therapies are widely utilized to help reduce pain, anxiety, and tension during labor by stimulating the body's natural relaxation responses [4].

The urgency of implementing complementary therapies in labor pain management has increased alongside growing awareness among healthcare providers and patients regarding the side effects and limitations of pharmacological therapies. Although chemical analgesics are effective, they may pose risks to both the mother and fetus, such as reduced uterine contractions, neonatal respiratory depression, or interference with breastfeeding. Complementary therapies offer a safe, non-invasive, easily applied, and relatively low-cost alternative to help women cope with labor pain more naturally. Furthermore, this approach aligns with the holistic midwifery paradigm, which emphasizes balance among the physical, emotional, and spiritual aspects of the patient, thereby enhancing a positive childbirth experience. One commonly used complementary therapy is aromatherapy, which has been shown to reduce labor pain and anxiety in women [5].

Aromatherapy is a complementary midwifery therapy that can reduce labor pain and alleviate anxiety experienced by women prior to and during childbirth. Pain-induced stress can lead to excessive release of stress hormones such as catecholamines and steroids, which cause vasoconstriction in smooth muscles and blood vessels, resulting in decreased uterine contractions [5].

Aromatherapy is included in the Decree of the Minister of Health No. 1109/Menkes/Per/IX/2007 as one type of complementary therapy service. The term aromatherapy is derived from the words

aroma (fragrance) and *therapy* (treatment), referring to a healing method that utilizes essential oils [6].

Essential oils can be absorbed by the body through the skin and the olfactory system. When inhaled, aromatic molecules are detected by receptors in the nose and transmitted to the amygdala and hippocampus in the brain, which regulate emotions and memory, thereby producing relaxation effects and reducing pain perception [7].

Research conducted by [6] demonstrated that lemon citrus aromatherapy significantly reduced pain intensity, with an average score decrease of 2.4, shifting pain levels from severe to moderate. This finding is consistent with the study by [7] which showed that non-pharmacological intervention using lavender aromatherapy was more effective in helping women adapt to first-stage labor pain compared to those who only practiced deep breathing techniques in the control group.

A study by [10] on the effect of inhaled lemon citrus aromatherapy on the reduction of pain during the active phase of the first stage of labor reported a statistically significant result (p = 0.009), indicating that inhaled lemon aromatherapy effectively reduced labor pain. Similarly, a study conducted by [10] on reducing pain intensity during the active phase of the first stage of labor using lemon essential oil aromatherapy found a significant effect, with a p-value of 0.001, indicating that lemon aromatherapy significantly influenced labor pain intensity.

Aromatherapy utilizes essential oils to balance hormone levels and reduce stress in women during labor, enabling them to feel more relaxed and better cope with the childbirth process. Several types of aromatherapy believed to be effective include lemon, grapefruit, calamansi, lavender, chamomile, and rose. These essential oils can be administered through various methods, such as inhalation, topical application, drops on tissue paper, or massage [8].

Pesanggrahan Regional General Hospital (RSUD Pesanggrahan) is a technical implementation unit under the authority of the Jakarta Provincial Health Office. RSUD Pesanggrahan is classified as a Class C hospital providing comprehensive individual healthcare services, including promotive, preventive, curative, and rehabilitative care, in both outpatient and inpatient settings.

In South Jakarta hospitals, RSUD Pesanggrahan recorded 39 childbirth visits over the past three months (July–September 2025). Based on these data, as of early October, 20 women experienced moderate labor pain and 9 reported severe pain during the active phase of the first stage of labor. Interviews with midwives working in the delivery ward revealed that labor pain management at this hospital remains largely conventional, such as providing verbal support. Pharmacological interventions, such as parenteral analgesics, are administered only in specific cases with strict medical indications.

Currently, complementary non-pharmacological techniques such as inhaled lemon aromatherapy have not been systematically implemented as part of routine pain management interventions in the delivery room. Based on this background, the researcher is interested in conducting a study entitled "The Effect of Inhaled Lemon Essential Oil Aromatherapy on Pain Intensity in Women During the Active Phase of the First Stage of Labor at Pesanggrahan Regional General Hospital in 2025."

METHOD

This study used a quasi-experimental design with a one-group pretest–posttest design, in which one group of subjects was observed by comparing measurements taken before and after the

intervention. The population in this study were mothers in the active phase of the first stage of labor who arrived and gave birth in the delivery room of Pesanggrahan Regional Hospital. Based on the Slovin formula, a sample size of 32 respondents was obtained. Respondents were selected using a purposive sampling technique. The inclusion criteria were: 1) Mothers in the active phase of the first stage of labor, 2) Full-term gestational age, and 3) Willingness to participate. The data collection tool used was a pain level observation sheet using the Wong Baker Face Scale. Lemon essential oil was administered to mothers in the active phase of the first stage of labor by inhalation. This method involved placing 3 drops of lemon essential oil on a tissue and inhaling it from a distance of 2–3 cm from the nose for approximately 10 minutes. Data analysis was performed using a paired t-test. This study aims to determine the effect of inhaled lemon essential oil aromatherapy on reducing pain intensity in women during the active phase of the first stage of labor at Pesanggrahan Regional General Hospital in 2025. Ethical approval for this study was obtained with approval number No. 005541/STIKes RSPAD Gatot Soebroto/2025.

RESULT

1. Univariate Analysis

a. Respondent Characteristics

Table 1. Distribution of Respondent Characteristics

Characteristics	Category	n	%
Age (years)	< 20 years	2	6.3
	20–35 years	30	93.7
Education	Low (Junior High School)	6	18.8
	Secondary (Senior High School)	21	65.6
	Higher Education	5	15.6
Parity	Primiparous	14	43.8
	Multiparous	18	56.2
Occupation	Employed	23	71.9
	Unemployed	9	28.1
Total		32	100.0

Based on the results presented in Table 1, the characteristics of respondents included age, level of education, parity, and occupation. The majority of respondents were aged 20–35 years, totaling 30 individuals (93.7%), while 2 respondents (6.3%) were under 20 years of age. In terms of educational level, most respondents had completed secondary education (senior high school), accounting for 21 individuals (65.6%), followed by those with junior high school education (6 individuals; 18.8%) and higher education (5 individuals; 15.6%). Regarding parity, most respondents were multiparous (18 individuals; 56.2%), while 14 respondents (43.8%) were primiparous. With respect to occupation, the majority of respondents were employed (23 individuals; 71.9%), whereas 9 respondents (28.1%) were unemployed.

b. Distribution of Pain Intensity in Pretest and Posttest

Table 2. Distribution of Pain Intensity in Pretest and Posttest

Pain Category	Pain Scale	Pretest (n)	Pretest (%)	Posttest (n)	Posttest (%)
Midle pain	1–3	0	0,0	14	43.8
Moderate pain	4–6	11	34.4	14	43.7
Severe pain	7–9	18	56.2	4	12,5
Very severe pain	10	3	9,4	0	0,0

Total	32	100	32	100

Based on the pretest results, most respondents experienced severe pain, totaling 18 individuals (56.2%), followed by moderate pain in 11 individuals (34.4%) and very severe pain in 3 individuals (9.4%). None of the respondents reported mild pain prior to the intervention. Posttest results indicated that most respondents experienced mild and moderate pain, each reported by 14 individuals (43.8%). Only 4 respondents (12.5%) continued to experience severe pain, and no respondents reported very severe pain after the intervention.

2. Analisa Bivariat

a. Uji Normalitas

Tabel 1. Uji Normalitas

Category	*Shapiro–Wilk (p-value)*	Interpretation
Intensitas Nyeri Pretest	0.062	Normal
Intensitas Nyeri Posttest	0.059	Normal

The Shapiro–Wilk normality test results indicate that the significance values for pain intensity data before (pretest) and after (posttest) the intervention were 0.062 and 0.059, respectively, both greater than 0.05. Therefore, the data were normally distributed.

b. The effect of lemon aromatherapy on the level of labor pain in the first active phase

Tabel 2. The effect of lemon aromatherapy on labor pain levels

Variable	Mean	Mean Difference	t	df	P-Value
Pretest pain intensity	7,3871				
Postest pain intensity	3,8065	3,5806	23,523	30	0,001

The results of the paired sample *t*-test indicate a *p*-value of 0.001, which is less than the significance level of 0.05. Thus, the alternative hypothesis (Ha) is accepted, indicating a statistically significant difference in mean pain intensity between the pretest and posttest measurements. This finding demonstrates that inhaled lemon essential oil aromatherapy has a significant effect on reducing pain intensity in women during the active phase of the first stage of labor at Pesanggrahan Regional General Hospital in 2025. The mean difference of 3.5806 represents the reduction in average pain intensity following the intervention.

DISCUSSION

1. Characteristics of Respondents

The healthy reproductive age for women to conceive and give birth ranges from 20 to 35 years. Within this age range, reproductive organs function optimally, and psychologically women are considered more mature and possess better coping mechanisms to deal with labor pain compared with adolescents (under 20 years) or women of advanced maternal age (over 35 years) [6].

[22] explain that psychological

readiness among women in the productive age range is more developed, enabling better control of anxiety and more effective cognitive processing of pain stimuli. Young adult women are generally better able to concentrate, practice breathing techniques, receive information, and respond cooperatively to non-pharmacological interventions. In contrast, women under 20 years of age have a higher risk of anxiety because they are psychosocially in the identity-seeking phase, making them more prone to panic and difficulty in managing pain.

The analysis showed that the majority of respondents had a secondary education level (senior high school), totaling 21 individuals (67.7%), while 5 respondents (12.9%) had completed higher education.

Most respondents were multiparous, accounting for 18 individuals (54.8%), while 14 respondents (45.2%) were primiparous. Parity is closely associated with pain perception. Primiparous women generally experience more intense pain because the uterus and birth canal are stretching for the first time, accompanied by higher levels of anxiety. Conversely, multiparous women tend to have a shorter active phase; however, they still require pain management to maintain calmness during cervical dilation [24].

The majority of respondents were not formally employed, with 23 individuals (74.2%), while 9 respondents (26.8%) were employed. Employment status influences stress levels and daily physical activity. Housewives have different activity patterns compared with women employed in the formal sector. Employment status is also associated with access to information and social interaction, which may affect maternal mental readiness for childbirth [25].

[21] state that occupation may serve as a predisposing, enabling, or reinforcing factor for health-related behaviors. Women engaged in informal work or serving as housewives often interact more frequently with family members, community health volunteers, or maternal–child health services, facilitating emotional support and health promotion related to childbirth. According to [13], employment is associated with mental workload that may trigger anxiety prior to labor; women working in the formal sector often face time pressure and administrative responsibilities.

2. Pain Intensity Before and After Aromatherapy Intervention

Labor pain during the active phase of the first stage is a physiological manifestation of increasingly strong uterine contractions, cervical dilation, and thinning of the lower uterine segment. During the active phase (4–10 cm dilation), pain intensity progressively increases due to fetal head pressure on the pelvis and stretching of soft tissues. Unmanaged pain may trigger excessive catecholamine release, increasing the risk of vasoconstriction and impaired oxygen delivery to the fetus [2].

[1] report that first-stage labor pain is visceral in nature, transmitted through T10–L1 nerve pathways, and influenced by the mother's emotional perception. When severe pain is experienced without adequate management, the limbic system triggers a stress response

characterized by increased cortisol levels, altered breathing patterns, and increased muscle tension. This condition may reduce maternal coping capacity and subjectively intensify pain. Psychological factors also play an important role. According to [13], uncontrolled fear and anxiety increase nociceptive neuron sensitivity, resulting in heightened pain perception, particularly among primiparous women who lack prior childbirth experience.

[26], emphasizes that unmanaged labor pain may lead to increased fatigue, hyperventilation, and disturbances in the body's acid–base balance.

The results of the analysis showed that after the intervention, pain intensity was most frequently reported at scales 3 and 4, with 6 respondents each (19.4%). Some respondents experienced mild pain at scale 1 (16.1%), while a small proportion still reported pain at scale 7 (9.7%).

This reduction in pain scale is associated with the mechanism of action of active compounds in lemon essential oil, particularly limonene, linalool, and β-pinene, which exhibit analgesic-like, anxiolytic, and mild sedative properties. Through inhalation, aromatic molecules are captured by olfactory receptors in the nasal cavity and transmitted as electrical signals to the olfactory bulb, limbic system, amygdala, hippocampus, and hypothalamus—regions responsible for mood regulation, stress response, pain memory, and emotional processing [13].

According to [28], activation of the limbic system stimulates the hypothalamus to regulate pituitary activity, resulting in the release of β-endorphins and enkephalins—endogenous opioids that inhibit pain impulse transmission at the spinal cord level. This mechanism as cited in [29] which states that non-nociceptive stimuli can inhibit nociceptive impulses from reaching the cerebral cortex, thereby significantly reducing pain perception. Limonene and linalool reduce sympathetic nervous system activity and enhance parasympathetic dominance. [30] note that parasympathetic dominance promotes vasodilation, lowers heart rate, slows respiratory rate, and improves oxygen delivery, enabling mothers to feel more relaxed and perform breathing techniques more effectively during contractions. [14] further reported that inhalation of citrus essential oils reduces anxiety and increases pain tolerance during labor through GABA receptor activation, producing a natural sedative effect on the central nervous system.

3. Effect of Inhaled Lemon Essential Oil Aromatherapy on Pain Intensity

The findings demonstrate that inhaled lemon essential oil aromatherapy significantly reduced pain intensity during the active phase of the first stage of labor. Statistical analysis using the Paired Sample *t*-Test yielded a *p*-value of 0.000, which is below the significance threshold of 0.05, indicating a statistically significant difference in pain intensity before and after the intervention. This *p*-value indicates that the observed pain reduction was not due to chance but was a genuine effect of the intervention, leading to acceptance of the alternative hypothesis.

The mean difference of 3.5806 indicates a substantial average

reduction in pain intensity between pre- and post-intervention conditions. Clinically, this value reflects a meaningful shift in pain perception from severe to mild or moderate levels, demonstrating the effectiveness of lemon aromatherapy in assisting women to manage labor pain during the active phase.

Pain during the active phase of labor is not only subjectively perceived but is also accompanied by physiological responses due to sympathetic nervous system activation, including increased heart rate, blood pressure, respiratory rate, muscle tension, and facial expressions such as grimacing and restlessness. Uncontrolled pain may lead to hyperventilation, increased oxygen consumption, and elevated stress hormone release, potentially disrupting uteroplacental perfusion and increasing maternal fatigue [6].

Complementary therapy using lemon aromatherapy is non-invasive and safe. [26] note that pleasant olfactory stimuli can "close the gate" of pain signal transmission to the brain, as olfactory nerves respond more rapidly than pain pathways. Lemon aroma specifically exhibits antidepressant and anxiolytic effects, helping mothers control anxiety [16].

As a non-invasive, non-pharmacological, easily applied intervention with minimal side effects, lemon aromatherapy can be used as an initial modality in labor pain management. [20] explain that non-nociceptive sensory stimulation, such as soothing aromas, activates large-diameter nerve fibers that inhibit pain impulse transmission at the dorsal horn of the spinal cord, preventing pain signals from reaching the cerebral cortex. This mechanism supports the effectiveness of lemon aromatherapy through olfactory modulation of pain.

In addition to sensory gating mechanisms, lemon essential oil contains limonene, linalool, and β-pinene—volatile compounds that influence the limbic system. Citrus inhalation produces antidepressant, anxiolytic, and mild sedative effects, helping mothers regulate anxiety, improve breathing patterns, and enhance endorphin release. Endorphins and enkephalins are endogenous opioids that suppress pain transmission at central synapses [18].

Inhaled lemon essential oil aromatherapy also suppresses physiological pain responses by reducing sympathetic activity and increasing parasympathetic activity. This effect manifests as more regular breathing, reduced muscle tension, and stabilization of heart rate and blood pressure, allowing mothers to appear more relaxed during contractions. Relaxation further reduces stress hormone release and increases endogenous endorphin secretion, enhancing natural analgesia and enabling mothers to cooperate more effectively with healthcare providers [19].

The reduction in pain intensity following inhaled lemon aromatherapy can be explained by the active chemical constituents of lemon oil, including geranyl acetate, nerol, and linalyl acetate, which possess antidepressant, antiseptic, mild stimulant, and sedative properties. These compounds promote psychological relaxation, thereby reducing pain perception during labor. Lemon essential oil also contains monoterpenes (approximately 6–14%), which exert mild sedative effects on the central nervous system, suppress stress

responses, and alleviate tension during uterine contractions in the active phase.

Linalyl acetate, an ester formed from organic acids and alcohols, contributes to emotional stabilization and nervous system sedation, further supporting pain reduction through enhanced comfort and emotional relaxation [20].

The success of this intervention was also supported by the calm and controlled environment of the delivery room at RSUD Pesanggrahan, which allowed optimal inhalation of the aroma without excessive noise or stressors. Consistent implementation of lemon aromatherapy by healthcare providers during the active phase of labor may effectively reduce severe pain-related trauma, maternal fatigue, and anxiety. In addition to improving maternal comfort, this method may help prevent excessive analgesic use, supporting a physiological, safe, and woman-centered childbirth process.

CONCLUSION

The results of this study indicate that the majority of respondents were aged 20–35 years, had a senior high school level of education, were multiparous, and were housewives. Prior to the intervention, most respondents experienced labor pain in the severe category. After the administration of lemon aromatherapy, pain intensity decreased to mild and moderate levels. The Paired Sample *t*-Test yielded a *p*-value of 0.000 (<0.05), indicating that lemon aromatherapy has a statistically significant effect in reducing labor pain intensity during the active phase of the first stage of labor.

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