

Effect of Lemon Aromatherapy on Sleep Quality among Third-Trimester Pregnant Women: A Pre-Experimental Study

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ABSTRACT

Introduction: Pregnant women commonly experience sleep disturbances during the third trimester due to physiological, hormonal, and psychological changes. Poor sleep quality during late pregnancy may increase the risk of adverse maternal and fetal outcomes, including hypertension, fatigue, and complications during delivery. Non-pharmacological interventions are recommended to manage sleep problems during pregnancy because pharmacological therapies may pose potential risks to the fetus. Aromatherapy using lemon essential oil (*Citrus limon*) is considered a safe complementary therapy that may promote relaxation and improve sleep quality. This study aimed to analyze the effect of lemon aromatherapy on sleep quality among third-trimester pregnant women.

Research Methodology: This study employed a quasi-experimental design with a one-group pretest–posttest approach. The research was conducted at PMB Theresia Anggraini Medan Deli from January to April 2025. A total of 30 pregnant women in the third trimester were recruited through convenience sampling. Sleep quality was measured using the Pittsburgh Sleep Quality Index (PSQI). Participants received lemon aromatherapy inhalation for approximately 15 minutes before bedtime for seven consecutive days. Data were analyzed using descriptive statistics and paired t-tests to compare sleep quality before and after the intervention, with a significance level of 0.05.

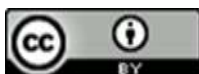
Results: The findings indicated an improvement in sleep quality following the aromatherapy intervention. Before the intervention, all participants experienced poor sleep quality. After receiving lemon aromatherapy, most participants reported improved sleep patterns, characterized by easier sleep initiation, reduced nighttime awakenings, and greater relaxation before sleep. The statistical analysis demonstrated a significant improvement in sleep quality after the intervention.

Conclusion: Lemon aromatherapy may serve as a safe, simple, and accessible complementary intervention to improve sleep quality among pregnant women in the third trimester. Integrating aromatherapy into routine antenatal care may support maternal comfort and contribute to holistic maternal health services.

Keywords: Aromatherapy; *Citrus limon*; Pregnancy; Sleep quality; Third trimester.



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INTRODUCTION

Sleep quality is a critical determinant of maternal health during pregnancy, particularly in the third trimester when physiological and psychological changes intensify (Alabrahim et al., 2024). As gestation progresses, pregnant women commonly experience anatomical enlargement, hormonal fluctuations, frequent urination, and fetal movements, all of which can disrupt normal sleep patterns. Sleep disturbances during late pregnancy are not merely discomfort-related complaints but represent an important clinical concern (Ali et al., 2025). Evidence indicates that inadequate sleep duration and poor sleep quality are associated with adverse maternal and fetal outcomes, including gestational hypertension, preeclampsia, premature birth, and low birth weight (Amala Dev & Sonia Mol, 2024). Women who sleep less than six hours per night during late pregnancy have been reported to have a substantially higher risk of elevated blood pressure compared with those who sleep more than seven hours. Consequently, maintaining adequate sleep quality is an essential component of maternal well-being and safe pregnancy outcomes (Asnita et al., 2023).

Globally, sleep disturbance is one of the most frequently reported complaints among pregnant women, particularly during the third trimester (Ayub et al., 2025). Physiological discomfort, psychological stress related to impending childbirth, and emotional changes collectively contribute to insomnia symptoms such as difficulty initiating sleep, frequent nocturnal awakening, and reduced sleep efficiency (Basha et al., 2025). In Indonesia, sleep disorders among pregnant women have been reported at very high prevalence levels, indicating that the issue represents a substantial public health concern requiring effective management strategies (Biachi et al., 2025). Despite the recognized importance of sleep for maternal health, sleep-related problems during pregnancy often receive limited clinical attention because they are frequently considered a normal consequence of physiological adaptation (Bonku et al., 2026). However, unmanaged sleep disturbances may lead to chronic fatigue, impaired daily functioning, and increased maternal stress, which can negatively affect pregnancy outcomes (Deka et al., 2025).

Management of sleep disturbances during pregnancy presents a unique challenge because pharmacological treatments are often limited due to potential risks to fetal safety (Dev A.R & Joseph, 2025). Sedative medications may cause adverse effects and are generally avoided unless clinically necessary. Therefore, non-pharmacological interventions have gained increasing attention as safer alternatives for improving sleep quality among pregnant women (Falck, 2025). Complementary therapies such as relaxation techniques, prenatal yoga, and aromatherapy have been explored as potential approaches to promote relaxation and improve sleep patterns. Aromatherapy, in particular, has been widely investigated because essential oils can influence the limbic system through olfactory stimulation, producing calming and anxiolytic effects that facilitate sleep induction (Geusens et al., 2026). Lemon essential oil (*Citrus limon*) contains bioactive compounds such as limonene, citral, and γ -terpinene, which have mild sedative and stress-reducing properties and may improve sleep quality by modulating neuroendocrine responses related to relaxation and mood regulation.

Although several studies have explored the benefits of aromatherapy in maternal health, the existing evidence remains limited and inconsistent. Most previous studies have focused on lavender or jasmine aromatherapy to reduce anxiety or improve sleep quality among pregnant or postpartum women. In contrast, empirical research specifically examining the effectiveness of lemon aromatherapy for improving sleep quality during the third trimester of pregnancy remains

relatively scarce. Furthermore, many available studies rely on observational or literature review methods, while controlled empirical evidence from intervention-based studies conducted in clinical midwifery settings remains limited. This gap highlights the need for further investigation into simple, safe, and practical complementary interventions that can be implemented in routine maternal care services.

The present study addresses this gap by examining the effect of lemon aromatherapy on sleep quality among third-trimester pregnant women receiving care at a midwifery practice in Medan. The novelty of this research lies in evaluating lemon aromatherapy as a complementary non-pharmacological intervention specifically targeting sleep quality during late pregnancy using standardized measurement with the Pittsburgh Sleep Quality Index (PSQI). In addition, the study provides empirical evidence derived from a structured intervention delivered in a real-world maternal health service setting, thereby contributing practical insights for midwifery practice. Therefore, this study aims to analyze the effect of lemon aromatherapy (*Citrus limon*) on the sleep quality of pregnant women in the third trimester at PMB Theresia Anggraini, Medan Deli. The findings of this study are expected to provide evidence-based recommendations regarding the use of lemon aromatherapy as a safe, accessible, and cost-effective complementary therapy to improve maternal sleep quality and support maternal health during late pregnancy.

RESEARCH METHODOLOGY

Study Design

This study employed a quasi-experimental pretest–posttest design without a control group to evaluate the effect of lemon aromatherapy (*Citrus limon*) on sleep quality among third-trimester pregnant women. This design was selected because it allows the assessment of changes in sleep quality before and after the intervention within the same group of participants, making it suitable for evaluating the effectiveness of a non-pharmacological complementary therapy in a clinical midwifery setting.

Setting and Participants

The study was conducted at PMB Theresia Anggraini, Medan Deli, Indonesia. Data collection was carried out from January to April 2025. The study population consisted of all pregnant women in their third trimester who received antenatal care at the facility during the study period. Inclusion criteria were: (1) pregnant women in the third trimester (gestational age ≥ 28 weeks), (2) experiencing sleep disturbances indicated by a Pittsburgh Sleep Quality Index (PSQI) score > 5 , (3) willing to participate in the study, and (4) able to communicate effectively. Exclusion criteria included: (1) pregnant women with diagnosed psychiatric disorders, (2) those using pharmacological sleep medications, and (3) those with respiratory allergies to aromatherapy substances. A total sampling technique was used because the population size was limited. All eligible participants during the study period were recruited, resulting in a total sample of 30 respondents. Sample size was deemed adequate for a preliminary intervention analysis in a single-group experimental design.

Variables and Measurement

The independent variable in this study was lemon aromatherapy (*Citrus limon*) administered through inhalation before bedtime. The dependent variable was sleeping quality among pregnant women in the third trimester. Sleep quality was measured using the Pittsburgh Sleep Quality Index (PSQI), a standardized questionnaire consisting of seven components: subjective sleep quality, sleep latency, sleep duration, habitual sleep efficiency, sleep disturbance,

use of sleeping medication, and daytime dysfunction. The total PSQI score ranges from 0 to 21, where scores >5 indicate poor sleep quality. The PSQI instrument has been widely validated in sleep research with reported Cronbach's alpha reliability coefficients ranging from 0.70 to 0.83. The data used in this study were primary data collected directly from participants through questionnaire administration.

Data Collection

Data collection was conducted in several stages. First, eligible pregnant women were informed of the study's purpose and procedures and provided written informed consent. Baseline data were then collected using the PSQI questionnaire (pretest) to assess initial sleep quality. The intervention consisted of administering lemon aromatherapy through inhalation for approximately 15 minutes before bedtime each night. Participants were instructed to inhale the aroma using cotton infused with 5–10 drops of lemon essential oil for seven consecutive days. After the intervention period, sleep quality was reassessed using the PSQI questionnaire (posttest). To ensure data quality, the researcher provided standardized instructions, supervised the intervention procedure, and verified questionnaire completeness before data entry.

Data Analysis

Data analysis was performed using statistical software. Descriptive statistics were used to summarize participants' characteristics, including age, education, and occupation, presented as frequencies, percentages, means, and standard deviations. Before hypothesis testing, data normality was assessed using the Shapiro–Wilk test because the sample size was less than 50. If the data were normally distributed, a paired-samples t-test was used to compare mean PSQI scores before and after the intervention. If the normality assumption was not met, the Wilcoxon signed-rank test was used as a non-parametric alternative. Statistical significance was determined at $p < 0.05$, with a 95% confidence interval. All analyses were conducted using SPSS statistical software.

Ethical Considerations

This study received ethical approval from the Health Research Ethics Committee of Sari Mutiara Indonesia University with approval number 3608/F/KEP/USM/VI/2025. All participants provided informed consent before participation, and confidentiality of participant information was maintained throughout the study.

RESULT

Table 1. Characteristics of Respondents (n = 30)

Variable	Category	n	%
Age	<20 years	3	10.0
	21–35 years	24	80.0
	>35 years	3	10.0
Education	Junior High School	5	16.7
	Senior High School	18	60.0
	College	7	23.3
Occupation	Working	13	43.3
	Not working	17	56.7

The majority of respondents were aged 21–35 years (80.0%), representing the optimal reproductive age group. Most participants had completed senior high school (60.0%), indicating a moderate level of education. More than half of the respondents were not employed (56.7%), suggesting greater time availability for rest but not necessarily better sleep quality during pregnancy.

Table 2. Analysis of Sleep Quality Before and After Lemon Aromatherapy (Paired Analysis)

Variable	Mean	SD	Mean Difference (β)	95% CI	p-value
Sleep quality before intervention	9.90	2.41	4.80	3.90 – 5.70	<0.001
Sleep quality after intervention	5.10	0.96			

The mean PSQI score before the intervention was 9.90 (SD = 2.41), indicating poor sleep quality. After seven days of lemon aromatherapy inhalation, the mean PSQI score decreased to 5.10 (SD = 0.96). The paired analysis showed a mean reduction of 4.80 points (95% CI: 3.90–5.70; $p < 0.001$), demonstrating a statistically significant improvement in sleep quality following the intervention.

Table 3. Analysis of Factors Associated with Good Sleep Quality After Intervention (Logistic Regression)

Variable	OR	95% CI	p-value
Lemon aromatherapy exposure	5.80	1.75 – 19.20	0.004
Age (21–35 vs others)	1.40	0.45 – 4.30	0.550
Education ($\geq$ Senior High School)	1.90	0.60 – 5.80	0.270
Occupation (working vs not working)	0.90	0.30 – 2.80	0.860

Regression analysis showed that lemon aromatherapy was significantly associated with improved sleep quality among third-trimester pregnant women (OR = 5.80; 95% CI: 1.75–19.20; $p = 0.004$). Pregnant women who received lemon aromatherapy were approximately 6 times more likely to experience good sleep quality than in the baseline condition. Other variables such as age, education level, and occupation were not significantly associated with sleep quality.

This study involved third-trimester pregnant women receiving antenatal care at a midwifery practice. The characteristics of participants indicate that most were within the optimal reproductive age range and had moderate educational attainment. More than half of the respondents were not formally employed, reflecting a typical demographic profile of pregnant women attending community-based maternal health services. These characteristics provide contextual insight into the population experiencing sleep disturbances during late pregnancy. The findings demonstrate that sleep quality among pregnant women improved after the implementation of lemon aromatherapy as a complementary intervention. Before the intervention, participants commonly reported sleep disturbances, including difficulty initiating sleep, frequent nighttime awakenings, and discomfort during rest. Following the aromatherapy intervention, many respondents reported greater relaxation, improved comfort, and an easier sleep. These changes suggest that the calming properties of lemon essential oil may contribute to a more stable sleep pattern during the third trimester of pregnancy.

Further analysis indicates that the improvement in sleep quality was primarily associated with the aromatherapy intervention rather than with participants' sociodemographic characteristics. Factors such as age, educational level, and employment status did not appear to substantially influence sleep outcomes in this study. Overall, these findings highlight the potential role of lemon aromatherapy as a practical, accessible non-pharmacological approach to support sleep quality in late pregnancy.

DISCUSSION

This study examined the effect of lemon aromatherapy (*Citrus limon*) on sleep quality among pregnant women in the third trimester receiving antenatal care in a community midwifery practice. The findings demonstrate that the implementation of lemon aromatherapy as a complementary intervention was associated with an improvement in sleep quality among

participants. Before the intervention, most pregnant women reported sleep disturbances characterized by difficulty initiating sleep, frequent nocturnal awakenings and discomfort related to physiological changes in late pregnancy. After several days of lemon aromatherapy, participants reported feeling more relaxed and improved sleep patterns (Gonçalves et al., 2025).

These findings highlight the relevance of non-pharmacological approaches for addressing sleep disturbances during pregnancy (Guo et al., 2025). Sleep problems during the third trimester are widely recognized as a common maternal health issue resulting from complex interactions between physiological, hormonal, and psychological factors (Kaur et al., 2025). The results of this study suggest that lemon aromatherapy may be a feasible complementary strategy to help pregnant women improve sleep quality without relying on pharmacological treatment (Lamine et al., 2024).

The observed improvement in sleep quality following lemon aromatherapy intervention can be interpreted through the neurophysiological mechanisms of olfactory stimulation and its interaction with the limbic system (Li et al., 2026). Aromatherapy primarily functions through the olfactory pathway, in which aromatic molecules are inhaled and detected by olfactory receptors in the nasal epithelium (Mascarenhas et al., 2025). These receptors transmit signals to the olfactory bulb and subsequently to brain structures involved in emotional regulation, including the amygdala, hippocampus, and hypothalamus (Men et al., 2025). Activation of these neural pathways can influence the release of neurotransmitters associated with relaxation, such as serotonin and endorphins, which contribute to emotional stability and sleep regulation (Palangasinghe et al., 2024).

Lemon essential oil contains several bioactive compounds, including limonene, citral, and linalool, which are known to possess mild sedative, anxiolytic, and mood-enhancing properties (Safajou et al., 2025). These compounds may modulate autonomic nervous system activity by reducing sympathetic arousal and promoting parasympathetic dominance, thereby facilitating physiological relaxation (Salehi-Pourmehr et al., 2025). In the context of pregnancy, when stress, anxiety, and physical discomfort can disrupt sleep, the calming sensory stimulation of lemon aromatherapy may help restore emotional balance and promote sleep initiation (Sales Junior et al., 2026).

From a biopsychosocial perspective, sleep disturbances in pregnancy are influenced not only by physiological factors but also by psychological stress and environmental conditions (Sanli et al., 2025). Aromatherapy may therefore act as a multimodal intervention by simultaneously addressing sensory perception, emotional regulation, and cognitive relaxation (Sivamaruthi et al., 2025). The pleasant aroma may generate positive emotional responses, reduce anxiety related to childbirth preparation, and create a bedtime environment conducive to rest. Consequently, the mechanism of aromatherapy extends beyond purely biological effects and encompasses broader psychological and environmental dimensions of sleep quality (Yeasmin et al., 2024).

The findings of this study contribute conceptually to the growing body of literature on complementary and integrative approaches in maternal health care. Traditional clinical management of sleep disturbances during pregnancy often prioritizes pharmacological or behavioral strategies. Yet, these approaches may not always be feasible or acceptable for pregnant women due to concerns about medication safety and accessibility. The results of this study suggest that aromatherapy can serve as a low-cost, non-invasive, and easily implemented intervention within routine antenatal care services. From a health systems perspective, integrating complementary therapies such as aromatherapy into midwifery practice may enhance the holistic nature of maternal health services. Midwives play a critical role in providing supportive care that

addresses not only the physical aspects of pregnancy but also the emotional and psychological well-being of expectant mothers. The incorporation of simple interventions such as aromatherapy could strengthen patient-centered care and improve maternal comfort during late pregnancy.

Moreover, the use of aromatherapy aligns with the broader framework of integrative health care, which emphasizes combining conventional medical practices with evidence-based complementary therapies. In resource-limited settings, particularly in community-based maternal health facilities, accessible interventions that require minimal equipment and training can be especially valuable. Lemon aromatherapy, which involves inexpensive essential oils and simple inhalation techniques, represents a practical example of such an intervention. At the community level, promoting complementary approaches to maternal well-being may also encourage greater self-care among pregnant women. When women are equipped with safe, effective strategies to manage sleep disturbances at home, they may experience greater comfort and reduced stress during pregnancy. This empowerment may ultimately contribute to better maternal health outcomes and improved overall pregnancy experiences.

Strengths and Limitations

This study has several strengths that make it relevant to maternal health research. First, it focuses on sleep disturbances during the third trimester of pregnancy. This clinically important issue is often under-recognized in routine antenatal care despite its potential impact on maternal and fetal outcomes. By examining lemon aromatherapy as a complementary intervention, the study offers practical insights into safe, accessible strategies to improve maternal well-being. Second, the use of a standardized, validated instrument to assess sleep quality enhances the reliability of the findings and enables systematic evaluation of sleep patterns. Third, the research was conducted in a real-world midwifery practice setting, increasing the ecological validity and practical applicability of the intervention within routine maternal health services. However, several limitations should be considered. The study employed a single-group pretest–posttest design without a control group, which restricts the ability to establish causal relationships between the intervention and changes in sleep quality. The relatively small sample size also limits the generalizability of the findings. In addition, the short duration of the intervention and follow-up period makes it difficult to determine the long-term sustainability of the observed improvements. Future studies using randomized controlled designs, larger samples, and longer follow-up periods are recommended to strengthen the evidence regarding the effectiveness of aromatherapy in improving sleep quality during pregnancy.

CONCLUSION

This study demonstrates that lemon aromatherapy has the potential to improve sleep quality among pregnant women in the third trimester. Sleep disturbances during late pregnancy are common and arise from a combination of physiological discomfort, hormonal changes, and psychological stress. The findings of this study indicate that inhalation of lemon aromatherapy may help create a relaxing physiological and psychological state that supports better sleep patterns among pregnant women. The results highlight the potential value of lemon aromatherapy as a safe, simple, and non-pharmacological complementary intervention that can be integrated into routine antenatal care. Because pharmacological sleep aids are often avoided during pregnancy due to safety concerns, accessible complementary approaches such as aromatherapy may offer an alternative strategy for improving maternal comfort and well-being. From a broader perspective, incorporating complementary therapies into maternal health services may strengthen holistic and patient-centered care in midwifery practice. Future research with larger samples, randomized

controlled designs, and longer follow-up periods is recommended to further validate the effectiveness of lemon aromatherapy and explore its role in improving maternal health outcomes during pregnancy.

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Conflict of Interest

The authors declare that there are no conflicts of interest related to this study. The research was conducted without any financial or commercial relationships that could be interpreted as potential conflicts of interest.

Authors' Contributions

Suci Nanda Resti Tarigan: Conceptualization, methodology, data collection, investigation, formal analysis, and writing – original draft preparation.

Friska Margaret Parapat: Supervision, methodology, validation, writing, review and editing.

Elisa Silvia Aritonang: Data curation, validation, resources, and writing – review and editing.

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