Original Article

Effectiveness of Foot Soaking Therapy Using Lemongrass (Cymbopogon citratus) Decoction to Reduce Blood Pressure among Pregnant Women with Mild Hypertension

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ARTICLE INFO

Article History

Submit : September 18, 2024
Accepted : November 19, 2025
Published : November 21, 2025

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Citation:

Situmorang, F. N. S., Fauzianty, A., Purba, H. E. ., Purba, P. I. B. ., & Zega, N. . (2025). Effectiveness of Foot Soaking Therapy Using Lemongrass (Cymbopogon citratus) Decoction to Reduce Blood Pressure among Pregnant Women with Mild Hypertension. Journal of Applied Nursing and Health, 7(3), 728–737. https://doi.org/10.55018/janh.v7i3.421

ABSTRACT

Background: Hypertension in pregnancy is a major contributor to maternal morbidity and mortality. Pharmacological therapy is common; however, evidence on safe and affordable non-pharmacological alternatives—such as lemongrass (Cymbopogon citratus) foot soaking—remains limited among pregnant women. Lemongrass contains citral and flavonoids that promote vasodilation and relaxation, potentially reducing blood pressure..

Methods: A quasi-experimental one-group pretest–posttest design following the TREND guideline was conducted at Sarfina Primary Outpatient Clinic, Medan, Indonesia (February–April 2025). Thirty pregnant women with mild hypertension (140–159/90–99 mmHg) participated voluntarily after providing informed consent. Exclusion criteria were preeclampsia, chronic illness, or lemongrass allergy. Participants soaked their feet daily for 15 minutes in 1 L of warm lemongrass decoction (38–40 °C) for four weeks. Blood pressure was measured twice using a validated Omron HEM-7130 device, and the mean was analyzed with the Wilcoxon signed-rank test.

Results: Mean systolic pressure decreased from 147.6 ± 5.8 mmHg to 132.4 ± 6.3 mmHg, and diastolic pressure from 93.8 ± 3.9 mmHg to 83.7 ± 4.2 mmHg ($Z = -3.21$, $p < 0.001$). The effect size ($r = 0.59$; 95% CI [−18.5, −11.3]) indicated a moderate clinical effect

Conclusion: Lemongrass foot soak therapy effectively lowers mild hypertension in pregnancy through vasodilatory and relaxation mechanisms. It represents a safe, simple, and culturally appropriate complementary method that midwives can integrate into antenatal care. Larger controlled trials are recommended to confirm its long-term efficacy.

Keywords: Foot Soak; Lemongrass; Mild Hypertension; Non-Pharmacological; Pregnant Women.

Implications for Practice:

- Integrating lemongrass foot-soak therapy into routine antenatal care can support clinically safe, non-pharmacological management of mild hypertension in pregnancy.
- Incorporating this intervention into local maternal-health policies may enhance midwives' capacity to deliver affordable, evidence-based complementary care within primary healthcare systems.
- Embedding standardized training on lemongrass foot-soak therapy into midwifery education can strengthen practical competencies, particularly in resource-limited LMIC settings where low-cost interventions are essential.

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Introduction

Hypertension in pregnancy, defined as blood pressure exceeding 140/90 mmHg, is a common complication that can lead to severe outcomes if not properly managed. Globally, the prevalence of hypertension during pregnancy ranges from 4% to 25%, with a pooled estimate of about 12.3% and higher rates observed in low- and middle-income countries (Wang et al., 2021). This condition is responsible for up to 18% of maternal deaths worldwide and is one of the top three causes of maternal morbidity and mortality (Tayar, 2024). In Southeast Asia, including Indonesia, the prevalence is particularly high, with recent hospital-based data from West Java reporting a prevalence of 25.1% among pregnant women (Pribadi et al., 2023).

One potential intervention to lower blood pressure in pregnant women with hypertension is foot soak therapy using lemongrass (Cymbopogon citratus). Lemongrass contains bioactive compounds such as citral, geraniol, and flavonoids, which act as natural vasodilators and blood vessel relaxants (Silva & Bárbara, 2022). A study by Tresna et al. (2023) showed that foot soak therapy with a mixture of Epsom salt and lemongrass significantly reduced blood pressure in pregnant women with hypertension, based on a Wilcoxon statistical test showing significant changes before and after the intervention. Vasorelaxation mechanisms support this antihypertensive effectincreased endothelial nitric oxide secretion, and mild diuretic activity of the active compounds in lemongrass (Silva & Bárbara, 2022). Furthermore, other studies have also found that foot soaks with warm water, salt, and lemongrass are effective in lowering blood pressure in hypertensive patients in the community. With the high maternal mortality rate due to hypertension in Indonesia, non-pharmacological therapies such as foot soaks with lemongrass are a safe, easy-to-implement alternative that has the potential to help lower blood pressure during pregnancy (Wulandari, 2017).

Although several studies have demonstrated the antihypertensive effects of lemongrass in the general population, both through tea consumption and extracts, evidence regarding its physiological mechanisms and application in pregnant women remains very limited. Most existing research focuses on non-pregnant individuals or animal models, so its clinical relevance for pregnancy-related hypertension remains uncertain. These studies have identified that citral and other active compounds in lemongrass can lower blood pressure through vasodilation, increased endothelial nitric oxide secretion, vascular smooth muscle relaxation, and a mild diuretic effect (Silva & Bárbara, 2022). However, the specific mechanisms related to peripheral and autonomic relaxation pathways in pregnant women with mild hypertension have not been widely explored. This limitation creates a research gap in understanding how lemongrass foot bath therapy may provide vasodilatory and relaxing effects in pregnant women with hypertension, and further studies are needed to confirm its benefits and safety in this population (Tazi et al., 2024).

Physiologically, the vasodilation theory explains that the bioactive compounds in lemongrass—such as citral and flavonoids—stimulate endothelial nitric oxide release and reduce calcium influx in smooth muscles, leading to vessel relaxation (Silva & Rita, 2022). In addition, the autonomic relaxation mechanism suggests that warm foot soaking can activate parasympathetic nervous responses and inhibit sympathetic tone, thereby lowering blood pressure (Kim et al., 2023). The combination of these mechanisms supports the potential of lemongrass foot soak as a safe

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complementary intervention for pregnant women.

Conceptually, this study is guided by the vasodilation and autonomic relaxation theories, proposing that lemongrass foot soaking induces peripheral vasodilation and reduces sympathetic activity, resulting in decreased systolic and diastolic blood pressure. Therefore, this study aims to evaluate the effectiveness of foot soak therapy using lemongrass (*Cymbopogon citratus*) decoction in reducing blood pressure among pregnant women with mild hypertension.

Methods

Study Design

This study employed a quasi-experimental one-group pretest–posttest design to evaluate the effectiveness of foot soak therapy using lemongrass (*Cymbopogon citratus*) decoction on blood pressure among pregnant women with mild hypertension. The study adhered to the Transparent Reporting of Evaluations with Nonrandomized Designs (TREND) guideline to ensure methodological rigor. The participant flow included three stages: enrollment (screening of eligible pregnant women), intervention (four weeks of daily lemongrass foot soak therapy), and posttest evaluation (measurement of blood pressure outcomes). To minimize bias, standardized protocols were applied for intervention delivery and measurement. Potential confounding factors such as age, parity, and gestational age were recorded and controlled statistically during analysis.

Participants

The study was conducted at Sarfina Primary Outpatient Clinic, Medan, Indonesia, from February to April 2025. The population included all pregnant women attending antenatal care at the clinic (n = 112). Participants were recruited through purposive sampling based on inclusion and exclusion criteria. Inclusion criteria were: second or third trimester pregnancy, systolic blood pressure between 140–159 mmHg or diastolic between 90–99 mmHg, no severe complications, and willingness to complete the four-week intervention. Exclusion criteria included preeclampsia/eclampsia, chronic cardiovascular or renal diseases, allergy to lemongrass, or ongoing pharmacological antihypertensive therapy. A total of 30 eligible women were enrolled, and all completed the study without dropping out. The sample size was determined based on a feasibility and pilot study approach commonly used in early-stage clinical interventions (Julious, 2005), aiming to assess practicality before large-scale trials.

Instruments

Blood pressure was measured using a digital sphygmomanometer (Omron HEM-7130, Omron Healthcare, Japan), which has been validated for use in pregnant populations (Khalil et al., 2019). The device was calibrated monthly by the clinic's biomedical technician, and each measurement was taken twice at one-minute intervals; the mean value was used for analysis. The measurement protocol followed the American Heart Association's guidelines for blood pressure assessment in pregnancy to ensure validity and reliability. Demographic and clinical data (age, parity, gestational age, and hypertension history) were collected using structured observation sheets.

Intervention

The intervention involved daily foot soak therapy using lemongrass decoction prepared by boiling 50 g of fresh or dried lemongrass in 1 liter of water, cooling it to 38–40°C, and immersing both feet for 15 minutes over four consecutive weeks. This procedure was based on the vasodilation and autonomic relaxation theory,

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suggesting that lemongrass compounds (citral, flavonoids) promote vascular relaxation, while warm water induces parasympathetic activation. The therapy was administered by trained midwives following a Standard Operating Procedure (SOP) to ensure fidelity. Adherence was monitored using daily checklists, and participants were instructed to report any discomfort or adverse reactions; none were recorded throughout the study.

Data Collection

Data were collected by trained enumerators who had undergone a two-day training program on measurement techniques, documentation, and ethical procedures. Quality control was maintained through double-entry verification and random data checks by the principal investigator. To ensure data integrity, all instruments were standardized, and observations were recorded consistently at the same time of day. Incomplete or missing data were verified directly with participants during follow-up visits; no missing data remained in the final dataset.

Data Analysis

Data were analyzed using SPSS version 26. Normality was tested using the Shapiro–Wilk test. As the data violated the normality assumption ($p < 0.05$), the nonparametric Wilcoxon signed-rank test was applied to compare pretest and posttest blood pressure values. Descriptive statistics summarized participant characteristics. The effect size (r) was calculated using the formula $r = Z / \sqrt{N}$, yielding $r = 0.47$, indicating a moderate effect. A 95% confidence interval (CI) was also computed to provide the precision of the estimate. The level of significance was set at $p < 0.05$.

Ethical Considerations

Ethical approval was obtained from the Institutional Ethics Committee of Universitas Islam Sumatera Utara (No. 283/KEPK/FK-UISU/VI/2025). All participants provided written informed consent prior to participation.

Results

Table 1. Demographic and Obstetric Characteristics of Respondents (n = 30)

Characteristic	n	%
Age		
< 20 years	1	3,3
20–35 years	24	80,0
> 35 years	5	16,7
Gestational Age		
20-28 weeks	11	36,7
29-32 weeks	4	13,3
33-36 weeks	15	50,0
Education Level		
Elementary School	8	26,7
Junior-Senior High School	17	56,7
Higher Education	5	16,7
Occupation		
Employed	9	30,0
Unemployed	21	70,0
Parity		
Primipara	9	30,0
Multipara	21	70,0

Table 1 illustrates the demographic and obstetric characteristics of the 30 pregnant women who participated in the study. Most participants were aged 20–35 years (80.0%), with the majority in the third trimester (33–36 weeks; 50.0%). More than half had a secondary education (56.7%), were unemployed (70.0%), and were multiparous (70.0%). These characteristics indicate that the majority of respondents were within the typical reproductive age and had prior pregnancy experience, potentially influencing their adaptation to non-pharmacological interventions

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Table 2. Comparison of blood pressure before and after lemongrass foot soak therapy (n = 30)

Variable	Pretest (Mean ± SD)	Posttest (Mean ± SD)	Mean Difference (95% CI)	Z-value	*p*-value
Systolic BP (mmHg)	147.6 ± 5.8 (140–159)	132.4 ± 6.3 (120–146)	−15.2 (−18.5, −11.3)	−3.21	0.002
Diastolic BP (mmHg)	93.8 ± 3.9 (90–99)	83.7 ± 4.2 (78–92)	−10.1 (−12.8, −8.4)	−3.09	0.003

Note: Values analyzed using the Wilcoxon signed-rank test; p < 0.05 considered significant. BP = blood pressure.

Table 2 presents the comparison of systolic and diastolic blood pressure before and after the lemongrass foot soak intervention. Both systolic and diastolic pressures significantly decreased after four weeks of treatment. The mean systolic blood pressure decreased from 147.6 ± 5.8 mmHg (range 140–159) at pretest to 132.4 ± 6.3 mmHg (range 120–146) at posttest. Similarly, the mean diastolic pressure decreased from 93.8 ± 3.9 mmHg (range 90–99) to 83.7 ± 4.2 mmHg (range 78–92). The Wilcoxon signed-rank test indicated a statistically significant reduction in both systolic (Z = –3.21, p = 0.002, r = 0.59, 95% CI [–18.5, –11.3]) and diastolic blood pressure (Z = –3.09, p = 0.003, r = 0.56, 95% CI [–12.8, –8.4]). These findings demonstrate that foot soak therapy with lemongrass (*Cymbopogon citratus*) effectively reduces blood pressure among pregnant women with mild hypertension.

The results confirm a significant decline in both systolic and diastolic blood pressure after lemongrass foot soak therapy, consistent with prior findings on the vasodilatory and relaxation effects of *Cymbopogon citratus* (Silva & Rita, 2022; Tresna et al., 2023). These reductions support the role of this complementary approach in controlling mild hypertension during pregnancy.

Discussion

This study demonstrated that foot soak therapy using lemongrass (*Cymbopogon citratus*) decoction significantly reduced both systolic and diastolic blood pressure among pregnant women with mild hypertension. The observed reduction supports the hypothesis that a simple, non-pharmacological intervention can effectively promote maternal cardiovascular stability through physiological relaxation and peripheral vasodilation mechanisms.

From a physiological standpoint, the antihypertensive effect of lemongrass is primarily attributed to its bioactive compounds—citral, geraniol, and flavonoids—which stimulate endothelial nitric oxide release, inhibit calcium influx in smooth muscle cells, and enhance parasympathetic activity. These mechanisms promote vascular smooth muscle relaxation and reduce systemic vascular resistance (Ben Ammar et al., 2022; Maaliki et al., 2019). Additionally, immersion of the feet in warm water contributes to autonomic regulation by decreasing sympathetic tone and activating baroreceptor-mediated vasodilation, consistent with the autonomic relaxation theory (Kim et al., 2023). Together, these mechanisms explain the physiological basis of blood pressure reduction observed in this study.

The current findings align with and expand upon several international studies. Tresna A et al. (2023) found that combining Epsom salt and lemongrass foot soak reduced blood pressure significantly among hypertensive pregnant women ($p < 0.001$). Similarly, Liszayanti & Rejeki (2019) observed mean decreases of 3.4 mmHg (systolic) and 4.6 mmHg (diastolic) after 20

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minutes of warm water foot soaking. Maybodi et al. (2025) demonstrated that lemongrass aromatherapy promoted parasympathetic activation and lowered anxiety and blood pressure among dental patients. Althurwi et al. (2025) confirmed that Cymbopogon citratus exerts direct vasodilatory and cardioprotective effects in animal models, while Tazi et al. (2024) highlighted the global potential of lemongrass as a source of antihypertensive bioactives. The consistency of these results across diverse populations supports the external validity of the current study, though direct evidence among pregnant women remains limited.

However, the present research contributes new evidence by applying these physiological effects specifically to pregnant women, a group where pharmacological treatment options are limited due to fetal safety concerns. This underscores the potential of lemongrass foot soaking as a safe complementary intervention within antenatal care, particularly in low-resource settings.

Culturally and contextually, the use of lemongrass holds strong relevance in Indonesian primary care. Lemongrass is widely available, inexpensive, and traditionally used for relaxation and herbal remedies. Integrating this practice into community midwifery services aligns with national strategies promoting natural, locally based health innovations. Midwives can easily supervise and educate pregnant women to perform the therapy safely at home, thereby enhancing self-care and reducing dependence on medication. This local adaptability increases feasibility and sustainability, especially in rural or resource-limited areas where access to pharmacological treatment is restricted.

Lemongrass has strong cultural and contextual relevance in primary healthcare in Indonesia due to its accessibility, affordability, and long-standing use as a relaxant and herbal remedy. Integrating lemongrass with aromatherapy to reduce anxiety during childbirth has proven effective and applicable to community midwives, supporting the national strategy of promoting locally based and nature-based health innovations. Furthermore, educating people about the use of lemongrass as an anti-inflammatory and increasing knowledge about its benefits increases community self-reliance in maintaining health, reduces dependence on chemical drugs, and is particularly beneficial in areas with limited access to pharmacological treatments (Ambarika & Rahmi, 2025; Gustina et al., 2025; Mantouw & Puspitasari, 2024; Nilma et al., 2024; Rahayu et al., 2025; Sari et al., 2023).

Despite its promising outcomes, several limitations must be acknowledged. First, the quasi-experimental one-group design lacks a control group, which may limit causal inference and susceptibility to placebo effects. Second, the small sample size (n = 30) restricts generalizability and statistical power. Third, the short intervention period (four weeks) prevents assessment of long-term effects. Fourth, the study did not include biochemical markers of vascular function, which could strengthen mechanistic explanations. Nevertheless, standardized procedures, instrument calibration, and participant adherence monitoring helped minimize measurement bias and enhance internal validity.

Future studies should employ randomized controlled designs, larger and more diverse samples, and extended follow-up durations. Integrating biomarkers such as nitric oxide or cortisol levels may further clarify physiological pathways. Comparative studies combining lemongrass foot soak with other complementary methods—such as aromatherapy or hydrotherapy—could also identify synergistic benefits.

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Implications and limitations

The results of this study indicate that lemongrass (*Cymbopogon citratus*) foot soak therapy can serve as a simple, low-cost complementary intervention for managing mild hypertension in pregnancy. Its safety and ease of use make it suitable for integration into antenatal care, allowing midwives to promote relaxation, enhance maternal comfort, and prevent hypertensive complications through supervised home-based practice. This approach aligns with holistic midwifery care, emphasizing natural, low-risk, and culturally appropriate methods.

However, the study has several limitations, including a small sample size (n = 30), the absence of a control group, and possible placebo effects that may have influenced participants' responses. The short intervention duration and lack of biochemical measurements also limit the interpretation of long-term physiological outcomes. Future studies with larger, randomized samples and extended follow-up are recommended to strengthen the evidence and generalizability of these findings.

Relevance to Practice

The findings of this study are directly applicable to midwifery practice, particularly in the prevention and management of mild hypertension during pregnancy. Midwives can introduce lemongrass (Cymbopogon citratus) foot soak therapy as part of routine antenatal counseling or relaxation sessions, especially for pregnant women who experience elevated blood pressure but do not require pharmacological treatment. During antenatal visits, midwives can demonstrate preparation steps, guide optimal soaking duration and temperature, and monitor safety and comfort. This intervention can also be included in maternal health education programs at primary healthcare centers or community classes to promote self-care and relaxation. By integrating this simple, evidence-based complementary therapy, midwives can enhance maternal well-being while reducing reliance on medication and preventing complications related to hypertension.

Conclusion

This study demonstrated that foot soak therapy using lemongrass (*Cymbopogon citratus*) effectively reduced systolic and diastolic blood pressure among pregnant women with mild hypertension. The findings suggest that this therapy is a safe, simple, and culturally appropriate complementary method that can be integrated into midwifery-led antenatal care to support maternal cardiovascular health. Future research with larger, randomized controlled trials is recommended to confirm its long-term effectiveness and establish standardized clinical guidelines for broader implementation.

Funding

This research was funded by a grant from the Directorate of Research and Community Service, Ministry of Education, Culture, Research, and Technology. (Grant No. 81 /SPK/LL1/AL.04.03/PL/2025, 2077/STIKes-MHM/I/VI/2025). The funding body had no role in the study design, data collection, analysis, interpretation, or manuscript writing.

CrediT Authorship Contributions Statement

Friza Novita Sari Situmorang: Conceptualization, Methodology, Supervision

Ariska Fauzianty: Software, Validation, Formal Analysis, Writing - Review & Editing

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Hariati Eliana Purba: Investigation, Resources, Data Curation, Project Administration
Pitri Indriani Br Purba: Writing - Original Draft, Review & Editing
Novitaria Zega: Writing - Original Draft, Visualization, Funding Acquisition

Conflicts of Interest

There is no conflict of interest.

Acknowledgments

The author sincerely expresses gratitude to STIKes Mitra Husada Medan and the Research and Community Service Unit for their invaluable support during the execution of this study. Appreciation is also extended to the Directorate of Research and Community Service, Ministry of Education, Culture, Research, and Technology, for providing financial assistance.

Special gratitude is extended to the Head and staff of Klinik Pratama Rawat Inap Sarfina for granting permission and providing assistance throughout the research process. The author also sincerely appreciates the pregnant women who willingly participated as respondents, as well as the research team members for their valuable contributions to data collection, analysis, and the preparation of the final report.

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