



The Effectiveness of Comparative Foot Soaks using Red Ginger Decoction and Lemongrass Decoction in Reducing Blood Pressure in Pregnant Women with Hypertension

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Abstract

Hypertension in pregnancy is a major cause of maternal and fetal morbidity and mortality, with serious complications such as preeclampsia, eclampsia, stroke, and even death. Data in Kotamobagu City in 2025 showed that 59 of 295 pregnant women (13.9%) experienced hypertension. Non-pharmacological efforts, such as herbal-based complementary therapies, are still rarely used due to lack of knowledge among the public and health workers. The research method used a quasi-experimental pretest-posttest with a control group design. A sample of 30 respondents was divided into three groups: red ginger ($n=10$), lemongrass ($n=10$), and control ($n=10$). The research instruments included an aneroid sphygmomanometer, a stopwatch, a water thermometer, an observation sheet, and an intervention SOP. Data analysis was performed using the Wilcoxon Signed Rank Test and Kruskal-Wallis with a significance level of 0.05. The results showed that red ginger foot baths reduced systolic blood pressure by an average of 22 mmHg and diastolic blood pressure by 14 mmHg ($p=0.007$; $p=0.004$), while lemongrass reduced systolic blood pressure by 27 mmHg and diastolic blood pressure by 11 mmHg ($p=0.004$; $p=0.008$). The control group did not show a significant decrease ($p>0.05$). The Kruskal-Wallis test showed a significant difference between the groups ($p=0.000$ systolic; $p=0.032$ diastolic), with lemongrass being more effective on systolic blood pressure, while red ginger was more dominant on diastolic blood pressure. In conclusion, red ginger and lemongrass foot baths are effective as a safe complementary therapy for hypertensive pregnant women, and have the potential to be a supporting intervention for antenatal care.

Introduction

Pregnancy is a long-awaited moment for all women in their lives, from labor to the birth of the baby. Couples always hope for a healthy pregnancy, which is influenced by several factors, not only from the mother's perspective but also from the husband, family, and social environment (Eddy & Fife, 2021). Pregnancy inherently carries risks, which can impact the health of both the mother and the fetus.

Many pregnancy complications, such as preeclampsia and eclampsia, antepartum hemorrhage, and diabetes mellitus, increase in incidence at certain ages. Hypertension, one of the triad of complications in pregnancy, is a major cause of increased morbidity and mortality among pregnant women, fetuses, and newborns (Ummyati & Asrofin, 2019).

The World Health Organization (WHO) stated that in 2020, the global maternal mortality rate (MMR) reached 223 per 100,000 live births. The leading causes of maternal death globally include severe bleeding, postpartum infections, high blood pressure during pregnancy (preeclampsia and eclampsia), childbirth complications, and unsafe abortion (WHO, 2023). According to Maternal Perinatal Death Notification (MPDN) data, the maternal mortality rate in Indonesia reached 4,005 in 2022 and increased to 4,129 in 2023.

Two main factors contributing to the high mortality rate in Indonesia are late diagnosis and late referral to a health facility with adequate facilities and infrastructure (Mahmood et al., 2021; Mahendradhata et al., 2021; Diba et al., 2019). Ministry of Health data shows that eclampsia accounted for 23% of maternal deaths in 2022 and 20% for hemorrhage. In 2023, eclampsia accounted for 24% and hemorrhage for 23%. Preeclampsia and eclampsia are specific cases that occur only in pregnant women and do not apply to other forms of hypertension (Hauspurg & Jeyabalan, 2022).

Preeclampsia is known as pregnancy poisoning because pregnancy itself causes hypertension in women who would not otherwise experience high blood pressure. Rana et al. (2019) and Nirupama et al. (2021) said that, preeclampsia generally occurs due to abnormalities, particularly in the placenta, which cause high blood pressure in pregnant women. Hypertension is a serious health problem and can be detrimental because it can lead to various complications, including death. Hypertension is a medical condition that can increase the risk of heart, brain, kidney, and other diseases.

Among other complications, hypertension can cause serious damage to the heart, such as heart attacks, heart failure, and sudden death (Messerli et al., 2017; Alrashed et al., 2024). Hypertension can also rupture or block arteries that supply blood and oxygen to the brain, leading to stroke or death for both the mother and the fetus. The Maternal Mortality Rate (MMR) in North Sulawesi Province in 2020 was 230 per 100,000 live births, higher than the national figure of 189. Many MMR cases occurred due to preeclampsia (a potentially dangerous pregnancy complication characterized by high blood pressure) which was not quickly handled due to the Covid 19 pandemic situation, some cases occurred in very young mothers and some of them occurred in poor residents in rural areas.

The still high maternal mortality rate can be caused by the inadequate quality of maternal health services (Antenatal Care), especially for pregnant women (Berhan & Berhan, 2014; Osungbade et al., 2008; Mahmood et al., 2018). Therefore, an unhealthy pregnant woman's condition will negatively impact the baby and also the safety of the pregnant woman. The main causes of maternal death that often occur include bleeding during childbirth, hypertension, anemia, pregnant women with diabetes, and four factors that can cause unhealthy pregnant women: becoming a mother at too young an age (<20 years), having children at too old an age (>30 years), having children too close together (<2 years), and having too many children (>4 children), which makes a mother biologically and socially unprepared.

The maternal mortality rate in Kotamobagu City in 2022 was 2 people, caused by preeclampsia (1 person), and hemorrhage (1 person). The initial survey conducted at 5 Kotamobagu Community Health Centers in December 2024, the number of pregnant women recorded in January-December was 1,286 people and those suffering from hypertension were 179 people (13.9%), in January-June 2025 the number of pregnant women recorded in 5 Kotamobagu Community Health Centers was 295 people and those suffering from hypertension were 59 people, for the treatment of hypertension in pregnant women in Kotamobagu City, complementary methods are still rarely used due to the lack of knowledge of midwives and the community about various complementary methods.

Non-pharmacological hypertension management provided by midwives involves only educating pregnant women about reducing salt intake and consuming healthy foods such as

fruits, vegetables, and fish. Herbal foot soaks are still rarely practiced, with the public only aware of red ginger and lemongrass as spices. In an effort to reduce maternal mortality, the Kotamobagu City Health Office is optimizing the role of health cadres in encouraging pregnant women to care for their health and collaborating with relevant cross-sector agencies.

Pregnancy counseling is always provided at every community health center (Puskesmas) to ensure they understand the do's and don'ts during pregnancy and prepare for childbirth. This is also supported by a program to reduce teenage pregnancy rates in collaboration with the Education Office. Researchers conducted observations and initial trials in February 2025 at the Gogagoman Community Health Center on six pregnant women in their second trimester with mild hypertension using a simple quasi-experimental method for three consecutive days, in accordance with the standard operating procedure (SOP).

The group was divided into two groups: three participants were given a red ginger bath and three participants were given a lemongrass bath, each receiving a foot bath using the red ginger bath (Azlina, 2025). Preliminary results showed that the average systolic blood pressure decreased by 7 mmHg in the red ginger group and 10 mmHg in the lemongrass group. Therefore, it can be concluded that lemongrass is more effective in lowering blood pressure in pregnant women with hypertension. This research served as the basis for formulating the research problem and hypothesis.

Podymow & August (2007) said that, hypertension in pregnant women is a pregnancy complication that can threaten the health of the mother and fetus. Hypertension in pregnancy, if not properly managed, can lead to preeclampsia and other serious complications (Ummyati & Asrofin, 2019). Conventional treatment of hypertension in pregnant women is often limited due to the risk to the fetus. Therefore, natural and non-pharmacological approaches are important to consider. Preventing morbidity and mortality from hypertension in pregnancy can be done by maintaining blood pressure below 130/90 mmHg.

Interventions that can be implemented are divided into two types: pharmacological and non-pharmacological interventions (Dyer et al., 2018; Rios et al., 2019; Gartlehner et al., 2017). Limitations of pharmacological therapy include the fact that it is only prescribed for severe cases of gestational hypertension, while no treatment is provided for mild cases. Furthermore, antihypertensive drug therapy has dangerous side effects because it can cross the placental barrier, disrupting fetal circulation, which can lead to fetal emergencies.

Therefore, appropriate management alternatives are needed to maintain blood pressure in pregnant women. Non-pharmacological therapies for lowering blood pressure during pregnancy or preeclampsia are considered safer because they do not cause side effects. A complementary therapy that can be done independently is foot hydrotherapy or foot soaks. Soaking the feet in warm water improves circulation and elicits a systemic response by causing vasodilation (Juwariyah & Febriani, 2025).

Foot soaks can also be modified by adding herbs such as red ginger and lemongrass. Red ginger itself contains essential oils that provide a warming and spicy sensation, widening blood vessels and improving blood flow. Lemongrass also contains many beneficial ingredients for lowering blood pressure. Besides its flavonoid essential oil content, it also contains calcium and magnesium, which are very useful for helping lower blood pressure by widening arteries (Caminiti et al., 2024).

Furthermore, red ginger and lemongrass are Asian-Pacific spices that are very easy to find and cultivated in Indonesia. Hydrotherapy with lemongrass helps improve blood circulation by dilating blood vessels and improving blood flow. This stimulates the nerves in the feet, activating the parasympathetic nervous system, which lowers blood pressure. Lemongrass

contains hypolipidemic substances that are useful for reducing the risk of hypertension and lowering blood pressure.

The hypolipidemic effect is a reduction in low-density lipid levels in the bloodstream (Kwiterovich, 2000). Antihypertensive compounds, flavonoids and alkaloids, are found in lemongrass extract due to its essential oil content. Foot Soak Therapy with Red Ginger Decoction is a technique for lowering blood pressure by soaking the feet in warm water containing red ginger decoction. Soaking feet in warm water improves circulation and elicits a systemic response by causing vasodilation (Augin & Soesanto, 2022). Midwives' competence in implementing complementary methods in midwifery refers to non-medical therapies used to support maternal health, particularly those experiencing hypertension during pregnancy.

The competence of midwives in carrying out this method includes three main aspects, namely knowledge, where midwives must know the basic concepts of complementary methods in midwifery and the working principles of alternative therapies, indications and contraindications for each complementary method based on the condition of pregnant women, childbirth, postpartum, and newborns, the safety and effectiveness of complementary therapy based on evidence-based practice (based on scientific evidence) and the interaction of complementary methods with medical therapy, especially for pregnant women with special conditions such as preeclampsia, gestational diabetes, or high-risk pregnancies, then midwives must have skills and a professional attitude where midwives must apply the correct techniques in complementary methods in accordance with existing evidence-based and must prioritize the safety of mothers and babies, not using complementary methods without a strong scientific basis.

Herbal therapy can be a complementary method in reducing hypertension in pregnant women (Ulbricht, 2010; Azizah et al., 2021; Smith et al., 2019). However, its use must be based on scientific evidence and consulted with a medical professional to avoid unwanted side effects. There are several herbs that have been studied as having the potential to help lower blood pressure in pregnant women, including red ginger, garlic, lemongrass, neem leaves, and celery. However, I chose red ginger and lemongrass because they are abundant in my area, making them easy to obtain and easy to apply to pregnant women. Red ginger contains gingerol, shogaol, and flavonoids, which have vasodilatory (widening blood vessels) and anti-inflammatory effects, helping to lower blood pressure, while lemongrass contains flavonoids, polyphenols, and essential oils, which are natural diuretics, helping to reduce fluid retention in the body that often causes increased blood pressure (Ummiyati & Asrofin, 2019).

Research conducted by Arinda & Khayati (2019) found that preeclampsia after receiving foot soak therapy with red ginger decoction resulted in a reduction in preeclampsia in the majority of respondents, with a percentage of 52.9%, with a mild preeclampsia rate. The results of this study showed a Wilcoxon statistical test before and after administering foot soak therapy with red ginger decoction for preeclampsia, resulting in a p-value of $0.001 < 0.05$. Therefore, the Ho conclusion was rejected, indicating that there was an effect of foot soak therapy with red ginger decoction on reducing blood pressure in pregnant women with preeclampsia.

Foot soak therapy with red ginger decoction is a technique for lowering blood pressure by soaking the feet in warm water containing red ginger decoction (Ali et al., 2023). Soaking the feet in warm water with red ginger produces a heating/warming effect that can cause liquids, solids, and gases to expand in all directions and increase chemical reactions. Metabolism occurs in tissues along with increased exchange between body chemicals and body fluids. Liszayanti & Rejeki (2019) and Santi et al. (2021) also found that citronella grass baths were quite effective in lowering blood pressure (systolic and diastolic) in mothers with preeclampsia.

Before receiving warm water citronella grass bath therapy, respondents often complained of swelling in the legs and neck tension. After receiving citronella grass bath therapy, respondents

experienced a decrease in symptoms, including dizziness and neck tension. The swelling in the legs also decreased. This is because one of the benefits of lemongrass is lowering blood pressure. Research has been conducted on the potential of lemongrass extract as a source of hypolipidemic substances that can reduce the risk of hypertension.

The hypolipidemic effect was recorded with a significant reduction in low-density lipid levels in the bloodstream (Atmeh et al., 1983). Antihypertensive flavonoids and alkaloids contained in lemongrass extract due to its essential oil content. One of the benefits of lemongrass is lowering blood pressure. The compounds contained in lemongrass have antihypertensive flavonoids and alkaloids contained in lemongrass extract and essential oils. This research has been conducted on the potential of lemongrass extract as a source of hypolipidemic substances that can reduce the risk of hypertension.

Methods

This study is a quantitative study with a quasi-experimental approach using a pretest-posttest with a control group design. This approach was used to measure the effect or effectiveness of two types of treatments (interventions): a red ginger foot bath and a lemongrass foot bath, compared to a control group that received no intervention but still received standard care. This design involved measuring blood pressure before and after the intervention in all three groups, with the aim of observing any changes that occurred and comparing the effectiveness of each treatment. This design is suitable for use in obstetric research situations where full randomization is not possible, but control over variables can still be done by comparing between groups. This method was chosen because it is able to provide objective, measurable data and can be analyzed statistically, thus allowing researchers to examine cause-and-effect relationships more accurately even without total randomization. The population in this study were all pregnant women with hypertension registered at five Community Health Centers (Puskesmas) within the Kotamobagu City area, North Sulawesi. The population was obtained based on medical records and monthly reports from each Puskesmas. The population of pregnant women with hypertension in January–June 2025 was 59 people. The number of samples in this study was 30 respondents, which were divided into three groups, namely Intervention Group I (Red Ginger decoction) 10 respondents, Intervention Group 2 (Lemongrass decoction) 10 respondents and the control group 10 respondents.

Research Instruments

Research instruments are tools used by researchers to obtain valid and reliable data. In this study, the instruments used included measuring instruments, observation guidelines, and intervention documentation sheets that supported systematic data collection. The instruments used consisted of:

Sphygmomanometer (Aneroid Sphygmomanometer)

This device is used to measure respondents' blood pressure, both before (pre-test) and after (post-test) the intervention. Measurements are conducted by trained researchers or enumerators, adhering to standard operating procedures (SOPs) for blood pressure measurement. The sphygmomanometer used has been calibrated and has good levels of validity and reliability.

Stopwatch

A stopwatch was used to measure the duration of the foot soaks according to the SOP, which was 15 minutes per session. The time was measured consistently to ensure uniform treatment across participants.

Water Thermometer

A water thermometer was used to ensure the foot soak water temperature was within the expected range (39–40°C), for both the red ginger decoction and lemongrass decoction interventions.

Observation Sheet

This is a checklist-like instrument used to record the participant's condition, attendance, response during the intervention, and blood pressure measurement results. This sheet also records whether the intervention procedures were carried out according to SOP.

SOP for Foot Soak Intervention

The SOP was developed to ensure that each intervention was carried out consistently. The SOP includes the procedure for preparing the red ginger/lemongrass decoction, the temperature and duration of the soak, and the technique for administering the foot soak.

Respondent Identity and Informed Consent Form

This form contains the respondent's demographic data and a statement of consent to participate in the study. Informed consent was obtained prior to data collection, in accordance with research ethics principles.

Data Processing

Data Processing According to Wang et al. (2018), data processing is performed using a computer with a computer data processing system program. The collected data is then processed using a computer with SPSS, which includes editing, coding, tabulating, data entry, data cleaning, processing, and data cleaning. The following are the steps in data processing:

Editing (Data Printing)

This is an effort to re-check the accuracy of the data obtained or collected. Editing is carried out during the data collection stage or after the data is collected. The researcher will check the accuracy and completeness of the data in the form of questionnaires collected by respondents.

Coding (Coding)

The researcher codes the data in the form of sentences or letters into numbers or figures. Coding is useful for simplifying data processing and is crucial when processing and analyzing data using a computer.

Tabulating Data (Data Collection)

The data is converted into codes and then arranged and grouped into tables by the researcher. The tabulation process is carried out by entering the data into a frequency distribution table. Grouping data in tabular form according to predetermined criteria and scores based on the questionnaire.

Data Entry

Researchers enter the collected data into a table or computer database, then create a simple frequency distribution. Data or answers from each respondent, in the form of numeric codes, are entered into a program or software.

Processing

In this stage, respondents' answers, translated into numbers, are then processed for easy analysis.

Cleaning

Rechecking data to detect coding errors, completeness of entered data, and so on, after which corrections or corrections are made.

Data Analysis

Data analysis is the analysis of processed data so that the results are easily understood by the reader. Data analysis includes information on the processed data, grouping the results, and summarizing the processed data to form research conclusions (Ahmed, 2019). Data analysis in this study was conducted to answer the research objective, namely to analyze the effectiveness of a comparison of foot baths using red ginger decoction and lemongrass decoction on reducing blood pressure in pregnant women with hypertension. The data analysis steps were carried out in stages. First, univariate analysis was used to describe the characteristics of each research variable descriptively. The data analyzed included respondent characteristics such as age, gestational age, parity, and baseline blood pressure, as well as the mean, standard deviation (SD), frequency, and percentage of blood pressure before and after treatment. The results of this analysis were then presented in the form of a frequency distribution table and statistical descriptions. Second, bivariate analysis was conducted to determine changes in blood pressure before and after the intervention and to compare effectiveness between the intervention and control groups. Before conducting the difference test, the data were tested for normality using the Shapiro-Wilk test (if the sample size was less than 50). The test results indicated that the data were not normally distributed, so nonparametric tests were used. The Wilcoxon Signed Rank Test was used to analyze differences between the pretest and posttest results within each group, followed by the Kruskal-Wallis Test to compare the results across the three groups as a whole. Third, the results were interpreted by comparing the statistical test values with a predetermined significance level of $\alpha = 0.05$. The decision-making criteria were as follows: if the p-value < 0.05 , there is a statistically significant difference or effect; if the p-value ≥ 0.05 , there is no significant difference or effect. All analyses were performed using the latest version of SPSS to ensure more accurate and efficient calculations.

Results and Discussion

Univariate Analysis

Respondent Characteristics

The frequency distribution of maternal characteristics at the Kotamobagu City Health Center, North Sulawesi is presented in table 1 below.

Table 1. Frequency Distribution of Maternal Characteristics at the Kotamobagu City Community Health Center, North Sulawesi

Mother's Characteristics	Ginger Intervention (n=10)		Lemongrass Intervention (n=10)		Control (n=10)		p-value
	f	%	f	%	f	%	
Mother's Age							
a. 20-35 years	8	80	9	90	8	80	-
b. <20 years	2	20	1	10	2	20	
Gravida:							0.901
a. Primipara	6	60	8	80	7	70	
b. Multipara	4	40	2	20	3	30	
Trimester of Pregnancy:							0.684
a. TM II	5	50	6	60	7	70	
b. TM III	5	50	4	40	3	30	
Education							0.913
a. Senior High School	8	80	8	80	8	80	

b. Senior High School	2	20	1	10	1	10	
c. Junior High School	0	0	1	10	1	10	
Occupation							
a. Housewife	4	40	6	60	5	50	0.764
b. Private sector	2	20	0	0	2	20	
c. Civil servant	1	10	2	20	2	20	
d. Self-employed	3	30	2	20	1	10	

Table 1 shows that the majority of respondents in the ginger, lemongrass, and control groups were aged 20–35 years, representing 80%, 90%, and 80%, respectively. The number of pregnancies (gravida) showed that the majority of respondents were primiparous: 60% in the ginger group, 80% in the lemongrass group, and 70% in the control group. The homogeneity test yielded a p-value of 0.901 ($p > 0.05$), indicating no significant differences between the groups. Based on trimester, the majority of respondents were in their second and third trimesters, with a nearly even distribution. In the ginger group, 50% were in their second and third trimesters, while in the lemongrass group, 60% were in their second and third trimesters, while in the control group, 70% were in their second and third trimesters. The homogeneity test yielded a p-value of 0.684 ($p > 0.05$), indicating no significant differences.

Respondents were predominantly high school graduates, representing 80% in all groups. A small proportion of respondents (10–20%) had a bachelor's degree, while only 10% of respondents in the lemongrass and control groups had a junior high school education. A homogeneity test showed a p-value of 0.913 ($p > 0.05$), indicating no significant difference between the groups. Regarding occupation, the majority of respondents worked as housewives (40% in the ginger group, 60% in the lemongrass group, and 50% in the control group). Other occupations, such as private sector employment, civil servant employment, and self-employment, were only a small proportion. The homogeneity test showed a p-value of 0.764 ($p > 0.05$), indicating no significant differences between the groups.

Overall, the analysis showed that the characteristics of respondents in the three study groups were relatively homogeneous, thus concluding that there were no significant differences between the groups based on age, gestational age, trimester of pregnancy, education, or occupation. Therefore, the study results can be more focused on the impact of the intervention.

Blood Pressure in Pregnant Women before Intervention and Control Group

Table 2. Blood Pressure in Pregnant Women before Intervention

No	Blood Pressure	N	Mean	SD	Min-Max
1.	Ginger Intervention Group	10	2.60	0.516	2-3
2.	Lemongrass Intervention Group	10	2.40	0.516	2-3
3.	Control Group	10	2.50	0.527	2-3

Table 2 shows the distribution of blood pressure in pregnant women before the intervention, broken down into three groups: the ginger intervention group, the lemongrass intervention group, and the control group. In this study, there were 10 respondents in each group, and the results showed nearly similar average blood pressure values across the three groups: 2.60 in the ginger intervention group, 2.40 in the lemongrass intervention group, and 2.50 in the control group. In general, blood pressure in pregnant women is an important indicator of maternal and fetal health. Several previous studies have shown that hypertension in pregnant women can pose risks to maternal and fetal health, such as increasing the risk of preeclampsia, fetal growth restriction, and preterm birth (Safitri & Djaiman, 2021). Therefore, proper blood pressure measurement and management are crucial in prenatal care.

In this study, the similar average results across the three groups indicate that there was no significant difference in blood pressure among the study participants before the intervention.

This is important because it provides a solid basis for comparing the effects of each intervention on subsequent changes in blood pressure. For example, a study by Nadia (2020) on the use of ginger to lower blood pressure showed that ginger can potentially lower blood pressure through its vasodilatory and anti-inflammatory effects, although significant changes may require a longer time or stronger effects. On the other hand, interventions with lemongrass have also been investigated in several studies, demonstrating its benefits as an antioxidant and anti-inflammatory that could potentially support blood pressure reduction. For example, research by Maybodi et al. (2025) showed that lemongrass can help lower blood pressure in patients with mild hypertension through its relaxing effect on vascular smooth muscle.

In the control group, which received no intervention, the average blood pressure was very close to the values of the other two intervention groups. This indicates that without intervention, pregnant women's blood pressure remained within the normal range, which aligns with the results of a study by Conen et al. (2007), which stated that pregnant women who did not receive additional medical intervention usually had relatively stable blood pressure within a certain range. Overall, these results indicate that baseline blood pressure levels were relatively balanced across the three groups, providing validity for subsequent analyses regarding the effectiveness of each intervention. With this uniformity in baseline conditions, it is expected that differences in post-intervention outcomes will be more pronounced, potentially indicating whether ginger or lemongrass has a significant effect on blood pressure management in pregnant women.

Table 3. Blood Pressure in Pregnant Women after Intervention

No	Blood Pressure	N	Mean	SD	Min-Max
1.	Ginger Intervention Group	10	1.60	0.843	0-3
2.	Lemongrass Intervention Group	10	0.70	0.823	0-2
3.	Control Group	10	2.70	0.675	2-4

Table 3 shows the distribution of blood pressure in pregnant women after the intervention. In the ginger intervention group, with 10 respondents, the average blood pressure was 1.60 with a standard deviation of 0.843 and a range of 0–3. In the lemongrass intervention group, with 10 respondents, the average blood pressure was 0.70 with a standard deviation of 0.823 and a minimum–maximum range of 0–2. Meanwhile, in the control group, with 10 respondents, the average blood pressure was 2.70 with a standard deviation of 0.675 and a range of 2–4.

Bivariate Analysis

Bivariate tests were used to examine changes in systolic and diastolic blood pressure in pregnant women before and after the ginger, lemongrass, and control interventions.

Normality Test

A normality test is a statistical procedure used to determine whether data in a variable follows a normal distribution. This test is important for determining whether further analysis will use parametric or non-parametric tests. The results of the normality test using the Shapiro-Wilk method (because the sample is ≤ 50), based on the results of the normality test using Shapiro-Wilk, the results were pre-systolic ginger ($p = 0.001$), post-systolic ginger ($p = 0.142$), pre-diastolic ginger ($p = 0.004$), post-diastolic ginger ($p = 0.002$), pre-systolic lemongrass ($p = 0.058$), post-systolic lemongrass ($p = 0.011$), pre-diastolic lemongrass ($p = 0.002$), post-diastolic lemongrass ($p = 0.000$) and pre-systolic control ($p = 0.001$), post-systolic control ($p = 0.410$), pre-diastolic control ($p = 0.000$), post-diastolic control ($p = 0.172$). The results of the normality test showed that most of the data were not normally distributed, especially in the pre-test and diastolic blood pressure data. Therefore, the use of non-parametric tests is highly recommended for most of the data in this study, especially when comparing pre and post data

in groups whose data are not normal. For further comparative analysis involving this data, the researcher used a non-parametric statistical test (Wilcoxon Test).

Analysis of Blood Pressure Before and After Being Given Ginger Soaking at The Kotamobagu City Health Center, North Sulawesi.

Table 4. Analysis of Blood Pressure Before and After Being Given Ginger Soaking at the Kotamobagu City Health Center, North Sulawesi

Ginger Soak	Negative Ranks	Positive Ranks	Mean Rank	Ties	Z	Signifikansi (p-value)
Pre Sistol-Post Sistol	9	0	5.00	1	-2.699	0.007
Pre Diatol- Post Diatol	10	0	5.50	0	-2.889	0.004

Table 4 explains the results of the analysis using the Wilcoxon Signed Ranks Test, it is known that in systolic blood pressure, there were 9 respondents who experienced a decrease after the intervention of foot soaking with red ginger decoction, no respondents experienced an increase, and 1 respondent had the same value before and after the intervention. The Z value = -2.699 with p-value = 0.007 (<0.05) indicates that the decrease in systolic blood pressure in this group was statistically significant. In diastolic blood pressure, all respondents (10 people) experienced a decrease after the intervention, without any increase or constant value. The Z value = -2.889 with p-value = 0.004 (<0.05) also indicates that the decrease in diastolic blood pressure was statistically significant. These results indicate that the intervention of foot soaking with red ginger decoction is effective in reducing systolic and diastolic blood pressure in hypertensive pregnant women.

Analysis of Blood Pressure Before and After Being Given Lemongrass Soaking at the Kotamobagu City Health Center, North Sulawesi.

Table 5. Analysis of Blood Pressure Before and After Being Given Lemongrass Infusion at the Kotamobagu City Health Center, North Sulawesi

Lemongrass Soak	Negative Ranks	Positive Ranks	Mean Rank	Ties	Z	Signifikansi (p-value)
Pre Sistol-Post Sistol	10	0	5.50	0	-2.859	0.004
Pre Diatol- Post Diatol	8	0	4.50	2	-2.636	0.008

The Wilcoxon Signed Ranks Test analysis results in Table 5 show that all 10 respondents (10) experienced a decrease in systolic blood pressure after the lemongrass foot bath intervention. No respondents experienced an increase or a constant value. The mean rank value was 5.50, Z = -2.859, with a p-value of 0.004 (<0.05), indicating that the decrease in systolic blood pressure was statistically significant. For diastolic blood pressure, eight respondents experienced a decrease, none experienced an increase, and two respondents had the same value before and after the intervention. The mean rank value was 4.50, Z = -2.636, with a p-value of 0.008 (<0.05), indicating that the decrease in diastolic blood pressure was also statistically significant.

These results indicate that the lemongrass foot bath intervention is effective in reducing both systolic and diastolic blood pressure in hypertensive pregnant women. This effectiveness can be explained by the active ingredients in lemongrass, such as citral, geraniol, and essential oils, which have vasodilatory and diuretic effects, helping to widen blood vessels, reduce peripheral resistance, and improve circulation. Furthermore, the warming effect of the foot soak can stimulate muscle relaxation and the parasympathetic nervous system, which also helps lower blood pressure.

Analysis of Blood Pressure Before and After in the Control Group at the Kotamobagu City Health Center, North Sulawesi

Table 6. Analysis of blood pressure before and after in the control group at the Kotamobagu City Health Center, North Sulawesi

Control	Negative Ranks	Positive Ranks	Mean Rank	Ties	Z	Signifikansi (p-value)
Pre Sistol-Post Sistol	2	2	2.50	6	0.000	-1.000
Pre Diatol- Post Diatol	6	3	5.00	1	1.000	0.317

The results of the Wilcoxon Signed Ranks Test analysis in Table 6 show that in systolic blood pressure, there were 2 respondents who experienced a decrease, 2 respondents experienced an increase, and 6 respondents had the same value before and after observation in the control group. The mean rank value = 2.50, Z = 0.000, with a p-value = 1.000 (> 0.05) indicates that there was no significant difference between systolic blood pressure before and after in the control group. In diastolic blood pressure, there were 6 respondents who experienced a decrease, 3 respondents experienced an increase, and 1 respondent had a constant value. The mean rank value = 5.00, Z = 1.000, with a p-value = 0.317 (> 0.05) also indicates that there was no significant difference between diastolic blood pressure before and after in the control group. These results indicate that in the control group, changes in both systolic and diastolic blood pressure were not statistically significant. Thus, the decrease in blood pressure that occurred in the treatment group (red ginger and lemongrass foot bath) was most likely caused by the intervention given, not by time factors or chance.

Multivariate Analysis

Multivariate analysis is a statistical technique used to analyze more than two variables simultaneously within a single research model. This analysis aims to compare the effectiveness of foot baths using ginger, lemongrass, and a control. The Kruskal-Wallis test is a non-parametric statistical test used to compare three or more independent groups against a single dependent variable on an ordinal or interval/ratio scale that is not normally distributed. It is an alternative to one-way ANOVA when the assumption of normality is not met.

Table 7. Comparison of the Effectiveness of Ginger, Lemongrass, and Control Soaks on Reducing Blood Pressure in Pregnant Women with Hypertension in Kotamobagu, North Sulawesi

Intervention		N	Mean Rank	Kruskal Wallis	Df	Sig
Sistol Pre	Ginger	10	17.55	1.655	2	0.437
	Lemongrass	10	12.95			
	Control	10	16.00			
	Total	30				
Sistol Post	Ginger	10	14.50	15.813	2	0.000
	Lemongrass	10	8.35			
	Control	10	23.65			
	Total	30				
Diastol Pre	Ginger	10	17.65	1.461	2	0.482
	Lemongrass	10	13.55			
	Control	10	15.30			
	Total	30				
Diastol Post	Ginger	10	12.30	6.868	2	0.032
	Lemongrass	10	13.50			
	Control	10	20.70			

	Total	30				
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The analysis results in Table 7 show that the Kruskal-Wallis test was used to compare the effectiveness of foot baths using ginger, lemongrass, and the control group in reducing blood pressure in hypertensive pregnant women in Kotamobagu, North Sulawesi. In systolic blood pressure measurements before the intervention (pre-systole), a p-value of 0.437 (>0.05) indicated no significant difference between the three groups. This indicates that the baseline systolic blood pressure in all groups was relatively similar before treatment. After the intervention (post-systole), a p-value of 0.000 (<0.05) was obtained, indicating a significant difference between the groups. Based on the mean rank value, the lemongrass group had the lowest score (8.35), followed by ginger (14.50), and the control group (23.65). A lower mean rank value indicates lower systolic blood pressure after treatment. Thus, the lemongrass foot bath proved more effective in reducing systolic blood pressure than both the ginger and control groups. For diastolic blood pressure before intervention (diastole pre), a p-value of 0.482 (>0.05) indicated no significant difference between groups before treatment. However, after intervention (diastole post), a p-value of 0.032 (<0.05) was obtained, indicating a significant difference between groups. Based on the mean rank value, the ginger group had the lowest score (12.30), followed by lemongrass (13.50), and the control group (20.70). This indicates that foot baths using boiled ginger were slightly more effective in lowering diastolic blood pressure than lemongrass, and both were more effective than the control group.

This study aims to determine the comparative effectiveness of foot soaks using boiled ginger and boiled lemongrass on reducing blood pressure in hypertensive pregnant women in Kotamobagu City.

Blood Pressure Before and After Ginger Soaking at the Kotamobagu City Community Health Center, North Sulawesi

The Wilcoxon Signed Ranks Test results showed a p-value of 0.007 for systolic blood pressure and a p-value of 0.004 for diastolic blood pressure, indicating a significant decrease in both after the intervention. The average decrease in systolic blood pressure of 22 mmHg and diastolic blood pressure of 14 mmHg demonstrates the effectiveness of red ginger (*Zingiber officinale* var. *rubrum*) as a complementary therapy. The active compounds gingerol and shogaol in red ginger are known to have a vasodilatory effect by increasing blood vessel dilation, reducing peripheral resistance, and improving blood flow (Ghayur et al., 2005). The warming effect of the foot bath can also stimulate the parasympathetic nervous system, thereby lowering blood pressure (Kumar & Shetty, 2021).

Blood pressure reduction in pregnant women can be influenced by several factors, including age, gestational age, parity, education, and occupation, as seen in the characteristics of the 10 respondents who received ginger intervention, 8 of whom were aged 20-35. Women of productive age typically have better blood vessel elasticity, resulting in a faster response to blood pressure-lowering therapy. Furthermore, maternal education also supported the research process, as all mothers had secondary or higher education, influencing the knowledge, attitudes, and health behaviors of pregnant women in accepting information and interventions.

This research aligns with research by Sari & Sari (2023), which reported that soaking feet in boiled red ginger water for three consecutive days in patients with mild hypertension significantly reduced systolic and diastolic blood pressure. Research by Yunas et al. (2024) also supports these findings, indicating that administering red ginger extract to hypertensive patients was able to lower blood pressure through vasodilatory mechanisms and diuretic effects. Furthermore, research by Sinatra & Murray (2022) found that a 15-minute red ginger foot bath can improve peripheral circulation and lower blood pressure, especially in groups with mild to moderate hypertension. These similar results indicate that the blood pressure-lowering effect of red ginger is consistent across various populations, including pregnant

women with hypertension, and can be explained by the combination of the pharmacological effects of gingerol-shogaol and thermal stimulation of the feet, which triggers peripheral vascular relaxation.

Red ginger (*Zingiber officinale* var. *rubrum*) is a ginger variety that contains higher levels of bioactive compounds than regular ginger, particularly gingerol, shogaol, zingerone, and paradol. These compounds play an important role in regulating blood pressure through several mechanisms: Vasodilation of Blood Vessels. Gingerol and shogaol inhibit calcium channels in vascular smooth muscle, resulting in vessel wall relaxation (vasodilation). Impact on hypertension Vasodilation reduces total peripheral resistance, lowers systolic and diastolic blood pressure Mild Diuretic Effect on red ginger increases sodium and water excretion through the kidneys, reduces circulating blood volume resulting in a decrease in intravascular fluid volume reducing cardiac load and lowering blood pressure. Antioxidants and Anti-inflammatory properties in red ginger also contain phenolics that reduce oxidative stress and suppress inflammation in the endothelium of blood vessels, thus improving endothelial function so that the vasodilation response is optimal. Relaxation Effect through Thermal Stimulation on Soaking feet in warm water with boiled red ginger increases peripheral blood circulation and activates the parasympathetic nervous system so that parasympathetic activation reduces heart rate and blood pressure.

Blood Pressure Before and After Ginger Soaking at the Kotamobagu City Community Health Center, North Sulawesi

The Wilcoxon test results showed a p-value of 0.004 for systolic blood pressure and a p-value of 0.008 for diastolic blood pressure, both significant. The average decrease in systolic blood pressure reached 27 mmHg and diastolic blood pressure 11 mmHg. Lemongrass (*Cymbopogon citratus*) contains citral, geraniol, and myrcene, which have diuretic and vasorelaxant properties, helping to reduce body fluid volume and dilate blood vessels. The effects of aromatherapy and warmth also contribute to relaxation, thus lowering blood pressure. The majority of respondents were in the healthy reproductive age range (20–35 years), where blood vessel elasticity is still good, so the vasodilatory response due to the effects of citral and geraniol from lemongrass is more optimal. According to Verma et al. (2021), mothers aged <35 years have a lower risk of hypertension than older women and are more responsive to non-pharmacological interventions. Most of the respondents in this study were housewives. This allows them sufficient time to participate in regular, relaxed foot baths. Moderate physical activity and adequate rest can enhance the relaxing effects of lemongrass baths. Steptoe & Willemsen (2004) explains that a low-stress work environment can help stabilize blood pressure.

This research aligns with Chowdhury et al. (2023), who reported that consuming lemongrass tea for two weeks can significantly lower systolic and diastolic blood pressure in healthy individuals, through its diuretic and vasodilatory effects. Research by Nuriza (2024) also found that foot baths containing lemongrass decoction lowered blood pressure in patients with mild to moderate hypertension, primarily through vasorelaxation and relaxation of vascular smooth muscle. Meanwhile, Silva & Bárbara (2022) demonstrated that inhalation of lemongrass aromatherapy can lower blood pressure in hypertensive patients, demonstrating the role of lemongrass' aromatherapy components in reducing stress and lowering blood pressure. Lemongrass is effective as a safe complementary therapy for lowering blood pressure in hypertensive pregnant women, both through the pharmacological effects of its active compounds and through stimulating relaxation of the body and mind.

During pregnancy, plasma volume increases by 40–50%, causing the heart to work harder. In women with hypertension, this condition further burdens the cardiovascular system. According to Mollaelahi & Shahali (2022), efforts to lower blood pressure in pregnant women must

consider fetal safety, making non-pharmacological methods such as herbal foot baths a safer option. Lemongrass baths provide vasodilatory and mild diuretic effects that do not interfere with blood supply to the fetus. Citral compounds can inhibit vascular smooth muscle contraction through a calcium channel blocker mechanism, resulting in vasodilation and lower blood pressure. Meanwhile, geraniol and myrcene have mild diuretic effects that help reduce intravascular fluid volume, thereby reducing the heart's workload. This theory is also supported by Chowdhury et al. (2023) stated that plants containing essential oils, such as lemongrass, have a relaxing effect on the central nervous system by stimulating the parasympathetic nervous system. Parasympathetic activation lowers heart rate and blood pressure. Furthermore, the aromatherapy effects of lemongrass contribute to reducing psychological stress in pregnant women.

Blood Pressure Before and After Observation in the Control Group at the Kotamobagu City Health Center, North Sulawesi

The control group showed a p-value >0.05 for both systolic (1.000) and diastolic (0.317), indicating no significant decrease. There was only a slight decrease in the average diastolic pressure of 3 mmHg, likely due to rest or a placebo effect. This confirms that the herbal foot bath intervention triggered the significant decrease in the treatment group. The small decrease in diastolic pressure was likely due to rest during the study, where respondents sat quietly and in a relatively comfortable environment before blood pressure measurements. This condition can trigger activation of the parasympathetic nervous system, resulting in a slight decrease in blood pressure. Furthermore, there is the possibility of a placebo effect, where respondents believe they are receiving a beneficial intervention, which psychologically induces mild relaxation that can influence the measurement results.

These results support the theory that the significant decrease in blood pressure in the treatment group (red ginger and lemongrass) was not solely due to time or rest conditions, but rather due to the pharmacological and physiological effects of the herbal foot bath intervention. In non-pharmacological intervention studies, a control group serves to distinguish the actual effects of therapy from external influences such as environmental conditions, rest, or suggestion. Thus, the findings in the control group reinforce the conclusion that the red ginger and lemongrass foot bath intervention plays a major role in significantly lowering blood pressure in hypertensive pregnant women, while in the group without any specific intervention, blood pressure changes were insignificant. Respondent characteristics such as reproductive age, secondary to higher education, relatively low-stress jobs, and low parity are indeed protective factors against hypertension. However, in the control group, these factors were not sufficient to produce significant blood pressure reductions without herbal interventions such as red ginger or lemongrass. This confirms that the significant reductions in the treatment group were purely influenced by the pharmacological and physiological effects of the herbal bath, not solely by the respondents' demographic factors.

Who reported that the control group in the herbal foot bath study did not experience significant blood pressure reductions, while the group receiving the herbal intervention (ginger/lemongrass) showed significant reductions. Abbott et al. (2014) found a similar finding in a study of complementary therapies for hypertension, where the control group experienced only minor changes due to psychological factors and rest conditions. Zimmermann-Viehoff et al. (2013) also revealed that the placebo effect can produce a small decrease in blood pressure, but this effect is much smaller than the pharmacological and physiological effects provided by herbal interventions. In their study, the control group showed an average decrease of only 2–4 mmHg, while the intervention group decreased by >10 mmHg. Thus, the results in the control group in this study strengthen the conclusion that the significant decrease in blood pressure in the treatment group (red ginger and lemongrass) was caused by the herbal intervention, not solely due to rest time, suggestion, or psychological factors.

Comparison of the Effectiveness of Blood Pressure Before and After Giving Foot Soaks Using Red Ginger Decoction, Lemongrass Decoction and Control Group in Pregnant Women with Hypertension at the Kotamobagu City Health Center, North Sulawesi

The Kruskal-Wallis test showed significant differences between the three groups after the intervention, both in systolic (p -value = 0.000) and diastolic (p -value = 0.032). In systolic, lemongrass had the lowest mean rank, indicating greater effectiveness than both red ginger and the control. In diastolic, red ginger was slightly superior to lemongrass, but both were significantly more effective than the control. This difference is likely influenced by the pharmacological mechanisms of each ingredient, with lemongrass having a stronger diuretic effect and red ginger being more dominant in peripheral vasodilation. The pharmacological effects of lemongrass (*Cymbopogon citratus*) are superior in systolic pressure because citral, geraniol, and myrcene contained in lemongrass have diuretic effects that work by reducing blood plasma volume by increasing sodium and water excretion.

This mechanism directly reduces preload and cardiac output, which primarily affects systolic pressure. This diuretic effect is more dominant than the vasodilatory effect, resulting in a more significant reduction in systolic pressure compared to red ginger. The pharmacological effects of red ginger (*Zingiber officinale* var. *rubrum*) are superior on diastolic pressure because red ginger contains gingerols and shogaols, which have a peripheral vasodilatory effect by inhibiting the entry of calcium ions into vascular smooth muscle, thereby reducing peripheral resistance. The reduction in peripheral resistance has a greater effect on diastolic pressure, which reflects blood vessel resistance when the heart relaxes. The thermal effect of a red ginger foot bath also increases peripheral blood flow through stimulation of the parasympathetic nervous system. Thermal and Relaxation Effects: Both red ginger and lemongrass produce a warming effect that stimulates reflex vasodilation in peripheral blood vessels.

This effect is enhanced by the psychological relaxation caused by the herbal aroma, which acts on the limbic system, reducing the release of stress hormones such as cortisol, which indirectly lowers blood pressure. It should be noted that all respondents in all three groups were taking standard antihypertensive medication as recommended by healthcare professionals. This means that the differences in blood pressure reduction between groups were more due to the additional effect of the herbal soak intervention, rather than solely due to medication consumption. Additional Diuretic Effect on Systolic Blood Pressure in the lemongrass group. Standard antihypertensive medications used by respondents (e.g., mild diuretics or calcium antagonists) work to lower blood pressure through specific pharmacological mechanisms. The addition of lemongrass soak provides a natural diuretic effect from the compounds citral, geraniol, and myrcene, which can enhance the drug's effect in reducing plasma volume and lowering systolic blood pressure more significantly than in the other groups. Meanwhile, in the red ginger group, the additional effect of diastolic vasodilation was observed.

Red ginger contains gingerols and shogaols, which act as peripheral vasodilators by inhibiting vascular smooth muscle contraction. This mechanism complements the effects of antihypertensive medications by lowering peripheral resistance, which primarily affects diastolic blood pressure. The effect of the medication on the control group that did not receive additional herbal intervention was not observed. The changes in blood pressure were entirely due to the effects of the antihypertensive medication and little to the influence of rest or placebo. Therefore, the decrease was much smaller than in the group receiving additional herbal infusions. This research aligns with that of Riyani et al. (2022), who reported that adding lemongrass foot baths to hypertensive patients who were still taking standard medication resulted in a greater reduction in systolic pressure compared to drug therapy alone. Lemongrass' diuretic effect is thought to enhance the blood volume-reducing mechanism of antihypertensive drugs.

Meanwhile, research by Alfillaturrohman & Wibowo (2020) showed that red ginger foot baths in patients with mild hypertension resulted in a greater reduction in diastolic pressure compared to a control treatment, even when respondents were still taking antihypertensive drugs. The peripheral vasodilatory effects of gingerols and shogaols complement the drug's mechanism. Herbal-based complementary interventions combined with pharmacological therapy were shown to produce a significant synergistic effect on blood pressure reduction, compared to relying on drugs alone. Thus, although all groups in this study received the same drug therapy, the added effectiveness of lemongrass and red ginger was shown to produce a more significant reduction in blood pressure. The difference in dominant effects lemongrass is more powerful in reducing systolic and red ginger is more dominant in diastolic can be explained by the pharmacological mechanisms of each ingredient, as has been proven in previous studies.

Conclusion

Foot baths using red ginger (*Zingiber officinale* var. *rubrum*) decoction significantly reduced blood pressure in hypertensive pregnant women, with an average reduction in systolic blood pressure of 22 mmHg and diastolic blood pressure of 14 mmHg (systolic p-value = 0.007; diastolic p-value = 0.004). This effect was primarily influenced by the gingerol and shogaol content, which have peripheral vasodilatory properties. Foot baths using lemongrass (*Cymbopogon citratus*) decoction also significantly reduced blood pressure, with an average reduction in systolic blood pressure of 27 mmHg and diastolic blood pressure of 11 mmHg (systolic p-value = 0.004; diastolic p-value = 0.008). This effect was primarily due to the diuretic and vasorelaxant content of citral, geraniol, and myrcene. In the control group, there was no significant decrease in blood pressure (systolic p-value = 1.000; diastolic p-value = 0.317). The diastolic decrease was only 3 mmHg, possibly due to rest or a placebo effect. The Kruskal-Wallis test showed a significant difference between the three groups (systolic p-value = 0.000; diastolic p-value = 0.032). Lemongrass was superior in reducing systolic blood pressure, while red ginger was slightly more dominant in diastolic blood pressure. This effect remained even though all groups were taking standard antihypertensive medication.

Suggestion

The results of the study, both red ginger and lemongrass foot baths have been proven effective in lowering blood pressure in pregnant women with mild hypertension. Therefore, midwives can make this therapy a routine complementary intervention in ANC services, especially for pregnant women with hypertension that is still in the mild category. Midwives are expected to provide practical education on how to perform red ginger and lemongrass foot baths at home, so that pregnant women can continue the therapy independently and safely. The results of this study indicate that the use of local herbs such as red ginger and lemongrass can be used as an alternative non-pharmacological therapy that is cheap, easy, and safe, therefore, health institutions are advised to integrate this therapy into maternal health service programs, for example through pregnancy classes or integrated health post activities. Given the results of the study prove that red ginger and lemongrass foot baths lower blood pressure, pregnant women with mild hypertension are advised to carry out this therapy regularly according to the instructions of health workers and families are expected to play an active role in helping to prepare materials and support pregnant women in carrying out this therapy at home for more optimal results. Recommendations for further research include developing a larger sample size to ensure more representative results and conducting a longer timeframe to assess the long-term effects of the intervention. Further research should also directly monitor the level of medication adherence, which can impact blood pressure measurement results in respondents, to achieve optimal results

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