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Original Research

Innovative Approach: Exploring the Efficacy of Red Ginger Infusion Therapy in Hypertension Management

Ni Wayan Sridani[1]*, Muh Sabir[1], Fauzan[1], Ratna Devi[1], Adhar Arifuddin[2,3], Abd Rahman[2], A Fahira Nur[4]

[1]Faculty of Medicine, Universitas Tadulako, Palu, Indonesia
[2]Faculty of Public Health, Universitas Tadulako, Palu, Indonesia
[3]Master Program in Statistics, Universitas Islam Indonesia, Yogyakarta, Indonesia
[4]Department of Midwifery, Universitas Widya Nusantara, Palu, Indonesia

*Corresponding author:
Ni Wayan Sridani
Faculty of Public Health, Universitas Tadulako, Palu, Indonesia
Email: niwayans76@gmail.com

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Abstract

Background: Hypertension is a serious global health issue due to its rising prevalence and its link to severe cardiovascular diseases. Red ginger *(Zingiber officinale var. rubrum)* infusion therapy has gained attention as a potential natural treatment for high blood pressure because of its active compounds, such as gingerols and shogaols, which have anti-inflammatory and vasodilatory effects.

Objectives: This study investigates the effectiveness of red ginger infusion therapy in reducing hypertension among residents of Kawatuna Village, where hypertension rates reached 12.2% in 2022. Given the community's dietary habits and limited healthcare access, alternative treatments like this are important for managing blood pressure.

Methods: The study used a Quasi-Experimental design with a Pretest-Posttest Control Group approach. A total of 66 participants were divided into an experimental group and a control group. The experimental group consumed red ginger infusion daily for seven days, while the control group received no intervention. Blood pressure was measured before and after the intervention.

Results: The results showed a significant decrease in blood pressure in the experimental group. Systolic pressure dropped by an average of 24 mmHg and diastolic pressure by 11 mmHg (both $p<0.001$). In contrast, the control group had only slight changes, with a decrease of 0.17 mmHg in systolic pressure and 1.1 mmHg in diastolic pressure. These findings suggest that red ginger infusion therapy can effectively lower blood pressure in the short term. However, the small sample size and short duration of the study highlight the need for further research. Future studies should explore the specific mechanisms behind red ginger's effects and assess its long-term safety and efficacy. Addressing lifestyle factors, like the high consumption of coconut milk in Kawatuna, through health education programs could also improve hypertension management.

Conclusion: Red ginger infusion therapy shows promise as a complementary treatment for hypertension, but more comprehensive studies are needed to confirm its long-term benefits.

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Background

Hypertension, commonly referred to as high blood pressure, is characterized by a systolic blood pressure of ≥140 mmHg and a diastolic blood pressure of ≥90 mmHg (WHO, 2021). It is a significant global health issue, with the American Heart Association (AHA) reporting a prevalence of 74.5 million cases in the United States among individuals aged over 20 years. Notably, 90-95% of these cases have no identifiable cause (Kemenkes RI, 2019). Projections indicate that by 2025, approximately 80% of the increase in hypertension cases will occur in developing countries,

with the number rising from 639 million in 2000 to 1.15 billion in 2025 (Sembiring & Utari, 2019).

In Indonesia, hypertension is also a major public health concern. In Palu City, for instance, the number of hypertension cases increased from 8,361 in 2017 to 8,397 in 2018, accompanied by 10 deaths, making it the second leading cause of mortality after respiratory infections. At the Kawatuna Community Health Center, the prevalence of hypertension reached 12.2% in 2018, with a steady increase in cases from 2015 to 2018: 8.08% (2015–2016), 6.77% (2016–2017), and 31.26% (2017–2018) (Kemenkes RI, 2021).

This increasing trend is attributed to factors such as population growth, unhealthy lifestyles, and hereditary predisposition. Without interventions to address behavioral risk factors, such as unhealthy diets, the prevalence of hypertension is expected to rise. Public health efforts must therefore focus on promoting healthy lifestyles and raising awareness about hypertension prevention (Puspitasari, 2018).

Complementary therapies, such as the use of red ginger (Zingiber officinale var. Rubrum), have shown promise in hypertension management. Red ginger contains bioactive compounds like gingerol and shogaol, which possess anti-inflammatory, antioxidant, and vasodilator properties, making it a potential therapeutic option (Mao et al., 2019; Syafitri et al., 2018; Singletary, 2023). Studies have demonstrated the effectiveness of red ginger in reducing blood pressure. For instance, foot soaking with red ginger water reduced systolic blood pressure from 149.05 mmHg to 135.83 mmHg and diastolic pressure from 78.69 mmHg to 75.95 mmHg ($p < 0.05$) (Sani & Fitriyani, 2021). Similarly, consuming red ginger was found to significantly lower blood pressure, with a p-value of 0.000 and a calculated Z value of -3.758 (Kristiani & Ningrum, 2021). Despite these promising findings, gaps remain in understanding the duration required for red ginger to exert its effects. Previous studies have not thoroughly explored the timeline for blood pressure reduction following red ginger consumption. Addressing this gap is critical to optimizing its application in hypertension management.

This study aims to evaluate the effectiveness and duration of red ginger water consumption in lowering blood pressure among individuals with hypertension in Kawatuna Village. The findings are expected to provide insights into the practical application of red ginger therapy in clinical settings and support community-based efforts to control hypertension.

Methods

Study Design

This study utilized a quasi-experimental design with a pretest-posttest control group approach. The design involved measuring the dependent variable, blood pressure, before and after the intervention of red ginger consumption in both the experimental and control groups. This approach enabled the assessment of the intervention's effect by comparing the changes in the experimental group to those observed in the control group.

Setting

The research was conducted in Kawatuna Village, Palu City, a region known for its high prevalence of hypertension. The study was carried out over an eight-month period, from July 2022 to February 2023.

Sample/Participants

The study population comprised all individuals aged 17-55 years in Kawatuna Village diagnosed with hypertension, totaling 80 individuals. Using the Slovin formula, a sample size of 66 was calculated, with 60 participants ultimately included in the study. These participants were equally divided into two groups of 30, with six additional individuals reserved as backups. Participants were selected using purposive sampling based on specific inclusion and exclusion criteria. The inclusion criteria required participants to be aged 17-55 years, willing to participate, diagnosed with hypertension, not on antihypertensive medication, and free from diabetes mellitus, cardiovascular disease, kidney disease, or preeclampsia as confirmed by a doctor. Exclusion criteria included unwillingness to participate, age outside the specified range, normal blood pressure, current use of antihypertensive medication, or a diagnosis of the aforementioned comorbidities.

Instruments

Blood pressure measurements were recorded using calibrated blood pressure monitors and stethoscopes. Additional materials used in the intervention included measuring cups, drinking glasses, pans, tea strainers, knives, and red ginger. Observations were documented on standardized observation sheets, and informed consent forms were collected from all participants.

Intervention

Participants in the experimental group consumed red ginger water daily for seven consecutive days, following a detailed Standard Operating Procedure (SOP) for preparation and consumption. The control group did not receive

any intervention. Blood pressure measurements were taken for all participants before the intervention (pretest) and after the intervention (posttest) to evaluate changes.

Data Analysis

Data analysis was conducted using bivariate statistical methods. The Chi-Square test was employed to examine associations between variables at a significance level of p=0.05. The Wilcoxon and Mann-Whitney tests were used to assess the effectiveness of red ginger consumption in reducing blood pressure, providing a robust statistical framework for evaluating the intervention's impact.

Ethical Considerations

The study adhered to ethical standards and received ethical clearance from the Ethics Committee of the Faculty of Medicine, Tadulako University, with approval number 3804/UN 28.1.30/KL/2023. All participants provided written informed consent, ensuring they were fully aware of the study's objectives, procedures, potential risks, and benefits before participation.

Results

The study included 60 participants diagnosed with hypertension, divided equally into control and treatment groups, with 30 individuals in each group. The participants ranged in age from 26 to 65 years, with an average age of 45.5 years. The gender distribution was slightly imbalanced, with males comprising 20.0% in the control group and 16.7% in the treatment group, while females constituted 80.0% in the control group and 83.3% in the treatment group. Genetic factors were present in 53.3% of the control group and 46.7% of the treatment group, indicating a relatively even distribution. The duration of hypertension showed variations, with the treatment group having a slightly lower percentage in the <1year category and a higher percentage in the "Unknown Duration" category compared to the control group. This suggests some differences in baseline characteristics, which may influence the intervention outcomes.

The **Figure 1** show that compares the baseline characteristics of the control and treatment groups. The data indicate no significant differences in the distribution of genetic factors, gender, or age range between the groups. These findings support the comparability of the groups prior to the intervention, ensuring that observed effects can be attributed to the red ginger therapy. Provides a descriptive summary of blood pressure changes in the control group. The mean change in systolic blood pressure (SBP) was 1.17 mmHg (SD = 9.80 mmHg), while the mean change in diastolic blood pressure (DBP) was 1.33 mmHg (SD = 4.29 mmHg). The 25th percentile showed no change in blood pressure, and the median also reflected zero change, indicating minimal variation for most participants. However, the maximum reductions of -20 mmHg (SBP) and -10 mmHg (DBP) highlight individual differences in response to non-intervention conditions, **see Figure 2.** Blood pressure changes in the treatment group. The mean reductions in SBP and DBP were 27.29 mmHg (SD = 14.52 mmHg) and 12.5 mmHg (SD = 8.52 mmHg), respectively. The median reductions were 25 mmHg for SBP and 10 mmHg for DBP, and the maximum reductions reached 50 mmHg (SBP) and 30 mmHg (DBP). These substantial changes suggest that red ginger therapy significantly reduced blood pressure in the treatment group, **see Figure 3.**

The **Figure 4** to presents paired t-test results for the control group. The t-statistics for SBP and DBP changes were 0.65 ($p = 0.52$) and 1.70 ($p = 0.10$), respectively. These findings indicate no significant differences in blood pressure before and after the observation period in the control group. The higher p-value for DBP (close to 0.05) suggests potential variability that could become significant with a larger sample size. Paired t-test results for the treatment group. The t-statistics for SBP and DBP changes were -9.21 ($p < 0.001$) and -7.19 ($p < 0.001$), respectively, confirming significant reductions in both systolic and diastolic blood pressure after red ginger therapy. These results demonstrate the effectiveness of the intervention in lowering blood pressure among hypertensive patients, **see Figure 5**

The **Table 1** to presents the Mann-Whitney U test results comparing blood pressure changes between the control and treatment groups. For SBP, the mean rank was 17.60 for the control group and 43.40 for the treatment group ($p < 0.001$). Similarly, for DBP, the mean ranks were 18.93 (control) and 42.07 (treatment), with a p-value < 0.001. These results confirm that the treatment group experienced significantly greater reductions in blood pressure compared to the control group, emphasizing the therapeutic impact of red ginger infusion.

The findings support the hypothesis that red ginger infusion therapy significantly reduces both systolic and diastolic blood pressure in hypertensive patients. The paired t-test and Mann-Whitney U test results highlight the effectiveness of the intervention. The control group showed minimal changes, while the treatment group demonstrated significant reductions, aligning with the study's objectives and confirming the hypothesis.

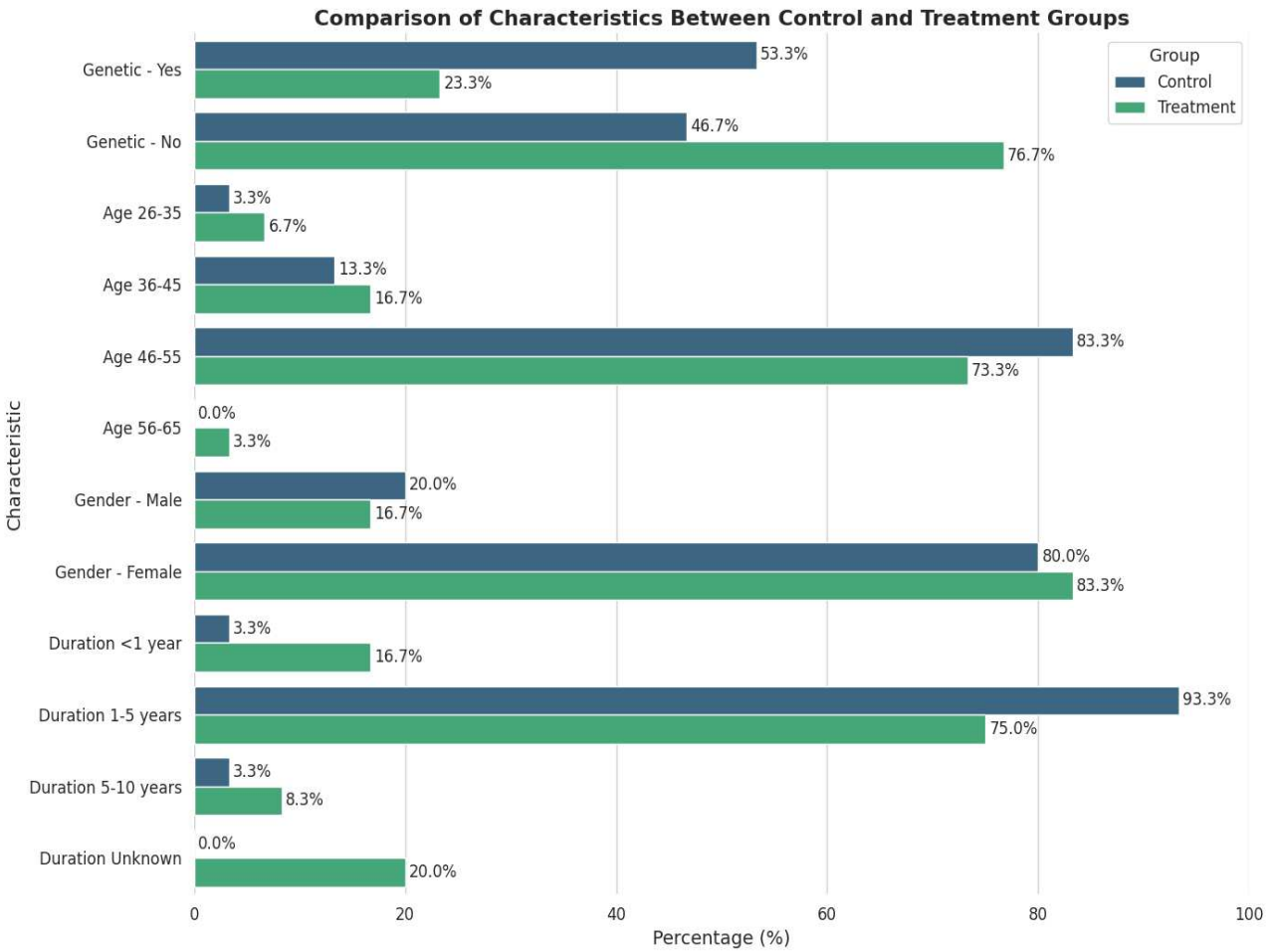


Figure 1 Characteristics between control and treatment groups

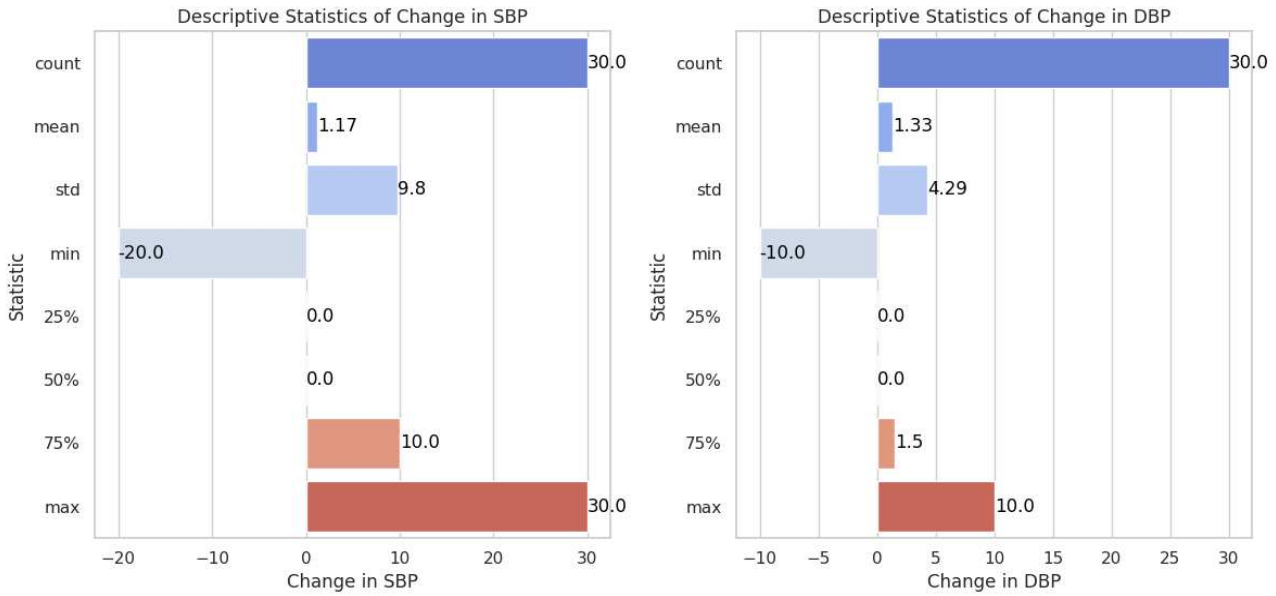


Figure 2 Descriptive Statistics Control Group

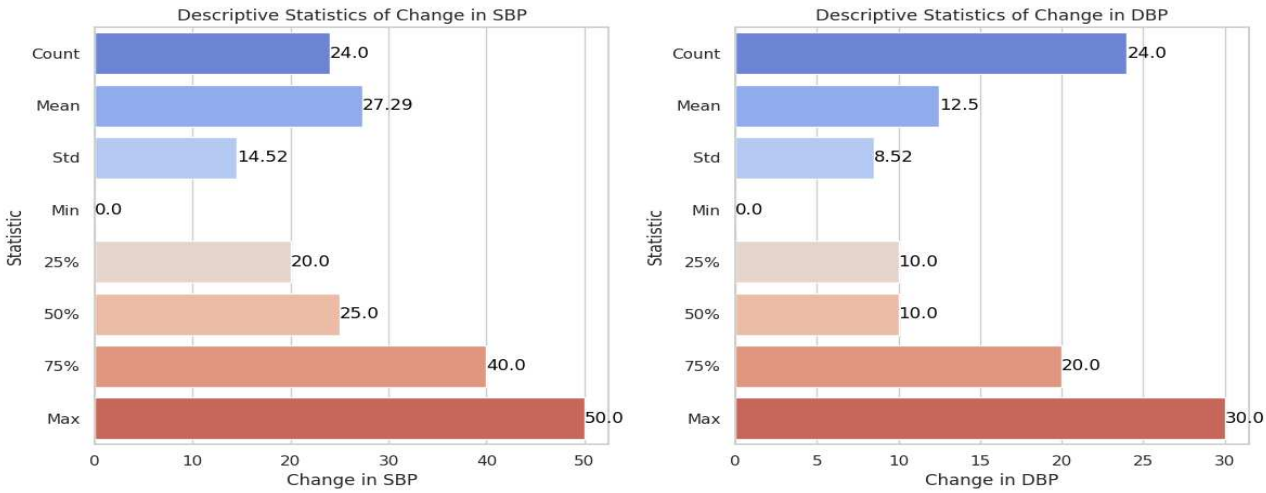
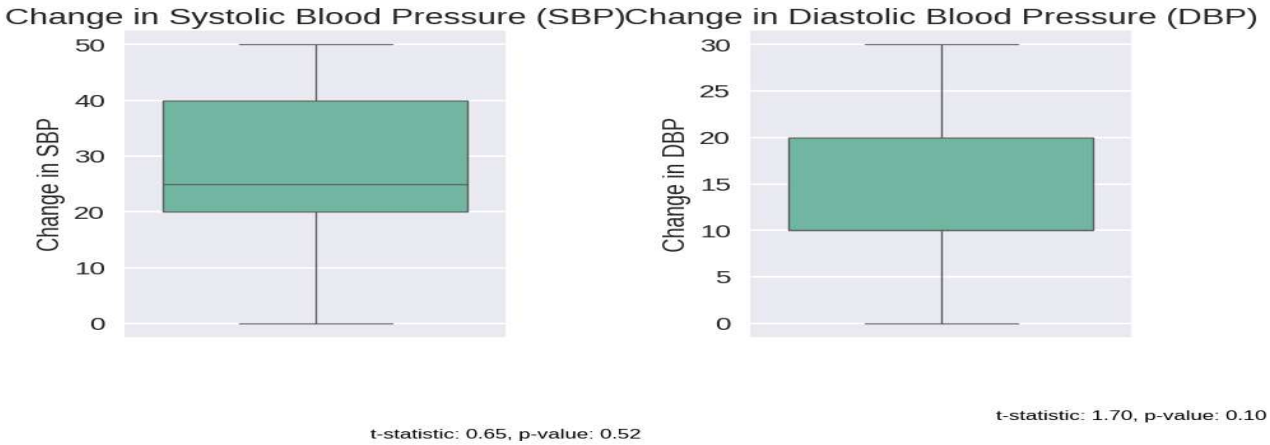
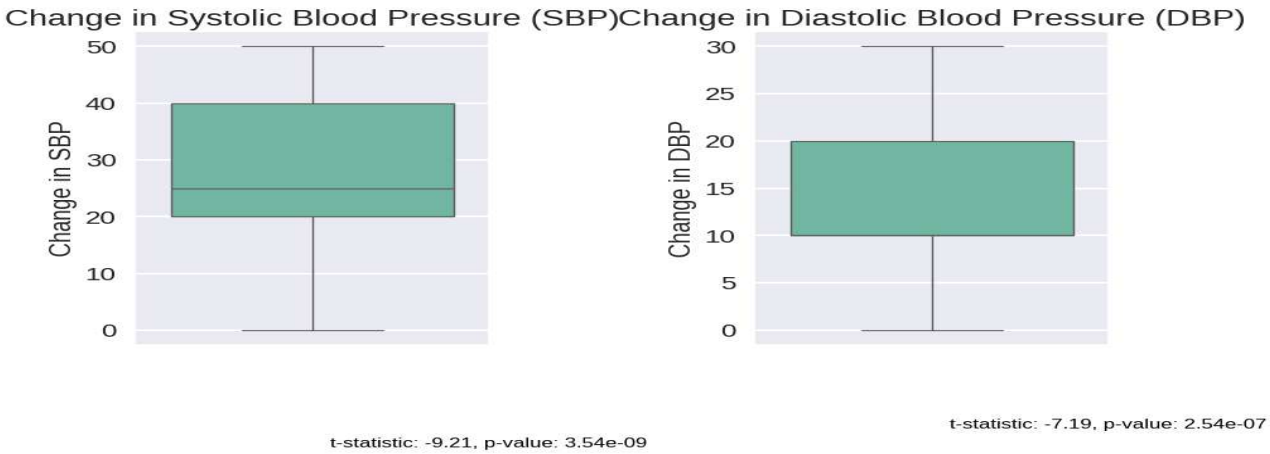


Figure 3 Descriptive Statistics Intervention Group



Paired t-test Results:
SBP - t-statistic: 0.6521669724480917 p-value: 0.5194295944869521
DBP - t-statistic: 1.7008139462623473 p-value: 0.09967903027356179

Figure 4 Tes Statistics Control Group



Paired t-test Results:
SBP - t-statistic: -9.20821330478287 p-value: 3.540259099730372e-09
DBP - t-statistic: -7.190871511404246 p-value: 2.540574312277146e-07

Figure 5 Tes Statistics Intervention Group

Table 1 Difference in blood pressure (systole and diastole) in the control group and treatment group (n=60).

Blood pressure	Group	Mean rank	*p-value**
Systolic	Control	17.60	<0.001
	Treatment	43.40	
Diastolic	Control	18.93	<0.001
	Treatment	42.07	

**Mann-whitney Test*

Discussion

The results of this study show a significant difference in the changes in systolic blood pressure (SBP) and diastolic blood pressure (DBP) before and after the intervention with red ginger water therapy in hypertensive patients. The paired t-test results indicate that red ginger water therapy has a significant impact on lowering blood pressure in hypertensive patients. This is evident from the SBP t-statistic value of -9.208 and a p-value of 3.54e-09, as well as the DBP t-statistic value of -7.191 and a p-value of 2.54e-07. Both p-values are well below the significance threshold of 0.05, indicating that the observed changes in blood pressure are not due to chance but rather due to the intervention. The negative t-statistic values indicate a significant reduction in both systolic and diastolic blood pressure following the intervention.

This significant reduction in systolic and diastolic blood pressure indicates that red ginger has a strong and consistent therapeutic effect in the management of hypertension (Hasani et al., 2019). The bioactive components in red ginger, such as gingerol and shogaol, are believed to have a vasodilator effect that can help dilate blood vessels and reduce vascular resistance, which in turn can lower blood pressure (Joven et al., 2014). Gingerol and shogaol are known to have anti-inflammatory and antioxidant properties that can help relax blood vessels and increase blood flow, ultimately contributing to lower blood pressure (Singletary, 2023)

Furthermore, these findings are in line with various previous studies which have identified the positive effects of red ginger in lowering blood pressure (Ma et al., 2021; Sani & Fitriyani, 2021; Kristiani & Ningrum, 2021). However, it is important to note that the results of this study still require confirmation through larger studies and with more diverse designs to ensure the generality and safety of red ginger water consumption therapy in the long term. However, further research is still needed to identify the more specific mechanisms behind the hypotensive effects of red ginger and to evaluate its long-term effects and tolerability in various populations of hypertension patients. Comprehensive studies are also required that consider other factors that may affect blood pressure, such as lifestyle, diet, and the use of other medications. Understanding the interaction between red ginger and these factors will provide deeper insights into how this therapy can be optimized for different individuals with varying health conditions.

Additionally, it should be noted that this study has several limitations, including a limited sample size and a possibly insufficient intervention duration to evaluate the long-term effects of the therapy. The small sample size may restrict the generalization of these findings to a broader population. The short duration of the intervention might also not reflect more sustained and long-term changes in blood pressure. Therefore, further research with a larger sample size and a longer intervention period is needed to provide a deeper understanding of the effectiveness and safety of consuming red ginger water in the management of hypertension.

The analysis of respondent characteristics based on genetics, age, gender, and duration of hypertension shows that the majority of the control group had a family history of hypertension (53.3%), whereas the majority of the intervention group did not have a family history of hypertension (76.7%). In terms of age, both the control and intervention groups were predominantly in the 46-55 year age range, which falls into the early elderly category. The majority gender in both groups was female, and the duration of hypertension was mostly between 1 to 5 years in both groups.

Based on the genetic characteristic analysis results, most of the control group had a family history of hypertension, while most of the intervention group did not. According to Charles et al. (2017), hypertension can be classified into two categories based on its causes: primary hypertension and secondary hypertension (Charles et al., 2017). Factors influencing primary hypertension include genetics, environment, and risk factors such as obesity, smoking, alcohol consumption, and lack of physical activity (Aronow, 2017). Secondary hypertension is caused by other medical conditions such as estrogen use, kidney disease, Cushing's syndrome, and pregnancy-related hypertension (Charles et al., 2017).

Based on this theory, the category of hypertension among respondents in this study is primary hypertension, either caused by genetic factors or habitual factors that increase the risk of hypertension, such as unhealthy eating

behavior resulting in obesity or a high increase in cholesterol levels in the blood. From the results of the researchers' observations, respondents still had unhealthy eating habits. The foods they most often consume are foods containing coconut milk, fried foods, salted fish, and duo (a type of anchovy preserved in salt and dried). This situation increases the risk of developing hypertension, which is even greater if there are hypertensive offspring.

The theory of Haas et al., 2014 states that if both parents suffer from hypertension, the risk decreases for their children by 45%. Meanwhile, if only one parent suffers from hypertension, the risk decreases for their children by 30% (Haas et al., 2014). Genetic factors plus unhealthy eating habits accelerate the process of hypertension (Pandit, 2017; Sharma et al., 2015). According to Roy Choudhury et al., 2021, if you have a genetic history of hypertension and do not receive treatment or treatment, the environment can cause hypertension to develop within 30 years, signs and symptoms of hypertension appearing with various complications (RoyChoudhury et al., 2021). This happened to respondents in this study, with the average age of hypertension sufferers being 45 - 55 years old, the youngest age affected by hypertension was 31 years old and the oldest 55 years old, with the majority being female in both the control and behavior groups. , and long suffering from hypertension 1 – 5 years.

Many women suffer from hypertension not only due to genetic factors, but also other risk factors such as menopause (Song et al., 2018). On average, Indonesian women experience menopause around the age of 45 - 50 years (M & Fatmawati, 2022). Menopausal women do not have the hormone estrogen, which functions to prevent the appearance of spots in blood vessels by increasing High Density Lipoprotein (HDL) levels in the arteries (Shen et al., 2019). HDL is good cholesterol which prevents spots from forming in blood vessels, so that the elasticity of blood vessels is maintained (Hussain et al., 2016). The elasticity of blood vessels will be maximized if accompanied by sufficient activity and exercise and reducing excessive consumption of fatty foods (Cohen et al., 2012). Research from Teh, et.al, 2015, shows that people who are physically inactive have higher blood pressure compared to people who are active, with a significant value of p=0.001 (Teh et al., 2015). Thus, while the results of this study show promising potential for the consumption of red ginger water in the management of hypertension, further efforts in research and development are needed to confirm these findings more broadly and integrate them better into clinical practice. These efforts will help ensure that this therapy is not only effective but also safe and widely applicable. With more in-depth research, it is hoped that red ginger therapy can become a recognized alternative in hypertension management, providing additional benefits for patients in managing their blood pressure.

In addition to the promising findings regarding the effect of red ginger water on lowering blood pressure, this study contributes new knowledge to the field of hypertension management. The results suggest that red ginger water therapy could serve as a potential natural intervention for hypertensive patients, supporting the idea that plant-based therapies might have therapeutic effects comparable to conventional medications. This knowledge challenges the existing focus on pharmaceutical interventions for hypertension, offering an alternative that may be more accessible and cost-effective, particularly for populations in resource-limited settings. The study also opens the door for further research into the underlying mechanisms through which red ginger exerts its hypotensive effects, potentially contributing to the development of new hypotheses or theories in the management of hypertension. Furthermore, the findings provide valuable insights into the interaction between genetic factors, lifestyle choices, and hypertension, which may inform future interventions and improve clinical practices for managing high blood pressure. However, the limitations of this study, such as the small sample size and short intervention duration, should be considered when interpreting the results. The findings may not be fully generalizable to larger or more diverse populations, and further research with a larger sample size and extended intervention period is necessary to confirm the long-term effects and safety of red ginger water therapy. These limitations also highlight the need for more robust studies to strengthen the validity and external generalizability of these findings.

Conclusion

This study demonstrates the significant effectiveness of red ginger infusion therapy in reducing blood pressure among hypertensive patients. The quasi-experimental design with a pretest-posttest control group clearly showed a substantial decrease in both systolic and diastolic blood pressure after a seven-day regimen of red ginger water consumption. Specifically, the treatment group exhibited a notable reduction of 24.33 mmHg in systolic blood pressure and 11 mmHg in diastolic blood pressure, compared to minimal changes in the control group. These findings suggest that red ginger can be an effective complementary therapy for hypertension management. However, the study acknowledges the need for further research to fully understand the underlying mechanisms of red ginger's hypotensive effects, evaluate its long-term efficacy and safety, and explore its integration into broader clinical practices. Larger sample sizes and longer intervention periods are recommended for future studies to provide a more comprehensive assessment. Additionally, qualitative research could offer valuable insights into cultural and

behavioral factors that influence the prevalence and management of hypertension, such as dietary habits prevalent in Kawatuna Village. In conclusion, while the initial results are promising, indicating that red ginger infusion therapy is an effective method for reducing blood pressure, ongoing research and development are essential to validate these findings and enhance the therapeutic strategies available for hypertension management.

Declaration Conflicting Interest
The authors have no conflicts of interest to declare.

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Author Contribution
N.W.S. led the conceptualization and design of the study, supervised the research project, and contributed to the writing and critical revision of the manuscript. M.S.F. was involved in data collection, statistical analysis, and interpretation of the results. R.D. assisted in the design of the study, coordinated with the Kawatuna Health Center, and contributed to data analysis. A.A. played a significant role in the literature review and drafting sections of the manuscript. A.R. provided expertise in the methodology, ensuring the rigor of the experimental procedures and assisting with data interpretation. A.F.N. was responsible for managing the logistics of the study, including participant recruitment and data management, and contributed to the ethical considerations section. All authors reviewed and approved the final version of the manuscript.

Author Biography
Ni Wayan Sridani is a Lecturer at the Department of Nursing, Faculty of Medicine, Universitas Tadulako, Palu, Indonesia.
Muh Sabir is a Lecturer at the Department of Medicine, Faculty of Medicine, Universitas Tadulako, Palu, Indonesia.
Fauzan is a Lecturer at the Department of Nursing, Faculty of Medicine, Universitas Tadulako, Palu, Indonesia.
Ratna Devi is a Lecturer at the Department of Nursing, Faculty of Medicine, Universitas Tadulako, Palu, Indonesia.
Adhar Arifuddin is a Lecturer at the Department of Epidemiology, Faculty of Public Health, Universitas Tadulako, Palu, Indonesia
Abd Rahman is a Lecturer at the Department of reproduction health, Faculty of Public Health, Universitas Tadulako, Palu, Indonesia.
A Fahira Nur is a Lecturer at the Department of Midwivery,Universitas Widya Nusantara, Palu, Indonesia.

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