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The Effect of Acupressure and Foot Hydrotherapy Using Red Ginger (*Zingiber officinale var rubrum*) on the Blood Pressure of Pregnant Women with Preeclampsia

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ABSTRACT

Hypertension in pregnancy, particularly preeclampsia, remains a significant health issue due to its potential risks to maternal and fetal health. Despite advances in medical management, there is a need for complementary interventions to address this condition effectively. This study investigates the impact of Acupressure and Foot Hydrotherapy interventions utilizing red ginger (*Zingiber officinale var. rubrum*) on reducing blood pressure in pregnant women with preeclampsia at the Kembaran I Health Center. The study employs a quantitative experimental design involving 15 pregnant women diagnosed with preeclampsia. Participants were selected through non-probability sampling based on inclusion criteria: gestational age of ≥ 20 weeks and Mean Arterial Pressure (MAP) > 90 mmHg. Blood pressure was measured using a digital sphygmomanometer before and after the intervention, while an observation sheet recorded the systolic, diastolic, and MAP values. Data analysis was conducted using Paired Samples Correlations and paired sample t-tests to assess the intervention's effectiveness. Results reveal that Acupressure combined with Foot Hydrotherapy using red ginger significantly reduces blood pressure in preeclamptic women. This is evidenced by the t-test value exceeding the critical t-table value at a 5% significance level and degrees of freedom ($n - 1$), specifically 2.145. Additionally, the analysis demonstrates a high correlation between pre- and post-intervention blood pressure parameters, indicating consistent effectiveness of the therapy. This research underscores the potential of integrating complementary interventions, such as Acupressure and Foot Hydrotherapy with red ginger, into maternal healthcare protocols to manage preeclampsia and improve maternal outcomes. Further studies with larger samples are recommended to validate these findings and explore broader applications.

Keyword: Acupressure; Foot Hydrotherapy; Red Ginger; Blood Pressure; and Preeclampsia

Introduction

The Maternal Mortality Rate (MMR) in Indonesia in 2023 recorded 4,482 deaths, representing a 25.48% increase compared to 3,572 deaths in 2022. The leading cause of maternal death in 2023 was preeclampsia, with 412 cases, followed by hemorrhage with 360 cases, and 204 other cases related to obstetric complications. Data indicates

that preeclampsia is a major contributor to the high maternal mortality rate in Indonesia¹.

However, the Maternal Mortality Rate in Banyumas Regency has shown a significant downward trend over the past three years. In 2021, there were 44 maternal deaths, which decreased to 24 cases in 2022, and further reduced to 19 cases in 2023. Analysis of the etiological factors contributing to maternal deaths revealed that

congenital diseases, brain neoplasms, and chronic liver conditions each contributed to 6 cases of death. Preeclampsia and hemorrhagic events each accounted for 5 cases, while cardiovascular disorders, tuberculosis, and amniotic fluid embolism each contributed 1 case. In 2023, preeclampsia and hemorrhage ranked as the second highest causes of maternal mortality in Banyumas Regency, comprising 10 cases (52.63%) of MMR. Based on this phenomenon, preeclampsia and hemorrhagic events are the primary causes of maternal death in Banyumas Regency².

Preeclampsia is a pregnancy disorder characterized by elevated blood pressure with systolic blood pressure ≥ 140 mmHg or diastolic blood pressure ≥ 90 mmHg, which appears after 20 weeks of gestation and often occurs toward the end of pregnancy. Preeclampsia is classified into mild and severe types based on clinical signs, laboratory results, and the presence of complications. Severe preeclampsia is defined as systolic blood pressure reaching ≥ 160 mmHg or diastolic blood pressure ≥ 110 mmHg, measured on two separate occasions with at least 4 hours apart. Preeclampsia is always followed by new onset hypertension with proteinuria, which indicates the development of hypertension and proteinuria during pregnancy. Preeclampsia can be diagnosed even without proteinuria, but may be accompanied by thrombocytopenia ($<100,000$), elevated SGOT/SGPT (twice the normal levels), right upper abdominal pain, shortness of breath, pulmonary edema, serum creatinine > 1.1 mg/dL, neurological symptoms, visual disturbances, headache, stroke, and fetal growth disturbances⁴.

In the diagnosis of Severe Preeclampsia (PEB), in addition to elevated systolic blood pressure ≥ 160 mmHg and diastolic blood pressure ≥ 110 mmHg, thrombocytopenia (platelet count $< 100,000/\text{microliter}$), liver dysfunction (abnormal or twice the normal liver enzyme concentration), epigastric pain, progressive renal insufficiency (serum creatinine > 1.1 mg/dL or double the normal levels in the absence of kidney disease), and the presence of edema and visual disturbances are also considered⁴.

Various efforts made by the government to reduce MMR (Maternal Mortality Rate) aim to ensure quality healthcare services for all pregnant women, including antenatal care, skilled assistance during labor, postpartum support for mothers and babies, providing special care, referring cases with complications, and offering postpartum family planning services at healthcare facilities¹. Efforts to

prevent preeclampsia represent a significant advancement in prenatal care, categorized systematically into primary, secondary, and tertiary prevention⁴. Primary prevention is the most effective and can be achieved by mitigating risk factors that may trigger the condition. Secondary prevention aims to prevent the progression of preeclampsia before clinical manifestations occur, while tertiary prevention focuses on mitigating complications arising as a consequence of the disease⁴.

Primary care requires healthcare professionals capable of identifying risk factors for preeclampsia according to guidelines outlined in the revised 2022 KIA (Kesehatan Ibu dan Anak) book, which includes screening for risk factors early in pregnancy before 20 weeks of gestation. This screening includes assessing parity, maternal age, previous preeclampsia occurrences, BMI evaluation, Mean Arterial Pressure (MAP) assessment, and laboratory testing using urinary dipstick for protein as one of the efforts to prevent preeclampsia. If one or more risk factors for preeclampsia are identified through screening, a low-dose aspirin (75 mg/day) and calcium supplementation (1-1.5 grams) are recommended, and pregnant women with preeclampsia are advised to regularly monitor their blood pressure with a local midwife every 3 days. According to the Family Health Report from Kembaran I Health Center in 2023, there were 98 cases of pregnant women with preeclampsia⁶.

The high incidence of preeclampsia at Kembaran I Health Center prompted healthcare providers to innovate in addressing the issue using a non-pharmacological approach that combines modern and traditional therapeutic elements, which are easy to apply independently and use materials readily available in the community, such as acupressure and hydrotherapy. Several studies on non-pharmacological therapies, such as acupressure, have shown significant differences in average systolic blood pressure before and after acupressure therapy for hypertension in pregnant women during the second trimester⁷. Acupressure is a physiotherapy modality that involves applying massage and stimulation to specific acupoints on the body. Meanwhile, Widiastini states that hydrotherapy, with warm water immersion and foot massage, can reduce edema in the lower extremities of pregnant women⁸. Applying warm foot baths (hydrotherapy) is effective in lowering blood pressure in pregnant women because warm water

helps dilate blood vessels and improve blood circulation⁹.

Non-Pharmacological Therapy to address the risk of hypertension in pregnant women with preeclampsia will include Foot Hydrotherapy combined with Red Ginger (*Zingiber Officinale var rubrum*), as red ginger is widely available in Indonesia and provides a spicy sensation along with the characteristic aroma of ginger from essential oils such as zingiberene, zingiberol, bisabolene, curcumin, gingerol, philandrene, and bitter resin¹⁰. Red ginger contains the highest essential oil content compared to other varieties, which is 2.58-3.90%, while white ginger has 1.5–3.5%, and yellow ginger has the lowest essential oil content, 0.82–1.66%¹¹. The spicy sensation and the warmth from the essential oils in red ginger help dilate blood vessels, improve blood circulation, and ease the heart's workload, which results in lowered blood pressure¹².

Based on this phenomenon, the researcher is interested in conducting a study on the Effect of Acupressure and Foot Hydrotherapy Using Red Ginger (*Zingiber Officinale var rubrum*) on blood pressure in pregnant women with preeclampsia at Kembaran I Health Center, Banyumas.

Methods

This study is a quantitative experimental research aimed at analyzing the effect of acupressure and foot hydrotherapy using red ginger (*Zingiber Officinale var rubrum*) on blood pressure in pregnant women with preeclampsia at Kembaran I Health Center. The study subjects are pregnant women with preeclampsia during the period of October-November 2024, totaling 15 respondents, with a non-probability sampling technique.

The inclusion criteria for this study are pregnant women with preeclampsia with a gestational age ≥ 20 weeks and a Mean Arterial Pressure (MAP) > 90 mmHg. The measurement tools include a digital sphygmomanometer (OMRON brand) for measuring blood pressure, certified with calibration certificate number 11-31-83309, an observation sheet for recording blood pressure (MAP) before and after the intervention, and a daily schedule sheet to record the implementation of Acupressure and Foot Hydrotherapy with red ginger, which will be performed 6 times over 2 weeks.

Data analysis will include univariate analysis (calculating numerical data, presented as mean, standard deviation, maximum and minimum values

with a 95% confidence interval) and bivariate analysis (assessing normality and homogeneity using Levene's test and Shapiro-Wilk test). The difference in mean pre- and post-intervention will be evaluated using paired sample t-test. The study has received ethical approval from the Health Research Ethics Committee of Poltekkes Kemenkes Semarang, with approval number No. 1231/EA/F.XXIII.38/2024.

Results and Discussion

The results of the descriptive statistical analysis of the blood pressure of pregnant women with preeclampsia at Kembaran I Health Center before and after the intervention are presented in Table 1.

Table 1. Descriptive Statistical Analysis of Blood Pressure

	Min	Max	Mean	Std. Dev
PreSistol_1	112.00	141.00	124.80	8.8898
PostSistol_1	101.00	127.00	111.33	6.3546
PreDiastol_1	78.00	90.00	83.73	3.1275
PostDiastol_1	67.00	87.00	76.73	5.0915
PreMAP_1	91.00	105.00	97.06	4.1248
PostMAP_1	80.60	97.00	88.17	4.7762
PreSistol_2	108.00	137.00	120.27	7.8692
PostSistol_2	102.00	129.00	110.40	7.4718
PreDiastol_2	67.00	95.00	80.33	7.3840
PostDiastol_2	65.00	90.00	73.87	6.7704
PreMAP_2	80.60	105.00	93.51	6.6922
PostMAP_2	78.30	99.00	85.98	6.3821
PreSistol_3	100.00	133.00	119.00	9.0947
PostSistol_3	95.00	121.00	110.80	7.4757
PreDiastol_3	67.00	95.00	79.40	8.1574
PostDiastol_3	66.00	93.00	74.73	6.9843
PreMAP_3	80.60	104.00	92.50	7.3149
PostMAP_3	78.30	102.00	86.63	6.2590
PreSistol_4	107.00	138.00	120.67	8.5161
PostSistole_4	99.00	124.00	109.93	6.8187
PreDiastol_4	66.00	90.00	79.733	7.4495
PostDiastol_4	66.00	81.00	74.73	5.3648
PreMAP_4	80.00	102.00	93.44	6.9317
PostMAP_4	77.00	93.30	86.44	5.1652
PreSistol_5	104.00	142.00	118.00	8.6355
PostSistol_5	97.00	126.00	109.07	6.5188
PreDiastol_5	66.00	96.00	78.93	7.6201
PostDiastol_5	64.00	82.00	74.13	5.3434
PreMAP_5	81.30	104.00	91.89	6.4870
PostMAP_5	77.00	93.30	85.70	4.5551
PreSistol_6	108.00	134.00	116.00	7.1514
PostSistol_6	101.00	114.00	107.27	4.0789

	Min	Max	Mean	Std. Dev
PreDiastol_6	67.00	88.00	77.40	6.1505
PostDiastol_6	65.00	84.00	72.53	6.1860
PreMAP_6	81.30	99.30	90.23	5.3887
PostMAP_6	77.00	92.00	84.09	4.6951

Source: Processed data, 2024

The statistical analysis reveals significant reductions in systolic, diastolic, and mean arterial pressure (MAP) following the intervention of acupressure and foot hydrotherapy using red ginger. A paired-sample t-test was conducted to evaluate the differences before and after each session. The results showed statistically significant reductions ($p < 0.05$) in all measured parameters across six intervention sessions, indicating the efficacy of the intervention. For instance, in the first session, systolic blood pressure decreased by an average of 13.47 mmHg, diastolic blood pressure by 7 mmHg, and MAP by 8.89 mmHg. These trends were consistent across subsequent sessions, with post-intervention values consistently lower than pre-intervention values. The findings underscore the therapeutic potential of the combined intervention in managing preeclampsia among pregnant women, offering a promising non-pharmacological approach to blood pressure regulation.

Normality Test

The results of the normality test using the Kolmogorov-Smirnov and Shapiro-Wilk tests are shown in Table 2 below.

Tabel 2. Data Normality Test

Kelompok	Kolmogorov-Smirnov ^a			Shapiro-Wilk		
	Stat	df	Sig.	Stat	df	Sig.
Pre intervensi	0.127	45	0.068	0.934	45	0.013
Post intervensi	0.137	45	0.033	0.923	45	0.005

Source : Processed data, 2024

Based on Table 2, it can be seen that the pre-intervention test showed a significance value (sig) less than the cut-off value of 5%, indicating that the data distribution was normal. However, the other variables did not follow a normal distribution as their significance values were less than 5%. Therefore, data transformation was performed for re-analysis. The results of the data analysis based on the transformed data, using the Kolmogorov-

Smirnov and Monte Carlo tests, are presented in Table 3.

Tabel 3. Normality Test Based on Transformed Data

One-Sample Kolmogorov-Smirnov Test				Sqrtpre	Sqrtpost
N				90	90
Normal Parameters ^{a,b}	Mean			10.1782	9.8609
	Std. Deviation			.99789	.98791
	Absolute			.082	.081
Most Extreme Differences	Positive			.082	.081
	Negative			-.061	-.049
Kolmogorov-Smirnov Z				.776	.767
Asymp. Sig. (2-tailed)				.584	.599
Monte Carlo Sig. (2-tailed)	Sig.			.558 ^c	.571 ^c
	99% Confidence Interval	Lower Bound		.546	.558
		Upper Bound		.571	.584

a. Test distribution is Normal.

b. Calculated from data.

c. Based on 10000 sampled tables with starting seed 2000000.

Source: Processed data, 2024

Based on Table 3, the Kolmogorov-Smirnov value for pre-intervention was 0.776 with an Asymp. sig (2-tailed) value of 0.584 (> 0.05). After the intervention, the Kolmogorov-Smirnov value was 0.767 with an Asymp. sig (2-tailed) value of 0.599 (> 0.05). This indicates that the data followed a normal distribution. The results of the Monte Carlo analysis showed a Sig (2-tailed) value of 0.558 for pre-intervention (> 0.05), and for post-intervention, the Sig value was 0.571 (> 0.05). Therefore, it can be concluded that the research data followed a normal distribution.

Homogeneity Test

The results of the homogeneity test for pre and post-intervention of Acupressure and Foot Hydrotherapy using red ginger on pregnant women with preeclampsia at Puskesmas Kembaran I are presented in Table 4.

Tabel 4. Homogeneity Test

		Levene Statistic	df ₁	df ₂	Sig.
		c			
Pre	Based on mean	2,36	1	8	0.12
	Based on median	5	1	8	8
	Based on median & with adjusted df	1.26	1	8	0.26
	Based on trimmed mean	9		8	3
				83.4	0,26
Post	Based on mean	2.31	1	8	0,13
	Based on median	7		8	2
	Based on median & with adjusted df	4.17	1	88	0,04
	Based on trimmed mean	1	1	88	4
		3.23	1	83.0	0,07

Levene Statistic	df ₁	df ₂	Sig.
c			
4.04	8	0,04	7

Source: Data processed, 2024

Homogeneity of variance was tested using Levene's test, with the results presented in Table 4. For the pre-intervention data, all tests (based on mean, median, adjusted median, and trimmed mean) showed significance values greater than 0.05 (e.g., based on mean: 0.128), indicating homogeneity of variance. In contrast, post-intervention data showed mixed results; significance values for tests based on mean (0.044) and trimmed mean (0.047) were less than 0.05, suggesting heterogeneity.

To address the lack of homogeneity, data transformation was applied. The transformed data yielded significance values above 0.05 for both pre- and post-intervention groups (Table 5 and Table 6), confirming homogeneity of variance after transformation.

Tabel 5. Homogeneity Test for Pre-Intervention Based on Transformed Data

Levene's Test of Equality of Error Variances ^a			
Dependent Variable: Sqrtpre			
F	df1	df2	Sig.
1.014	1	88	0,317

Tests the null hypothesis that the error variance of the dependent variable is equal across groups.

a. Design: Intercept + kelompok

Source: Data processed, 2024

Based on Table 5, it can be seen that for the pre-intervention, the Levene's test of equality of error variances resulted in an F value of (1.014) with a significance value of 0.317 (> 0.05). This indicates that homogeneity occurred. Meanwhile, the post-intervention Levene's test of equality of error variances is presented in Table 6.

Tabel 6. Homogeneity Test for Post-Intervention Based on Transformed Data

Levene's Test of Equality of Error Variances ^a			
Dependent Variable: Sqrtpost			
F	df1	df2	Sig.
2.108	1	88	0,150

Tests the null hypothesis that the error variance of the dependent variable is equal across groups.

a. Design: Intercept + kelompok

Source: Data processed, 2024

Based on Table 6, the results of the post-intervention homogeneity test using Levene's test of equality of error variances showed an F value of (2.108) with a significance value of 0.150 (> 0.05). This indicates that homogeneity occurred.

Blood Pressure Measurement (MAP)

Based on the results of the Paired Samples Correlations analysis for pregnant respondents with preeclampsia after being intervened with Acupressure and Foot Hydrotherapy using red ginger at Puskesmas Kembaran I, the results can be seen in Table 7 below.

Tabel 7. Paired Samples Correlations Analysis

		Correlation	Sig.
Pair 1	PreSistol_1 & PostSistol_1	0.827	0.000
Pair 2	PreDiastol_1 & PostDiastol_1	0.323	0.241
Pair 3	PreMAP_1 & PostMAP_1	0.708	0.003
Pair 4	PreSistol_2 & PostSistol_2	0.783	0.001
Pair 5	PreDiastol_2 & PostDiastol_2	0.814	0.000
Pair 6	PreMAP_2 & PostMAP_2	0.866	0.000
Pair 7	PreSistol_3 & PostSistol_3	0.780	0.001
Pair 8	PreDiastol_3 & PostDiastol_3	0.867	0.000
Pair 9	PreMAP_3 & PostMAP_3	0.842	0.000
Pair 10	PreSistol_4 & PostSistol_4	0.714	0.003
Pair 11	PreDiastol_4 & PostDiastol_4	0.590	0.021
Pair 12	PreMAP_4 & PostMAP_4	0.710	0.003
Pair 13	PreSistol_5 & PostSistol_5	0.921	0.000
Pair 14	PreDiastol_5 & PostDiastol_5	0.844	0.000
Pair 15	PreMAP_5 & PostMAP_5	0.889	0.000
Pair 16	PreSistol_6 & PostSistol_6	0,629	0,012
Pair 17	PreDiastol_6 & PostDiastol_6	0.814	0.000
Pair 18	PreMAP_6 & PostMAP_6	0.815	0.000

Source: Data processed, 2024

Paired samples correlation analysis was conducted to assess the relationship between pre- and post-intervention blood pressure measurements, including systolic, diastolic, and mean arterial pressure (MAP). As shown in Table 7, most pairs exhibited strong correlations (e.g., preMAP_5 and postMAP_5: 0.889, $p < 0.001$), indicating a significant association between pre- and post-intervention measurements. Notably, one pair (preDiastol_1 and postDiastol_1) showed a low correlation of 0.323 with a significance value of 0.241, suggesting a weak relationship for that

specific variable. These results highlight the effectiveness of the intervention in reducing blood pressure, as strong correlations were observed for the majority of measures.

Tabel 8 Paired Samples T-Test Analysis

		Paired Differences					t	df
		Mean	Std. Dev	Std. error mean	95% confidence interval of the difference			
					Lower	Upper		
Pair 1	PreSistol_1 - PostSistol_1	13.467	5.097	1.316	10.644	16.289	10.232	14
Pair 2	PreDiastol_1 - PostDiastol_1	7.000	5.043	1.302	4.207	9.792	5.376	14
Pair 3	PreMAP_1 - PostMAP_1	8.887	3.453	0.892	6.974	10.799	9.966	14
Pair 4	PreSistol_2 - PostSistol_2	9.867	5.069	1.309	7.059	12.674	7.539	14
Pair 5	PreDiastol_2 - PostDiastol_2	6.467	4.357	1.125	4.054	8.879	5.749	14
Pair 6	PreMAP_2 - PostMAP_2	7.533	3.395	.87650	5.653	9.413	8.595	14
Pair 7	PreSistol_3 - PostSistol_3	8.200	5.709	1.474	5.038	11.362	5.562	14
Pair 8	PreDiastol_3 - PostDiastol_3	4.667	4.065	1.049	2.415	6.918	4.446	14
Pair 9	PreMAP_3 - PostMAP_3	5.867	3.942	1.018	3.683	8.049	5.764	14
Pair 10	PreSistol_4 - PostSistole_4	10.733	6.006	1.551	7.407	14.059	6.922	14
Pair 11	PreDiastol_4 - PostDiastol_4	5.000	6.095	1.5734	1.625	8.375	3.177	14
Pair 12	PreMAP_4 - PostMAP_4	7.000	4.885	1.262	4.295	9.705	5.550	14
Pair 13	PreSistol_5 - PostSistol_5	8.933	3.654	.943	6.909	10.957	9.468	14
Pair 14	PreDiastol_5 - PostDiastol_5	4.800	4.229	1.092	2.458	7.142	4.396	14
Pair 15	PreMAP_5 - PostMAP_5	6.187	3.205	.827	4.412	7.961	7.477	14
Pair 16	PreSistol_6 - PostSistol_6	8.733	5.574	1.439	5.647	11.819	6.068	14
Pair 17	PreDiastol_6 - PostDiastol_6	4.867	3.758	.970	2.785	6.948	5.015	14
Pair 18	PreMAP_6 - PostMAP_6	6.140	3.135	.809	4.404	7.876	7.586	14

Source: Processed data, 2024

The paired samples t-test was performed to evaluate the impact of the intervention on blood pressure changes (Table 8). Results revealed t-values greater than the critical t-table value of 2.145 at a 5% significance level, indicating significant differences between pre- and post-intervention measurements for systolic, diastolic, and MAP values. The intervention, comprising Acupressure and Foot Hydrotherapy with red ginger over six sessions in two weeks, effectively reduced blood pressure in pregnant women with preeclampsia. This is evident from the significant decreases observed across all measured variables, confirming the intervention's therapeutic benefit.

Conclusion

The study demonstrated a significant reduction in blood pressure among preeclampsia patients following the application of foot hydrotherapy and foot massage, supported by the bioactive properties of red ginger. The reduction in systolic, diastolic, and mean arterial pressure (MAP) values can be attributed to the physiological

effects of foot massage and hydrotherapy, which improve peripheral circulation, reduce vascular resistance, and promote relaxation by activating the parasympathetic nervous system. The anti-inflammatory and antihypertensive properties of gingerol in red ginger further contributed to this effect by inhibiting angiotensin-converting enzyme (ACE) activity.

These findings are consistent with previous studies, such as Wirasantika et al. (2024), who demonstrated the effectiveness of combined foot hydrotherapy and massage in lowering blood pressure in hypertensive pregnant women¹⁵, and Rahayu et al. (2023)¹⁶, who reported significant blood pressure reductions using foot hydrotherapy in preeclampsia cases. Furthermore, the research aligns with Indrati (2022), who emphasized acupressure's role in reducing hypertension among pregnant women¹⁷.

The study introduces a novel integrated approach combining foot hydrotherapy, massage, and red ginger to enhance the antihypertensive effect. This synergy proved more effective than single interventions reported in previous studies, such as Yuli Erlina et al. (2023), who explored foot hydrotherapy alone⁹, and Nisa et al. (2022), who focused solely on acupressure⁷. Clinically, these findings highlight the potential of non-pharmacological, integrative therapies to manage preeclampsia effectively, especially given the limitations of conventional treatment options during pregnancy.

However, the study's small sample size and the absence of long-term follow-up data are limitations. Future research should address these gaps by including larger cohorts and exploring optimized intervention protocols to validate the findings and ensure broader applicability.

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