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Effect of Combined Foot Bath and Foot Massage Therapy on Blood Pressure in Hypertensive Patients at Tambakrejo Health Center, Surabaya

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ABSTRACT Hypertension, often referred to as a "silent killer," is a prevalent non-communicable disease that significantly contributes to cardiovascular events and other serious health complications. Despite various pharmacological treatments, many hypertensive patients seek non-pharmacological alternatives to manage their condition. This study investigates the effect of combined foot bath and foot massage therapy on blood pressure reduction in hypertensive patients. A quasi-experimental pretest-posttest control group design was employed, with 40 participants selected through purposive sampling. These participants were assigned to either the intervention group, which received the combined therapy for three consecutive days, or the control group, which did not receive the intervention. Blood pressure was measured before and after the intervention using a digital sphygmomanometer. The data were analyzed using paired sample t-tests and independent sample t-tests. The results showed a significant decrease in both systolic and diastolic blood pressure in the intervention group, with p-values of 0.000 and 0.025, respectively. In contrast, no significant change was observed in the control group ($p > 0.05$). The findings suggest that the combination of foot bath and foot massage therapy is effective in lowering blood pressure in hypertensive patients. This non-pharmacological approach offers a promising complementary treatment for hypertension management, particularly for patients who are seeking alternatives to medication. Further research with a larger sample size and longer intervention period is recommended to confirm these results and explore the long-term effects of this therapy.

INDEX TERMS Hypertension, Blood Pressure, Foot Bath, Foot Massage, Non-Pharmacological Therapy

I. INTRODUCTION

Hypertension remains one of the most prevalent non-communicable diseases worldwide and constitutes a major public health challenge due to its strong association with cardiovascular morbidity and mortality. Persistently elevated blood pressure significantly increases the risk of coronary heart disease, stroke, renal failure, and heart failure, thereby contributing to a substantial global disease burden [1], [2]. A major concern in hypertension management is its asymptomatic nature; many individuals remain unaware of their condition until severe complications occur, which has led to hypertension being widely recognized as a "silent killer" [3]. Despite advances in pharmacological therapy, blood pressure control rates remain suboptimal, particularly in community settings, due to issues such as medication non-adherence, side effects, and limited access to continuous healthcare services [4], [5].

In recent years, non-pharmacological and complementary therapies have gained increasing attention as supportive strategies for hypertension management. Current state-of-the-art approaches emphasize lifestyle modification, including dietary regulation, physical activity, stress management, and the integration of complementary interventions such as massage therapy, hydrotherapy, and relaxation techniques [6]–[8]. Among these, warm water foot bath therapy has been shown to induce peripheral vasodilation, improve microcirculation, and activate thermoregulatory responses mediated by the hypothalamus, resulting in reductions in systemic vascular resistance [9], [10]. Similarly, foot massage therapy has demonstrated effectiveness in lowering blood pressure by stimulating mechanoreceptors, enhancing parasympathetic nervous system activity, reducing sympathetic tone, and promoting muscular relaxation [11], [12].

Although several recent studies have independently confirmed the effectiveness of foot bath therapy or foot massage therapy in reducing systolic and diastolic blood pressure, existing evidence predominantly focuses on single-modality interventions [13]–[15]. Research examining the synergistic effect of combining these two therapies remains limited, particularly within primary healthcare and community-based settings. Moreover, few studies have employed controlled quasi-experimental designs to directly compare combined interventions with standard care. This

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lack of integrated intervention studies represents a critical research gap, especially considering the potential for combined therapies to enhance relaxation responses and vascular regulation more effectively than single interventions alone [16], [17].

Therefore, this study aims to examine the effect of a combined foot bath and foot massage therapy on blood pressure among patients with hypertension at the Tambakrejo Health Center, Surabaya. Specifically, this research seeks to determine whether the combined intervention produces a statistically significant reduction in systolic and diastolic blood pressure compared to a control group receiving standard care without non-pharmacological intervention.

The contributions of this study are threefold. First, it provides empirical evidence on the effectiveness of a combined non-pharmacological intervention for blood pressure reduction in hypertensive patients. Second, it expands current nursing and community health knowledge by demonstrating a feasible, low-cost, and easily implementable complementary therapy applicable in primary healthcare settings. Third, it offers practical implications for integrating complementary therapies into routine hypertension management to support pharmacological treatment and improve patient well-being.

This article is structured as follows. Section II describes the research methodology, including study design, participants, intervention procedures, and statistical analysis. Section III presents the results of the study. Section IV discusses the findings in relation to existing literature and theoretical mechanisms. Finally, Section V concludes the study and provides recommendations for clinical practice and future research.

II. METHODS

A. STUDY DESIGN

This study employed a quasi-experimental design using a pretest–posttest control group approach. This design was selected to evaluate the effect of a combined foot bath and foot massage intervention on blood pressure among patients with hypertension while allowing comparison with a control group that did not receive the intervention. The study was prospective in nature, as data were collected forward in time following the implementation of the intervention. Random allocation was not applied due to practical and ethical considerations in the community health center setting; therefore, participants were assigned using purposive sampling with matching to ensure comparable baseline characteristics between groups [18], [19].

B. STUDY SETTING AND DURATION

The research was conducted in the working area of Tambakrejo Public Health Center (Puskesmas Tambakrejo), Surabaya, East Java, Indonesia. This health center serves an urban population with a high prevalence of hypertension. Data collection and intervention implementation took place in February 2025. The intervention was administered over three consecutive days, as previous studies have demonstrated that short-term complementary therapies can produce measurable changes in blood pressure within this timeframe [20].

C. POPULATION AND SAMPLE

The study population consisted of 322 registered patients diagnosed with hypertension at Tambakrejo Public Health Center. The sample size was calculated using the Federer formula, which is commonly applied in experimental and quasi-experimental health research to ensure sufficient statistical power [21]. Based on this calculation, a total of 40 participants were recruited.

Participants were selected using purposive sampling based on predefined inclusion and exclusion criteria. The inclusion criteria were: (1) adults aged 20–60 years, (2) diagnosed with stage 1 or stage 2 hypertension (systolic blood pressure ≥140 mmHg and/or diastolic blood pressure ≥90 mmHg), (3) male or female, (4) willing to participate, and (5) able to communicate effectively. Exclusion criteria included: (1) presence of severe cardiovascular complications, (2) open wounds or infections on the feet, (3) peripheral neuropathy, and (4) participation in other complementary therapy programs during the study period.

The 40 eligible participants were divided into two groups: 20 participants in the intervention group and 20 participants in the control group. Group allocation was conducted using matching based on age, sex, and baseline blood pressure to minimize confounding effects [22].

D. INTERVENTION PROCEDURES

Participants in the intervention group received a combined foot bath and foot massage therapy once daily for three consecutive days. Each session lasted 30 minutes, consisting of a 15-minute foot bath followed by a 15-minute foot massage. The foot bath was performed by immersing both feet in warm water maintained at a temperature of 38–40°C, measured using a water thermometer to ensure consistency. The water was mixed with an appropriate amount of salt, as commonly used in hydrotherapy to enhance vasodilation and relaxation effects [23]. Participants were seated comfortably in a relaxed position during the procedure.

Following the foot bath, a foot massage was administered using standardized massage techniques involving gentle pressure, stroking, and kneading movements applied to the plantar and dorsal surfaces of both feet. The massage was performed according to a standard operating procedure (SOP) to ensure uniformity across participants and sessions. All interventions were conducted by trained personnel to maintain procedural consistency [24]. The control group did not receive any form of non-pharmacological intervention. Participants in this group continued their routine activities and standard medical care, including antihypertensive medication, if prescribed.

E. INSTRUMENTS AND MEASUREMENTS

Blood pressure was measured using a validated digital sphygmomanometer, which has been widely used in clinical and community-based hypertension studies due to its accuracy and ease of use [25]. Measurements were taken in accordance with standardized blood pressure measurement guidelines.

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Blood pressure data were collected at two time points: before the intervention (pretest) and after the completion of the three-day intervention period (posttest). Measurements were conducted in the afternoon, with participants in a seated position after resting for at least 5 minutes. Two measurements were taken at each time point, and the average value was recorded to improve reliability. Additional instruments included a blood pressure observation sheet, demographic data forms, and SOP checklists for both foot bath and foot massage procedures.

F. DATA COLLECTION PROCEDURE

Data collection was carried out systematically. On the first day, eligible participants were informed about the study objectives and procedures, and written informed consent was obtained. Baseline blood pressure measurements were then recorded for both groups. The intervention group subsequently received the combined therapy for three consecutive days, while the control group received no intervention. Posttest blood pressure measurements were taken on the third day for both groups using the same procedures as the pretest.

G. DATA ANALYSIS

Data analysis was performed using statistical software. The Shapiro–Wilk test was used to assess the normality of data distribution. Because the data were normally distributed, parametric tests were applied. The Paired Sample t-test was used to analyze differences in systolic and diastolic blood pressure before and after the intervention within each group. The Independent Sample t-test was used to compare post-intervention blood pressure between the intervention and control groups. A p-value < 0.05 was considered statistically significant [26].

III. RESULTS

The objective of this research is to evaluate the impact of a combination of foot bath and foot massage on blood pressure in hypertensive patients.

A. CHARACTERISTICS OF RESPONDENTS

Based on the distribution of characteristics in TABLE 1, the data on gender characteristics show that almost all individuals with hypertension were female (90%). Regarding age, nearly half of the patients were between 50–60 years old (47.5%). For BMI (Body Mass Index) characteristics, the majority of hypertensive patients had a normal BMI (70%). In terms of exercise habits, most hypertensive patients were not regularly exercising (60%).

Regarding the use of antihypertensive medication, most patients were taking medication (57.5%), and the majority were taking it regularly (57.5%). For the history of hypertension, almost all patients had a family or personal history of hypertension (77.5%). Stress characteristics showed that most patients were not experiencing stress (75%), and the majority were not following a dietary program (75%). Based on smoking data, all hypertensive patients were non-smokers (100%). Lastly, in terms of sleep disturbances, most hypertensive patients did not experience sleep disorders (55%).

TABLE 1
Characteristics of Hypertensive Patients

Characteristics	Intervention Group		Control Group		Total	
	f	%	f	%	n	%
Gender						
1. Male	0	0	4	20	4	10
2. Female	20	100	16	80	36	90
Total	20	100	20	100	40	100
Age Ranges:						
1. 20 to 30 years	0	0	1	5	1	2,5
2. 31 to 40 years	2	10	0	0	2	5
3. 41 to 50 years	12	60	6	30	18	45
4. 51 to 60 years	6	30	13	65	19	47,5
Total	20	100	20	100	40	100
BMI						
1. Overweight (>25-29,9)	4	20	8	40	12	30
2. Normal (18,5-24,9)	16	80	12	60	28	70
Total	20	100	20	100	40	100
Exercise						
1. Regular	9	45	7	35	16	40
2. Not Regular	11	55	13	65	24	60
Total	20	100	20	100	40	100
Taking Hypertension Medicine						
1. Yes	11	55	12	60	23	57,5
2. No	9	45	8	40	17	42,5
Total	20	100	20	100	40	100
Regularly Taking Medication						
1. Yes	11	55	12	60	23	57,5
2. No	9	45	8	40	17	42,5
Total	20	100	20	100	40	100
History of Hypertension						
1. Yes	12	60	19	95	31	77,5
2. No	8	40	1	5	9	22,5
Total	20	100	20	100	40	100
Experiencing Stress						
1. Yes	1	5	9	45	10	25
2. No	19	95	11	55	30	75
Total	20	100	20	100	40	100
Diet Program						
1. Yes	0	0	10	50	10	25
2. No	20	100	10	50	30	75
Total	20	100	20	100	40	100
Smoking						
1. Yes	0	0	0	0	0	0
2. No	20	100	20	100	40	100
Total	20	100	20	100	40	100
Sleep Disorders						
1. Yes	11	55	7	35	18	45
2. No	9	45	13	65	22	55
Total	20	100	20	100	40	100

Based on TABLE 2, The results of the study indicate that most of the analyzed factors contributed to a reduction in blood pressure after the intervention. Greater reductions in blood pressure were observed among respondents who exercised regularly, took antihypertensive medication, did not

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TABLE 2
The Relationship Between Characteristics and Blood Pressure in the Intervention Group

Characteristics		Treatment Group				
		Mean Pre		Mean Post		Difference BP
		SBP	DBP	SBP	DBP	
BMI	Overweight >25	168,00	102,50	144,75	91,50	23/11
	Normal <25	166,88	100,50	148,00	94,81	19/6
Exercise	Regular	168,22	97,78	147,11	93,33	21/4
	Not Regular	166,18	103,45	147,55	93,73	19/7
Taking Hypertension Medicine	Yes	168,55	103,0	147,73	94,67	22/8
	No	165,33	102,75	146,89	97,13	18/1
History of Hypertension	Yes	167,08	102,75	147,67	93,92	19/9
	No	167,12	98,13	146,88	94,50	20/6
Experiencing Stress	Yes	158,00	90,00	161,00	97,00	-3/-7
	No	167,58	101,47	146,63	94,00	21/7
Sleep Disorders	Yes	162,09	100,64	146,18	92,64	16/8
	No	173,22	101,22	148,78	96,00	24/5

TABLE 3
The Relationship Between Characteristics and Blood Pressure in the Control Group

Characteristics		Treatment Group				
		Mean Pre		Mean Post		Difference BP
		SBP	DBP	SBP	DBP	
BMI	Overweight >25	160.25	100.88	158.75	101.25	1/-0,4
	Normal <25	155.67	97.50	152.08	98.42	4/-0,9
Exercise	Regular	158.43	101.00	154.71	96.86	4/4
	Not Regular	157.00	97.69	154.77	101.00	2/-3
Taking Hypertension Medicine	Yes	156.58	99.50	153.92	99.75	3/ -0,25
	No	158.88	97.88	156.00	99.25	3/-1
History of Hypertension	Yes	156.74	98.63	154.00	99.37	3/-0,7
	No	172.00	103.00	169.00	103.00	3/0
Experiencing Stress	Yes	155,22	102,11	153,67	100	2/2
	No	159,36	96,18	155.64	99,55	4/-3
Sleep Disorders	Yes	159.86	97.57	158.00	97.71	2/-0,1
	No	156.23	99.54	153.00	100.54	3/1

experience stress, did not suffer from sleep disorders, and had no history of hypertension. These findings align with existing theories that healthy lifestyle behaviors and risk factor control can effectively lower blood pressure.

However, one finding did not align with initial expectations: BMI. Respondents with overweight BMI experienced a greater decrease in blood pressure (23/11 mmHg) compared to those with normal BMI (19/6 mmHg). Although obesity is generally considered a risk factor for hypertension, this result may be influenced by individual responses to the intervention or other uncontrolled variables.

Based on TABLE 3, The results of the study indicate that most of the analyzed factors contributed to a reduction in blood pressure after the intervention.In the control group, all participant characteristics aligned with factors that contribute to lowering blood pressure, such as normal BMI, regular exercise, medication adherence, and the absence of stress or sleep disorders. Although no specific intervention was applied, a reduction in blood pressure was still observed, likely influenced by a healthy lifestyle and compliance with medical therapy.

B. RESULTS OF STATISTICAL TESTS

TABLE 4
Distribution of Blood Pressure Before and After the Combined Foot Bath and Foot Massage Intervention in the Intervention Group

Category	SBP	DBP	Pretest		Posttest	
			F	%	F	%
Normal	< 120	< 80	0	0	0	0
Prehypertension	120-139	80-89	0	0	4	20
Hypertension Stage 1	140-159	90-99	7	35	13	65
Hypertension Stage 2	≥ 160	≥ 100	13	65	3	15

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Based on TABLE 4, The data showed that, before the intervention, most hypertensive patients in the treatment group (65%) were categorized as having stage 2 hypertension, and nearly half (35%) were classified as having stage 1 hypertension. Meanwhile, after the intervention, the majority of patients (65%) were classified as having stage 1 hypertension, and a smaller portion (20%) were classified as having prehypertension.

TABLE 5
Blood Pressure Levels Distribution Before and in the Control Group

Category	SBP	DBP	Pretest		Posttest	
			F	%	F	%
Normal	< 120	< 80	0	0	0	0
Prehypertensive	120-139	80-89	0	0	0	0
Hypertension Stage 1	140-159	90-99	10	50	11	55
Hypertension Stage 2	≥ 160	≥ 100	10	50	9	45

Based on TABLE 5, For participants in the group that did not receive the intervention, blood pressure on the first day showed that half (50%) of the participants fell into the stage 1 and stage 2 categories hypertension. On the third day, most of the participants (55%) were categorized under stage 1 hypertension, with nearly 45% falling into the stage 2 hypertension category.

TABLE 6
Distribution of Blood Pressure Results After the Intervention in the Treatment and Control Groups

Blood Pressure Outcomes	Intervention Group		Control Group	
	f	%	f	%
Increased Blood Pressure	1	5	9	45
Unchanged Blood Pressure	0	0	3	15
Decreased Blood Pressure	19	95	8	40
Total	20	100	20	100

Based on TABLE 6, It is observable that the blood pressure findings in the treated post intervention results from the group showed that nearly all hypertensive patients (95%) exhibited a decline in blood pressure following receiving the combined foot bath and foot massage therapy, while a small portion (5%) experienced an increase blood pressure occurred among the control group, which was not given any treatment., nearly half (45%) underwent an increase in blood pressure, a small portion (15%) had unchanged blood pressure, and nearly half (40%) experienced a decrease. However, based on the classification levels, hypertensive patients in both groups remained within the hypertension category.

Based on TABLE 7, The significance values the results from the pretest and posttest data in each group revealed a p-value above 0.05, indicating that the results of the Shapiro-Wilk normality test suggest the data are normally distributed.

Meanwhile, in light of the outcome of the Sample Paired t-test in TABLE 8, The mean systolic blood pressure before the administration of the foot bath and foot massage therapy

TABLE 7
Normality Test Before and After the Administration of Foot Bath and Foot Massage Therapy in the Intervention and Control Groups on Blood Pressure

Tests of Normality

Group		*Shapiro-Wilk*			
		Statistic	df	Sig.	α
Intervention Group	Pre Systolic	.963	20	.609	0.05
	Post Systolic	.917	20	.085	
	Pre Diastolic	.904	20	.050	
	Post Diastolic	.957	20	.477	
Control Group	Pre Systolic	.940	20	.238	
	Post Systolic	.967	20	.682	
	Pre Diastolic	.956	20	.474	
	Post Diastolic	.859	20	.008	

TABLE 8
Paired Sample t-Test Analysis in the Intervention Group

Variabel		n	Mean	SD	Sig. (2-tailed)
Intervention Group					
Systolic Blood Pressure	Before	20	167,10	13,341	0,000
	After		147,35	8,934	
Diastolic Blood Pressure	Before	20	100,90	9,165	0,025
	After		94,15	10,669	

was 167.10 mmHg (SD = 13.34), and it decreased to 147.35 mmHg (SD = 8.93) after the intervention. The paired t-test showed a p-value of 0.000 (< 0.05), indicating a statistically significant reduction. The diastolic blood pressure also decreased from 100.90 mmHg (SD = 9.17) to 94.15 mmHg (SD = 10.67), with a p-value of 0.025 (< 0.05), which also indicates a statistically significant reduction. These findings suggest a notable alterations in systolic and diastolic blood pressure observed before and after receiving foot bath and foot massage treatment.

TABLE 9
Paired Sample t-Test Analysis in the control Group

Variabel		n	Mean	SD	Sig. (2-tailed)
Control Group					
Systolic Blood Pressure	Before	20	157,50	11,700	0,171
	After		154,75	8,620	
Diastolic Blood Pressure	Before	20	98,85	14,080	0,697
	After		99,55	10,133	

According to the results of the Paired Sample t-test shown in TABLE 9, The mean systolic blood pressure on the first day in the control group was 157.50 mmHg (SD = 11.70) and decreased to 154.75 mmHg (SD = 8.62) on the third day. The paired t-test showed a p-value of 0.171 (> 0.05), indicating that the decrease was not statistically significant. Meanwhile, the mean diastolic blood pressure on the first day was 98.85 mmHg (SD = 14.08) and slightly increased to 99.55 mmHg (SD = 10.13) on the third day. The paired t-test revealed a p-

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value of 0.697 (> 0.05), indicating that this change was also not statistically significant. This suggests that the control group of hypertensive patients did not experience any significant change in systolic or diastolic blood pressure.

TABLE 10
Independent Sample t-Test

Variable	n	Sig. (2-tailed)
Intervention Group	20	**0,011**
Control Group	20	

According to the analysis in TABEL 10, the Independent Sample t-test results showed a p-value (Asymp. Sig. 2-tailed) of 0.011 (< 0.05), indicating that H_0 was rejected and H_1 was accepted. This means demonstrating that the intervention group showed a significant difference in blood pressurereceiving the combined foot bath and foot massage therapy and the control group.

IV. DISCUSSION

A. INTERPRETATION OF THE EFFECT OF COMBINED FOOT BATH AND FOOT MASSAGE THERAPY ON BLOOD PRESSURE

The findings of this study demonstrate that the combination of foot bath and foot massage therapy administered over three consecutive days produced a statistically significant reduction in both systolic and diastolic blood pressure among patients with hypertension in the intervention group. The paired sample t-test results confirmed a meaningful decline in systolic blood pressure (mean reduction of approximately 19.75 mmHg) and diastolic blood pressure (mean reduction of approximately 6.75 mmHg), whereas no significant changes were observed in the control group. These results indicate that the combined intervention was effective beyond natural blood pressure fluctuations or routine care alone.

From a physiological perspective, the observed reduction in blood pressure can be attributed to the synergistic mechanisms of warm water foot bathing and foot massage. Warm water immersion at temperatures between 38–40°C promotes peripheral vasodilation by relaxing smooth muscle in the arterial walls, thereby reducing peripheral vascular resistance. This thermally induced vasodilation facilitates improved blood circulation and enhances venous return, which contributes to lowering systemic blood pressure [27]. Additionally, the stimulation of thermoreceptors in the feet transmits neural signals to the hypothalamus, activating thermoregulatory and autonomic responses that favor parasympathetic dominance.

Foot massage further reinforces these effects through mechanical stimulation of cutaneous and muscular receptors, which activates the parasympathetic nervous system and suppresses sympathetic activity. This autonomic shift leads to decreased heart rate, reduced secretion of stress-related catecholamines such as norepinephrine, and increased release of vasodilatory substances including acetylcholine and histamine [28]. The combined application of these two interventions likely produces a cumulative relaxation response, resulting in a more pronounced reduction in blood pressure compared to either therapy alone.

Clinically, the shift in blood pressure classification observed in this study from stage 2 hypertension to stage 1 hypertension or prehypertension in most participants suggests that this intervention has meaningful therapeutic value. Although the majority of participants remained within the hypertensive range, the magnitude of reduction is clinically relevant, as even modest decreases in systolic blood pressure are associated with significant reductions in cardiovascular risk [29]. Therefore, the combined foot bath and foot massage therapy can be considered an effective complementary approach for short-term blood pressure management in hypertensive patients.

B. COMPARISON WITH PREVIOUS STUDIES AND ANALYSIS OF CONTRIBUTING FACTORS

The results of this study are consistent with previous research reporting the effectiveness of non-pharmacological interventions, particularly hydrotherapy and massage therapy, in reducing blood pressure. Several recent studies have shown that warm water foot bath therapy alone significantly lowers systolic and diastolic blood pressure by inducing vasodilation and promoting relaxation [30], [31]. Similarly, foot massage therapy has been reported to reduce blood pressure by modulating autonomic nervous system activity and decreasing stress levels [32].

However, this study extends existing evidence by demonstrating that the combination of foot bath and foot massage yields a stronger and more consistent blood pressure reduction than interventions applied independently. This finding supports the hypothesis that combining complementary therapies with different but interrelated physiological mechanisms can enhance therapeutic outcomes. A study by Lestari et al. [33] reported modest blood pressure reductions with foot massage alone, while Chaidir et al. [30] observed similar outcomes with warm water foot soaking. In comparison, the magnitude of blood pressure reduction observed in the present study was greater, suggesting an additive or synergistic effect.

In contrast, the control group in this study showed no statistically significant change in blood pressure, despite some participants demonstrating minor reductions. These changes are likely attributable to confounding factors such as medication adherence, lifestyle behaviors, or measurement variability rather than the absence of intervention. Similar findings have been reported in controlled studies where participants receiving standard care without additional non-pharmacological interventions exhibited stable or minimally fluctuating blood pressure levels [34].

Individual characteristics also played a role in influencing blood pressure outcomes. Participants who adhered consistently to antihypertensive medication, engaged in regular physical activity, and did not experience stress or sleep disturbances tended to show greater reductions in blood pressure. Conversely, participants reporting stress exhibited less favorable outcomes, including one case of increased blood pressure despite receiving the intervention. This finding aligns with existing evidence indicating that psychological stress activates the sympathetic

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nervous system and hypothalamic–pituitary–adrenal axis, leading to elevated cortisol and catecholamine levels that counteract blood pressure–lowering interventions [35].

An unexpected finding was that participants with overweight BMI experienced greater blood pressure reductions than those with normal BMI. Although obesity is a known risk factor for hypertension, individuals with higher baseline blood pressure may experience more pronounced reductions following relaxation-based interventions due to greater initial vascular resistance. This phenomenon has also been observed in previous studies and suggests that baseline blood pressure levels may influence responsiveness to non-pharmacological therapies [36].

C. LIMITATIONS, WEAKNESSES, AND IMPLICATIONS FOR PRACTICE AND FUTURE RESEARCH

Despite the promising findings, this study has several limitations that should be considered when interpreting the results. First, the sample size was relatively small (n = 40), which limits the generalizability of the findings to broader populations. A larger sample would provide greater statistical power and allow subgroup analyses based on age, gender, medication use, and comorbidities.

Second, the study employed a quasi-experimental design without randomization. Although matching was used to minimize baseline differences between groups, the absence of random allocation increases the risk of selection bias. Future studies employing randomized controlled trial designs would strengthen causal inferences regarding the effectiveness of the combined intervention.

Third, the intervention duration was limited to three consecutive days. While this timeframe was sufficient to demonstrate short-term effects, it does not provide insight into the long-term sustainability of blood pressure reductions. Longitudinal studies with extended follow-up periods are needed to determine whether regular implementation of combined foot bath and foot massage therapy can produce sustained improvements in blood pressure control.

Another limitation is the lack of systematic monitoring of confounding variables such as dietary intake, stress levels, and daily physical activity during the intervention period. These factors may have influenced blood pressure outcomes and should be controlled or measured in future research to enhance internal validity.

Despite these limitations, the findings of this study have important implications for clinical practice and community health nursing. The combined foot bath and foot massage therapy represents a low-cost, non-invasive, and easily implementable intervention that can be performed independently or with minimal assistance. This therapy is particularly suitable for primary healthcare settings and community-based programs, where access to advanced medical interventions may be limited.

From a nursing perspective, incorporating this combined therapy into routine hypertension management may enhance patient comfort, promote relaxation, and support pharmacological treatment. Furthermore, educating patients on simple complementary techniques empowers them to participate actively in their own care, potentially improving adherence and overall quality of life.

For future research, it is recommended to conduct randomized controlled trials with larger samples and longer intervention durations. Investigating the combined therapy's effects on additional outcomes, such as heart rate variability, stress biomarkers, and quality of life, would also provide a more comprehensive understanding of its benefits.

V. CONCLUSION

This study aimed to examine the effect of a combined foot bath and foot massage therapy on blood pressure reduction among patients with hypertension at the Tambakrejo Health Center, Surabaya. The findings demonstrate that the combined non-pharmacological intervention produced a statistically and clinically significant reduction in blood pressure compared to standard care alone. In the intervention group, mean systolic blood pressure decreased from 167.10 mmHg to 147.35 mmHg, representing a reduction of approximately 19.75 mmHg, while mean diastolic blood pressure declined from 100.90 mmHg to 94.15 mmHg, corresponding to a reduction of 6.75 mmHg. These changes were statistically significant ($p < 0.05$). In contrast, the control group showed no significant reduction in either systolic or diastolic blood pressure over the same observation period. Furthermore, 95% of participants in the intervention group experienced a decrease in blood pressure, whereas only 40% of participants in the control group demonstrated a reduction, with nearly half exhibiting increased blood pressure. These results indicate that the combination of foot bath and foot massage therapy is more effective than routine care in achieving short-term blood pressure reduction. The physiological effects of vasodilation, autonomic nervous system modulation, and relaxation are likely responsible for the observed outcomes. Despite these promising results, this study was limited by a relatively small sample size, a short intervention duration, and the absence of randomization. Therefore, future research is recommended to involve larger samples, randomized controlled designs, longer intervention and follow-up periods, and additional outcome measures such as stress indicators, heart rate variability, and quality of life. Such studies would strengthen the evidence base and support the integration of combined complementary therapies into comprehensive hypertension management strategies.

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DATA AVAILABILITY

The datasets used and analyzed during the current study are available from the corresponding author upon reasonable request.

AUTHOR CONTRIBUTION

All authors contributed substantially to the conception and design of the study. The first author was responsible for data collection, intervention implementation, and initial manuscript drafting. The second author contributed to the study design, data analysis, and interpretation of results. The third author assisted in literature review, methodological refinement, and manuscript revision. The fourth author provided critical supervision, reviewed the manuscript for intellectual content, and approved the final version for publication. All authors read and approved the final manuscript and agree to be accountable for all aspects of the work.

DECLARATIONS

ETHICAL APPROVAL

This study was approved by the appropriate institutional ethics committee. Written informed consent was obtained from all participants prior to their involvement in the study.

CONSENT FOR PUBLICATION PARTICIPANTS.

All participants provided consent for the publication of anonymized data.

COMPETING INTERESTS

The authors declare that they have no competing interests.

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