Jurnal Kesehatan Komunitas Indonesia (JKKI)
Volume 6 Issue 1, April 2026, pp 80-90
https://ebsina.or.id/journals/index.php/jkki
eISSN 2503-2801, pISSN 2985-3435

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Non-Pharmacological Management of Hypertension in the Elderly: Integrating Warm Water Foot Soaks with Slow Deep Breathing Therapy

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Article History
Submitted: 31-07-2025
Revised: 26-12-2025
Accepted: 27-04-2026

doi.org/10.58545/jkki.v6i1.377

Abstract

Background: Blood pressure tends to increase with age due to elevated peripheral vascular resistance and reduced blood vessel elasticity. Non-pharmacological therapies offer viable alternatives or complement to pharmacological interventions for hypertension management. **Objective:** This study aimed to evaluate the effect of integrating warm-water foot soaks with slow, deep breathing therapy on blood pressure reduction in elderly individuals with hypertension. **Methods:** A case study with a pretest-posttest design was conducted at Bondowoso Nursing Home. The participant was an elderly individual aged >60 years with stage 2 hypertension. Blood pressure was measured using a sphygmomanometer before and after the intervention. The combined intervention consisted of warm-water foot soaks (30-40°C) and slow, deep breathing exercises (4-4-4 technique: 4 seconds inhalation, 4 seconds breath-holding, 4 seconds exhalation) for 15 minutes per session. The intervention was administered twice weekly for two weeks (4 sessions total). **Results:** The mean blood pressure before the intervention was 175.00/92.50 mmHg, which decreased to 169.75/90.75 mmHg after the intervention. The mean reduction in systolic and diastolic blood pressure was 5.25 mmHg and 1.75 mmHg, respectively. **Conclusion:** The integration of warm-water foot soaks and slow, deep breathing therapy shows potential to lower blood pressure among elderly individuals with hypertension. For optimal therapeutic effects, consistent, regular implementation beyond 4 sessions is recommended. This combined non-pharmacological approach can be considered as a complementary therapy in hypertension management for the elderly.

Keywords

Blood pressure, Elderly, Hypertension, Slow deep breathing, Warm water foot soaks

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How to cite:
Hendita, Y. I., Kurdi, F., Iswanto, & Fitriasari, M. (2026). Non-Pharmacological Management of Hypertension in the Elderly: Integrating Warm Water Foot Soaks with Slow Deep Breathing Therapy. Jurnal Kesehatan Komunitas Indonesia, 6(1), 80-90. https://doi.org/10.58545/jkki.v6i1.377

1. BACKGROUND

Blood pressure tends to rise as people get older due to increased peripheral vascular resistance and reduced blood vessel elasticity (Nasrullah, 2016). Pharmacological treatment is known to have an impact in the form of financial burden, high drug burden, and side effects

of antihypertensive drugs on drug compliance in hypertension sufferers (Elnaem et al., 2022). Various non-pharmacological therapies are an alternative to pharmacological therapy for lowering blood pressure. In addition, the duration and compliance with implementing non-pharmacological therapy are concerns for achieving effective reductions in blood pressure (Mawaddah et al., 2024). Therefore, research on non-pharmacological therapies that are effective in lowering blood pressure in the elderly with hypertension is important.

Based on WHO data in 2019, hypertension has affected at least 33% of the 30-79 years old age range globally. In the same year, hypertension contributed to 9.4 million deaths each year (WHO, 2023). In 2023, there were around 17 million people diagnosed with hypertension in Indonesia (Kemenkes RI, 2023). Then, the Jember Regency ranks second in the number of sufferers, with 767,032 people (Dinas Kesehatan Provinsi Jawa Timur, 2023). Based on an assessment of 27 Penerima Manfaat (hereinafter referred to as PM) at the UPT PSTW Bondowoso. Data was obtained that four PMs had hypertension.

Physical examination and interview assessment of a Patient aged 63 years who is known to have chronic hypertension health problems. The physical assessment showed the Patient's blood pressure was 170/80 mmHg. According to the literature, age › 60 years increases an individual's risk of experiencing hypertension by 2 times (Hustrini et al., 2023). Furthermore, in the elderly, there is an increase in blood pressure due to increased peripheral vascular resistance and loss of blood vessel elasticity, leading to higher blood pressure (Nasrullah, 2016). The older you get, the more difficult it will be to restore blood pressure to normal due to the loss of elasticity or stiffness of the blood vessels. Especially in the elderly aged 60-70 years with blood pressure › 160 mmHg (Elvira et al., 2023). Therefore, an intervention is needed to lower the Patient's blood pressure significantly.

Several studies have shown the benefits of non-pharmacological interventions in lowering blood pressure. Research shows that soaking feet in warm water twice a week for 4 weeks lowers blood pressure (Elvira et al., 2023). The literature on soaking feet in warm water explains that this intervention is effective in lowering blood pressure. Warm air increases vasodilation and relaxes blood vessels and muscles, especially in the feet and other cool areas (Kurnia et al., 2022). Other studies also show that slow, deep breathing performed four times a day for 4

days can lower blood pressure (Aritonang, 2020). The mechanism by which exhaling slowly and deeply lowers blood pressure is that it relaxes the body (Andrena & Kurdi, 2023; Merschel et al., 2023). This relaxation response is characterized by decreased blood pressure and pulse rate (Witriyani, 2023). So far, several studies have only focused on one intervention. Thus, the selection of the two interventions to be combined in this study is intended to lower blood pressure significantly.

Hypertension needs attention because uncontrolled blood pressure will cause complications. Based on the description above, it serves as a basis for research to test the effectiveness of combining warm-water foot soaks and slow deep breathing in lowering the blood pressure. Research on warm-water foot soaks and slow, deep breathing is a recommended non-pharmacological therapy because it has no dangerous side effects (Pratiwi, 2020; Sukri et al., 2024). Therefore, this study was conducted to test the effectiveness of combining warm-water foot-soak interventions with slow, deep breathing on blood pressure in elderly with hypertension.

2. METHODS

This study employed a case study design with a pretest-posttest design to evaluate the effect of integrating warm-water foot soaks and slow, deep breathing therapy on blood pressure reduction among elderly individuals with hypertension. The study was conducted over 2 weeks at the UPT PSTW (Unit Pelaksana Teknis Pusat Sosial Tresna Werdha) Bondowoso Nursing Home in East Java, Indonesia. The participant was selected using purposive sampling based on predefined criteria: aged ≥60 years, diagnosed with Stage 2 hypertension (systolic blood pressure ≥160 mmHg and/or diastolic blood pressure ≥100 mmHg), willing to participate, able to communicate effectively, and without physical limitations that would prevent participation in foot immersion or breathing exercises. Individuals with foot wounds or infections, severe cardiovascular complications, or cognitive impairment preventing cooperation with the intervention were excluded from the study.

Ethical approval for this study was obtained from the Health Research Ethics Committee of the Faculty of Nursing, Universitas Jember. Written informed consent was secured from the participant following a comprehensive explanation of the study's purpose, procedures, potential benefits, and the right to withdraw at any time without consequence. Participant

confidentiality was strictly maintained throughout all stages of the research.

The combined intervention consisted of two components administered simultaneously for 15 minutes per session. For the warm-water foot soak, the water temperature was maintained at 30–40°C, monitored with a calibrated thermometer, and immersion extended from the soles to the ankles in a plastic container. Concurrently, the participant performed slow, deep breathing exercises using a 4-4-4 technique: inhaling through the nose for 4 seconds, holding the breath for 4 seconds, and exhaling through the mouth for 4 seconds. The participant remained in a comfortable seated position with back support throughout the session, while the researcher provided verbal guidance to ensure proper technique. The intervention was administered twice weekly for two weeks, totaling four sessions.

Blood pressure was measured with a calibrated digital sphygmomanometer, with readings taken from the brachial artery of the right arm. At the same time, the participant was seated and had rested for five minutes. The same instrument and protocol were used for all measurements to ensure consistency. Data collection followed a standardized procedure: pre-intervention blood pressure was recorded after a five-minute rest period; the combined intervention was then administered under researcher supervision; and post-intervention blood pressure was measured immediately following completion of the 15-minute session. All readings, including date, time, and systolic and diastolic values, were documented in a structured data collection form.

Data were analyzed using descriptive statistics to calculate the mean, standard deviation, and range of systolic and diastolic blood pressure before and after the intervention. Mean differences between pretest and posttest measurements were computed for each session and aggregated across all four sessions. Given the single-participant case study design, a paired t-test was used to compare mean blood pressure before and after the intervention, with $p<0.05$ set as the significance threshold. To ensure measurement validity and reliability, the researcher received training in standardized blood pressure measurement techniques, the sphygmomanometer was calibrated prior to study initiation, and detailed standard operating procedures were followed for all intervention sessions. The same researcher conducted all measurements and interventions to minimize inter-rater variability and enhance internal consistency.

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3. RESULTS

This study involved one elderly participant aged 63 years with Stage 2 hypertension residing at the Bondowoso Nursing Home. Blood pressure was measured before (pretest) and after (posttest) each session of the combined intervention comprising warm-water foot soaks and slow, deep breathing exercises. The intervention was administered twice weekly for 2 weeks, totaling 4 sessions, with each lasting 15 minutes.

Table 1 presents the systolic and diastolic blood pressure values recorded before and after each intervention session. Prior to the intervention, the participant's mean systolic blood pressure was 175.00 mmHg (range: 160–190 mmHg), and the mean diastolic blood pressure was 92.50 mmHg (range: 80–102 mmHg), both falling within the Stage 2 hypertension category according to clinical guidelines. Following the combined intervention, the mean systolic blood pressure decreased to 169.75 mmHg (range: 155–188 mmHg), while the mean diastolic blood pressure decreased to 90.75 mmHg (range: 78–100 mmHg).

Table 1. Systolic and Diastolic Blood Pressure Measurements Before and After Combined Intervention

Session	Pretest Systolic (mmHg)	Pretest Diastolic (mmHg)	Posttest Systolic (mmHg)	Posttest Diastolic (mmHg)
1st	170	90	166	90
2nd	190	102	188	100
3rd	180	98	170	95
4th	160	80	155	78
Mean	175.00	92.50	169.75	90.75
Δ Mean	−5.25	−1.75	—	—

Note: Δ Mean = Mean difference between pretest and posttest values.

The mean reduction in systolic blood pressure across all sessions was 5.25 mmHg, while the mean reduction in diastolic blood pressure was 1.75 mmHg. The greatest reduction in systolic pressure was observed during the third session (10 mmHg decrease), whereas the smallest change occurred during the second session (2 mmHg decrease). For diastolic pressure, the most notable reduction was recorded in the third session (3 mmHg), while the first session showed no change.

Table 2. Paired Sample t-Test Analysis of Blood Pressure Before and After Intervention

Variable	Mean Pretest (mmHg)	Mean Posttest (mmHg)	Mean Difference (mmHg)	SD of Difference	SE	t-value	df	p-value	95% CI
Systolic BP	175.00	169.75	5.25	3.40	1.70	3.09	3	0.054	-0.48 to 10.98
Diastolic BP	92.50	90.75	1.75	1.26	0.63	2.78	3	0.069	-0.35 to 3.85

Note: SD = Standard Deviation; SE = Standard Error; df = degrees of freedom; CI = Confidence Interval

Statistical analysis using paired sample t-test showed that systolic blood pressure decreased by 5.25 mmHg (t=3.09, df=3, p=0.054), while diastolic blood pressure decreased by 1.75 mmHg (t=2.78, df=3, p=0.069). Although both reductions demonstrated a consistent downward trend, the p-values did not reach statistical significance at the conventional α=0.05 level, likely due to the small sample size (n=4 sessions) inherent in this case study design.

4. DISCUSSION

This study demonstrated that integrating warm-water foot soaks and slow, deep breathing therapy reduced mean systolic blood pressure by 5.25 mmHg and diastolic blood pressure by 1.75 mmHg in an elderly individual with Stage 2 hypertension. Although the paired t-test analysis revealed that these reductions did not reach statistical significance at the conventional α=0.05 level (systolic: t=3.09, df=3, p=0.054; diastolic: t=2.78, df=3, p=0.069), the consistent downward trend across intervention sessions suggests a clinically meaningful effect that warrants further investigation with larger sample sizes.

The magnitude of blood pressure reduction observed in this study was comparatively modest relative to previous investigations. Kumar et al. (2021) reported average reductions of 6.84 mmHg in systolic and 5.82 mmHg in diastolic blood pressure following warm-water foot-soak interventions. More substantial reductions were documented by Ignasimuthu & Parimala (2022), who observed decreases of 23.5 mmHg (systolic) and 11.2 mmHg (diastolic) in their treatment group. Similarly, Elvira et al. (2023) found reductions of 14.56 mmHg and 7 mmHg for systolic and diastolic pressures, respectively. The smaller effect size in the present study may be attributed to several factors, including the limited number of intervention sessions (4 over 2 weeks), the participant's advanced age (63 years), and the chronic nature of hypertension and associated vascular stiffness.

Regarding slow deep breathing interventions, Aritonang (2020) demonstrated a statistically significant relationship between slow deep breathing exercises and blood pressure reduction ($p<0.001$) when performed four times daily for four consecutive days. The present study's findings, while showing a consistent reduction pattern, did not achieve statistical significance, likely due to the constrained sample size inherent in case study designs and the relatively brief intervention period. Nevertheless, the observed trend aligns with the

physiological mechanisms described in the literature, in which slow, deep breathing stimulates vagal nerve activity, promoting parasympathetic dominance and inducing a relaxation response characterized by decreased blood pressure and heart rate (Andrena & Kurdi, 2023; Merschel et al., 2023; Witriyani, 2023).

The researchers posit that intervention frequency and duration are critical determinants of therapeutic efficacy. The present study's four-session protocol may have been insufficient to elicit statistically significant changes, particularly in an elderly population with chronic hypertension and age-related endothelial dysfunction. This assertion is supported by Elvira et al. (2023), whose protocol involved twice-weekly sessions over four weeks (totaling eight), and by Ignasimuthu (2022), who conducted five sessions over one month. The cumulative effect of repeated interventions appears essential for achieving optimal vasodilation and sustained blood pressure reduction.

The physiological mechanisms underlying warm water foot soaks involve multiple pathways. Thermal stimulation of the lower extremities promotes peripheral vasodilation through direct effects on vascular smooth muscle and baroreceptor-mediated reflexes (Kurnia et al., 2022). When arterial walls are stretched by elevated blood pressure, warm water immersion stimulates baroreceptor nerves to transmit impulses to the vasomotor center, resulting in arterial dilation and subsequent blood pressure reduction (Kumar et al., 2021). Additionally, warm water therapy enhances peripheral circulation by decreasing peripheral vascular resistance, thereby improving hemodynamic and cardiovascular function (Kurnia et al., 2022).

The combination of warm-water foot soaks and slow, deep breathing represents a synergistic approach targeting both peripheral and central mechanisms of blood pressure regulation. While warm water primarily affects peripheral vasodilation, slow, deep breathing modulates the balance of the autonomic nervous system, potentially amplifying the hypotensive effect. However, the present study's findings indicate that post-intervention blood pressure values (169.75/90.75 mmHg) remained within the Stage 2 hypertension category, suggesting that although the intervention reduced blood pressure, more intensive or prolonged therapy is necessary to achieve normotensive targets in elderly individuals with chronic hypertension.

Age-related physiological changes present significant challenges in hypertension management among older

adults. The participant's age (>60 years) is associated with degenerative declines in organ function, endothelial dysfunction, and increased arterial stiffness, all of which contribute to elevated peripheral vascular resistance and diminished responsiveness to antihypertensive interventions (Hustrini et al., 2023; Nasrullah, 2016). These age-related changes explain why blood pressure reduction in elderly populations is often more modest and more difficult to sustain than in younger individuals. The present study's findings underscore the importance of realistic expectations and long-term management strategies when addressing hypertension in geriatric populations.

Several limitations of this study must be acknowledged. First, the case study design with a single participant limits the generalizability of findings and statistical power. Second, the absence of a control group precludes attributing blood pressure changes solely to the intervention. Third, the short duration (two weeks) and the limited number of sessions (four) may have been insufficient to demonstrate statistically significant effects. Fourth, potential confounding factors, such as dietary intake, physical activity levels, and medication adherence, were not controlled for. Finally, blood pressure measurements were taken post-intervention immediately, and the sustainability of the effects over time remains unknown.

Despite these limitations, this study contributes valuable insights into the potential benefits of combining non-pharmacological interventions for hypertension management in elderly populations. The consistent downward trend in blood pressure, coupled with the absence of adverse effects, supports the safety and feasibility of warm-water foot soaks and slow, deep breathing as complementary therapies. Future research should employ randomized controlled trial designs with larger sample sizes, extended intervention periods (minimum 8-12 sessions), and longer follow-up periods to assess both immediate and sustained effects. Additionally, investigations into optimal intervention parameters (water temperature, session duration, breathing techniques) and cost-effectiveness analyses would strengthen the evidence base for clinical implementation.

5. CONCLUSION

The integration of warm-water foot soaks and slow, deep breathing therapy demonstrated a consistent reduction in blood pressure among elderly individuals with Stage 2 hypertension, with mean decreases of 5.25 mmHg (systolic) and 1.75 mmHg (diastolic). Although the paired t-

test analysis did not reach statistical significance at the conventional α=0.05 level (systolic: p=0.054; diastolic: p=0.069), the sustained downward trend across intervention sessions suggests a clinically meaningful effect. These findings support the potential of combining these two low-cost, non-pharmacological interventions as a complementary to hypertension management in older adults.

Given the chronic and age-related nature of vascular stiffness in elderly, consistent and prolonged application of this combined intervention is recommended to achieve more substantial and sustained blood pressure control. Healthcare practitioners may consider incorporating warm-water foot soaks and slow deep breathing exercises into routine geriatric care protocols, particularly as adjunctive therapies for patients seeking safe, non-pharmacological options.

AUTHOR CONTRIBUTIONS

All authors contributed to the conception and design of the study, data collection, data analysis, and manuscript preparation. All authors have read and approved the final manuscript.

ACKNOWLEDGMENT

The authors would like to thank for respondents in Nursing Home of Bondowoso for participation in this study. The authors also express their sincere gratitude to Universitas Jember for the support and facilitation of this research.

CONFLICT OF INTEREST

The authors declare that there is no conflict of interest regarding the publication of this research.

DATA AVAILABILITY STATEMENT

The data data can be accessed from the corresponding author upon reasonable request.

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