

The Effectiveness of Tomato Juice Consumption in Reducing Blood Pressure Among Postmenopausal Women

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ABSTRACT

Introduction: Hypertension is a major health problem among postmenopausal women, largely attributable to the decline in estrogen levels, which results in the loss of estrogen's cardioprotective effects and leads to increased vascular stiffness and elevated blood pressure. Although pharmacological therapy remains the primary approach for hypertension management, long-term use of antihypertensive medications is often associated with adverse effects and reduced treatment adherence. Therefore, safe and accessible non-pharmacological interventions are needed. Tomato juice, which is rich in bioactive compounds such as lycopene and potassium, has been suggested as a potential dietary intervention for blood pressure control.

Objective: This study aimed to evaluate the effectiveness of tomato juice consumption in reducing systolic and diastolic blood pressure among postmenopausal women with hypertension.

Methods: A pre-experimental study with a one-group pretest-posttest design was conducted in the service area of a primary healthcare center in Banda Aceh, Indonesia. The study involved 22 postmenopausal women with mild to moderate hypertension who were selected using purposive sampling. The intervention consisted of daily administration of 250 mL of tomato juice for four consecutive days. Blood pressure was measured before and after the intervention, and data were analyzed using the Wilcoxon Signed-Rank Test.

Results: The results demonstrated a significant reduction in mean systolic blood pressure by 12.5 mmHg, from 156.25 mmHg to 143.75 mmHg, and in mean diastolic blood pressure by 15.0 mmHg, from 98.75 mmHg to 83.75 mmHg. Statistical analysis indicated that these reductions were significant, with p-values of 0.005 for systolic blood pressure and 0.001 for diastolic blood pressure ($p < 0.05$).

Conclusion: Regular consumption of tomato juice for four consecutive days was effective in significantly reducing both systolic and diastolic blood pressure among postmenopausal women. This intervention may serve as a safe and practical non-pharmacological strategy for hypertension management in postmenopausal populations.

KEYWORDS: tomato juice; hypertension; menopause; blood pressure; lycopene

INTRODUCTION

Menopause is a natural and irreversible phase in a woman's life cycle, marked by the permanent cessation of ovarian activity and a substantial decline in estrogen production[1], [2], [3]. This hormonal transition is accompanied by a wide range of physiological changes that significantly affect women's health, particularly the cardiovascular system[4], [5]. Estrogen plays a critical protective role in maintaining vascular function by promoting endothelial integrity, enhancing vasodilation through nitric oxide synthesis, suppressing inflammatory responses, and improving lipid metabolism[6], [7], [8]. Consequently, estrogen deficiency during the postmenopausal period contributes to structural and functional alterations in blood vessels, including increased arterial stiffness and reduced vascular compliance, which predispose women to elevated blood pressure and hypertension.

Hypertension is one of the most prevalent chronic conditions among postmenopausal women and represents a major public health concern[9], [10], [11], [12]. The increase in blood pressure observed during this stage of life is not solely attributable to chronological aging, but is also strongly influenced by the loss of estrogen's cardioprotective effects. In Indonesia, the prevalence of hypertension among postmenopausal women has demonstrated a concerning upward trend. Data from Puskesmas Yosomulyo in Metro City illustrate a dramatic rise in hypertension cases, from 141 cases in 2018 to 839 cases in 2023. This nearly six-fold increase highlights the growing burden of hypertension in postmenopausal women and underscores the urgency of implementing effective prevention and management strategies tailored to this vulnerable population[13], [14].

If left uncontrolled, hypertension can lead to severe and life-threatening complications, including stroke, chronic kidney disease, and coronary heart disease. These complications not only increase morbidity and mortality rates but also substantially impair quality

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of life by limiting physical functioning, increasing psychological distress, and reducing social participation among postmenopausal women. At the global level, the World Health Organization (WHO) estimates that the prevalence of hypertension will reach approximately 29% of the adult population by 2025. Postmenopausal women constitute a high-risk group due to a combination of hormonal changes and modifiable lifestyle factors, such as excessive sodium and fat intake, physical inactivity, obesity, and chronic stress, all of which may further exacerbate blood pressure elevation.

Pharmacological therapy remains the cornerstone of hypertension management; however, long-term use of antihypertensive drugs is frequently associated with adverse effects, including dizziness, fatigue, electrolyte imbalance, and decreased medication adherence [15], [16]. In addition, economic constraints and limited access to healthcare services may hinder sustained pharmacological treatment, particularly in resource-limited settings. These challenges highlight the importance of identifying safe, affordable, and easily implementable non-pharmacological interventions that can complement conventional therapy and support long-term blood pressure control.

One promising non-pharmacological approach is the consumption of tomato juice. Tomatoes are rich in lycopene, a potent carotenoid antioxidant that plays a crucial role in reducing oxidative stress, protecting vascular endothelial cells, and inhibiting the progression of atherosclerosis [17], [18]. Furthermore, tomatoes contain substantial amounts of potassium, which contributes to blood pressure regulation by promoting sodium excretion and reducing extracellular fluid volume. Additional bioactive compounds in tomatoes, including vitamin C and various phytochemicals, have been shown to improve endothelial function and exert anti-inflammatory effects, thereby enhancing overall cardiovascular health [19]. Several previous studies have demonstrated that regular consumption of tomato juice is associated with significant reductions in both systolic and diastolic blood pressure among individuals with hypertension and prehypertension. Despite these promising findings, empirical evidence in the Indonesian context remains limited, particularly among postmenopausal women, whose physiological characteristics and lifestyle patterns may differ from other populations [20], [21], [22]. Consequently, there is a clear need for context-specific experimental studies to evaluate the effectiveness of tomato juice as a non-pharmacological intervention for blood pressure control in this high-risk group. Therefore, this study aims to examine the effectiveness of tomato juice consumption in reducing blood pressure among postmenopausal women, with the intention of providing scientific evidence to support the development of accessible and sustainable non-pharmacological strategies for hypertension management.

METHODS

This study employed a pre-experimental design with a one-group pretest–posttest approach, conducted within the working area of the Banda Aceh City Public Health Center (Puskesmas). The study population consisted of all postmenopausal women with mild to moderate hypertension, and a total of 22 participants were recruited using purposive sampling based on inclusion criteria. Eligible participants were postmenopausal women aged 45–60 years who had ceased menstruation for at least 12 months, presented with systolic blood pressure between 140–160 mmHg or diastolic blood pressure between 90–100 mmHg, were not currently taking antihypertensive medications, resided in Banda Aceh City, and agreed to participate by signing informed consent. Exclusion criteria included a history of chronic diseases such as diabetes mellitus, kidney failure, or heart disease, tomato allergy, as well as non-compliance in completing the intervention until the end of the study. The intervention consisted of 250 ml of tomato juice administered daily for four consecutive days. The juice was prepared using 200 grams of fresh local tomatoes, 5 grams of granulated sugar, and 50 ml of boiled water, blended without additional ingredients, and consumed every morning under the supervision of the researcher to ensure compliance. Blood pressure measurements were conducted using a calibrated aneroid sphygmomanometer and stethoscope following the World Health Organization (WHO) standard procedure. Respondents were instructed to sit quietly for five minutes before measurement; blood pressure was measured twice with a one-minute interval, and the average was recorded. Measurements were taken at baseline (pretest) and after the fourth day of intervention (posttest). Data were collected using an observation sheet to document systolic and diastolic blood pressure values. The data were then analyzed univariately to describe respondent characteristics and the distribution of mean blood pressure, and bivariately using the Wilcoxon Signed-Rank Test to determine differences in blood pressure before and after the intervention, with a significance level set at $p < 0.05$.

RESULTS

Characteristics of Respondents

This study involved 22 postmenopausal women with hypertension who met the inclusion criteria. Respondents were recruited based on an initial diagnosis of hypertension, with systolic blood pressure ≥ 140 mmHg or diastolic blood pressure ≥ 90 mmHg, were not routinely taking pharmacological antihypertensive medications, and agreed to participate in the four-day intervention program. The characteristics of the respondents are described according to age, duration of menopause, body mass index (BMI), and blood pressure category before the intervention. The data are presented in Table 1.

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Table 1. Characteristics of Respondents (n = 22)

Characteristics	Frequency (n)	Percentage (%)
Age (years)		
45–50	6	27.3
51–55	9	40.9
56–60	7	31.8
Duration of Menopause (years)		
≤ 5	10	45.5
> 5	12	54.5
Body Mass Index (kg/m ²)		
Normal (18.5–24.9)	7	31.8
Overweight (25–29.9)	9	40.9
Obese (≥ 30)	6	27.3
Blood Pressure Category		
Hypertension Grade 1	14	63.6
Hypertension Grade 2	8	36.4

The majority of respondents were aged 51–55 years (40.9%), followed by those aged 56–60 years (31.8%) and 45–50 years (27.3%). In terms of menopausal duration, more than half of the women (54.5%) had been menopausal for over 5 years, while 45.5% had experienced menopause for 5 years or less. Regarding nutritional status, most respondents were classified as overweight (40.9%), while 31.8% had a normal BMI and 27.3% were categorized as obese. In terms of hypertension severity, the majority were classified as having Grade 1 hypertension (63.6%), while 36.4% were in the Grade 2 hypertension category.

UNIVARIATE ANALYSIS

A univariate analysis was conducted to examine the distribution of mean systolic and diastolic blood pressure values before and after the tomato juice intervention. The results are presented in **Table 2**.

Table 2. Mean Blood Pressure Before and After Tomato Juice Intervention (n = 22)

Variable	Pre-Intervention (mmHg)	Post-Intervention (mmHg)	Mean Reduction (mmHg)
Systolic Blood Pressure	156.25 ± 7.80	143.75 ± 6.50	12.5
Diastolic Blood Pressure	98.75 ± 6.10	83.75 ± 5.85	15.0

The univariate analysis revealed a notable decrease in both systolic and diastolic blood pressure following the four-day tomato juice intervention. The mean systolic blood pressure decreased from 156.25 ± 7.80 mmHg to 143.75 ± 6.50 mmHg, representing a reduction of 12.5 mmHg. Meanwhile, the mean diastolic blood pressure decreased from 98.75 ± 6.10 mmHg to 83.75 ± 5.85 mmHg, corresponding to a reduction of 15.0 mmHg. These findings indicate that the intervention led to a meaningful improvement in both systolic and diastolic blood pressure among the postmenopausal women in the study.

BIVARIATE ANALYSIS

A bivariate analysis was conducted to test the hypothesis regarding the significant difference in blood pressure before and after the tomato juice intervention. The Wilcoxon Signed-Rank Test was used, considering the paired nature of the data and its non-normal distribution. The results are presented in **Table 3**.

Table 3. Wilcoxon Signed-Rank Test Results for Blood Pressure Before and After Tomato Juice Intervention (n = 22)

Variable	p-value	Interpretation
Systolic Blood Pressure	0.005	Significant (p < 0.05)
Diastolic Blood Pressure	0.001	Significant (p < 0.05)

The Wilcoxon Signed-Rank Test revealed a statistically significant reduction in both systolic and diastolic blood pressure following the four-day tomato juice intervention. Systolic blood pressure decreased by 12.5 mmHg and diastolic blood pressure by 15.0 mmHg. The corresponding p-values were 0.005 for systolic and 0.001 for diastolic blood pressure, both below the significance threshold of 0.05. These results indicate that the daily consumption of tomato juice effectively lowered both systolic and diastolic blood pressure among postmenopausal women with mild to moderate hypertension.

DISCUSSION

The intervention consisting of daily tomato juice consumption for four consecutive days resulted in a statistically and clinically significant reduction in blood pressure among postmenopausal women with hypertension. The mean systolic blood pressure

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decreased markedly from 156.25 mmHg at baseline to 143.75 mmHg after the intervention, while the mean diastolic blood pressure declined from 98.75 mmHg to 83.75 mmHg. Statistical analysis using the Wilcoxon Signed-Rank Test confirmed the significance of these changes, with p-values of 0.005 for systolic blood pressure and 0.001 for diastolic blood pressure. These findings indicate that tomato juice consumption exerts a meaningful antihypertensive effect, even within a relatively short intervention period. From a clinical standpoint, the average reductions of 12.5 mmHg in systolic blood pressure and 15 mmHg in diastolic blood pressure are of substantial medical importance. Such reductions are sufficient to shift blood pressure classification from grade 2 hypertension toward grade 1 hypertension or even into the prehypertensive range. Evidence from large-scale epidemiological studies suggests that a reduction of 10 mmHg in systolic blood pressure or 5 mmHg in diastolic blood pressure can significantly decrease the risk of major cardiovascular events, including stroke, heart failure, and coronary artery disease. Therefore, the magnitude of blood pressure reduction observed in this study suggests a meaningful potential for cardiovascular risk reduction in postmenopausal women.

The antihypertensive effects observed are likely mediated by the bioactive compounds present in tomatoes, particularly lycopene, potassium, vitamin C, and other phytochemicals. Lycopene, a potent carotenoid antioxidant, plays a crucial role in protecting the vascular endothelium from oxidative stress by neutralizing free radicals and preventing lipid peroxidation. Oxidative stress is widely recognized as a major contributor to endothelial dysfunction and arterial stiffness, conditions that are especially prevalent in postmenopausal women due to estrogen deficiency. By mitigating oxidative damage, lycopene may help restore endothelial function and improve vascular elasticity, thereby reducing peripheral vascular resistance and lowering blood pressure. Potassium is another key component of tomatoes that contributes to blood pressure regulation. High potassium intake enhances renal sodium excretion, reduces plasma volume, and attenuates sodium-induced vasoconstriction [23], [24], [25]. These mechanisms are particularly relevant in postmenopausal women, who tend to exhibit increased salt sensitivity due to hormonal changes and aging-related physiological alterations. In addition, vitamin C and other polyphenolic compounds found in tomatoes exert anti-inflammatory effects, improve nitric oxide bioavailability, and promote vasodilation, further supporting cardiovascular health [26], [27].

The findings of this study are consistent with previous research investigating the effects of tomato and tomato-based product consumption on blood pressure regulation. Several randomized and quasi-experimental studies have reported significant reductions in both systolic and diastolic blood pressure following regular consumption of tomato juice or lycopene-rich supplements among individuals with hypertension and prehypertension. These effects have been reported to be particularly pronounced among older adults and postmenopausal women, reinforcing the biological plausibility of the present findings. Moreover, these results align with broader dietary strategies for hypertension management, such as the Dietary Approaches to Stop Hypertension (DASH) diet, which emphasizes the intake of fruits and vegetables rich in potassium, antioxidants, and dietary fiber.

CONCLUSIONS

This study demonstrates that daily consumption of 250 mL of tomato juice for four consecutive days produces a statistically significant and clinically meaningful reduction in both systolic and diastolic blood pressure among postmenopausal women with mild to moderate hypertension. The observed reductions of 12.5 mmHg in systolic blood pressure and 15.0 mmHg in diastolic blood pressure indicate a substantial antihypertensive effect with the potential to lower the risk of major cardiovascular complications, including stroke and coronary heart disease. The significant differences between pre- and post-intervention blood pressure measurements confirm the effectiveness of tomato juice as a non-pharmacological intervention. Owing to its rich content of bioactive compounds, particularly lycopene and potassium, tomato juice may be considered an effective, safe, and easily implementable complementary strategy for hypertension management in postmenopausal women. These findings highlight the importance of nutrition-based interventions as part of an integrated approach to blood pressure control in this high-risk population.

CONFLICT OF INTEREST

The authors declare that there is no conflict of interest.

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