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Effect of Edamame (*Glycine max* (L.) Merr.) Consumption on Blood Pressure in Patients with Hypertension

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Abstract

Functional foods have emerged as promising non-pharmacological strategies for blood pressure control. Edamame (*Glycine max* (L.) Merr.) is rich in isoflavones, potassium, magnesium, calcium, and dietary fiber, all of which may contribute to blood pressure reduction. This study evaluated the effect of steamed edamame consumption on blood pressure among hypertensive patients. A quasi-experimental pretest–posttest study with a control group was conducted in June 2025 at the Kandang Community Health Center, Lhokseumawe, Indonesia. Forty hypertensive patients aged 35–60 years were selected through purposive sampling and assigned to intervention (n = 20) and control (n = 20) groups. The intervention group consumed 40 g of steamed edamame daily for seven consecutive days, whereas the control group received steamed soybeans. Blood pressure was measured before and after the intervention using a standardized digital sphygmomanometer. Data were analyzed using paired and independent *t*-tests with a significance level of $p < 0.05$. The intervention group experienced significantly greater reductions in systolic and diastolic blood pressure than the control group. Mean systolic and diastolic blood pressure decreased by 11.0 mmHg and 7.85 mmHg, respectively, compared with reductions of 3.55 mmHg and 1.75 mmHg in the control group. Between-group differences were statistically significant for both systolic (7.4 mmHg) and diastolic (6.1 mmHg) blood pressure ($p < 0.001$). Steamed edamame effectively reduced systolic and diastolic blood pressure among hypertensive patients, suggesting its potential as a locally available functional food and complementary non-pharmacological strategy for hypertension management.

Keywords: blood pressure, edamame, functional food, hypertension, non-pharmacological intervention

Introduction

Hypertension remains one of the leading global public health challenges because of its high prevalence and its substantial contribution to cardiovascular morbidity and mortality. According to the World Health Organization (WHO), approximately 1.28 billion adults aged 30–79 years are living with hypertension worldwide, yet nearly half are unaware of their condition. Furthermore, fewer than one in four adults with hypertension achieve adequate blood pressure control, highlighting the urgent need for effective prevention and management strategies beyond pharmacological treatment (WHO, 2023). Persistent hypertension substantially increases the risk of cardiovascular diseases, stroke, chronic kidney disease, and premature mortality, while also reducing quality of life and increasing healthcare expenditures (World Health Organization, 2023; International Society of Hypertension, 2020).

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Hypertension also represents a major health concern in Indonesia. Data from the 2023 Indonesian Health Survey (SKI) showed that hypertension remains one of the most prevalent non-communicable diseases among adults, with particularly high prevalence reported in several provinces, including Aceh (Indonesian Ministry of Health, 2023). According to the Aceh Provincial Health Profile, hypertension continues to be among the leading causes of outpatient visits at primary healthcare facilities. In Lhokseumawe City, hypertension is one of the most frequently reported chronic diseases, with more than 1,100 registered patients at the Kandang Community Health Center in 2024. These findings emphasize the importance of strengthening community-based interventions to improve blood pressure control and prevent hypertension-related complications.

Lifestyle modification is considered the cornerstone of hypertension management and includes maintaining a healthy diet, increasing physical activity, limiting sodium intake, achieving a healthy body weight, and consuming foods rich in minerals and bioactive compounds (World Health Organization, 2023; International Society of Hypertension, 2020). Among various functional foods, edamame (*Glycine max* (L.) Merr.) has attracted increasing attention because it is naturally rich in plant protein, dietary fiber, potassium, magnesium, calcium, and soy isoflavones. These bioactive compounds have been reported to improve endothelial function, enhance nitric oxide bioavailability, reduce oxidative stress, and promote vasodilation, thereby contributing to blood pressure reduction (Edamame; Soybean) (Kurniawati et al., 2026; Lei L et al., 2024).

Growing evidence suggests that regular consumption of soy-based foods is associated with lower blood pressure and a reduced risk of cardiovascular disease. A systematic review and meta-analysis demonstrated that soy isoflavone supplementation significantly reduced both systolic and diastolic blood pressure, particularly among individuals with hypertension (Lei L et al., 2024). Likewise, the cardioprotective effects of soy foods have been attributed to their combined antioxidant, anti-inflammatory, and vasodilatory properties, which support vascular health and improve blood pressure regulation (Kurniawati et al., 2026).

The nutritional quality of edamame may also be influenced by processing methods. Thermal processing affects the retention of vitamins, minerals, and phytochemicals. Compared with boiling, steaming has been shown to better preserve water-soluble nutrients, antioxidant compounds, and the sensory characteristics of vegetables because of reduced nutrient leaching during cooking (Shen, C et al., 2025; Meghana D et al., 2025). Therefore, steamed edamame may provide greater nutritional benefits while maintaining consumer acceptability.

Despite the growing evidence regarding soy consumption and cardiovascular health, studies specifically evaluating the effects of steamed edamame on blood pressure among hypertensive patients in Indonesian primary healthcare settings remain scarce. In particular, evidence from Aceh Province is limited. Therefore, this study aimed to evaluate the effect of steamed edamame consumption on blood pressure among patients with hypertension in the Kandang Community Health Center service area, Lhokseumawe, Indonesia. The findings are expected to provide scientific evidence supporting the utilization of locally available functional foods as complementary non-pharmacological interventions for hypertension management.

Methods

This study employed a quasi-experimental pretest–posttest control group design to evaluate the effect of steamed edamame (*Glycine max* (L.) Merr.) consumption on blood pressure among patients with hypertension. The study was conducted in June 2025 at the Kandang Community Health Center, Lhokseumawe, Aceh, Indonesia. Ethical approval was

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obtained from the Health Research Ethics Committee of Poltekkes Kemenkes Aceh (Ethical Clearance No. DP.04.03/12.7/021/2026).

The study population comprised patients with hypertension aged 35–60 years who were registered at the Kandang Community Health Center. Participants were eligible if they had systolic blood pressure between 140 and 180 mmHg and/or diastolic blood pressure between 90 and 120 mmHg, were able to consume the intervention, and provided written informed consent. Patients with severe cardiovascular complications, chronic kidney disease, pregnancy, allergies to soy products, or those who failed to complete the intervention were excluded.

The minimum sample size was calculated using the Slovin formula with a precision level of 10%, resulting in a required sample of 33 participants. To improve statistical power and minimize potential attrition, 40 participants were recruited using purposive sampling and equally allocated into an intervention group (n = 20) and a control group (n = 20).

Participants in the intervention group consumed 40 g of steamed edamame (*Glycine max* (L.) Merr.) once daily for seven consecutive days, whereas the control group received 40 g of steamed soybeans with the same frequency and duration. The edamame pods were steamed for approximately 5–10 minutes until fully cooked before consumption.

Blood pressure was measured before and after the intervention using a calibrated Omron® digital sphygmomanometer operated by trained health personnel. Measurements followed standardized procedures recommended by international hypertension guidelines. Participants were instructed to avoid smoking, caffeine consumption, and vigorous physical activity for at least 30 minutes before measurement. After resting in a seated position for 5 minutes, two blood pressure measurements were obtained at 1–2-minute intervals, and the average value was used for analysis.

Primary outcome measures were changes in systolic and diastolic blood pressure following the intervention. Demographic characteristics were collected using a structured questionnaire, while secondary data were obtained from the Kandang Community Health Center records.

Data were analyzed using IBM SPSS Statistics. The normality of continuous variables was assessed using the Shapiro–Wilk test. Normally distributed data were analyzed using the paired-samples t-test for within-group comparisons and the independent-samples t-test for between-group comparisons. When the assumption of normality was not met, the Wilcoxon signed-rank test and the Mann–Whitney U test were applied. Statistical significance was established at $p < 0.05$.

Results

Respondent Characteristics

A total of 40 participants completed the study, comprising 20 participants in the intervention group and 20 participants in the control group. Overall, the baseline characteristics of the two groups were comparable. Most participants were female, aged 41–50 years, had completed secondary education, had a history of hypertension for more than five years, and were predominantly homemakers.

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Table 1. Baseline Characteristics of the Participants

Characteristic	Category	Intervention (n = 20) n (%)	Control (n = 20) n (%)
Education	Primary	6 (30.0)	8 (40.0)
	Secondary	12 (60.0)	11 (55.0)
	Higher	2 (10.0)	1 (5.0)
Sex	Male	2 (10.0)	3 (15.0)
	Female	18 (90.0)	17 (85.0)
Age (years)	<40	2 (10.0)	4 (20.0)
	41–45	6 (30.0)	5 (25.0)
	46–50	6 (30.0)	7 (35.0)
	>51	6 (30.0)	4 (20.0)
Duration of Hypertension	<5 years	10 (50.0)	12 (60.0)
	≥5 years	10 (50.0)	8 (40.0)
Occupation	Homemaker	16 (80.0)	16 (80.0)
	Trader	2 (10.0)	3 (15.0)
	Civil servant	2 (10.0)	1 (5.0)
Family History of Hypertension	Yes	15 (75.0)	13 (65.0)
	No	5 (25.0)	7 (35.0)

Blood Pressure Before and After the Intervention

The Shapiro–Wilk test showed that all systolic and diastolic blood pressure variables were normally distributed (all $p > 0.05$). Therefore, parametric statistical tests were applied.

Table 2. Blood Pressure Before and After the Intervention

Variable	Group	n	Mean ± SD	Minimum	Maximum
Systolic BP Before (mmHg)	Intervention	20	162.25 ± 13.32	135	179
	Control	20	151.80 ± 13.85	130	176
Systolic BP After (mmHg)	Intervention	20	151.25 ± 12.14	128	168
	Control	20	148.25 ± 13.28	128	172
Diastolic BP Before (mmHg)	Intervention	20	97.45 ± 13.31	70	120
	Control	20	91.70 ± 8.24	75	104
Diastolic BP After (mmHg)	Intervention	20	89.60 ± 11.98	65	110
	Control	20	89.95 ± 7.91	74	102

Table 2 presents the mean systolic and diastolic blood pressure before and after the intervention. In the intervention group, mean systolic blood pressure decreased from 162.25 ± 13.32 mmHg to 151.25 ± 12.14 mmHg, while mean diastolic blood pressure decreased from 97.45 ± 13.31 mmHg to 89.60 ± 11.98 mmHg. In contrast, the control group showed only modest reductions in systolic blood pressure (151.80 ± 13.85 to 148.25 ± 13.28 mmHg) and diastolic blood pressure (91.70 ± 8.24 to 89.95 ± 7.91 mmHg).

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Effect of Steamed Edamame on Blood Pressure

Within-group analysis demonstrated significant reductions in both systolic and diastolic blood pressure following the intervention. Participants in the intervention group experienced greater reductions in systolic blood pressure (11.00 mmHg) and diastolic blood pressure (7.85 mmHg) than those in the control group, who showed reductions of 3.55 mmHg and 1.75 mmHg, respectively (all $p < 0.001$).

Table 3. Within-Group Comparison of Blood Pressure Before and After the Intervention

Outcome	Group	n	Mean Difference (mmHg)	p-value
Systolic Blood Pressure	Intervention	20	11.00	<0.001
	Control	20	3.55	<0.001
Diastolic Blood Pressure	Intervention	20	7.85	<0.001
	Control	20	1.75	<0.001

Comparison of Blood Pressure Reduction Between Groups

The independent-samples *t*-test demonstrated significant differences in blood pressure reduction between the intervention and control groups (Table 4). Participants who consumed steamed edamame experienced significantly greater reductions in both systolic and diastolic blood pressure than those in the control group. The mean between-group difference was 7.40 mmHg for systolic blood pressure and 6.10 mmHg for diastolic blood pressure (both $p < 0.001$).

Table 4. Between-Group Comparison of Blood Pressure Reduction

Outcome	Intervention Mean Reduction (mmHg)	Control Mean Reduction (mmHg)	Mean Difference Between Groups (mmHg)	p-value
Systolic Blood Pressure	11.00	3.55	7.45	<0.001
Diastolic Blood Pressure	7.85	1.75	6.10	<0.001

Discussion

This study demonstrated that consuming 40 g of steamed edamame (Glycine max (L.) Merr.) daily for seven consecutive days significantly reduced both systolic and diastolic blood pressure among patients with hypertension. Participants in the intervention group experienced a mean reduction of 11.00 mmHg in systolic blood pressure and 7.85 mmHg in diastolic blood pressure, whereas the control group showed only modest reductions of 3.55 mmHg and 1.75 mmHg, respectively. Between-group analysis further confirmed that the reductions in blood pressure were significantly greater among participants receiving steamed edamame ($p < 0.001$). These findings indicate that steamed edamame may serve as a beneficial dietary adjunct for blood pressure management in individuals with hypertension.

The antihypertensive effect of edamame is likely attributable to its rich nutritional composition, particularly its high contents of potassium, magnesium, dietary fiber, vegetable protein, and isoflavones. Potassium contributes to blood pressure regulation by promoting

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sodium excretion through the kidneys, reducing vascular resistance, and improving endothelial function. Magnesium supports vascular smooth muscle relaxation and enhances vasodilation, while dietary fiber may improve metabolic health and reduce systemic inflammation associated with hypertension. In addition, soy isoflavones, especially genistein and daidzein, have antioxidant and anti-inflammatory properties that improve nitric oxide bioavailability, leading to improved endothelial function and reduced arterial stiffness (Kurniawati et al., 2026; World Health Organization, 2023).

The present findings are consistent with previous clinical studies demonstrating the cardiovascular benefits of soy-based foods. A comprehensive umbrella review by Kurniawati et al., (2026) concluded that regular soy food consumption is associated with modest but clinically meaningful reductions in systolic and diastolic blood pressure, particularly among individuals with hypertension or elevated cardiovascular risk. Similarly, a systematic review and meta-analysis by Lei L, et al., (2024) reported that soy isoflavone supplementation significantly improves endothelial function and contributes to lower blood pressure, especially in middle-aged and older adults. These mechanisms support the observed reductions in blood pressure following steamed edamame consumption in the present study.

The beneficial effect observed in this study may also be related to the cooking method. Steaming is considered one of the most appropriate preparation methods for vegetables because it preserves heat-sensitive nutrients and bioactive compounds more effectively than boiling. Compared with boiling, steaming minimizes the leaching of water-soluble vitamins, minerals, and phenolic compounds, thereby maintaining the antioxidant capacity of vegetables and legumes (Shen, C et al., 2025; Meghana D et al., 2025). Consequently, steamed edamame retains more of its functional components, which may contribute to its blood pressure-lowering effect.

The observed reductions in blood pressure are clinically meaningful. Evidence from large epidemiological studies indicates that even modest reductions of 5–10 mmHg in systolic blood pressure substantially reduce the risk of stroke, coronary heart disease, heart failure, and cardiovascular mortality. Therefore, the average reduction of 11 mmHg in systolic blood pressure observed in this study may provide important cardiovascular benefits when incorporated into comprehensive hypertension management alongside lifestyle modification and appropriate pharmacological therapy (World Health Organization, 2023).

Despite these promising findings, several limitations should be acknowledged. The intervention lasted only seven days, which may not fully reflect the long-term effects of regular edamame consumption on blood pressure. The relatively small sample size also limits the generalizability of the findings. Furthermore, dietary intake, physical activity, sodium consumption, body mass index, and adherence to antihypertensive medication were not fully controlled during the intervention period. Future randomized controlled trials with larger sample sizes, longer intervention periods, and more comprehensive dietary monitoring are needed to confirm the long-term efficacy of steamed edamame as a functional food for hypertension management.

Conclusion

Daily consumption of 40 g of steamed edamame (Glycine max (L.) Merr.) for seven consecutive days significantly reduced both systolic and diastolic blood pressure among patients with hypertension compared with the control group. These findings suggest that steamed edamame has potential as a locally available functional food to complement non-pharmacological management of hypertension. Incorporating steamed edamame into a

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balanced diet may contribute to improved blood pressure control and cardiovascular health. Further well-designed randomized controlled trials with larger sample sizes and longer intervention durations are warranted to confirm these findings and evaluate their long-term clinical benefits.

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