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The Effect of Edamame Jelly on Lowering Blood Pressure in Primary Hypertension Patients

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Abstract
Hypertension is the cause of death in Indonesia, with 23.8% of the 1.7 million population. Management of primary hypertension is non-pharmacological therapy carried out by modifying lifestyle, namely increasing consumption of nuts that contain bioactive components that are beneficial for sufferers of primary hypertension, such as edamame (Glycine max (L.) Merrill). This study aims to determine how giving edamame jelly reduces blood pressure in primary hypertension patients. This research was quasi-experimental and used a pre-post-test control group design. The study population consisted of outpatients at the Sumbersari Jember Community Health Center who met the inclusion and exclusion criteria, totaling 42 subjects. Subjects were randomly divided into treatment and control groups. The intervention group was given amlodipine 5 mg/day and edamame jelly 150 grams/day. The control group was only assigned 5 mg of amlodipine. Statistical tests use the Paired t-test, Wilcoxon signed-rank test, and Mann-Whitney U-tests. The test results showed a significant difference in systolic and diastolic blood pressure between the control and treatment groups with a p-value <0.001. The median systolic blood pressure of the control group was 147.5 mmHg, and that of the treatment group was 130 mmHg. The median diastolic blood pressure in the control group was 90 mmHg, and the treatment group's was 80 mmHg. The reduction in systolic blood pressure in the treatment group was 17.5 mmHg greater than in the control group. The decrease in diastolic blood pressure in the treatment group was 10 mmHg greater than in the control group. Giving 150 grams of edamame jelly/day for 30 days effectively reduces blood pressure in sufferers of primary hypertension.

Keywords: Blood Pressure, Edamame, Primary Hypertension.

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1. INTRODUCTION

Hypertension is a trigger for cardiovascular disease, which causes death throughout the world. Hypertension is called the silent killer because it often occurs without symptoms (Lazdia et al., 2020). Hypertension attacks 22% of the world's population, and the incidence rate in Southeast Asia has reached 36%. The death rate due to hypertension in Indonesia was 23.8% of the 1.7 million population in 2019 (Abbafati et al., 2020). Based on the 2023 Indonesian Health Survey (SKI) report, the national prevalence of hypertension is 29.2%, and East Java Province exceeds the national average of 32.8% (Kementerian Kesehatan RI, 2023). The number of hypertension sufferers aged ≥15 years in Jember Regency is 741,735 people, with the most significant number of hypertension sufferers being at the Sumbersari Community Health Center, with 26,736 people (Dinas Kesehatan Kabupaten Jember, 2020)

Hypertension occurs due to the thickening of the blood vessel walls and loss of elasticity of the artery walls. The heart will pump blood faster, and peripheral resistance increases, increasing blood pressure (Yuni, 2016). Consuming foods containing potassium, calcium, and magnesium can lower blood pressure in people with hypertension. Potassium lowers blood pressure by reducing sodium in the urine and extracellular fluid, while calcium relaxes blood vessel muscles to stabilize blood pressure (Rohatin & Prayuda, 2020). According to Nurmayanti & Kaswari (2020), if the magnesium concentration in the blood increases, the heart muscle can work optimally and reduce blood pressure.

Hypertension is divided into two, namely primary and secondary hypertension. Primary hypertension is suffered by >90% of patients. Management of primary hypertension is divided into pharmacological and non-pharmacological therapy. One of the non-pharmacological therapies can be done by modifying lifestyle (Yulanda & Lisiswanti, 2017). One healthy lifestyle that you can adopt is increasing your consumption of nuts. Nuts that contain bioactive components that are beneficial for sufferers of primary hypertension are vegetable soybeans or edamame (Glycine max (L.) Merrill). Edamame is a source of protein, carbohydrates, fibre, amino acids, potassium, calcium, and magnesium. Phytochemical components in edamame, such as isoflavones, sterols, and saponins, can reduce the risk of hypertension (Samruan et al., 2014).

The vitamin C in edamame helps reduce systolic and diastolic blood pressure because an increase in nitric oxide can counteract oxidative stress in the endothelium (Bhagwat & Haytowitz, 2015). Isoflavones, free radical-fighting antioxidants found in edamame, can improve the immune system, reduce the risk of arteriosclerosis (hardening of the arteries), and lower blood pressure (Ningsih et al., 2018). Research using 25 grams of edamame with the drug amlodipine 5 grams/day for 30 days by Sumarni et al. (2020) Showed results in reduced blood pressure, both systolic and diastolic, in WUS suffering from hypertension.

Edamame is one of the mainstay commodities that is characteristic of Jember Regency. The largest and most superior edamame production center in Indonesia is also in Jember Regency because the edamame produced has succeeded in penetrating the international market or being exported abroad. Edamame has been developed into a functional food by processing it into jelly as an intervention for primary hypertension sufferers. The choice of jelly was because, in previous research, the edamame was given in frozen form with a hard texture. In contrast, jelly is a semi-solid food ingredient popular with all groups because of its dense and chewy texture (Prakarsa, 2017). Making edamame jelly involves mixing edamame with carrageenan, a seaweed ingredient that functions as a gel former. Carrageenan has a high fibre and potassium content, which can help reduce the risk of hypertension if consumed (Kusumaningrum & Rahayu, 2018). This study aims to determine how giving edamame jelly reduces blood pressure in primary hypertension patients at the Sumbersari Community Health Center, Jember Regency.

2. RESEARCH METHOD

This research was quasi-experimental and used a pre-test and post-test with a control group design. This design uses two groups: a control group and a treatment group. The treatment group was given standard medication from the community health center, namely 5 mg amlodipine and edamame jelly, for 30 days, while the control group was only given 5 mg amlodipine obtained from the community health center.

Making edamame jelly refers to previous research with several modifications to the additional ingredients (Afiska et al., 2021). The ingredients used are 25 grams of cooked edamame, 16.7 grams of granulated sugar, 2.3 grams of carrageenan, 0.7 grams of vanilla powder, and 450 ml of water. The total weight of cooked edamame used refers to previous research (Sumarni, 2020). By modifying the recipe, it produces 150 grams of edamame jelly per serving. The process for making edamame jelly is to boil raw edamame for ± 5 minutes, peel the edamame and weigh it according to the weight listed, blend the edamame with 100 ml of boiled water until smooth, then pour it into a container, dissolve the carrageenan with 50 ml of boiled water in a separate container then stir well. Until there are no lumps, add granulated sugar to the bowl of fine edamame and stir well; put the dissolved carrageenan into the edamame container, then stir until evenly mixed; heat and cook the mixture over low heat while continuing to stir, add vanilla powder if the mixture pops and stir evenly, remove the mixture, pour it into serving cups, then refrigerate for at least 2 hours. The edamame jelly is ready to serve.

The research population was outpatients at the Sumbersari Community Health Center, Jember Regency, in March – April 2023 who had been diagnosed with primary hypertension with systolic blood pressure >140 mmHg and diastolic >90 mmHg based on the results of examinations carried out by the doctor in charge of the community health centre and patient register data totaling 139 people. This data was matched with patient medical records, and it was discovered that 72 patients had complications, 11 people were taking amlodipine 10 mg, and three people were pregnant. Fifty-three research subjects met the inclusion criteria, including outpatients who had been diagnosed with primary hypertension with systolic blood pressure >140 mmHg and diastolic >90 mmHg based on the results of examinations carried out by the doctor in charge of the health center, taking amlodipine 5 mg, and able to communicate. The subject has no memory problems, is 31 – 59 years old, is not pregnant, is not breastfeeding, and is willing to sign an informed consent form. Subjects were excluded if they were diagnosed with diabetes mellitus, coronary heart disease, kidney dysfunction, stroke, and cancer, which was known from the diagnosis of the doctor in charge of the community health center and based on medical record data from the community health center, had experienced allergies or intolerance to soybeans or edamame, smoked and consumed alcohol, the subject is not willing to be a respondent and the subject's address is not found. The sample size is calculated using the following formula (Sastroasmoro & Ismael, 2014):

$$n1 = n2 = 2\left[\frac{(Z\alpha + Z\beta) \times SD}{X_1 - X_2}\right]^2$$

Information :
n = Sample size
Zα = Type I error (1.96) 5%
Zβ = Type II error (0.84) 80%
SD = Standard deviation based on previous research
X1 – X2 = Average difference based on previous research

Based on previous research by Sumarni et al (2020), the standard deviation was 20.575, and the mean difference was 20.7.

$$n = 2\left[\frac{(Z\alpha + Z\beta)\ x\ SD}{X_1 - X_2}\right]^2$$

$$= 2\left[\frac{(1{,}96 + 0{,}84)\ x\ 20{,}575}{20{,}7}\right]^2$$

$$= 2\ (2{,}78)^2$$

$$= 15{,}4 = 15$$

The number of research samples was calculated by adding the previous values into the formula; the result was that n1 = n2 was 15 to anticipate dropout, then 10% was added so that n1 = n2 was 17 samples and a total of 34 samples. The research sample criteria were as described previously by looking at patient visit data in March and April 2023, then selected according to consecutive sampling to obtain a minimum number of subjects. The subjects of this research were 42 people who met the inclusion and exclusion criteria. Two people dropped out because they traveled out of town and did not want to continue, so the number of subjects who took part in this research until completion was 40, with details of 20 people in the treatment group and 20 people in the control group.

This research was conducted for 30 days, from May to June 2023. The treatment group received 5 mg amlodipine and 150 grams of edamame jelly, which they consumed every day. Edamame jelly is made from 25 grams of cooked edamame, 16.7 grams of sugar, 2.3 grams of carrageenan, 0.7 grams of vanilla powder, and 150 ml of water. Edamame jelly is consumed every day as an afternoon snack. The control group received 5 mg amlodipine, which was consumed once every day for 30 days. Blood pressure measurements on all research subjects were carried out before entering the treatment day. Blood pressure measurements were performed again on the sixteenth day of treatment and after treatment, namely on the thirty-first day.

Test normality of blood pressure data using the Shapiro-Wilk method (<50 respondents). A comparative test of differences in mean blood pressure before and after treatment in two paired groups using the paired t-test for normally distributed data and the Wilcoxon signed rank test for data that is not normally distributed. The comparative test for differences in mean blood pressure between the control and treatment groups used the Mann-Whitney U Test because there was data that was not normally distributed. Statistical data analysis using the STATA application version 15 and Flourish for data visualization and storytelling. This research has received approval from the Research Ethics Commission of the Faculty of Medicine, Sebelas Maret University, with letter number 92/UN27.06.11/KEP/EC/2023 on May 10, 2023.

3. RESULTS AND DISCUSSION

Subject characteristics in this study included gender, age, BMI, education, and occupation. Table 1 shows the distribution of research subject characteristics.

Table 1. Frequency Distribution Based on Research Subject Characteristics

Subject characteristics	Control		Edamame Jelly		p-value
	n	(%)	n	(%)	
Gender					
Male	5	(25.0)	5	(25.0)	0.642
Female	15	(75.0)	15	(75.0)	
Education					
No school	1	(5.0)	3	(15.0)	

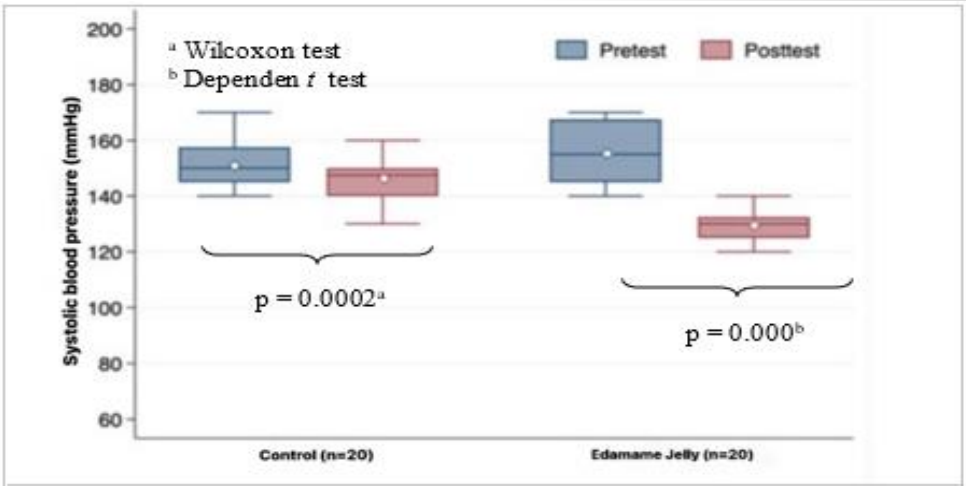
Elementary school	4	(20.0)	5	(25.0)	0.825
Junior high school	5	(25.0)	4	(20.0)	
Senior high school	8	(40.0)	6	(30.0)	
College	2	(10.0)	2	(10.0)	
Work					
Housewife	13	(65.0)	14	(70.0)	0.703
Government employees	1	(5.0)	0	(0.0)	
Private sector employee	4	(20.0)	3	(15.0)	
Businessman	2	(10.0)	2	(10.0)	
Retired	0	(0.0)	1	(5.0)	
Age (years)					
25 – 34	0	(0.0)	1	(5.0)	0.619
35 – 44	3	(15.0)	4	(20.0)	
45 – 54	11	(55.0)	6	(30.0)	
55 – 64	6	(30.0)	9	(45.0)	
Body mass index					
Normal	12	(60.0)	9	(45.0)	0.412
Fat	3	(15.0)	2	(10.0)	
Obesity	5	(25.0)	9	(45.0)	

[a] χ^2 Test
Source: Primary data (2023)

Based on Table 1, the number of subjects is more female than male. Most respondents in the control and treatment groups were educated in high school. The most common occupation in the control and treatment groups was housewife. Both groups' most extensive age range was 45–54, and the highest BMI was normal. The p-value>0.05 for each characteristic indicates that gender, education, occupation, and history of hypertension from fathers and mothers from both groups are homogeneous, and there are no significant differences.

The data obtained in this research was subjected to a normality test to determine whether the data was normally distributed or not. The data normality test in this study used the Shapiro-Wilk test because the research sample was <50. In the pretest data normality test, both groups' systolic and diastolic blood pressure was usually distributed. Posttest data on systolic and diastolic blood pressure in the control group showed a p-value <0.05, which means the data was not normally distributed, whereas, in the treatment group, the data showed a normal distribution so that the correct test for differences in posttest data between the control and treatment groups was the Mann-Whitney test. The normality test of pretest and post-test data for systolic and diastolic blood pressure in the treatment group showed that the data were normally distributed, so the difference test used the paired t-test. The control group's systolic and diastolic blood pressure contained abnormally distributed data, so the pretest-posttest difference test used the Wilcoxon signed rank test. The next stage of statistical testing was conducted to determine the difference in blood pressure before and after giving edamame jelly to each group and the difference in blood pressure between the treatment and control groups after giving edamame jelly.

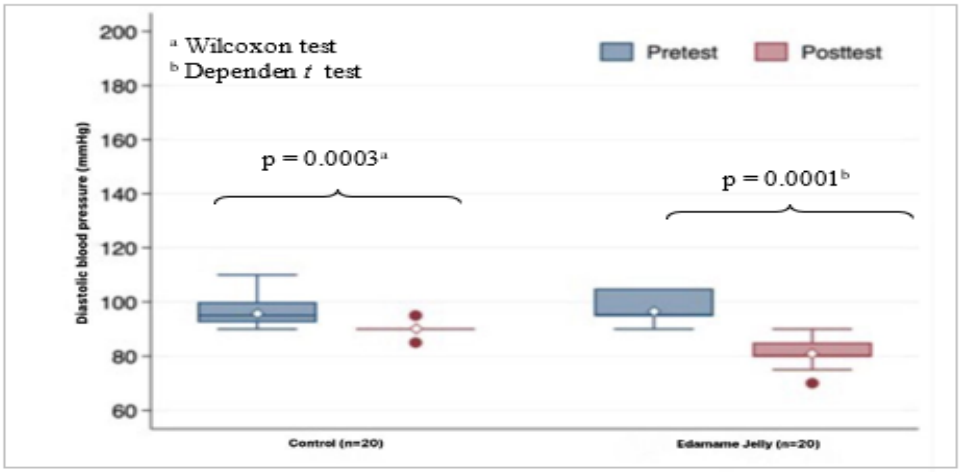
The statistical test to determine the difference in blood pressure between the pretest and posttest on a numerical scale was the Wilcoxon signed rank test in the control group and the paired t-test in the edamame jelly treatment group. The statistical test results are shown in Figures 1 and 2. The mean is marked with a white diamond symbol in the middle of the box, and the median is marked with a red horizontal line in the middle.



Mean ± SD	152.0 ± 9.4	144.8 ± 7.5	155.0 ± 11.4	129.8 ± 6.6
Median (IQR)	150.0 (145.0-157.5)	147.5 (140.0-150.0)	155,0 (145.0-167.5)	130.0 (125.0-132.5)

SD: *standard deviation*; IQR: *interquartile range*

Figure 1. The difference in systolic blood pressure before and after giving edamame jelly to the control and treatment groups.



Mean ± SD	96.0 ± 5.3	90.3 ± 2.0	98.3 ± 5.2	81.5 ± 4.3
Median (IQR)	95.0 (92.5-100)	90.0 (90.0-90.0)	95.0 (95.0-105.0)	80.0 (80.0-85.0)

SD: *standard deviation*; IQR: *interquartile range*

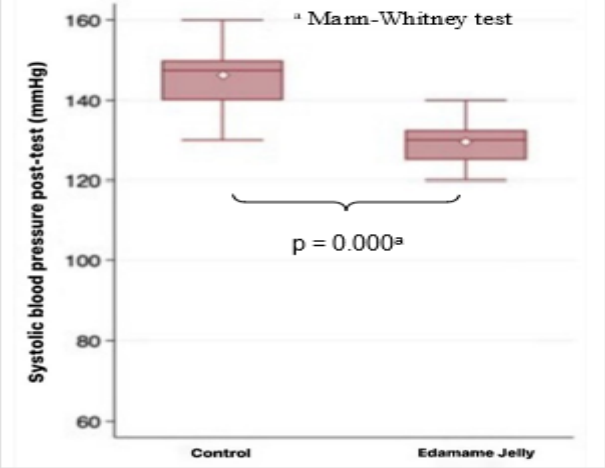
Figure 2. Difference in diastolic blood pressure before and after giving edamame jelly to the control and treatment groups.

In Figure 1, the mean systolic blood pressure in the control group before treatment was 152 mmHg, and after treatment was 144.8 mmHg. The mean systolic blood pressure before giving edamame jelly in the treatment group was 155 mmHg, and after giving edamame jelly was 129.8 mmHg. The reduction in systolic blood pressure in the control group was 7.2 mmHg, and in the treatment group was 25.2 mmHg. In Figure 2, the mean diastolic blood pressure in the control group before treatment was 96 mmHg, and after treatment was 90.3 mmHg. The average diastolic blood pressure before giving edamame jelly in the treatment group was 98.3

mmHg, and after giving edamame jelly was 81.5 mmHg. The reduction in diastolic blood pressure in the control group was 5.7 mmHg, and in the treatment group was 16.8 mmHg.

It can be seen that the mean blood pressure, both systolic and diastolic, in the edamame jelly and control groups decreased. Still, the difference in a reduction for systolic blood pressure was significantly more significant in the edamame jelly group (-25.2 mmHg, p-value = 0.000) compared to the control group (-7.2 mmHg, p-value = 0.0002). Similar results were also observed for diastolic blood pressure, where the edamame jelly group had a significantly more significant difference in reduction, namely -16.8 mmHg with a p-value = 0.0001 compared to the control group (-5.7 mmHg, p-value = 0.0003).

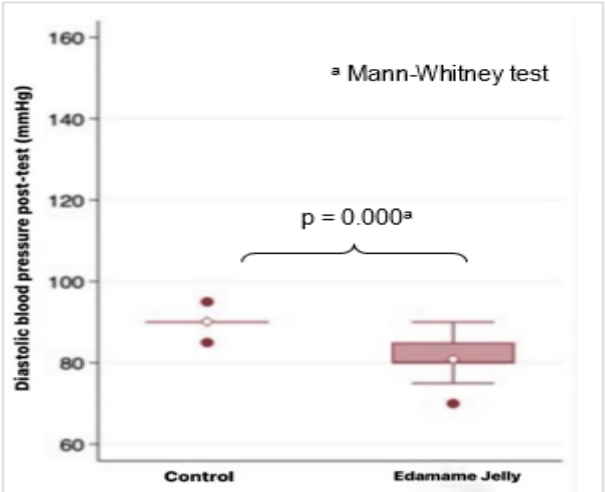
Based on the previous normality test results, the Mann-Whitney test was used to analyze the difference in post-test systolic and diastolic blood pressure between the control and edamame jelly groups. The analysis results are shown in Figure 3 for systolic blood pressure and Figure 4 for diastolic blood pressure.



	Control	Edamame Jelly
Mean ± SD	144.8 ± 7.5	129.8 ± 6.6
Median (IQR)	147.5 (140.0 – 15.0)	130.0 (125.0 – 132.5)

SD: *standard deviation*; IQR: *interquartile range*

Figure 3. Differences in systolic blood pressure after administration of edamame jelly



	Control	Edamame Jelly
Mean ± SD	90.3 ± 2.0	81.5 ± 4.3
Median (IQR)	90.0 (90.0 – 90.0)	80.0 (80.0 – 85.0)

SD: *standard deviation*; IQR: *interquartile range*

Figure 4. The difference in diastolic blood pressure after administration of edamame jelly

Systolic and diastolic blood pressure after treatment was significantly lower in the edamame jelly group compared to the control group (p <0.001). The mean systolic blood pressure after treatment in the control group was 144.8 mmHg. In the treatment group, it was 129.8 mmHg, with the difference in mean systolic blood pressure between the control group and edamame jelly being 15 mmHg. The mean diastolic blood pressure in the control group was 90.3 mmHg; in the treatment group, it was 81.5 mmHg, with a mean difference of 8.8 mmHg.

In this study, a multivariate analysis was also carried out to determine the effect of giving edamame jelly on blood pressure after treatment by considering the influence of several characteristics of the respondents at once. The research sample consisted of 40 people, so a maximum of only three confounding variables (covariates) could be added to the multivariate analysis, referring to the rule of thumb N = 10 x number of covariates. The sociodemographic variables chosen were classic variables relevant to hypertension, namely age, gender, and BMI.

Analysis of covariance (ANCOVA) was used to determine the effect of giving edamame jelly on systolic blood pressure by controlling the variables age, gender, and BMI. The test results are listed in Table 2.

Table 2. Influence of demographic factors on systolic blood pressure after giving edamame jelly

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	2417.076[a]	4	604.269	12.222	.000
Intercept	9520.420	1	9520.420	192.562	.000
Age	2.478	1	2.478	.050	.824
Gender	109.588	1	109.588	2.217	.145
BMI	23.734	1	23.734	.480	.493
Edamame Jelly Feeding	2238.290	1	2238.290	45.272	.000
Error	1730.424	35	49.441		
Total	757650.000	40			
Corrected Total	4147.500	39			
R Squared = .583 (Adjusted R Squared = .535)					

*[a] ANCOVA; * Statistically meaningful (p<0,05).*

Table 2 shows that age, gender, and BMI do not influence systolic blood pressure. Administration of edamame jelly together with sociodemographic factors explained the systolic blood pressure value by 53.5% (adjusted R^2=0.535), while the rest was influenced by other factors not studied.

Table 3. Effect of demographic factors on diastolic blood pressure after administration of edamame jelly

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	833.978[a]	4	208.495	20.248	.000
Intercept	3914.792	1	3914.792	380.186	.000
Age	6.433	1	6.433	.625	.435
Gender	16.342	1	16.342	1.587	.216
BMI	26.766	1	26.766	2.599	.116
Edamame Jelly Feeding	797.686	1	797.686	77.467	.000
Error	360.397	35	10.297		
Total	296175.000	40			
Corrected Total	1194.375	39			
R Squared = .698 (Adjusted R Squared = .664)					

*[a] ANCOVA; * Statistically meaningful (p<0,05).*

Table 3 shows that age, gender, and BMI do not influence diastolic blood pressure. Administration of edamame jelly together with sociodemographic factors explained the systolic blood pressure value by 66.4% (adjusted R^2=0.664), while the rest was influenced by other factors not studied.

Based on the results of research in the treatment and control groups, respondents aged >40 years were more likely to suffer from primary hypertension than those aged under 40 years. These results are in line with the research conducted. Meliana (2021), Hypertension is common after a person is 40 years old because the blood vessels narrow and become stiff, so blood

pressure will also increase. Gender in the treatment and control groups, more female respondents suffered from primary hypertension than men. These results are in line with the research conducted. Ayukhaliza (2020), it states that women tend to have higher blood pressure due to hormonal factors, namely a reduction in the hormone estrogen, and psychological factors, such as changes within the woman.

The results of the test analysis show that there are significant differences before and after treatment in both the treatment and control groups. The mean reduction in systolic blood pressure in the treatment group was 25.2 mmHg (p = 0.000), and the diastolic blood pressure was 16.8 mmHg (p = 0.0001). The mean decrease in systolic blood pressure in the control group was 7.2 mmHg (p = 0.0002), and the reduction in diastolic blood pressure was 5.7 mmHg (p = 0.0003). This shows a more significant decrease in systolic and diastolic blood pressure in the treatment group than in the control group. A reduction in blood pressure of 20/10 mmHg in hypertensive patients can reduce the risk of cardiovascular events by 50% (Kandarini, 2017).

Previous research conducted by Maulina et al., (2020), it was stated that giving 25 grams of edamame/day was very effective in reducing blood pressure in women of childbearing age with hypertension, so consuming 25 grams of cooked edamame/day is recommended for hypertension sufferers. The bioactive components in edamame jelly provide a vasodilating effect and lower blood pressure (Yuni, 2016). Analysis tests showed a significant reduction in blood pressure in the treatment group given edamame jelly and 5 mg of amlodipine. These results are due to how amlodipine works: it reduces calcium ion levels, providing a vasodilation effect on blood vessels. When combined with consuming edamame jelly, this significantly lowers blood pressure (Maulina et al., 2020).

This research chose to process edamame into jelly because, in previous research, the edamame was given in frozen form with a hard texture, while jelly is a semi-solid food ingredient that is popular with all groups because its texture is dense and chewy (Prakarsa, 2017). The process of making edamame jelly is by mixing edamame with carrageenan, which is an ingredient from seaweed and functions as a gel former. According to Kusumaningrum & Rahayu (2018), carrageenan has a high fibre and potassium content, which, if consumed, can help reduce the risk of developing hypertension.

The control group that only received amlodipine also showed decreased systolic blood pressure. Still, the reduction in blood pressure in the treatment group was 18 mmHg greater, and diastolic blood pressure was 11 mmHg greater than in the control group. This is in line with a similar study using amlodipine as a control, which was also carried out (Maulina et al., 2020). The result was a difference in the mean systolic and diastolic blood pressure values before and after treatment with 5 mg amlodipine therapy of 10.75 mmHg and 6.5 mmHg, respectively.

The results of statistical tests of differences in blood pressure between the treatment group and the control group after giving edamame jelly showed a significant difference in reducing systolic and diastolic blood pressure (p <0.001). The treatment group's median posttest systolic blood pressure was 130 mmHg and diastolic 80 mmHg. The median post-test systolic blood pressure in the control group was 147.5 mmHg and diastolic 90 mmHg. The decrease in systolic blood pressure in the treatment group was 17.5 mmHg greater than the control group. In comparison, the reduction in diastolic blood pressure in the treatment group was ten mmHg greater than the control group.

Edamame jelly in this study was given for 30 days to subjects in the treatment group. Giving edamame jelly affected reducing blood pressure in the treatment group. One hundred fifty grams of edamame jelly is consumed daily as an afternoon snack. The amount per serving of edamame jelly is based on the dosage given for edamame in previous research as well as modification of the recipe, which has gone through the organoleptic testing stage and nutritional value testing in the laboratory. Edamame jelly per serving contains 139.5 kcal calories, 9.1

grams of protein, 2 grams of fat, 21.4 grams of carbohydrates, 147 mg potassium, 36 mg calcium, 19.5 mg magnesium, and 8.1 mg isoflavones. Subjects in the treatment group and control group also received amlodipine 5 mg as pharmacological therapy for sufferers of primary hypertension.

Research conducted by Wei et al. (2020), it was stated that the group that consumed ≥125 grams/day of soy products had lower systolic and diastolic blood pressure than those that consumed <125 grams/day. The study also stated that intake of soy products can reduce blood pressure in the long term and can be implicated in preventing primary hypertension.

Another study comparing food sources of vegetable (soybean) and animal (cow's milk) protein sources showed that respondents who consumed 25 grams of soybeans/day had lower systolic and diastolic blood pressure than those who drank cow's milk (Ghidanac et al., 2023). The vegetable protein in edamame contains essential amino acids that increase the active transport process from the blood to muscle cells and other tissues. This effect on the cardiovascular system increases peripheral blood flow, increasing cardiac output, which decreases blood pressure (Kusumastuty et al., 2016). The potassium content in edamame jelly provides a diuretic and vasodilator effect. It maintains the balance of extracellular sodium and potassium concentrations to reduce blood pressure in hypertension sufferers (Yuni, 2016). Respondents also consumed edamame jelly, which increased calcium and magnesium intake and maintained the balance of calcium and magnesium in the blood. Blood calcium levels are essential because calcium can help flex blood vessel muscles, while blood magnesium makes the heart muscle work optimally and decreases blood pressure (Rohatin & Prayuda, 2020).

Edamame contains isoflavones, which are thought to show antihypertensive activity by increasing NO, reducing angiotensin, and inhibiting the formation of free radical reactions. Isoflavones work as antihypertensive agents by inhibiting the conversion of angiotensin I to angiotensin II, thereby inhibiting the release of aldosterone by ACE. Aldosterone impacts the kidneys in retaining sodium and water; more water is excreted, and blood pressure will decrease if aldosterone production is inhibited. (Putri & Nofia, 2020). These results align with other research on giving 40 grams of black soybean cookies for four weeks made from 20 grams of black soybean powder. Mean systolic blood pressure decreased by 7.5 mmHg and diastolic by four mmHg (Yamashita et al., 2020).

The results of the ANCOVA test on the influence of sociodemographic factors on systolic and diastolic blood pressure show that edamame jelly can be used as a non-pharmacological therapy in addition to pharmacological therapy using the drug amlodipine, which provides benefits for treating primary hypertension.

This research has limitations, namely that researchers have not been able to optimally control other factors that can influence blood pressure, including genetics, lifestyle, stress, and physical activity. Researchers also have limitations in finding more research samples. Another limitation of this research is that food intake was not monitored for all research subjects.

4. CONCLUSION

Giving 1 cup of edamame jelly (150 grams) for 30 days can reduce systolic blood pressure by 17.5 mmHg and diastolic by 10 mmHg. This study recommends that future researchers explore other forms of soy products or other bioactive components in edamame to determine their antihypertensive effects.

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