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The Effect of 'Pikebi Bar' (Musa Paradisiaca), Soybeans (Glycine Max L.), and Yellow Sweet Potatoes (Ipomoea Batatas L.) on Blood Pressure in Hypertension Patients

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ABSTRACT

Background: *Hypertension increases the chance of significant, frequently asymptomatic consequences. Hypertension is rising in Indonesia due to age, obesity, and family history. Pharmacological and non-pharmacological treatments for hypertension include the DASH diet, which promotes fruits, vegetables, and grains. Recently, bananas, soybeans, and sweet potatoes have been shown to reduce blood pressure.*

Research Methods: *A Non-equivalent Pretest-Posttest quasi-experimental design was used. The Lameshow formula with purposive sampling chose 32 participants. A treatment group of 16 individuals drank 45 grams of PIKEBI Bar every day for 7 days, whereas a control group of 16 received no intervention.*

Research Result: *The intervention group showed a reduction in systolic blood pressure from an average of 162.69±12.663 mmHg to 144.56±17.413 mmHg, a difference of 18.13 mmHg. Diastolic blood pressure also decreased, from an average of 91.25±22.035 mmHg to 84.44±12.559 mmHg, a difference of 6.81 mmHg.*

Conclusion: *Consumption of the PIKEBI Bar significantly reduced systolic blood pressure but did not affect diastolic blood pressure.*

BACKGROUND

Hypertension is one of the most common non-communicable diseases and is known as "The Silent Killer" because its symptoms are subtle. This disease is caused by excessive blood pressure in the major arteries. Heart disease, stroke, and kidney disease can be caused by hypertension. Hypertension can damage organs silently because patients are often unaware of it. The rate of hypertension in Indonesia is increasing every year. According to WHO data from 2022, 40.3% of the Indonesian population had hypertension in 2019. The Indonesian Ministry of Health reported that hypertension in people aged 18 years and over had increased to 34.1% in the 2018 Basic Health Research (Riskesdas). Age, gender, smoking, poor diet, obesity, diabetes, and a family history of heart disease or hypertension are the leading causes of hypertension. The WHO 2020 projected that 29% of people will have hypertension by 2025, resulting in 8 million deaths (Purwono et al., 2020). In West Nusa Tenggara Province, the prevalence of hypertension was recorded at 27.8% in 2023, with 44,637 people living with hypertension in West Lombok Regency. At the Sigerongan Community Health Center, 769 cases of hypertension were recorded, with the majority of patients being women (Puskesmas P2PTM data, 2024).

Pharmacological and non-pharmacological treatments can control hypertension. The DASH diet lowers blood pressure naturally. DASH emphasizes fruits, vegetables, whole grains, cereals, low-fat dairy, and protein, while being low in salt, sugar, and saturated fat. Potassium-rich bananas increase salt excretion

in the urine, reducing blood volume and pressure. Regular consumption of lemongrass bananas reduces systolic and diastolic blood pressure (Sutriyanto, 2019).

Along with bananas, soybeans support the DASH diet. Soybeans provide plant-based protein, unsaturated fats, and antioxidants that reduce LDL oxidation, increasing cardiovascular disease risk. The high potassium content in soybeans helps lower blood pressure. Bananas reduce systolic and diastolic blood pressure in people with hypertension (Darni et al., 2023).

Sweet potatoes, which are high in fiber, can also be part of the DASH diet. The polyphenols in sweet potatoes are antioxidants, and their fiber concentration lowers blood pressure and the risk of obesity and diabetes. Research shows that consuming snacks made from soy flour and sweet potatoes can significantly lower blood pressure in people with hypertension (Zahra et al., 2022). One practical solution is to create snack bars made from plantains, lemongrass, soybeans, and sweet potatoes to facilitate the implementation of a healthy diet. These snack bars can be a healthy and convenient snack for people with hypertension. The advantage of these snack bars is their portability and long-term storage, making them suitable for consumption at any time. The development of this product aims to provide a healthy food alternative for people with hypertension and help them maintain stable blood pressure through nutritious foods that align with the principles of the DASH diet. With this combination of natural ingredients, it is hoped that these snack bars can contribute to reducing the prevalence of hypertension and improving the quality of life of those with hypertension.

RESEARCH METHODS

This research was conducted from mid-July to August 2024. The research process began with obtaining ethical clearance issued under the number DP.04.03/F.XLVIII.14/429/2024 on July 23, 2024. This research has obtained a permit letter from the West Lombok BAPPEDA with number 070/467/BAPPEDA/2024 on July 24, 2024, and a research permit letter from the Mataram Ministry of Health Polytechnic with number PP.06.02/F.XLVIII/3523/2024 on July 15, 2024.

This study used a non-equivalent pretest-posttest quasi-experimental design. The following inclusion criteria were used to select 32 participants in this study: (1) Hypertensive patients aged 30-59 years, male and female; (2) Able to communicate; (3) Taking antihypertensive medication; (4) Willing to participate in the study with informed consent; (5) Having systolic blood pressure ⩾140 mmHg and diastolic blood pressure ⩾90 mmHg at the time of examination.

The sample was selected using a purposive or non-probability sampling method based on the researcher's criteria. In the treatment group, an intervention was given as a PIKEBI Bar snack weighing 45 grams/portion once a day. The nutritional content in one portion of PIKEBI Bar consists of 278.3 kcal, 15.1 grams of protein, 13.7 grams of fat, 27.1 grams of carbohydrates, 803.9 mg of potassium, and 3.92 grams of fiber. One serving of PIKEBI Bar contains 5.7 grams of fresh lemongrass plantain mashed with medium ripeness, 10 grams of yellow sweet potato flour obtained from 37.5 grams of fresh yellow sweet potato, and 4.2 grams of soybean flour obtained from 12 grams of fresh soybeans.

RESULT

Characteristics of Research Subjects

This study involved 32 hypertension patients registered in the Sigerongan Community Health Center (Puskesmas) working area. The subjects were divided into two groups: 16 subjects in the intervention group and 16 subjects in the control group. The characteristics of the study subjects are presented in Table 1.

Table 1. Distribution of Characteristics of Research Subjects

Characteristics	Group				ρ
	Intervention (n=16)		Control (n=16)		
	n	%	n	%	
Age					
- 19-29 years old	0	0	3	18.8	
- 30-49 years old	9	56.3	8	50.0	0.213
- 50-64 years old	7	43.8	5	31.3	
Gender					
- Male	4	25.0	2	12.5	0,000
- Female	12	75.0	14	87.5	
Family history of hypertension					
- Yes	6	37.5	5	31.3	0,081
- No	10	62.5	11	68.8	
Nutritional status					
- Underweight	1	6.3	3	18.8	
- Normal Weight	6	37.5	3	18.8	
- Overweight	1	6.3	2	12.5	0, 547
- Obesity I	2	12.5	5	31.3	
- Obesity II	6	37.5	3	18.8	
Smoking History					
- Yes	3	18.8	2	12.5	0,000
- No	13	81.3	14	87.5	
Consumption of hypertension medication					
- Amlodipine B	9	56,3	4	25.0	1,000
- Captopril	7	43.8	12	75.0	
Physical Activity					
- Light	13	81.3	15	93.8	
- Moderate	1	6.3	0	0	0.309
- Heavy	2	12.5	1	6.3	

P value: Mann-Whitney

Data were not normally distributed according to the Shapiro-Wilk test. Using the Mann-Whitney U test, age, history of hypertension, nutritional status, physical activity, and medication use were not significantly different between groups ($p > 0.05$). However, gender and smoking history were significantly different ($p < 0.05$).

Results of blood pressure measurements before and after the Pikebi bar intervention

The following shows the results of blood pressure checks before and after being given a Pikebi bar.

Table 2. Average Blood Pressure Test

Blood Pressure (mmHg)	Intervention (n=16) Mean ± SD	Δ	ρ	Control (n=16) Mean ± SD	Δ	ρ
Systolic						
Before	162,69 ± 12,663	18,13	0,000[b]	165,63 ± 12,088	-0,75	0,416[b]
After	144,56 ± 17,413			166,38 ± 10,443		
Diastolic						
Before	91,25 ± 22,035	6,81	0,320[a]	80,50 ± 13,049	0,56	0,909 [a]
After	84,44 ± 12,559			79,94 ± 7,038		

[a]uji Wilcoxon, [b]uji Paired T-Test

After the intervention, the treatment group experienced a significant decrease in systolic blood pressure (p=0.000; p<0.05), averaging 18.13 mmHg (Table 3). Systolic blood pressure did not change in the control group before and after the intervention (p=0.416; p>0.05). Diastolic blood pressure did not differ between the treatment and control groups before and after the intervention (p>0.05). The intervention lowered systolic blood pressure but did not lower diastolic blood pressure in the treatment group.

Table 3. Statistical Test of the Effect of Giving PIKEBI Bar Interludes on Blood Pressure

Blood Pressure (mmHg)	Group				ρ
	Intervention (n=16)		Control (n=16)		
	Δ	SD	Δ	SD	
Δ TD Systolic	18,13	13,301	-0,75	3,587	0,000[a]
Δ TD Diastolic	6,81	22,016	0,56	12,220	0,326[a]

[a]uji *Mann*-Whitney

Table 3 shows a significant difference (p<0.05) in changes in systolic blood pressure between the treatment and control groups, with the treatment group experiencing a greater reduction. Diastolic blood pressure did not differ between groups (p>0.05). This indicates that the PIKEBI Bar resulted in lower systolic blood pressure, but not diastolic blood pressure.

DISCUSSION

Characteristics of Research Subjects

Age

It was found that the majority of the 32 respondents were between 30 and 49 years old in both categories. The intervention group had 9 (56.3%) respondents in this age range, while the control group had 8 (50.0%) with an average age of 45. A comparative study by Aisya, Purbowati, and Nurohmi (2023) found that most of the 164 hypertensive patients were aged 30–49. Age is a persistent risk factor for hypertension because blood pressure increases with age. This is related to decreased effectiveness in regulating calcium metabolism, which leads to increased blood viscosity and blood pressure. In addition, conditions such as arteriosclerosis, a narrowing of the blood vessels that impedes blood flow, and changes in the structure and function of peripheral blood vessels due to aging also contribute to increased blood pressure with age (Aisya, Purbowati, & Nurohmi, 2023).

Gender

Based on gender, most respondents were female, with 12 (75.0%) in the treatment group and 14 (87.5%) in the control group. Adila and Mustika (2023) found that 86% of hypertension patients were female. Another study by Taiso, Sudayasa, and Paddo (2021) found that 73.3% of hypertension patients were female. Estrogen levels in women gradually decline before menopause, usually between the ages of 45 and 55. Estrogen increases HDL cholesterol during perimenopause. High HDL protects against atherosclerosis, which may help premenopausal women avoid hypertension (Zikra, Yulia, & Tri Wahyuni, 2020).

History of Hypertension

The results showed that 10 (62.5%) respondents in the treatment group and 11 (68.8%) respondents in the control group had no history of hypertension. Six (37.5%) respondents in the treatment group and five (31.3%) respondents in the control group had a history of hypertension. According to Sandi Husada et al. (2019), 41.4% of hypertensive patients had no history of hypertension, while 18.6% did. An unhealthy lifestyle, particularly nutrition, can influence heredity or the development of hypertension. Although genetic factors play a role, a healthy and balanced diet helps minimize the risk of hypertension (Rahmadhani, 2021).

Nutritional Status (BMI)

Based on research findings, the majority of respondents in both groups had obesity in nutritional status. However, in the treatment group, most respondents had normal nutritional and obesity II status, with six respondents (37.5%) each. Meanwhile, in the control group, the majority were classified as obesity II, with five respondents (31.3%). The average Body Mass Index (BMI) in both groups was 25.5, which falls into the obesity I category. Direct and indirect pathways link obesity to hypertension. Body mass directly increases blood demand and cardiac output. Obesity indirectly activates the sympathetic nervous system and

RAAS through cytokines, hormones, and adipokines (Tiara, 2020). According to Alfalah et al. (2022), Minangkabau women with hypertension had an average BMI of 32.82 kg/m², indicating a link between obesity and hypertension.

Smoking History

Most respondents, 13 (81.3%) in the therapy group and 14 (87.5%) in the control group, were nonsmokers. According to Garwahusada and Wirjatmadi (2020), most office workers were nonsmokers, and 34.8% of respondents in the case group had quit smoking. Several studies have linked smoking to heart disease, circulatory system disease, lung cancer, oral cavity cancer, laryngeal cancer, hypertension, impotence, pregnancy complications, and fetal abnormalities. Smoking harms both active and passive smokers who inhale secondhand smoke. In fact, exposure to passive smokers can pose greater health risks than exposure to active smokers (Nurhaeni, Aimatun Nisa, & Marisa, 2022).

Antihypertensive Medications

Based on the survey, all respondents were taking amlodipine besylate and captopril. Nurdin, Marsia, and Baedlawi (2024) demonstrated a substantial correlation between adherence to antihypertensive medication and blood pressure reduction in hypertensive patients at the Parit Timur Community Health Center, Kubu Raya Regency. Amlodipine selectively affects blood vessels, has a long half-life, low oral bioavailability, and slow absorption. Amlodipine reduces unexpected drops in blood pressure. Ten milligrams of this drug lowers blood pressure within 10 minutes in hypertensive situations (Febri, Munif, & Puspandari, 2020). Captopril, an ACE inhibitor, inhibits the conversion of Angiotensin I to Angiotensin II. This mechanism helps the kidneys excrete salt and potassium, reducing blood pressure and cardiac workload (preload and afterload). Captopril lowers blood pressure by reducing peripheral vascular and arterial resistance. Because food can reduce absorption, captopril should be given two hours before meals up to three times daily, depending on blood pressure (Mayasari, 2020).

Physical Activity

Most respondents engaged in light exercise, 13 (81.3%) in the treatment group and 15 (93.8%) in the control group. Kadek et al. (2019) reported that 81.3% of respondents in the treatment group and 93.8% in the control group engaged in light exercise. Physical activity includes all body movements that require energy. Physical inactivity increases the heart rate, making each contraction harder. As the heart pumps, arterial pressure increases, leading to high blood pressure. Regular exercise strengthens the heart and lowers vascular resistance, preventing hypertension. Exercise also releases endorphins, which relax muscles and provide pleasure, helping to maintain blood pressure (Marleni, 2020).

Treatment

Statistical testing revealed that the treatment and control groups had different average systolic blood pressures before and after the PIKEBI Bar intervention, but no differences in diastolic blood pressure. After the intervention, the systolic blood pressure in the treatment group decreased from 162.69 to 144.56 mmHg. The control group had an average systolic blood pressure of 165.63 mmHg before the intervention and 166.38 mmHg afterward.

The treatment group had an average diastolic blood pressure of 91.25 mmHg before the intervention and 84.44 mmHg afterward. The control group had an average diastolic blood pressure of 80.50 mmHg before the intervention and 79.94 mmHg afterward. Because it contains 803.9 mg of potassium and 3.92 grams of fiber, the PIKEBI Bar likely lowered systolic blood pressure in the treatment group. The administration of these products contributes positively to lowering systolic blood pressure and supporting the healthy eating patterns recommended in the DASH diet, which is rich in fiber and potassium, two important components in managing hypertension.

The Effect of Giving PIKEBI Bar Intervals on Blood Pressure in Hypertension Patients

In hypertensive patients, the PIKEBI Bar snack significantly reduced systolic blood pressure (p 0.05). Systolic blood pressure decreased by 18.4 mmHg in the treatment group and increased by 0.75 mmHg in the control group. Zahra et al. (2022) found that a soy flour and sweet potato snack reduced systolic blood pressure after seven days.

Systolic blood pressure decreased significantly, while diastolic blood pressure did not, with a p value of 0.320 ($p>0.05$). Diastolic blood pressure decreased by 6.81 mmHg in the treatment group and 1.01 mmHg in the control group. These results are similar to those of Darni et al. (2023), who reported that administering certain ingredients did not significantly reduce diastolic blood pressure.

Several factors can explain the lack of significant changes in diastolic blood pressure. One is the respondents' ongoing use of antihypertensive medications, which reduce vascular resistance and increase arterial elasticity. Antihypertensive medications are generally more effective in controlling diastolic blood pressure, which is more influenced by blood vessel elasticity and blood volume than other factors such as dietary intake.

Nevertheless, the PIKEBI Bar intervention has the potential to provide long-term benefits in lowering blood pressure in hypertensive patients who are also taking antihypertensive medications. PIKEBI Bars, with their potassium and fiber content, can support antihypertensive treatment by continuously managing blood pressure, increasing treatment effectiveness, and helping maintain better blood pressure control.

Regarding dietary intake, the study results showed that although fiber consumption in both the treatment and control groups was still below the DASH diet recommendations (less than 30 grams per day), consuming PIKEBI Bars could positively contribute to fiber intake. Angelina et al. (2021) also found that stress increases blood pressure. Stress increases the chemical adrenaline, which increases heart contractions and hypertension. Stress management is crucial for preventing long-term cardiovascular health problems and hypertension.

CONCLUSIONS

Participants in this study were predominantly aged 30-49 years (mean 45). Women (75% in the treatment group, 87.5% in the control group) and those without a family history of hypertension (62.5%) predominated. The treatment group had a higher prevalence of normal nutritional status and obesity II, while obesity I (mean BMI 25.5 kg/m²) was the most common nutritional condition. Most participants (81.3% in the treatment group, 87.5% in the control group) were nonsmokers taking amlodipine besylate and captopril. Most individuals engaged in moderate exercise (81.3% in the treatment group, 93.8% in the control group).

The treatment group consumed more sodium than the control group. Both groups consumed higher amounts of potassium and fiber. Statistical testing showed no significant difference in average salt intake ($p>0.05$), but substantial changes in potassium and fiber intake ($p<0.05$) in the treatment group. At the same time, there were no significant changes in the control group ($p>0.05$).

Systolic blood pressure was 162.69 mmHg in the treatment group and 165.63 mmHg in the control group before the intervention. The average diastolic blood pressure in the treatment group was 91.25 mmHg, while the average diastolic blood pressure in the control group was 80.50. An independent t-test showed no significant difference between the groups. Systolic blood pressure decreased to 144.56 mmHg in the treatment group and 166.38 mmHg in the control group after the intervention. Diastolic blood pressure changed, but not significantly. In hypertensive patients, the PIKEBI Bar interval increased systolic blood pressure but not diastolic blood pressure.

RECOMMENDATION

The study found that 45 grams of PIKEBI BAR in the afternoon lowered systolic blood pressure, not diastolic blood pressure, over 7 days. Further research and dosage studies are needed to confirm its effectiveness. Furthermore, this study only measured sodium and potassium intake, without measuring blood levels. Therefore, further research should measure blood sodium and potassium levels concerning blood pressure.

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