Jurnal Gizi Prima (Frime Nutrition Journal)
Vol.9, Edisi.1, Maret 2024, pp. 54-60
ISSN: 2656 - 2480 (Online)
ISSN: 2355 - 1364 (Print)
Website : http://jgp.poltekkes-mataram.ac.id/index.php/home

The Effect Of Moringa Leaves And Banana (Morina) Cookies On Blood Pressure In Hypertensive Patients

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Article Info

Article history:
Received Januay 2th, 2024
Revised February 25th, 2024
Accepte March 28th, 2024

Keyword:
Banana flour; Hypertension; Morina Coockies; Moringa leaf;

ABSTRACT

Background: *Hypertension is a disease that often does not cause symptoms until the sufferer's condition worsens. This disease has become one of the main causes of death globally. Various methods continue to be sought to manage blood pressure. Apart from appropriate medication, it is also recommended to adopt a healthy lifestyle by choosing nutritious foods as recommended in the Dietary Approach to Stop Hypertension.*

Objective: *Evaluating the effect of Morina cookies on the blood pressure of individuals with hypertension.*

Research Methods: *This research uses the Randomized Controlled Trial method with a Pretest-Posttest design including a control group. The number of subjects was calculated using the Lemeshow formula, resulting in 28 subjects.*

Research Result: *In subjects aged 45-80 years, with 82% being female, both systolic and diastolic blood pressure decreased after the intervention ($p<0.05$).*

Conclusion: *There was a significant reduction in systolic and diastolic blood pressure after administering Morina cookies for 7 days in hypertensive patients.*

BACKGROUND

Hypertension, often referred to as the "silent killer," is a degenerative disease and the leading global cause of mortality, with the potential to lead to serious conditions such as heart disease, kidney failure, diabetes mellitus, and stroke if not detected and managed early (Ministry of Health of the Republic of Indonesia, 2019). The World Health Organization (WHO) reports a staggering 972 million cases of hypertension globally.In Indonesia, hypertension ranks as the second most prevalent disease, with a notable increase in its prevalence from 25.8% in 2013 to 34.1% in 2018 according to the Basic Health Research conducted in 2018. The vascular endothelium plays a vital role in regulating blood pressure through the release of various mediators, including endothelium-derived relaxing factors and endothelium-derived constriction factors. Endothelium-derived nitric oxide (NO), primarily synthesized by endothelial NO synthase, is identified as the most crucial endothelium-derived relaxing factors. Reduced NO bioavailability significantly contributes to endothelial dysfunction associated with hypertension. Notably, plants are recognized as a natural source of eNOS, showing promise in inducing vasorelaxation within blood vessels (Aekthammarata, 2020; S. Yang et al., 2020).

Non-pharmacological treatments that have been proven to reduce blood pressure, such as the Dietary Approaches to Stop Hypertension (DASH diet), can be used to manage and prevent hypertension. The DASH diet emphasizes foods high in potassium and fibre, which are believed to help control blood pressure (Persagi, 2019). Fruits and vegetables rich in potassium and fibre, such as Ambon bananas and Moringa leaves, can work similarly to antihypertensive drugs. Research studies have shown that Moringa leaves possess medicinal properties, including pain relief, antioxidant, antihypertensive, anticarcinogenic,

anti-diabetic, hepatoprotective, and antimicrobial activities (Borgonovo et al., 2020; Sun et al., 2020; IL Jung et al., 2015).

Galuh et al. (2018) found that consuming Ambon banana smoothies led to a significant decrease in blood pressure (p-value = 0.001, p < 0.05). Similarly, Yanti and Nofia (2019) reported a notable reduction in blood pressure among hypertensive individuals after consuming boiled Moringa leaves for seven consecutive days. The average decrease in systolic blood pressure was 23.94 mmHg (p-value = 0.000), and the reduction in diastolic blood pressure was 8.13 mmHg (p-value = 0.000). The researchers aimed to investigate the effects of administering Morina cookies, made from Moringa leaf flour and Ambon banana flour, on the blood pressure of hypertensive patients in Mataram City

RESEARCH METHODS

The methodology employed was an experimental Randomized Controlled Trial (RCT) with a Pretest-Posttest design including a control group. The sample size was determined using the Lemeshow formula n=2. $\left[\frac{(Z\alpha + Z\beta).\ Sd}{d}\right]^2$ The participants were allocated to treatment and control groups using a simple random sampling technique, specifically by drawing lots. There were 28 participants in total, with 14 in each group. Data analysis was performed using the Wilcoxon and Mann-Whitney tests at a 95% confidence level ($\alpha = 0.05$).

RESULTS

Subject Characteristics

Table 1: Distribution of Subject Characteristics

No	Characteristics	Intervention		Control		P
		n	%	n	%	
1.	Age					0.050
	- 30 – 49 years	0	0	2	14.3	
	- 50 – 64 years old	6	42.9	9	64.3	
	- 65 – 80 years	8	57.1	3	21.4	
	Amount	14	100.0	14	100.0	
2.	Gender					0.769
	- Man	3	21.4	2	14.3	
	- Woman	11	78.6	12	85.7	
	Amount	14	100.0	14	100.0	
3.	Nutritional status					0.571
	- BB Less	0	0	0	0	
	- BB Normal	11	78.6	8	57.1	
	- With Risk	2	14.3	4	28.6	
	- Obesity I	0	7.1	2	14.3	
	- Obesity II	1	0	0	0	
	Amount	14	100.0	14	100.0	
4.	Family/Genetic History of Hypertension					0.541
	- There is	10	71.4	12	85.7	
	- There isn't any	4	28.6	2	14.3	
	Amount	14	100.0	14	100.0	
6.	Consumption of Antihypertensive Medicines					1,000
	- There is	14	100.0	14	100.0	
	- There isn't any	0	0	0	0	
	Amount	14	100.0	14	100.0	

In Table 1, the characteristics of the subjects are presented. In the treatment group, most subjects (57.1%) were aged 65-80 years, while in the control group, most subjects (64.3%) were aged 50-64 years. The majority of subjects in both groups were female, comprising 78.6% in the treatment group and 85.7% in the control group. The majority of subjects in both groups had normal nutritional status, with 78.6% in the treatment group and 57.1% in the control group.

In both groups, most subjects had a family history of hypertension and were regularly taking antihypertensive medication, specifically one tablet of amlodipine per day. The Mann-Whitney test revealed no significant differences in age, gender, nutritional status, family history of hypertension, smoking habits, alcohol consumption, and antihypertensive drug usage between the treatment and control groups.

Nutrient Intake

Nutrient intake data, including potassium, sodium, and fibre, was collected using the 1x24-hour food recall method for 2 non-consecutive days before and during the study. The nutrient intake data can be found in Tables 2 and 3.

Table. 2. Distribution of Subjects based on Potassium, Sodium and Fiber Consumption Levels Before Intervention

No	Characteristics	Intervention		Control		p
		n	%	n	%	
1.	Potassium					
	Heavy Deficit	14	100.0	14	100.0	0.769
	Amount	14	100.0	14	100.0	
2.	Sodium					
	Good	5	35.7	8	57.1	0.114
	More	9	64.3	6	42.9	
	Amount	14	100.0	14	100.0	
3.	Fibre					
	Mild Deficit	0	0.0	2	14.3	
	Moderate Deficit	2	14.3	1	7.1	0.982
	Heavy Deficit	12	85.7	11	78.6	
	Amount	14	100.0	14	100.0	

The data from Table 2 clearly shows that both the treatment and control groups had inadequate potassium and fibre intake. Specifically, the treatment group had a higher proportion of subjects with high sodium intake (64.3%) compared to the control group (42.9%). However, statistical analysis indicates that there was no significant difference in nutrient intake between the two groups ($p>0.05$). The average potassium intake in the treatment group was 1386.8 mg (27%), and 1307.9 mg (28%) in the control group. In terms of sodium consumption, the treatment group averaged 2326 mg, while the control group averaged 1961.8 mg. Both groups had an average fibre intake of 19 grams

Table 3. Mean intake of sodium, potassium and fibre before and during intervention

Nutrient intake	Treatment Group (n=14)		Control Group (n=14)		p
	Average	± SD	Average	± SD	
Sodium Intake					
Before	2326.0	101.0	1961.8	85.1	0.052
During	1669.7	73.0	2299.0	100.3	0,000
Potassium Intake					
Before	1386.8	29.0	1307.9	28.0	0.582
During	2445.3	52.0	1158.4	25.2	0,000
Fiber Intake					
Before	18.7	62.0	18.9	63.0	0.870
During	24.7	82.0	16.3	54.0	0,000

Table 3 shows notable variations in intake between the treatment group and the control group for the three studied micronutrients.

Blood pressure

The study measured the subjects' blood pressure twice: once before the intervention and once after. The results are displayed in Table 4.

Table 4 . Distribution of Blood Pressure Before study

Hypertension Category	Treatment Group		Control Group	
	n	%	n	%
Grade I	9	64.3	5	35.7
Grade II	4	26.6	8	57.1
Grade III	1	7.1	1	7.1
Amount	14	100.0	14	100.0

Before the intervention, Table 4 shows that in the intervention group, the majority of subjects (64.3%) had grade I hypertension, followed by 26.6% with grade II hypertension, and 7.1% with grade III hypertension. In the control group, 35.7% had grade I hypertension, 57.1% had grade II hypertension, and 7.1% had grade III hypertension. The average blood pressure before the intervention was categorized as grade I hypertension, with readings of 156.4/101.4 mmHg in the intervention group and 158.6/101.4 mmHg in the control group.

Table 5. Distribution of subjects based on Blood Pressure After Study

Blood Pressure Category	Treatment group		Control Group	
	n	%	n	%
Normal	1	7.1	0	0.0
Pre Hypertension	3	21.4	1	7.1
Grade I Hypertension	10	71.4	9	64.3
Grade II Hypertension	0	0.0	4	28.6
Amount	14	100.0	14	100.0

After the study, it was noted that the average blood pressure of the participants in the treatment group was in the pre-hypertension category at 139.3/92.8 mmHg. In contrast, the average blood pressure of the control group was in the grade I hypertension range, with an average value of 150/99.3 mmHg.

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Table 6: Analysis of the impact of providing Morina cookies on the blood pressure

No	Information	Systolic		Diastolic	
		Intervention	Control	Intervention	Control
1.	Δ Blood Pressure	17.8	11.2	18.6	10.4
2.	Std. Deviation	9.9	7.7	5.3	4.2
3.	Sig.	0.035		0.007	

* Information: Δ: Average Change in Blood Pressure, Sig . : Mann-Whitney Test Value at $\alpha = 0.05$.

Table 6 presents the average change in blood pressure, showing that the treatment group experienced a significant difference compared to the control group.

DISCUSSION

In both groups, the majority of subjects were aged 50-80 years, which is consistent with previous research on hypertension prevalence in older individuals. Female subjects were predominant in the study, aligning with previous findings on the relationship between gender and hypertension. Most subjects had a normal nutritional status, and there was no apparent correlation with blood pressure. The majority of subjects had a family history of hypertension, which is in line with existing research on the hereditary nature of hypertension. All subjects in both groups were regularly taking amlodipine, an anti-hypertension medication that reduces blood pressure.

The study's results show a majority of female subjects, consistent with previous research indicating a significant relationship between gender and blood pressure, with female subjects having a 2.7 times greater chance of developing hypertension compared to men (Azhari, 2017).

Regarding nutritional status, 3 subjects were classified as obese (10.7%), and 6 were at risk (21.4%). This is supported by research results (Farahdini, 2020) indicating no significant relationship between nutritional status and blood pressure, with a p-value of 0.884.

In terms of family disease history, the majority of subjects had a family history of hypertension, with 10 people (71.4%) in the treatment group and 12 people (85.7%) in the control group. This aligns with research conducted by Nainar et al. (2019) indicating a significant relationship between heredity/genetics and hypertension.

Nutrient Intake

Micronutrient intake associated with hypertension includes sodium, potassium, magnesium, and calcium. Additionally, fibre also plays a crucial role in this context. According to the data presented in Table 3, the study gathered information on potassium, sodium, and fibre intake. Potassium is crucial for maintaining fluid, electrolyte, and acid-base balance, thereby impacting blood pressure regulation (Susanti, 2017). A high potassium intake leads to increased concentration in intracellular fluid, causing it to attract fluid from the extracellular part and lower blood pressure (Astawan, 2002; Wildan, 2016).

The study's results align with previous research by Regina et al. (2016), illustrating the impact of potassium intake on blood pressure levels. Based on statistical tests using the Mann-Whitney test, there was no difference in potassium intake before the study ($p = 0.769$). However, during the study, a significant difference was observed between the treatment and control groups ($p = 0.00$). The consumption of the Morina product provided to the treatment group led to an increase in potassium intake by 695 mg per serving. Analysis of the average sodium intake before the study revealed that the treatment group's intake exceeded the recommended amount. Excessive sodium consumption results in fluid retention, leading to increased blood volume.

Moreover, excessive sodium intake can narrow the arteries, causing the heart to work harder to push blood volume through restricted spaces, ultimately resulting in increased blood pressure. Previous research by Febriana et al. (2017) found a higher prevalence of high blood pressure (58.3%) among subjects who frequently consumed high-sodium foods compared to those who rarely consumed such foods.

The study revealed a decrease in sodium intake among the subjects in the treatment group due to the intervention. Consuming Morina cookies with low sodium and high fibre content made the subjects feel full for longer periods, reducing their inclination to consume other high-sodium snacks. This resulted in a significant decrease in overall sodium intake compared to the control group ($p= 0.000$).

In terms of fibre intake, the treatment group showed good mean intake, while the control group displayed poor intake. Each serving of Morina cookies consumed by the subjects increased their fibre intake by 2.4 grams. Furthermore, the increased consumption of vegetables and fruits by the treatment group brought their total fibre intake close to the recommended daily amount of 25-30 grams, equivalent to consuming 4-5 portions of vegetables and fruits each day. It's worth noting that consuming dietary fibre can enhance the binding of bile acids, leading to reduced absorption of fat and blood cholesterol, which can help lower blood pressure (Yuriah, et al., 2019).

The Effect of Giving Morina Cookies on Blood Pressure in Hypertensive Patients

Morina Cookie is a dry snack that combines Moringa oleifera leaf flour with Ambon banana flour (Musa paradisiaca). It is given every day for 7 consecutive days, 6 pieces a day, with a fairly high potassium content of 695 mg and 2.4 grams of fibre. Before the study, the mean blood pressure in the treatment group was 156.4/101.4 mmHg, while in the control group it was 158.6/101.4 mmHg. At the end of the study, it decreased to 139.3/92.8 mmHg and 150/99.3 mmHg in the control group. The reduction in systolic and diastolic blood pressure in the treatment group was greater than in the control group, namely 17.8 ± 9.9 mmHg (treatment) and 11.2 ± 7.7 mmHg in the control group ($p = 0.035$). Diastolic blood pressure in the treatment group decreased by 18.6 ± 5.3 mmHg, while the control group decreased by 10.4 ± 4.2 mmHg ($p = 0.007$). This study aligns with Affan's (2018) research, which demonstrated the positive effects of using Moringa extract to lower systolic and diastolic blood pressure in hypercholesterolemia patients in Semarang City.

Moringa leaves are rich in active compounds that can help decrease vascular dysfunction and oxidative stress while boosting vasorelaxation in the endothelium, leading to a reduction in blood pressure (Aekthammarat et al., 2019). Previous studies by Toripah et al. (2014) revealed that Moringa leaves contain a total phenol content of 126/52 mg/kg gallic acid equivalents and exhibit strong antioxidant activity (with IC50 values of 117.19 ppm for the ethyl acetate fraction, 189.09 ppm for the chloroform-methanol fraction, and 286.75 ppm for the chloroform fraction). Furthermore, it was found that products containing Moringa and Ambon banana can contribute to further blood pressure reduction.

In a study by Galuh et al. (2018), it was demonstrated that consuming Ambon banana smoothies had a significant impact on reducing systolic blood pressure by 15.29 mmHg and diastolic blood pressure by 7.14 mmHg ($p = 0.028$). The study involved the daily consumption of 400 ml of Ambon banana smoothies made from 350 grams of Ambon banana and 100 ml of low-fat liquid milk for 7 consecutive days. Bananas are known to contain antioxidants and anti-inflammatories, which may contribute to their potential in reducing blood pressure (Pusparani et al., 2020).

Similarly, Yanti and Nofia (2019) conducted a study that aligns with these findings. They observed a significant reduction in blood pressure among individuals with hypertension after receiving 250 ml of Moringa leaf decoction from 50 grams of Moringa leaves for 7 consecutive days. The average decrease in systolic blood pressure was 23.94 mmHg with a standard deviation of 8.501 (p-value = 0.000), and the decrease in diastolic blood pressure was 8.13 mmHg with a standard deviation of 4.933 (p-value = 0.000).

Potassium helps lower blood pressure in several ways. Firstly, it causes vasodilation, which reduces peripheral resistance and increases cardiac output. Secondly, it acts as a diuretic, increasing the excretion of sodium and fluid. Thirdly, it can affect renin-angiotensin activity, reducing vasoconstriction and aldosterone levels. Additionally, potassium regulates nerve function, influencing blood pressure (Tulungnen, et al., 2016).

In addition to potassium, fibre also plays a role in lowering blood pressure by increasing bile acids and reducing the absorption of fat and cholesterol (Yuriah, et al., 2019).

CONCLUSIONS

Morina Cookies have been found to reduce systolic and diastolic blood pressure in hypertensive patients. This suggests that they could be considered as a beneficial snack for people with hypertension, in addition to regular medication.

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