Food Consumption Patterns and Hypertension in Communities in the Martapura River Basin, Indonesia

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Abstract: Hypertension is a major risk factor for cardiovascular disease and remains a public health problem in Indonesia, including South Kalimantan. Diet plays a significant role in the development of hypertension, particularly in communities living in river basins characterized by high sodium and low fiber consumption. This study aims to analyze the relationship between dietary patterns and the incidence of hypertension in communities along the Martapura River Basin, South Kalimantan. The study, conducted in 2025, used a cross-sectional design with 260 purposively selected respondents. Data were collected through interviews using a structured questionnaire and blood pressure measurements. The Spearman test showed a significant association between the consumption of fatty foods (Rho=0.323; p=0.000), salty foods (Rho=0.341; p=0.000), fruit (Rho=0.575; p=0.000), and vegetables (Rho=0.477; p=0.000) and the incidence of hypertension. High sodium consumption and low fruit and vegetable consumption are determinants contributing to the high prevalence of hypertension in the Martapura River Basin community. This study emphasizes the need for contextual public health interventions through nutrition education and increased access to healthy foods to reduce the burden of hypertension in the region.
Keywords: Consumption patterns; hypertension; Martapura watershed; salty foods; vegetables.

INTRODUCTION

Hypertension, defined as systolic blood pressure ≥140 mmHg and/or diastolic blood pressure ≥90 mmHg, is a significant global health challenge. This diagnosis, which is based on repeated measurements and serves as a general guideline considering variations in individual risk profiles, has been recognized as a major cause of morbidity and mortality worldwide[1]. The burden of this disease is unevenly distributed; the World Health Organization (WHO) estimates that more than three-quarters of adults aged 30–79 years with hypertension live in low- and middle-income countries (LMICs), reflecting profound disparities in health care access, awareness, and disease control[2].

The situation in Indonesia presents a worrying picture. The 2018 Basic Health Research data show that while the prevalence of hypertension based on doctor diagnosis in the population aged ≥15 years was 8.4%, the prevalence based on actual measurements in adults (≥18 years) reached 34.1%. This indicates that most sufferers are unaware of their condition, making hypertension a hidden health threat. In South Kalimantan Province, the prevalence based on measurements was 33.4%, a figure

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slightly lower than the national average but still reflecting a serious public health problem[3].

As a major risk factor for cardiovascular disease, hypertension contributes significantly to the global burden of disease. Scientific evidence shows that a 10 mmHg reduction in systolic blood pressure can reduce the risk of stroke by 27%, heart failure by 28%, and cardiovascular events by 20%[4]. In this context, diet plays an important role in the development and progression of hypertension[5-7]. A comprehensive dietary approach, which assesses food consumption holistically rather than individual components, has been shown to be more effective in reflecting the combined impact of nutrients and is widely used as an alternative method for evaluating the relationship between diet and hypertension[8,9].

Dietary patterns vary across regions and cultures. This variation is reflected in the high-protein and spice diet in Inner Mongolia, Northern China[10]; the consumption of tubers, meat, fruits, and vegetables in Diqing, Yunnan Province[11]; and the typical Yangtze River Delta diet with high consumption of seasonal fruits and vegetables, fish, freshwater shrimp, and vegetable oils[12]. In South Kalimantan, community consumption patterns also have unique characteristics, demonstrated by a variety of traditional cakes made from flour, coconut milk, eggs, and sugar[13]. This consumption of coconut milk and sugar aligns with the 2013 Basic Health Research data, which showed a prevalence of sweet food consumption of 65.7%, higher than the national average. Furthermore, consumption of salty foods was recorded at 16.6%, while consumption of fatty and fried foods more than once a day reached 35.8%[14]. A high consumption pattern of sugar, salt, and saturated fat, including coconut milk, is a major risk factor for hypertension and cardiovascular disease.

Dietary characteristics that require special attention are evident in riverbank communities. Literature shows that riverbank communities tend to consume fatty foods derived from coconut milk and salty foods, such as salted fish and mandai (cempedak skin preserved in salt)[15]. This pattern is closely related to geographic conditions and food availability. Communities utilize river resources by preserving fish into salted fish as a side dish throughout the year, especially when fresh fish is scarce. Conversely, fruit and vegetable consumption is relatively low.

This combination of consumption patterns has the potential to increase the burden of hypertension through several mechanisms. Excessive sodium intake from salted fish and mandai can directly increase blood pressure[16]. Low fruit and vegetable consumption reduces potassium intake, which helps lower blood pressure, so an imbalance in the sodium-potassium ratio increases the risk of hypertension[17]. Furthermore, the habit of consuming saturated fat from coconut milk contributes to obesity and insulin resistance, which are indirect risk factors for hypertension.

Observations along the Martapura River, South Kalimantan, reinforce these findings. Communities tend to choose cheap, salty, and preserved foods. However, to date, comprehensive research examining specific consumption patterns and their relationship to hypertension in tropical riverbank populations such as the Martapura River is still limited. Therefore, this study aims to analyze the relationship between food consumption patterns and hypertension in communities along the Martapura River and examine the role of sociodemographic characteristics in shaping these health outcomes.

MATERIALS AND METHODS

This study used a quantitative analytical approach with a cross-sectional design. The study was conducted in 2025 among communities living along the Martapura River in South Kalimantan, Indonesia. A total of 260 respondents aged 18 years and older, who had lived in the area for at least two years, were recruited using purposive sampling.

Data were collected through face-to-face interviews using a structured questionnaire and direct blood pressure measurements. Blood pressure was measured using a calibrated digital sphygmomanometer, following standard procedures (respondents sat, rested for 5 minutes, and repeated measurements were taken twice). Independent variables: dietary patterns, including sodium intake (frequency of salty and processed food consumption) and vegetable intake (frequency of daily servings). Sociodemographic variables included education, occupation, and income. Dependent variable: hypertension, categorized according to the 2017 American College of Cardiology/American Heart Association (ACC/AHA) classification[12]. A descriptive analysis was conducted to describe the sociodemographic characteristics and dietary patterns of respondents. Bivariate analysis was performed using Spearman's rank correlation test to assess the relationship between ordinal variables and hypertension, while the Chi-square test with contingency coefficient (CC) was used for nominal variables. A significance level of $p < 0.05$ was applied. Data analysis was performed using SPSS version 26.

Ethical Considerations : The study protocol was reviewed and approved by the Research Ethics Committee of the Health Polytechnic of the Ministry of Health, Banjarmasin (Approval No: 166/KEPK-PKB/2025). Written informed consent was obtained from all participants prior to data collection.

RESULTS AND DISCUSSION

Table 1 shows that based on age, the largest number of respondents were young adults (104 people) (40.0%), followed by middle-aged adults (88 people) (34.0%), and elderly people (68 people) (26.0%). The correlation test showed a significant relationship between age and hypertension (Rho=0.293; p=0.000). Based on gender, there were 120 male respondents (46.0%) and 140 female respondents (54.0%). There is no significant relationship with hypertension (CC=0,011; p=0,858).

Based on education, the majority of respondents had an elementary school education (192 people (73.85%), followed by junior high school (32 people (12.31%), high school (16 people (6.15%), university (16 people (6.15%), and no education (4 people (1.54%). Education was significantly associated with hypertension (Rho=0.370; p=0.000).

Based on occupation, the most respondents were farmers/fishermen owners with 112 people (43.08%), followed by farm laborers/fishermen workers with 52 people (20.0%), unemployed/housewives with 48 people (18.47%), private sector as staff with 16 people (6.15%), motorcycle taxi drivers and others with 16 people (6.15%), civil servants as staff with 8 people (3.07%), and traders/business owners with 4 people each (1.54%). Occupation was significantly related to hypertension (Rho=0.148; p=0.017).

Based on income, the majority of respondents (204 people) had an income of <1 million, followed by 40 people (15.39%) with an income of 1–3.5 million, and 16 people (6.15%) with an income of >3.5 million. There was a significant relationship between income and hypertension (Rho=0.333; p=0.000).

Table 1. Sociodemographic Characteristics of Respondents

Characteristics	Frequency	Prosen	Correlation test
Age			
Young Adults	104	40.00	Rho = 0.293
Middle Adulthood	88	34.00	P value = 0.000
Elderly	68	26.00	
Gender			
Man	120	46.00	CC = 0.011
Woman	140	54.00	P value = 0.858
Education			
No school	4	1.54	Rho = 0.370
Elementary school	192	73.85	P value = 0.000
Junior high school	32	12.31	
High school	16	6.15	
College	16	6.15	
Work			
Civil servants	8	3.07	Rho = 0.148
Private sector	16	6.15	P value = 0.017
Traders	4	1.54	
Entrepreneurs	4	1.54	
Farmers/Fishermen	112	43.08	
Laborers	52	20.00	
Motorcycle taxi drivers	16	6.15	
Housewives	48	18.47	
Income			
< 1 million	204	78.46	Rho = 0.333
1 – 3.5 million	40	15.39	P value = 0.000
> 3.5 million	16	6.15	
Number of Samples	260	100.00	

Based on Table 2, the respondents' consumption pattern of fatty foods shows that most respondents consumed fatty foods once a week (100 people) (38.5%), while only 36 people (13.8%) never consumed them. In terms of salty food consumption, the majority of respondents consumed more than three times a week (132 people) (50.8%), while the least consumed twice a week (8 people) (3.1%). Fruit consumption was highest in the 2-3 times a week category, with 72 people (27.7%) each, while no respondents consumed fruit more than three times a week. In terms of vegetable consumption, most respondents never consumed vegetables (96 people) (36.9%), followed by consumption once a week (80 people) (30.8%), and only a few respondents consumed more than three times a week (8 people) (3.1%).

Table 3 shows that the majority of respondents were in the high-normal blood pressure category, amounting to 100 people (38.5%). Respondents with normal blood pressure were recorded at 60 people (23.1%). Meanwhile, respondents with grade I hypertension numbered 52 people (20.0%) and grade II hypertension numbered 48 people (18.5%). This indicates that the proportion of respondents with hypertension (grades I and II) reached 38.5%, which is equivalent to the proportion of respondents with

high-normal blood pressure.

Table 2. Distribution of Respondents Based on Consumption Patterns

Category Consumption	Food Fatty n(%)	Salty Foods n(%)	Fruit n(%)	Vegetables n(%)
No consumption	36 (13.8)	20 (7.7)	64 (24.6)	96 (36.9)
1x a week	100 (38.5)	52 (20.0)	52 (20.0)	80 (30.8)
2x a week	52 (20.0)	8 (3.1)	72 (27.7)	44 (16.9)
3x a week	44 (16.9)	48 (18.5)	72 (27.7)	32 (12.3)
>3x a week	28 (10.8)	132 (50.8)	0 (0.0)	8 (3.1)

Table 3. Distribution of Respondents Based on Hypertension Incidence

Hypertension Category	Frequency	Percentage (%)
Normal	60	23.1
Normal high	100	38.5
Grade I Hypertension	52	20.0
Grade II Hypertension	48	18.5

Based on Table 4, fatty food consumption patterns have a significant relationship with the incidence of hypertension (Rho = 0.323; p = 0.000). Respondents who consume fatty foods ≥3 times per week tend to experience stage II hypertension as many as 20 people. Consumption of salty foods is also significantly associated with hypertension (Rho = 0.341; p = 0.000), with the majority of respondents who consume salty foods more than 3 times per week suffering from stage I hypertension (52 people) and stage II (52 people).

Fruit consumption patterns showed a strong correlation with the incidence of hypertension (Rho = 0.575; p = 0.000). Respondents who consumed fruit three times per week mostly experienced stage I hypertension (32 people) and stage II hypertension (36 people). Vegetable consumption was also significantly associated with hypertension (Rho = 0.477; p = 0.000). Respondents who did not consume vegetables were predominantly in the stage I (16 people) and stage II (16 people) hypertension groups. Overall, the four food consumption patterns (fatty, salty, fruit, and vegetables) were significantly associated with the incidence of hypertension, with the highest correlation strength in fruit consumption (Rho = 0.575).

The results of this study revealed a significant association between dietary patterns and the incidence of hypertension in communities along the Martapura River Basin (DAS), South Kalimantan. These findings reinforce previous evidence of the important role of dietary patterns in the pathophysiology of hypertension[5,6].

The results showed a significant positive correlation between salty food consumption and hypertension (rho=0.341; p=0.000) (Table 4). The majority of respondents (50,8%) reported consuming salty foods ≥3 times per week (Table 2). This high consumption of salty foods cannot be separated from the local socioeconomic context and food security. Sociodemographic data in this study indicate that 78.46% of respondents have low incomes (<Rp 1,000,000 per month)(Table 1). In this context, riverbank communities rationally rely on food that is cheap, easy to store, and long-lasting. Salted fish and instant noodles fulfill these criteria, making them inevitable staple

side dishes. The culture of preserving food with salt (such as salted fish and mandai) is an adaptive strategy to secure food supplies throughout the year, especially when river catches are uncertain, although it implies high sodium intake. The affordability and high shelf-life of these types of foods make them a logical choice for low-income households, ultimately shaping a high-salt consumption pattern. This finding is in line with a meta-analysis by Ettehad et al. (2016), which concluded that blood pressure-lowering interventions—including dietary modification—provide significant benefits in the prevention of cardiovascular disease[4].

Table 4. Relationship between Food Consumption Patterns and Hypertension Incidence

Consumption Patterns	Hypertension Incident				Total	Spearman test
	Normal	Normal High	Grade I Hypertension	Grade II Hypertension		
Food Consumption Fatty						
- No consumption	8	16	0	12	36	Rho =
- 1 x a week	8	40	40	12	100	0.323
- 2 x a week	12	12	16	12	52	p value =
- 3 x a week	0	4	16	24	44	0.000
- >3 x a week	4	4	0	20	28	
Consumption of Salty Foods	8	8	0	4	20	Rho =
- No consumption	4	32	4	12	52	0.341
- 1 x a week	0	0	8	0	8	p value =
- 2 x a week	8	20	8	12	48	0.000
- 3 x a week	12	16	52	52	132	
- >3 x a week						
Fruit Consumption						
- No consumption	24	32	0	8	64	Rho =
- 1 x a week	4	24	20	4	52	0.575
- 2 x a week	4	12	16	24	58	p value =
- 3 x a week	0	4	32	36	72	0.000
- >3 x a week	0	4	4	8	16	
Vegetable Consumption						
- No consumption	16	48	16	16	96	Rho =
- 1 x a week	16	24	24	16	80	0.477
- 2 x a week	0	0	20	24	44	p value =
- 3 x a week	0	4	12	16	32	0.000
- >3 x a week	0	0	0	8	8	

* indicates p < 0.05, statistically significant (Spearman test). Rho indicates the strength and direction of the relationship between consumption patterns and hypertension.

An interesting and seemingly paradoxical finding in this study is the positive correlation between fruit consumption and hypertension (Rho = 0.575; p = 0.000) (Table 4), where respondents with hypertension actually reported a higher frequency of fruit consumption. This finding contradicts general epidemiological evidence that suggests

that whole fruit consumption is protective. Therefore, this result needs to be criticized and interpreted with caution. Several possible explanations are: (1) the existence of reverse causality, where respondents who have been diagnosed with hypertension actually start to increase fruit consumption as an effort to manage their health; (2) the type, quantity, and method of fruit consumption may be key factors. The type of fruit consumed may be high in sugar (such as durian, longan, or sapodilla, which are widely available in Kalimantan) and consumed in excessive portions or in sweet processed forms (as a mix in kolak, ice fruit, or preserved with sugar). It is important to note that processed fruit with added sugar and low in fiber does not have the same cardiovascular benefits as whole fruit. Therefore, a high frequency of fruit consumption does not necessarily reflect a healthy diet if the type and method of consumption are not appropriate. This context explains why our findings differ from other evidence confirming the benefits of fruit. These findings are consistent with Wang et al.'s (2022) study in China, which found that a "fruit-dairy" pattern rich in whole fruit and dairy products was associated with a significantly reduced risk of hypertension (OR = 0.55; 95% CI: 0.40, 0.75)[18].

This difference underscores that comprehensive dietary approaches such as these, which have been shown to better reflect the combined effects of nutrients than single-nutrient approaches[9], are highly dependent on the quality and form of intake. As shown in the Dietary Approaches to Stop Hypertension (DASH), dietary patterns rich in fruits and vegetables in appropriate forms are effective in lowering blood pressure[19], a pattern that may not be fully reflected in the intake of the population in this study area.

The analysis shows that sociodemographic factors play a significant role in influencing consumption patterns and the risk of hypertension. Respondents with low education (73.85% had only elementary or junior high school education) and low income (78.46% earned <1 million rupiah/month) (Table 1) tended to have unhealthy consumption patterns. This is consistent with research by Bundy & He (2016), which reported that the burden of hypertension is unevenly distributed and is strongly influenced by socioeconomic determinants[20]. Low levels of education are associated with limited nutritional knowledge, while low income limits access to healthy foods such as fresh fruits and vegetables, leading to a preference for cheap, salty, and preserved foods that are high in sodium and saturated fat[21].

The consumption patterns of the Martapura River Basin community have unique characteristics and differ from dietary patterns identified in various regions of China. In contrast to the protective "fruit-dairy" pattern in Eastern China (18) or the "Southern River-style" pattern in the Yangtze River Delta, which is rich in vegetables and freshwater fish[12], the people of the Martapura River Basin show a high dependence on salty processed foods and low fiber consumption. These differences underscore the importance of a contextual approach in nutrition interventions that consider local characteristics, food availability, and cultural preferences.

This study has several limitations. The cross-sectional design does not allow for causal inferences. Measuring consumption frequency using a questionnaire is also prone to recall bias. However, these findings have important implications for public health policy. Community-based interventions focused on practical and affordable nutrition education and programs that increase access to healthy foods are urgently needed in the Martapura watershed. Approaches that emphasize overall dietary pattern modification, as

recommended in Wang et al.'s (2022) study, may be more effective than simply salt reduction campaigns[18].

CONCLUSION

Overall, this study confirms that a high-sodium, low-fiber, and low-fruit consumption pattern is a significant determinant of hypertension incidence in the Martapura watershed. This vulnerability is exacerbated by sociodemographic factors such as low education and income. Comprehensive and contextualized public health interventions are needed to address the burden of hypertension in this area. These findings highlight the importance of culturally tailored interventions to promote healthier dietary habits among riverine populations in Indonesia.

ACKNOWLEDGEMENT

The author would like to thank those who have helped carry out this research.

CONFLICT OF INTEREST

In this study there is no conflict of interest.

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