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RELATIONSHIP BETWEEN NUTRITIONAL STATUS, SODIUM, POTASSIUM AND FIBER WITH THE INCIDENCE OF HYPERTENSION AT THE CIMAUNG HEALTH CENTER, BANDUNG REGENCY

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Abstract
Hypertension is a prevalent condition characterized by blood pressure exceeding 140/90 mmHg, often resulting from the heart's increased effort to supply oxygen and essential nutrients. This study aims to determine the relationship between nutritional status, sodium, potassium, and fiber intake with the incidence of hypertension at the Cimaung Public Health Center, Bandung Regency. The research design used was case control. The sample consisted of 132 respondents consisting of 66 cases and 66 controls obtained by accidental sampling. Data collection on characteristics such as age, gender, level of education was obtained through interviews. Data on sodium, potassium, and fiber intake were obtained through interviews using the Semi-Quantitative Food Frequency Questionnaire (SQ-FFQ). Nutritional status data were gathered through direct measurements of body weight and height. Data analysis was carried out using the Chi-Square test. Statistical test results of the relationship between nutritional status and hypertension (p-value = 0,456 (p>0.05)), sodium (p-value = 0,000 (p0.05)). The conclusion of this study is that there is a relationship between sodium and potassium and the incidence of hypertension at the Cimaung Public Health Center, Bandung Regency. There is no relationship between nutritional status, fiber and the incidence of hypertension at the Cimaung Public Health Center, Bandung Regency.

Introduction

According to the World Health Organization (WHO) in 2015, about 1.13 billion people in the world suffer from hypertension. The number of people with hypertension is increasing every year. It is estimated that by 2025, 1.5 billion people will be affected by hypertension. This rise can be attributed to factors such as poor dietary habits, lack of physical activity, and an aging population (1). Hypertension significantly impacts public health, leading to increased risks of heart disease, stroke, and other serious health conditions. Hypertension is a condition that causes continuously high blood pressure (2). It is defined by a systolic blood

pressure of more than 140 mmHg and a diastolic pressure of 90 mmHg or more (3). This occurs because the heart works faster to pump blood. The increased effort is to meet the body's needs for oxygen and nutrients (4). The incidence of hypertension in Indonesia has increased. Based on the results of the 2013 Basic Health Research, the prevalence of hypertension was 25.8%, rising to 34.1% in 2018. A similar trend occurred in West Java Province, where the prevalence increased from 34.5% in 2013 to 39.6% in 2018, according to Basic Health Research findings.

One of the factors that trigger the onset of hypertension is unbalanced nutritional status. An unbalanced diet, rich in sodium, low in potassium and low fiber, can lead to an increase in blood pressure (5,6). Excessive sodium intake can cause the body to retain water, increasing blood volume and, consequently, blood pressure. Insufficient potassium impairs the body's ability to balance sodium levels, further contributing to hypertension. Additionally, a lack of dietary fiber is associated with poor cardiovascular health, which can exacerbate high blood pressure. Changes in lifestyle during adulthood have led to an increase in non-communicable diseases in Indonesia, including hypertension. Unhealthy eating behaviors, smoking habits, alcohol consumption, stress, and lack of physical activity all contribute to the occurrence of hypertension (7). Research by Agus Nurika Nugroho et al. in 2022 found a relationship between nutritional status and the incidence of hypertension in the elderly in Girisekar Village.

A healthy lifestyle that includes limiting salt and alcohol consumption, increasing the intake of vegetables and fruits, achieving and maintaining an ideal body weight (BMI 18.5 - 22.9 kg/m^2), and engaging in regular light to moderate physical activity (at least 30 minutes a day) has been shown to reduce blood pressure (8). Sodium, an essential component of table salt (NaCl), is also found in Monosodium Glutamate, preserved foods (including canned foods), and processed meats (9). In addition to controlling sodium intake, eating foods that are high in potassium content is also beneficial for controlling blood pressure so that blood pressure becomes normal and there is a balance between sodium and potassium in the body (10). High potassium will increase the concentration of intracellular fluid so that it tends to draw fluid from the extracellular part and lower blood pressure. Potassium plays a role in reducing the risk of hypertension (11). According to research by Marianawati, et al in 2020, potassium intake has been shown to significantly reduce blood pressure responsively in patients with diastolic hypertension. Adequate potassium intake can overcome excess sodium, because potassium acts as a diuretic and inhibits renin release so that blood pressure becomes normal.

Based on the Top Ten Disease Data of Cimaung Health Center 4 in 2023, hypertension is a non-communicable disease with the number of sufferers increasing every month, consistently ranking second and third. In the last three months of 2023, the percentage of visits by hypertensive patients was 16.79% in July, 17.69% in August, and 21.77% in

September. This trend indicates a growing public health concern. Researchers are interested in exploring the relationship between nutritional status, sodium, potassium, and fiber intake with the incidence of hypertension at the Cimaung Health Center. The findings of this study are expected to contribute significantly to public knowledge by providing insights into how dietary factors influence hypertension, potentially guiding dietary recommendations and interventions to manage and prevent hypertension in the community.

Materials and Methods

This study is a quantitative research using a case control research design. This study is a type of quantitative research using a case-control research design. The case-control design was chosen because it is effective for identifying and comparing factors, such as nutritional status and dietary intake, between individuals with hypertension (cases) and those without (controls). This design is particularly useful for studying conditions that are relatively common in the population and allows for a more efficient and focused investigation of potential risk factors. A minimum sample size obtained is 66 samples. To maintain a ratio of 1:1 for cases and controls, the study requires 66 cases and 66 controls, ensuring an equal number of participants in each group. The inclusion criteria are as follows: Respondents aged 15 years and over, diagnosed with hypertension by a doctor, new members of the prolanis program, not currently on a diet, not moderate, willing to participate. While the exclusion criteria are as follows: The respondent was diagnosed with hypertension and was on a diet. Sampling in this study used the Accidental sampling method.

The questionnaire used in this study includes a personal data section. This section collects information such as name, age, gender, occupation, education level, weight, height, body mass index (BMI), and health history/disease. Additionally, the study uses the Semiquantitative Food Frequency Questionnaire (SQFFQ) to assess dietary intake. Data collection involves administering the questionnaires to participants during face-to-face interviews conducted by trained research assistants. This approach ensures that the respondents understand the questions and provides accurate answers. To validate the data, the researchers will cross-check the responses with medical records and perform consistency checks on the dietary intake information. This study used a chi-square test with a significance limit of 0.05, carried out using SPSS version 22 software.

Results

This study employs univariate analysis to describe the characteristics of each variable studied. The univariate data include age, gender, education level, body mass index (BMI), sodium, potassium, and fiber intake.

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Table 1. Characteristics of Respondent

Characteristics	Case Group		Control Group	
	n	%	n	%
AGE				
16 – 18 years	1	1.5	1	1.5
19 – 29 years	0	0	2	3
30 – 49 years	8	12.1	28	42.4
50 – 64 years	28	42.4	30	45.5
65 – 80 years	29	43.9	5	7.6
SEX				
Man	9	13.6	20	30.3
Woman	57	86.4	46	69.7
EDUCATION				
Elementary School	48	72.73	36	54.54
Junior High School	13	19.69	15	22.73
High School	3	4.55	13	19.69
College	2	3.03	2	3.03
NUTRITIONAL STATUS				
Normal	55	83.3	47	71.2
Abnormal	11	16.7	19	28.8
Total	**66**	**100**	**66**	**100.0**

The majority of respondents in the case group were in the age range of 65-80 years (43.9%), followed by those in the age range of 50-64 years (42.4%). In contrast, the majority of the control group were in the age range of 50-64 years (45.5%) and 30-49 years (42.4%). Only a few respondents were aged 16-18 years and 19-29 years in both groups. For gender, the majority of respondents in the case group were female (86.4%), while in the control group, the proportion of females was also higher (69.7%) than males. In terms of education, most respondents in the case group had primary school education (72.73%), followed by junior high school (19.69%), senior high school (4.55%), and college (3.03%). A similar pattern was seen in the control group, with the majority of respondents having primary school (54.54%) and junior high school (22.73%) education levels.

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Table 2 Frequency Distribution Based on Intake

Characteristics	Case Group		Control Group	
	n	%	n	%
SODIUM INTAKE				
Enough (≤2000mg/day)	8	12.1	46	69.7
More (≥2000mg/day)	58	87.9	20	30.3
POTASSIUM INTAKE				
Enough (≥4700mg/day)	5	7.6	54	81.8
Less (<4700mg/day)	61	92.4	12	18.2
FIBER INTAKE				
Enough (≥30g/day)	6	9.1	2	3
Less(<30g/day)	60	90.9	64	97
Total	**66**	**100**	**66**	**100.0**

Table 2 presents the frequency distribution of sodium, potassium, and fiber intake in the case and control groups. In the case group, the majority of respondents (87.9%) had sodium intake that exceeded 2000 mg per day, while in the control group, the majority of respondents (69.7%) had adequate sodium intake (≤2000 mg per day). For potassium intake, most respondents in the case group (92.4%) had an intake of less than 4700 mg per day, while most respondents in the control group (81.8%) had an adequate potassium intake (≥4700 mg per day). In terms of fiber intake, the majority of respondents in the case group (90.9%) had fiber intake of less than 30 g per day, while most respondents in the control group (97%) also had insufficient fiber intake. Overall, this table shows that the case group tended to have higher sodium intake and lower potassium and fiber intake compared to the control group.

Table 3 Relationship between Intake and Hypertension Incidence at Cimaung Health Center

Characteristics	Case Group		Control Group		*P Value*	OR 95% CI
	n	%	n	%		
SODIUM INTAKE						
Enough (≤2000mg/day)	8	12.1	46	69.7	0.00	16,68 (6,735-
More (≥2000mg/day)	58	87.9	20	30.3		41,287)
POTASSIUM INTAKE						
Enough (≥4700mg/day)	5	7.6	54	81.8	0.00	54,9 (18,171-
Less (<4700mg/day)	61	92.4	12	18.2		165,868)
FIBER INTAKE						
Enough (≥30g/day)	6	9.1	2	3	0.274	-
Less(<30g/day)	60	90.9	64	97		

Total	**66**	**100**	**66**	**100.0**

Table 3 shows the relationship between sodium, potassium, and fiber intake and the incidence of hypertension in Cimaung Health Center. In the case group, the majority of respondents (87.9%) had sodium intake exceeding 2000 mg per day, compared to only 30.3% in the control group. The significant association between sodium intake and hypertension, indicated by a p-value of 0.00 and an odds ratio (OR) of 16.68 (95% CI: 6.735-41.287), suggests a strong link between high sodium consumption and increased risk of hypertension. This finding underscores the importance of understanding the physiological mechanisms, such as sodium's role in fluid balance and vascular resistance, that contribute to elevated blood pressure and the development of hypertension. Further research into these mechanisms could provide deeper insights into preventive strategies and therapeutic interventions. For potassium intake, most respondents in the case group (92.4%) had an intake of less than 4700 mg per day, while in the control group only 18.2% had a deficient potassium intake. This relationship was also significant with a p value of 0.00 and OR 54.9 (95% CI: 18.171-165.868). In terms of fiber intake, the majority of respondents in both groups had fiber intake less than 30 g per day, 90.9% in the case group and 97% in the control group. However, the association between fiber intake and incidence of hypertension was not significant with a p value of 0.274. Overall, this table shows that sodium and potassium intake had a significant association with the incidence of hypertension, while fiber intake showed no significant association.

DISCUSSION

The case group had a total sodium intake that was 87.9% higher than that of the control group. The samples frequently consumed several sources of sodium, including soy sauce, salted fish, instant noodles, sardines, biscuits, and sausages. Sodium intake is one of the risk factors for hypertension that can be changed. that can be changed. If sodium intake increases, the kidneys will respond by increasing salt excretion with urine. If sodium excretion exceeds the optimal ability, the kidneys will retain water so that the intravascular volume increases. The increase in intravascular volume causes an increase in blood pressure. High sodium intake can lead to increased plasma volume, cardiac output and high blood pressure. High sodium causes the body to retain water at levels exceeding the body's normal threshold so that it can increase blood volume and high blood pressure (12). This study aligns with the research by Ilham et al. (2019), which found a significant relationship between a sodium-rich diet and the incidence of hypertension (13). This finding is supported by previous research by Yulia Fitri et al. (2018), which examined the relationship between sodium intake and hypertension in older adults (14). Their study showed that 82.4% of

respondents with hypertension had higher sodium intake, while 92.3% of non-hypertensive respondents had sufficient sodium intake. Statistical tests using the chi-square test indicated a significant relationship between sodium intake and the incidence of hypertension ($p < 0.05$), with an OR value of 4.02.

Blood volume and blood pressure will drop if too much water leaves the body. When blood pressure drops, it stimulates the kidneys, so that the juxtaglomerulus in the kidneys will secrete renin, which acts as an enzyme. Renin activates a protein in the blood called angiotensinogen into the active form of angiotensin. Renin circulates in the direction and works by catalyzing the breakdown of a small protein, angiotensin II, with the help of angiotensin I. Angiotensin I is converted into angiotensin II with the help of Angiotensin Converting Enzyme (ACE). Angiotensin II acts as a vasoconstrictor. Angiotensin II will stimulate the adrenal cortex and will increase the secretion of hormone aldostreron. Aldosterone acts as a kidney. Increased secretion of aldosterone will increase the reabsorption of sodium and water, the increase will affect the increase in blood volume, cardiac output and peripheral pressure to drain more blood into the blood vessels. This increase will cause blood pressure to increase (15).

Total low potassium intake in the case group was greater than the control group at 92.4%. Some sources of potassium that were often consumed by the sample included soybean tempeh, kidney beans, vegetables such as chayote and mustard greens, as well as sweet oranges and bananas. Consumption of vegetables and fruits in the case group is still in the category of less because not all respondents consume fruits and vegetables every day with the amount consumed not too much so that in the case group there are still many who have low potassium intake not in accordance with the recommended. Chi-square test results showed there was a relationship between potassium intake and the incidence of hypertension (P-value 0.00). The results of the OR calculation showed that respondents whose potassium intake was less (<4700 mg/day) had a risk of 54.9 times to experience hypertension compared to respondents with adequate potassium intake (4700 mg/day) (95% CI 18.171-165.868). This is in accordance with the results of Sangadah's research (2023), that there is a significant relationship between sodium intake, potassium intake, and physical activity with the incidence of hypertension (pvalue = 0.013, OR = 3.26; p-value = 0.035, OR = 2.56; p-value = 0.021, OR = 2.8).

Low potassium intake is one of the risk factors for hypertension that can be changed. Potassium consumption can protect individuals from hypertension, potassium intake will reduce systolic and diastolic blood pressure. The mechanism of potassium in reducing systolic and diastolic blood pressure is by inhibiting the release of renin resulting in increased sodium and water excretion. Potassium intake helps reduce excessive sodium and water retention. This causes a decrease in plasma volume, cardiac output, and peripheral pressure so that blood pressure will drop (16).

Based on the results of the SQ-FFQ survey conducted by the researcher, it shows that respondents with low fiber intake in the control group have sufficient potassium intake with the most consumed potassium sources are from legumes such as tempeh, tofu, kidney beans, and green beans. So that fiber is not the only intake that is a risk factor for hypertension and is not directly related to blood pressure, this is in accordance with the mechanism of fiber to reduce hypertension related to bile acids. Food fiber is able to reduce circulating cholesterol levels in blood plasma, because food fiber can bind bile salts, prevent cholesterol absorption in the intestine, and increase bile acid excretion through feces, so as to increase the conversion of plasma cholesterol into bile acids. Overweight people are at greater risk of hypertension than lean people. Obesity is a risk factor associated with hypertension (17). However, this study has certain limitations. The reliance on self-reported dietary intake data through the SQ-FFQ survey may introduce recall bias or inaccuracies in reporting.

Conclusion

This study found that women were more at risk of hypertension than men. Sodium intake in the case group was higher, and potassium intake was lower than in the control group. This was inversely proportional to fiber intake, where the control group had lower fiber intake than the case group. There was a significant relationship between sodium and potassium intake and the incidence of hypertension. Specifically, higher sodium intake and lower potassium intake were associated with an increased risk of developing hypertension. In contrast, no association was found between nutritional status and fiber intake with the incidence of hypertension. These findings highlight the importance of dietary modifications in the prevention and management of hypertension. Reducing sodium intake and increasing potassium intake could be effective strategies to lower hypertension risk. Public health initiatives should focus on educating the population about the benefits of these dietary changes.

However, this study has certain limitations. The reliance on self-reported dietary intake data through the SQ-FFQ survey may introduce recall bias or inaccuracies in reporting. The cross-sectional design of the study limits the ability to establish causality between dietary factors and hypertension. Moreover, the sample size may not be representative of the broader population, and potential confounding factors such as genetic predisposition and lifestyle variables were not fully accounted for. Future research should address these limitations by employing longitudinal designs, larger and more diverse sample sizes, and comprehensive data collection methods. Additionally, further studies should explore the underlying mechanisms linking sodium and potassium intake with hypertension and investigate other potential dietary and lifestyle factors that may contribute to hypertension risk.

Reference

1. Yannakoulia M, Mamalaki E, Anastasiou CA, Mourtzi N, Lambrinoudaki I, Scarmeas N. Eating habits and behaviors of older people: Where are we now and where should we go? Maturitas. 2018 Aug 1;114:14–21.

2. Tackling G, Borhade MB. Hypertensive Heart Disease. In: StatPearls [Internet]. Treasure Island (FL): StatPearls Publishing; 2024 [cited 2024 Jul 30]. Available from: http://www.ncbi.nlm.nih.gov/books/NBK539800/

3. Tan JL, Thakur K. Systolic Hypertension. In: StatPearls [Internet]. Treasure Island (FL): StatPearls Publishing; 2024 [cited 2024 Jul 30]. Available from: http://www.ncbi.nlm.nih.gov/books/NBK482472/

4. Pittman RN. The Circulatory System and Oxygen Transport. In: Regulation of Tissue Oxygenation [Internet]. Morgan & Claypool Life Sciences; 2011 [cited 2024 Jul 31]. Available from: https://www.ncbi.nlm.nih.gov/books/NBK54112/

5. Lee YS, Rhee MY, Lee SY. Effect of nutrition education in reducing sodium intake and increasing potassium intake in hypertensive adults. Nutr Res Pract. 2020 Oct;14(5):540–52.

6. Wright A, Burstyn PG, Gibney MJ. Dietary fibre and blood pressure. Br Med J. 1979 Dec 15;2(6204):1541–3.

7. Mills KT, Stefanescu A, He J. The global epidemiology of hypertension. Nature reviews Nephrology. 2020 Apr;16(4):223.

8. Börjesson M, Onerup A, Lundqvist S, Dahlöf B. Physical activity and exercise lower blood pressure in individuals with hypertension: narrative review of 27 RCTs. Br J Sports Med. 2016 Mar;50(6):356–61.

9. McGough MM, Sato T, Rankin SA, Sindelar JJ. Reducing sodium levels in frankfurters using a natural flavor enhancer. Meat Science. 2012 Jun 1;91(2):185–94.

10. Levings JL, Gunn JP. The Imbalance of Sodium and Potassium Intake: Implications for Dietetic Practice. J Acad Nutr Diet. 2014 Jun;114(6):838–41.

11. Kim BS, Yu MY, Shin J. Effect of low sodium and high potassium diet on lowering blood pressure and cardiovascular events. Clinical Hypertension [Internet]. 2024 [cited 2024 Jul 30];30. Available from: https://www.ncbi.nlm.nih.gov/pmc/articles/PMC10759559/

12. Darmawan H, Tamrin A, Nadimin N. Hubungan Asupan Natrium dan Status Gizi Terhadap Tingkat Hipertensi Pada Pasien Rawat Jalan Di RSUD Kota Makassar. Media Gizi Pangan. 2018 Jun 30;25(1):11–7.

13. Ilham D, Harleni H, Miranda SR. Hubungan Hubungan Status Gizi, Pola Makan (Lemak, Natrium, Kalium) Dan Riwayat Keluarga Dengan Kejadian Hipertensi Pada Lansia Di Wilayah Kerja Puskesmas Lubuk Buaya Padang Tahun 2019. Prosiding Seminar Kesehatan Perintis. 2019;2(1):1–1.

14. Fitri Y, Rusmikawati R, Zulfah S, Nurbaiti N. Asupan natrium dan kalium sebagai faktor penyebab hipertensi pada usia lanjut. AcTion: Aceh Nutrition Journal. 2018 Nov 30;3(2):158–63.

15. Dalal R, Bruss ZS, Sehdev JS. Physiology, Renal Blood Flow and Filtration. In: StatPearls [Internet]. Treasure Island (FL): StatPearls Publishing; 2024 [cited 2024 Jul 30]. Available from: http://www.ncbi.nlm.nih.gov/books/NBK482248/

16. Perez V, Chang ET. Sodium-to-Potassium Ratio and Blood Pressure, Hypertension, and Related Factors12. Adv Nutr. 2014 Nov 3;5(6):712–41.

17. Sari N, Rahmawati W, Nugroho FA, Wirawan NN. Asupan Serat dan Tekanan Darah WUS Madura Penderita Tekanan Darah Tinggi di Malang (Fiber Intake and Blood Pressure among Madurese People Residing in Malang). Indonesian Journal of Human Nutrition. 2016 Jun 30;3(1):1–10.