

Macrominerals Consumption, Physical Activity and The Incidence Of High Blood Pressure in Adults

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ABSTRACT

High blood pressure is a prevalent risk factor for cardiovascular disease in adults. The consumption of macrominerals, including sodium, potassium, calcium, and magnesium, together with physical activity, is believed to affect the prevalence of high blood pressure. The purpose of this study is ascertain the correlation between macromineral consumption and physical activity about the prevalence of high blood pressure in adulthood within the jurisdiction of the Jembatan Kecil Community Health Center in Bengkulu City. This research utilized a cross-sectional design involving 117 adult participants chosen via purposive sampling. Mineral consumption data were collected by the Semi-Food Frequency Questionnaire (SQ-FFQ), whereas physical activity data were acquired using the GPAQ questionnaire. Chi-square test was employed for analysis. The findings revealed a notable correlation between salt consumption ($p=0.010$) and physical activity ($p=0.043$) with the occurrence of high blood pressure. No significant association was observed between potassium consumption ($p=0.164$), calcium consumption ($p=0.843$), and magnesium consumption ($p=0.127$) with the occurrence of high blood pressure. This study indicates that increased salt consumption and insufficient physical activity are linked to the initiation of high blood pressure in adulthood. Nutrition education and the advocacy of physical exercise should be implemented consistently at the community health center level.

KEYWORDS: High blood pressure, Macro Minerals, Physical Activity

ARTICLE DETAILS

Published On:
04 July 2026

Available on:
<https://ijmscrs.com>

I. INTRODUCTION

High blood pressure can be attributed to genetic and environmental factors. Genetic variables encompass a familial predisposition to high blood pressure, whereas environmental factors comprise poor dietary practices, tobacco use, alcohol consumption, and insufficient physical exercise. Key environmental variables contributing to high blood pressure encompass a high-sodium diet, insufficient consumption of fruits and vegetables, and excessive consumption of saturated fats together with cholesterol. This detrimental diet may escort to a progressive elevation in blood pressure (Rahmadhani *et al.*, 2025).

High blood pressure is defined by a systolic blood pressure over 140 mmHg and a diastolic blood pressure surpassing 90 mmHg (Agira, Atnadja and Puspareni, 2024). Hypertension is sometimes referred to be a silent killer since it is asymptomatic, causing patients to remain unaware of

their illness until they encounter comorbidities or complications arising from it (Ekaningrum, 2021).

A sedentary lifestyle significantly contributes to the heightened risk of high blood pressure. Modifications in diet along with enhanced physical activity are two essential strategies for the deterrence and control of high blood pressure. The World Health Organization (WHO) asserts that the incidence of high blood pressure is higher in low-income countries than in high-income or industrialized ones (Damasceno, 2016).

Unhealthy dietary habits can result in unregulated nutrient consumption, leading to elevated blood pressure. Sodium, potassium, calcium, and magnesium are macro mineral nutrients that significantly influence high blood pressure (Arismawati *et al.*, 2022; Khaira, 2022).

Excessive sodium consumption connects to fluid retention in the body, resulting in an elevated blood volume.

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Conversely, potassium contributes to the reduction of blood pressure via vasodilation, which diminishes total peripheral resistance and enhances cardiac output (Eryanti, 2023). Calcium and magnesium inhibit blood vessel constriction, therefore diminishing peripheral resistance and lowering blood pressure (Apriani *et al.*, 2024).

Excess sodium induces fluid retention in the body, hence elevating blood volume. This may also constrict the diameter of arteries, compelling the heart to exert greater effort to circulate blood through restricted passages, thereby elevating blood pressure and inducing high blood pressure. In the elderly, alterations in gustatory perception and sensory sensitivity frequently transpire, resulting in diminished appetite (Otarini *et al.*, 2023).

Elevated potassium consumption enhances its concentration in intracellular fluid, thereby extracting fluid from the extracellular space and aiding in the reduction of blood pressure (Fitri *et al.*, 2018). Sinarti (2017) findings indicate that there is no significant correlation among potassium consumption and high blood pressure. Findings indicate that there is no significant correlation among potassium consumption and high blood pressure.

Calcium consumption is crucial for sustaining appropriate blood pressure levels. Proper calcium consumption may mitigate the risk of high blood pressure. The translocation of calcium within cardiac muscle is essential for cellular activation and subsequent contraction. This process transpires via a complex system whereby agonist neurotransmitter hormones enhance cell permeability, facilitating the influx of calcium ions across the membrane into the cell (Lestari, 2019).

Magnesium consumption is crucial for regulating blood pressure by fortifying endothelial tissue, enhancing prostaglandin synthesis, and augmenting glucose absorption, which in turn diminishes insulin resistance. Moreover, magnesium has a role in the contraction of cardiac muscle. A reduction in blood magnesium levels impairs the normal functioning of the heart muscle, potentially influencing blood pressure (Salsabila *et al.*, 2023).

According to the Recommended Dietary Allowance (AKG) 2019, the recommended daily consumption for adults is approximately 1300–1500 mg of salt, 4700 mg of potassium, 1000–1200 mg of calcium, and 330–360 mg of magnesium. Alongside dietary modifications, physical activity is an essential component in the control of high blood pressure.

Consistent physical activity can decrease blood pressure, enhance cardiovascular health, and mitigate additional risk factors including obesity, elevated cholesterol, and insulin resistance. Research by Pedersen and Saltin (2015) indicates that consistent physical activity, like walking, running, or swimming, can lower blood pressure by 5–10 mmHg in persons with mild to severe high blood pressure. A substantial correlation exists between physical activity and the severity of high blood pressure in

older hypertensive patients participating in Prolanis (Setiyawan *et al.*, 2025). Physical fitness has been demonstrated to diminish the likelihood of acquiring high blood pressure. Nonetheless, no direct correlation between physical activity and fitness was identified; physical activity significantly influenced the onset of high blood pressure solely among people possessing elevated fitness levels (Fatmawati *et al.*, 2022).

The widespread presence of high blood pressure in Indonesia was 8.6%, and in Bengkulu Province, it was 7.4%, as reported by SKI 2023 based on medical diagnostics and measures. According to data from the Bengkulu City Health Office in 2023, there are 50,898 individuals with high blood pressure, of which 20.1% live in the Telaga Dewa Community Health Centre region, amounting to 4,248 individuals (23.5%). The Jembatan Kecil Community Health Centre documented the second highest incidence, with 4,120 persons (13.3%). This study is necessary to analyse the correlation between macromineral consumption and physical activity about the incidence of high blood pressure in adulthood within the Jembatan Kecil Community Health Centre jurisdiction in Bengkulu City.

METHODS

The study employed a quantitative cross-sectional design to examine the connection between macro mineral consumption and physical activity about the prevalence of high blood pressure at the Jembatan Kecil Community Health Centre in Bengkulu City.

The study population consisted of all patients at the Jembatan Kecil Community Health Centre in 2025. The sample was selected via purposive sampling based on inclusion criteria: respondents aged 18 to 60 years, resident in the study area, able to communicate, and consenting to participate. The sample size, as determined by the Lemeshow formula, was 117 persons.

Primary data was collected by interviews utilizing the SQ-FFQ (Semi Qualitative -Food Frequency Questionnaire) for macro mineral consumption and the GPAQ (Global Physical Activity Questionnaire) for physical activity assessment. Secondary data was extracted from health centre medical records, encompassing blood pressure, age, gender, marital status, and highest educational attainment. Data processing involved editing, coding, tabulating, and input for analysis.

The data analysis employed univariate tests to characterize variable distributions and bivariate tests, such as the Chi-Square test, to examine the relationships between variables. The significance level was set at $p < 0.05$. This study has obtained ethical approval from the Ethics Committee of Poltekkes Kemenkes Bengkulu, under Number KEPK.BKL/454/05/2025, dated May 29, 2025, guaranteeing the confidentiality of respondents' identities, which have been replaced by research numbers.

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RESULTS AND DISCUSSIONS

This research seeks to investigate the connection between independent variables (macromineral consumption and physical activity) and dependent variables (high blood pressure incidence). The subsequent table 1 presents an overview of the consumption of sodium, potassium, calcium, and magnesium, with physical activity levels and the incidence of high blood pressure, as derived from the SQ-FFQ questionnaire.

Table 1. Sodium, Potassium, Calcium, and Magnesium Consumption, Physical Activity, and High blood pressure

Variable	n	(%)
Sodium Consumption		
Poor	86	73.5
Good	31	26.5
Potassium Consumption		
Poor	106	90.6
Good	11	9.4
Calcium Consumption		
Poor	112	95.7
Good	5	4.3
Magnesium Consumption		
Poor	110	94
Good	7	6
Physical Activity		
Light and Moderate	58	49.6
Heavy	59	50.4
High blood pressure		
Yes	27	23.1
No	90	76.9

Table 1 shows that out of 117 respondents, 86 people (73.5%) had poor sodium consumption, poor potassium consumption, namely 106 people (90.6%), poor calcium consumption, namely 112 people (95.7%). Almost all had poor magnesium consumption, namely 110 people (94.0%), half engaged in light and moderate physical activity, namely 58 people (49.6%), a small portion had high blood pressure, namely 27 people (23.1%).

Table 2. Relationship Between Sodium Consumption And High blood pressure

Sodium Consumption	<u>High Blood Pressure</u>				<i>p value</i>	<i>OR</i>
	Yes		No			
	n	%	n	%		
Poor	25	29.1	61	70.9	0.01	5.9
Good	2	6.5	29	93.5		
Total	27	23.1	90	76.9		

Table 2 reveals a p-value of 0.01, indicating a strong correlation between salt consumption and high blood pressure. The odds ratio is 5.94, indicating that individuals who ingest excessive sodium are 5.943 times more likely to experience high blood pressure. The correlation between potassium consumption and the prevalence of high blood pressure in the workplace is illustrated in Table 3.

Table 3. Relationship Between Potassium Consumption and Incidence of High blood pressure

Potassium Consumption	<u>High Blood Pressure</u>				<i>p value</i>	OR
	Yes		No			
	n	%	n	%		
Poor	25	23.6	81	76.4	0.1	1.3
Good	2	18.2	9	81.8		
Total	27	23.1	90	76.9		

Table 3 reveals a p-value of 0.164, indicating a lack of a significant association between potassium consumption and the incidence of high blood pressure. Table 4 below illustrates the association between calcium consumption and the prevalence of high blood pressure.

Table 4. Relationship Between Calcium Consumption and The Incidence of High blood pressure

Calcium Consum ption	<u>High Blood Pressure</u>				<i>p value</i>	<i>OR</i>
	Yes		No			
	n	%	n	%		
Not Good	25	12.3	87	77.7	0.8	0.4
Good	2	10	3	60		
Total	27	13.1	90	76.9		

Table 4 presents a p-value of 0.843, signifying a lack of significant link between calcium consumption and the incidence of high blood pressure. Table 5 below illustrates the link between magnesium consumption and the prevalence of high blood pressure at the Jembatan Kecil Community Health Centre in Bengkulu City.

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Tabel 5. Relationship Between Magnesium Consumption and Incidence of High blood pressure Relationship Between Calcium Consumption and High blood pressure

Magnesium Consumption	High Pressure		Blood		p value	OR
	Yes	No	Yes	No		
	n	%	N	%		
Poor	5	22.7	85	77.3	0.1	0.7
Good	2	28.6	5	71.5		
Total	27	23.1	90	76.9		

Table 5 reveals a p-value of 0.127, indicating an absence of a meaningful correlation between magnesium consumption and the occurrence of high blood pressure. This is illustrated in Table 6 below.

Table 6. Relationship Between Physical Activity and High blood pressure

Physical Activity	High Blood Pressure				p value	OR
	Yes	No	Yes	No		
	n	%	n	%		
Light and Moderate	18	31	40	69	0.04	2.5
Heavy	9	15.3	50	84.7		
Total	27	23.1	90	76.9		

P-value in Table 6 of 0.043 means that there is a significant relationship between physical activity and the incidence of high blood pressure. The OR value shows a value of 2.500, meaning that respondents who engage in light and moderate physical activity are 2.5 times more likely to suffer from high blood pressure.

According to the World Health Organization (2018), the recommended daily sodium consumption is no more than 2 grams of sodium per day, which is equivalent to about 5 grams of table salt. However, in daily practice, Indonesians tend to consume more sodium than this limit, both through salt used in cooking and from packaged and processed foods such as instant noodles, canned foods, salty snacks, and fast food (Sabu *et al.*, 2024).

The elevated levels of harmful sodium consumption in this study may be attributable to various variables. The inadequate public awareness on appropriate salt consumption thresholds. Numerous individuals fail to recognize that sodium is not solely derived from table salt, but also from various processed food items consumed on a regular basis (Kurniasih *et al.*, 2017). Secondly, the practice of consuming rapid foods and spices rich in sodium has become integral to the diets of the majority. Third, there is a limited awareness of reading nutritional information labels on food packaging, resulting in individuals being

uninformed about the elevated sodium levels in the items they consume (Firman, 2024; Lubis *et al.*, 2024).

The research indicates that excessive salt consumption, when not counterbalanced by potassium consumption, significantly adds to the prevalence of high blood pressure among the senior population in Aceh (Fitri *et al.*, 2018). Excessive salt consumption is a nutritional issue that necessitates particular focus, particularly within the working-age population and the elderly (Melva *et al.*, 2024).

Potassium is an essential macromineral important for regulating blood pressure, muscular and neuronal function, and maintaining fluid balance in the body. Potassium acts as a sodium antagonist by promoting sodium excretion through urine and decreasing vascular tension (vasodilation), therefore contributing to lower blood pressure (Nainggolan *et al.*, 2019). Thus, adequate potassium consumption is essential for high blood pressure prevention, especially when combined with reduced salt consumption (Whelton *et al.*, 2018).

The World Health Organization (2020) stipulates that the daily potassium need for adults is at least 3510 mg, preferably sourced from natural foods including fruits (such as bananas, papayas, and oranges), green vegetables, nuts, and tubers. In actuality, many individuals do not habitually consume adequate quantities of potassium-rich foods. A diet deficient in vegetables and fruits while being excessive in processed foods is a prevalent cause of inadequate potassium consumption (Atun *et al.*, 2021).

Fitri *et al.* (2018) indicate that merely 20% of the older population in Aceh ingests adequate potassium, a factor that exacerbates the high incidence of high blood pressure. This suggests that, overall, the population's dietary habits are still unbalanced, necessitating continued attempts to enhance potassium consumption through dietary modifications (Fitri *et al.*, 2018); Onwuakagba *et al.*, 2024). Calcium shortage may elevate vascular resistance, resulting in increased blood pressure. This transpires as the body endeavours to regulate calcium equilibrium by augmenting parathyroid hormone release, perhaps resulting in elevated blood pressure (Fitri *et al.*, 2018).

The Ministry of Health of Indonesia Institute of Medicine (IOM) state that the daily calcium requirement for adults is roughly 1000–1200 mg/day, contingent upon age group and physiological condition.

Nonetheless, numerous Indonesians continue to face challenges in fulfilling this requirement, mostly attributable to insufficient consumption of milk and dairy products, along with a lack of awareness of non-dairy calcium sources such as tiny fish consumed with their bones, tofu, tempeh, dark green vegetables, and nuts (Lestari, 2019). The research conducted in Saudi Arabia revealed that a low-calcium diet considerably elevates blood pressure, particularly in young and middle-aged adults (Pescatello *et al.*, 2015). Research conducted on the teaching staff at the Faculty of Public Health in Manado indicates that the

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consumption of macro minerals, including sodium, potassium, calcium, and magnesium, is predominantly insufficient, while phosphorus consumption is largely high (Bawoleng *et al.*, 2022). Lestari (2019) observed that sufficient calcium consumption can mitigate systolic blood pressure in older individuals with a history of moderate high blood pressure.

Magnesium is a crucial mineral in the body's metabolic functions, including the regulation of smooth muscle contraction and nervous system activity. Magnesium contributes to blood pressure regulation by inducing vasodilation and opposing calcium ions within cells (Irwanto *et al.*, 2023). Magnesium shortage can lead to electrolyte imbalance and heightened vascular resistance, ultimately resulting in high blood pressure (Lestari, 2019).

Irwanto *et al.*, (2023) concluded in her research that although magnesium consumption does not show a statistically significant relationship with high blood pressure, low consumption still has the potential to be a contributing factor if accompanied by potassium and calcium deficiencies (Bawoleng *et al.*, 2022). Physical activity plays a prominent role in maintaining stable blood pressure. Various studies show that moderate to vigorous exercise or physical activity can help lower blood pressure by increasing blood vessel elasticity, insulin sensitivity, and heart function (Kusumo, 2020). Diaz's (2013) research shows that individuals who are physically inactive have twofold the risk of developing high blood pressure compared to those who are physically active. Meanwhile, Yunarsih *et al.*, (2025) in the journal high blood pressure states that regular physical exercise can lower systolic blood pressure by 5–10 mmHg, even in patients with mild high blood pressure (Yunarsih *et al.*, 2025).

The bivariate test findings indicated a statistically significant correlation between sodium consumption and the occurrence of high blood pressure, with a p-value of 0.010. Among the 117 respondents, 73.5% exhibited inadequate salt consumption (≥ 1300 –1500 mg/day), with a greater prevalence of high blood pressure individuals identified within this cohort. No substantial correlation exists between potassium consumption and the occurrence of high blood pressure ($p = 0.164$). The percentage of respondents exhibiting inadequate potassium consumption is significantly high, totalling 76.4%. The contrivance suggest that the plethora of individuals fail to achieve the required daily potassium consumption; nevertheless, this deficiency has not demonstrated a statistically significant effect on blood pressure within this sample (Wati *et al.*, 2023).

The bivariate test findings indicated no significant correlation between calcium consumption and high blood pressure incidence ($p=0.843$). Despite being statistically insignificant, the majority of responders (77.7%) exhibited inadequate calcium consumption. The data suggest that most respondents failed to reach the recommended daily calcium

consumption, which may adversely impact long-term blood pressure (Marhabatsar & Sijid, 2021).

The bivariate test results demonstrate no significant link between magnesium consumption and the occurrence of high blood pressure ($p=0.127$). Nevertheless, 77.3% of subjects had insufficient magnesium consumption. This indicates that insufficient magnesium consumption continues to be a widespread concern in the community's diet.

The bivariate test findings indicate no significant association between physical activity and high blood pressure ($p = 0.043$). The majority of study participants exhibited moderate to high levels of physical exercise. This indicates that while physical activity is acknowledged as a preventive measure for blood pressure, it may not directly influence all demographics or be apparent in cross-sectional studies.

Thus, the results of this study correspond with various earlier investigations that similarly found no statistically notable connection between physical exercise and blood pressure. The importance of physical activity in preventing high blood pressure is vital from both physiological and public health intervention perspectives. Regular physical activity is recommended as a fundamental aspect of a healthy lifestyle to reduce the long-term risk of high blood pressure (Setiyawan *et al.*, 2025).

CONCLUSION

The data indicate a correlation between salt consumption along with the incidence of high blood pressure, as well as between physical activity and the incidence of high blood pressure. No significant association was identified between the consumption of potassium, calcium, and magnesium and the occurrence of high blood pressure. Individuals with high blood pressure are advised to modify their dietary habits by reducing sodium consumption to prevent elevated blood pressure and increasing potassium consumption. Nutrition education and the promotion of physical exercise must be routinely applied at the community health centre level.

ACKNOWLEDGEMENT

The author expresses sincere gratefulness to all who give support, assistance, and guidance during the research, especially the lecturers who imparted knowledge and inspiration, ensuring the successful execution of this research.

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