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Lifestyle Factors are Related to Hypertension in Indonesia: K-Means Clustering And Correlational Study

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Abstract

Background: Hypertension is a major health problem in Indonesia with complex risk factors, including lifestyle. This study aims to analyze the relationship between consumption of salty foods, instant noodles, sweet drinks, and smoking with the prevalence of hypertension at the provincial level. **Methods:** This cross-sectional study used data from 38 provinces in Indonesia in 2023. Normality tests were carried out followed by Spearman correlation analysis to measure the relationship between variables. **Results:** Consumption of salty foods showed a strong positive correlation with hypertension ($p < 0.001$), while instant noodles had a moderate negative correlation that was not significant ($p = 0.052$). No significant relationship was found between hypertension and consumption of soft drinks ($p = 0.210$), energy drinks ($p = 0.280$), or smoking ($p = 0.540$). **Conclusion:** Excessive salt intake is a dominant risk factor for hypertension in Indonesia, which requires policy intervention, and the insignificance of other lifestyle factors requires further research with a longitudinal approach and multivariate analysis.

Keywords: correlational study, factors, hypertension, lifestyle

INTRODUCTION

Hypertension, characterized by persistent elevation of systolic or diastolic blood pressure equal to or exceeding 140/90 mmHg in adults aged 18 years and above, has become a global health problem. Hypertension is a significant risk factor for chronic kidney disease, heart failure, myocardial infarction, and premature death, contributing significantly to rising health care costs.¹ Hypertension is a major preventable risk factor for cardiovascular disease (CVD) and all-cause mortality worldwide.^{1,2} In 2010, 31.1% of the global adult population (1.39 billion people) had hypertension.

The prevalence of hypertension is increasing globally due to population aging and increased exposure to lifestyle risk factors including unhealthy diets (e.g., high sodium and low potassium intakes and lack of physical activity).³ Modifiable risk factors include unhealthy diets (excessive salt intake, diets high in saturated and trans fats, low fruit and vegetable intakes), lack of physical activity, tobacco and alcohol consumption, and overweight or obesity. In addition, there are environmental risk factors for hypertension and related diseases, of which air pollution is the most significant.⁴

Hypertension increases the risk of heart, brain, kidney, and other disorders. It is a major modifiable risk factor for cardiovascular disease (including coronary heart disease, heart failure, stroke, myocardial infarction, atrial fibrillation, and peripheral arterial disease) and premature death worldwide.^{5,6} More than one billion people worldwide, approximately 1 in 4 men and 1 in 5 women, had hypertension in 2016.⁷ Two-thirds of hypertension is found in low- and middle-income countries, partly because there have been more common risk factors in these populations over the past decades. Therefore, effective strategies that focus on the prevention and management of hypertension should be emphasized. The prevalence of hypertension is regionally heterogeneous and may be partly explained by variations in the prevalence of hypertension risk factors such as high sodium intake, low potassium intake, obesity, alcohol consumption, physical inactivity, and unhealthy diet. According to the World Health Organization, hypertension has been declared a global public health problem affecting 1 billion people worldwide and more than 10 million deaths per year. The prevalence of

hypertension globally is 22% of the world's population.⁴ Hypertension is one of the non-communicable diseases with a prevalence of 22% in the world.⁴

Meanwhile, in Southeast Asia, the prevalence of hypertension is 24.7%. In countries with lower middle income levels, the prevalence of hypertension is around 21.3%.⁴ One of the risk factors for increasing cases of hypertension worldwide is the consumption of salty foods. Research conducted by Villela et al.⁸ compared the preference for salty foods between elderly hypertensive subjects and normotensive subjects and showed that hypertensive individuals preferred and consumed salty foods more than normotensive individuals.

Several studies have shown that older people prefer stronger tastes than younger people because the number of papillae and taste buds decreases with age.^{9,10} Intersult research.¹¹ Showed a strong relationship between salt intake and a progressive increase in blood pressure (BP) with increasing age of up to 4 mmHg per year for a salt intake of 6 g/day. Therefore, reducing salt intake is likely to reduce the increase in BP with age, in addition to having a direct BP-lowering effect.¹² Since high blood pressure across its entire range is a major cause of cardiovascular disease, reducing salt intake, if it lowers blood pressure, will reduce cardiovascular risk. 1 Scientific research on this topic is scarce and only a few studies have been conducted in real-world experimental settings.¹³

Some research has also been conducted with regard to soft drink consumption. Sugar-sweetened beverage (SSB) consumption has been associated with weight gain.^{14,15,16} Type 2 diabetes and coronary heart disease.^{16,17,18} Furthermore, animal studies have found that high SSB intake may lead to hypertension and prospective studies support the hypothesis of a positive association between SSB intake and high blood pressure and hypertension.^{14,15,16,17,18,19} With results indicating that soft drink consumption increases blood pressure.

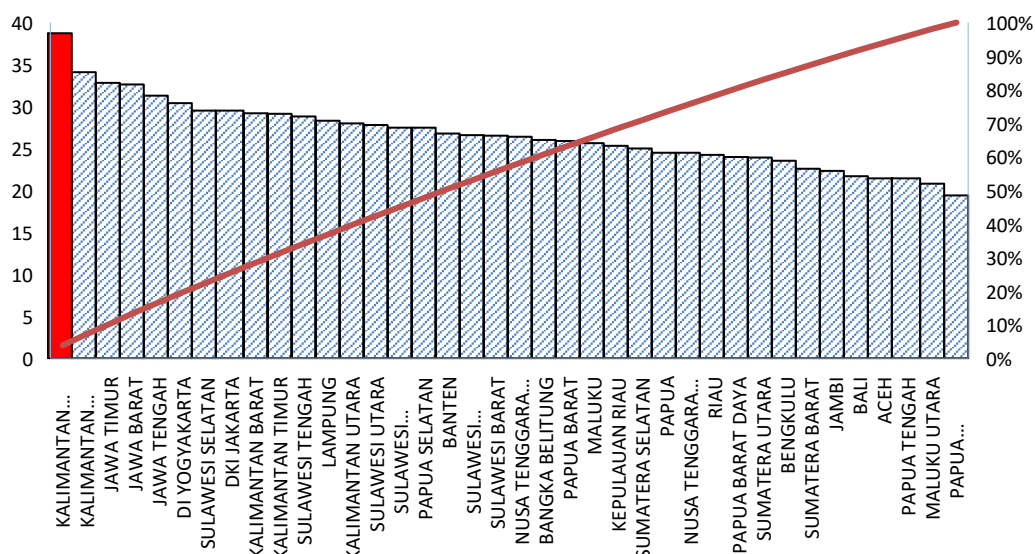
METHOD

In this study, researchers used quantitative research with a cross-sectional research design, the data used were secondary data obtained from the Indonesian Health Survey (SKI). Where the data collected was the percentage of hypertension cases in 2023 in 39 provinces throughout Indonesia, and consumption of salty foods, carbonated drinks, energy drinks, smoking and instant noodle consumption. The sample used in collecting this SKI data was patients suffering from hypertension based on Doctor's Diagnosis in the Population Aged ≥ 18 Years with a total of 602,982, then the data was presented in each province. Furthermore, the data was tested statistically using person correlation to ensure there was a correlation between consumption of salty foods, carbonated drinks, energy drinks, smoking and instant noodle consumption with hypertension.

RESULT & DISCUSSION

Result

Table 1. Hypertension Cases In 39 Provinces 2023



The data in the graph shows the number of hypertension cases in 39 provinces in Indonesia in 2023. The province with the highest number of cases is Central Kalimantan, followed by South Kalimantan, East Java, and West Java. The further to the right, the number of cases decreases gradually, with provinces such as Central Papua, North Maluku, and Papua Pegunungan showing the lowest number of cases. The graph also includes a cumulative curve (in orange) showing the cumulative percentage contribution of each province to the total number of hypertension cases nationally, where about half of the total cases come from the first 15 provinces. This distribution illustrates the inequality of the burden of hypertension between regions and can be the basis for determining the priority of public health interventions.

TABLE 2. Clusters based on variables related to hypertension and lifestyle

Variable	Cluster 0 (13 Provinces)	Cluster 1 (16 Provinces)	Cluster 2 (9 Provinces)
Hypertensin (%)	24,73	29,71	24,07
Salty Food Consumption (%)	17,14	30,97	19,86
Soft Drink (%)	2,92	2,51	6,57
Energy Drink (%)	1,98	1,60	6,24
Smoking (%)	20,68	21,11	16,71
Instant Noodle Consumption (%)	5,69	6,53	14,40

The clustering results on the data show that 38 provinces in Indonesia can be grouped into three clusters based on variables related to hypertension and lifestyle. Cluster 0 consists of 13 provinces, Cluster 1 includes 16 provinces, and Cluster 2 consists of 9 provinces.

1. Cluster 0 (13 Provinces):

This cluster has a prevalence of hypertension of 24.73%, which is relatively low compared to Cluster 1 but almost the same as Cluster 2. Consumption of salty foods in this cluster is 17.14%, much lower than Cluster 1. However, consumption of energy drinks (1.98%) and soft drinks (2.92%) is at a moderate level. The habit of smoking in this cluster is quite high, at 20.68%, while consumption of instant noodles is among the lowest among the three clusters (5.69%).

2. Cluster 1 (16 Provinces):

This cluster stands out with the highest prevalence of hypertension (29.71%) and very high consumption of salty foods (30.97%). Although the consumption of soft drinks (2.51%) and energy drinks (1.60%) is relatively low, the habit of smoking is still quite high (21.11%). The consumption of instant noodles is at a moderate level (6.53%). The high rate of hypertension may be related to the high consumption of salty foods.

3. Cluster 2 (9 Provinces):

This cluster has the lowest prevalence of hypertension (24.07%), but the consumption of soft drinks (6.57%) and energy drinks (6.24%) is much higher than other clusters. The consumption of instant noodles is also the highest (14.40%), while the habit of smoking is the lowest (16.71%). Although the consumption of salty foods is not as high as Cluster 1 (19.86%), the high consumption of sweet drinks and instant noodles may be other health risk factors

Table 3. Normality Test

Variable	P-Value	Conclusion
Hypertension	0.032	Abnormal
Salty Food Consumption	0.001	Abnormal
Soft Drink	0.000	Abnormal
Energy Drink	0.000	Abnormal
Smoking	0.012	Abnormal
Instant Noodle Consumption	0.000	Abnormal

Based on the normality test table above, all variables are not normally distributed (p-value < 0.05), so the Spearman correlation test.

Table 4. Corelation Test

Variable	Correlation Coefficient	P-Value	Interpretation
Salty Food Consumption	0.621	0.000	Strong positive correlation (significant)
Soft Drink	-0.210	0.210	Not significant
Energy Drink	-0.185	0.280	Not significant
Smoking	0.105	0.540	Not significant
Instant Noodle Consumption	-0.320	0.052	Negative correlation (almost significant)

The results of the Spearman correlation test showed that there was a significant relationship between salty food consumption and the prevalence of hypertension at the provincial level. The correlation coefficient of 0.621 (p-value <0.001) indicated a strong positive correlation, meaning that the higher the consumption of salty food in a province, the higher the hypertension rate. This finding is consistent with several studies that mention salt as a major risk factor for hypertension. Provinces such as West Java and Bengkulu which have high salty food consumption (46.5% and 36% respectively) are also recorded to have a prevalence of hypertension above the national average.

On the other hand, instant noodle consumption actually showed a moderate negative correlation with hypertension ($\rho = -0.320$, p-value = 0.052), although it was not statistically significant at the 95% confidence level. This pattern is seen in provinces such as Papua and North Maluku where instant noodle consumption is high but hypertension rates are relatively low. This may be influenced by other factors such as demographic characteristics or active lifestyles of the people in the region. Other lifestyle variables such as soft drink consumption ($\rho = -0.210$), energy drinks ($\rho = -0.185$), and smoking habits ($\rho = 0.105$) did not show significant correlation with hypertension (all p-values > 0.05). These results suggest that in the context of this provincial-level data, salty food factors have a more dominant influence on hypertension than other lifestyle factors. These findings reinforce the importance of public health interventions focused on reducing salt consumption, while other risk factors may need to be further studied with more detailed data.

Discussion

The results of this study consistently show a strong positive relationship between salty food consumption and hypertension prevalence at the provincial level in Indonesia. The Spearman correlation coefficient of 0.621 ($p < 0.001$) indicates that a high salt consumption pattern contributes significantly to the increase in hypertension cases. This finding is in line with global epidemiological evidence stating that excessive sodium intake is a major risk factor for hypertension.²⁰

The biological mechanism involves fluid retention, increased plasma volume, and activation of the renin-angiotensin-aldosterone system which ultimately increases blood pressure.²¹ Provinces with the highest salty food consumption such as West Java (46.5%) and Bengkulu (36%) also recorded a prevalence of hypertension above the national average (> 30%). This pattern is consistent with previous studies in Southeast Asia that reported a significant impact of high-salt diets on cardiovascular health.²² Cultural factors such as the habit of consuming processed foods, salted fish, and the use of soy sauce in traditional cooking are thought to be the main contributors to high sodium intake in these provinces.²³

An interesting result is the finding of a moderate negative correlation between instant noodle consumption and hypertension ($\rho = -0.320$, $p = 0.052$), although it did not reach full statistical significance. This phenomenon is clearly seen in provinces such as Papua and North Maluku where instant noodle consumption is high but hypertension rates are relatively low. Some explanations based on the results of this analysis are the possibility of Demographic Factors, where the younger population in these provinces may have better cardiovascular resilience.²⁴

In addition, Physical Activity, the active lifestyle of people in certain areas can be a protective factor against the negative effects of sodium consumption.²⁵ However, this finding needs to be interpreted with caution considering that the high sodium content in instant noodles remains a proven

risk factor for hypertension.²⁷ Further research with a longitudinal design is needed to reveal the basis of these findings. Furthermore, inconsistent with several previous studies, this study did not find a significant correlation between hypertension and soft drink consumption ($\rho = -0.210$, $p = 0.210$), energy drinks ($\rho = -0.185$, $p = 0.280$), smoking habits ($\rho = 0.105$, $p = 0.540$). Some possible explanations for this result include consumption patterns may differ significantly between provinces, so that their effects cancel each other out in the aggregate analysis.²⁸ Confounding factors such as smoking duration variables or the number of cigarettes per day were not taken into account in this analysis.²⁹ In addition, data on consumption of sweetened drinks may not fully cover all sources of added sugar in the diet.³⁰

CONCLUSION

Based on the results of the study, it can be concluded that consumption of salty foods has a strong positive correlation with the prevalence of hypertension in Indonesia, while other lifestyle factors such as consumption of sweet drinks and smoking do not show a significant relationship. These findings reinforce the importance of policy interventions focused on reducing salt intake, especially through public education and regulation of sodium levels in processed foods. However, the interesting pattern between lower instant noodle consumption and hypertension in several provinces requires further research with a longitudinal approach and multivariate analysis to control for confounding variables such as age, physical activity, and sociodemographic factors.

In addition, although some risk factors were not significant in this study, promotive-preventive efforts against excessive sugar consumption and smoking still need to be maintained considering their impact on other chronic diseases. Therefore, it is recommended that the government and policy makers develop comprehensive, evidence-based health programs that are tailored to regional characteristics, while encouraging more in-depth research to understand the dynamics of hypertension risk factors at the individual and community levels.

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DECLARATION OF CONFLICTING INTERESTS

The author declares that he has no conflict of interest, either financial or non-financial, in this research.

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