ASSOCIATION BETWEEN DIETARY PATTERNS OF SALTY FOODS, SWEET DRINKS, FRUIT AND VEGETABLES AND THE PREVALENCE OF HYPERTENSION IN EAST JAVA: MULTIVARIATE ANALYSIS OF INDONESIAN BASIC HEALTH SURVEYS DATA 2018

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ABSTRACT

Hypertension remains the main cause of mortality globally, including in Indonesia, with a prevalence rate of 34.1%. Various studies have reported an association between dietary patterns and the prevalence of hypertension. Therefore, further analysis is needed to determine preventive intervention strategies in each region. This study aimed to analyze the effect of dietary patterns on the prevalence of hypertension in East Java Province. The sample is the result of multistage random sampling from the census block of Basic Health Research (Riskesdas) report in the East Java Province collected from 2013 – 2018. The classical assumption test was carried out using the Kolmogorov-Smirnov method, bivariate test using the Pearson method, and multivariate test using the multiple linear regression method. There are three variables tested that have a p-value below the value of α <0.05, including eating salty foods once a day (p=0.021), drinking sweet drinks three times per month (p=0.008), and non-routine of fruits and vegetables consumption (p=0.003). Based on the r-value, the association between predictor variables and prevalence in order from the largest to the smallest of the habit of not consuming fruits and vegetables (r=-0.469), the habit of drinking sugary drinks three times per month (r=-0.425), and salty eating habits one time per day (r=-0.372). Multivariate multiple linear regression analysis showed that daily intake of salty foods (p=0.013) was associated with the prevalence of hypertension.

Keywords: hypertension; dietary pattern; salty foods; sweet drinks; fruits and vegetables

INTRODUCTION

Hypertension, a persistent increase in systolic blood pressure of 140 mmHg or above and/or a persistent increase in diastolic blood pressure of 90 mmHg or above, is a serious medical condition that can significantly increase the risk of developing fatal heart, kidney, and central nervous system disease. Although a number of important findings related to its pathophysiology and therapy are well understood, hypertension is still one of the most prevalent diseases with 1.13 million cases globally, where 1 in 4 men and 1 in 5 women worldwide have hypertension, and 2 out of 3 sufferers come from low-middle income countries. Hypertension is one of the leading causes of premature death and is one of the major modifiable risk drivers for cardiovascular disease (Carretero, 2000).

Hypertension remains the leading cause of mortality in both high and low income countries (Forouzanfar, 2017). The cause of death in these countries is estimated to be almost two-thirds caused by diseases related to hypertension (Arima, 2011). Meanwhile, 35% of adults in Southeast Asia are estimated to have suffered from hypertension and 9.4% of deaths are caused by hypertension (Krishnan, 2013). Low levels of consciousness and a high proportion of uncontrolled blood pressure are associated with high rates of cardiovascular mortality (Suh, 2015).

According to the doctor's diagnosis, Indonesia had a prevalence of hypertension of 8.36% (8.26% - 8.47%) in 2018, which is 658,201 people. Meanwhile, based on measurements and diagnosis of the doctor, the prevalence of hypertension in East Java Province was 8.01% and 36.3%. The prevalence of hypertension as measured by this measurement method has increased significantly compared to the results of the previous study in 2013, which was 26.2%. According to Indonesia's Sample Registration System data in 2014, hypertension and its complications are in the 5th position as the most common cause of

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death in Indonesia. The results of the Household Health Survey in 1995, 2001, 2004, 2007, and 2013 reported that cardiovascular disease is the number one cause of death in Indonesia, where about 20-35% are caused by hypertension. Basic Health Research data referring to the results of a multistage cross-sectional national survey by the Research and Development Agency of the Ministry of Health shows that both in Indonesia and in East Java, hypertension consistently ranks first in the prevalence of the most disease. This trend is likely to continue to increase globally, it is estimated that 1.5 billion people worldwide suffer from hypertension, with 9.4 million people dying from complications of hypertension each year (Riskesdas, 2018).

Various studies have reported a significant relationship between a number of risk factors and hypertension prevalence. Unhealthy dietary patterns, excess nutritional status based on body mass index, increase lipid profile, smoking and alcohol consumption habits, physical inactivity, psychosocial condition, to outreach access to health services have been reported as a number of modifiable risk factors that influence the prevalence of hypertension in addition to non-modifiable factors such as genetic, age, and gender. These factors have varying strength of risk from one location to another depending on the characteristics of the area and the community. Therefore, analysis is needed to determine effective preventive intervention strategies in each area (Singh, 2017). This study aims to analyze the association between dietary patterns with the prevalence of hypertension in East Java Province.

METHODS

Research Design

This study applied a cross-sectional design and quantitative data with observational analysis based on secondary data. The purpose of the study was aimed at determining the relationship between food consumption patterns and the prevalence of hypertension in East Java based on secondary data from the Basic Health Research of East Java Province.

Sampling

The research population consisted of all households in the districts and cities of the East Java Province that were included in the 2010 Population Census sample frame with a total of 720,000 sample blocks (CB) with details of 1 CB consisting of 10 households.

Data Collection

The research sample consisted of all districts and cities in East Java Province, which were included in the 2018 Susenas (National Socio-Economic Survey) framework and in the 2018 RISKESDAS sample. The sample target was visited by 300,000 households from 30,000 Susenas Census Blocks (BS) conducted by the Central Agency Statistics using the PPS (Probability Proportional to Size) method using systematic linear sampling with two-stage sampling.

The independent variables in this study were (1) salty foods intake, (2) consumption of fatty/cholesterol/fried foods, (3) consumption of sugary drinks, (4) consumption of fruit and vegetables, and (5) consumption of roasted foods. The dependent variable in this study was the prevalence of hypertension in districts and cities in East Java Province. The data was taken from the Basic Health Research (Riskesdas), Health Research and Development Agency of East Java Province from 2013 – 2018, which is already in the form of aggregated data based on the survey results on family heads in districts and cities of East Java Province. All required data is then tabulated in excel according to the variables and measurements of the required variables. The column tabs are variables, while the rows are district and city-data.

Statistical Analysis

Data management was carried out using the SPSS 23.0 program. Data from the independent and dependent variables in the form of interval data processed descriptively by looking at the mean standard deviation, then the statistical tests used are bivariate and multivariate. Assumption testing was performed to examine the normality of the data distribution. The assumption test was carried out using Kolmogorov-Smirnov analysis by examining the significance value > with the following hypotheses: (1) H0 if the data is

normally distributed; and (2) Hi if the data is not normally distributed. A correlation test was used to determine the degree of relationship between the two variables. As long as the data is normally distributed, the Pearson correlation test is used, on the other hand, if the data is not normally distributed, the Spearman correlation test is used. The correlation test results with a p-value below 0.05 showed that there was a significant relationship between dietary patterns and the prevalence of hypertension. The two correlation coefficients, both Pearson's and Spearman's correlation have r values between -1 to 1. The closer to 1, the stronger the correlation, while the closer to zero, the lower the correlation between the two variables. At the same time, the sign of the correlation coefficient indicates the direction of the relationship. A negative sign (-) indicates an inverse relationship, and a (+) sign indicates a unidirectional relationship. The opposite means that as the value of a variable increase, the other variables decrease. Unidirectional means that as the value of a variable increase, the other variables also increase. Multiple linear regression multivariate tests were conducted to determine the variables that were predictors of the prevalence of hypertension.

RESULTS

Testing Assumptions between Diet Patterns and Prevalence of Hypertension

Assumption testing was done to verify the normality of the data distribution. The assumption test was carried out using Kolmogorov-Smirnov analysis by examining the significance value > with the following hypotheses: (1) H0 if the data is normally distributed; and (2) Hi if the data is not normally distributed. Based on the results of testing assumptions using a significance level of 5%, it is obtained that the decision H0 is accepted. So, it can be concluded that the dietary pattern on the prevalence of hypertension is normally distributed (Table 1).

Pearson Correlation Test

Among the five variables studied, the Pearson correlation test was conducted to find the relationship between two variables, namely the independent and the dependent variables. The Pearson correlation test was chosen because the researcher used dependent and independent variables with ratio or interval (parametric) scales. Assumptions in Pearson correlation, data must be normally distributed. The results of the Pearson

Table 1. Testing Assumptions Between Diet Patterns and Prevalence of Hypertension

Dependent Variable		Means	Standard deviation	p-value
Prevalence of hypertension		36.89	4.42	0.989
Independent Variable	**Frequency**	**Means**	**Standard deviation**	**p-value**
Salty foods	≥ 1 per day	27.27	10.60	0.999
	1 - 6 per week	43.76	7.48	0.474
	≤3 per month	28.51	10.03	0.355
Fatty foods	≥ 1 per day	50.19	15.04	0.804
	1 - 6 per week	37.96	11.30	0.993
	≤3 per month	11.86	6.18	0.904
Sweet beverages	≥ 1 per day	57.40	11.62	0.245
	1 - 6 per week	32.39	9.93	0.125
	≤3 per month	10.21	3.09	0.589
	No consumption	8.51	5.52	0.353
Fruits and vegetables	1-2 per day	60.32	10.21	0.776
	2-4 per day	24.99	9.60	0.997
	≥5 per day	6.18	5.16	0.057
Roasted foods	≥ 1 per day	2.74	1.24	0.626
	1 - 6 per week	25.17	7.03	0.870
	≤3 per month	72.09	7.57	0.984

Table 2. The Variables that Show a Relationship with the Prevalence of Hypertension.

Variable	Frequency	r-value	p-value
Salty foods	≥ 1 per day	-0.372	0.021
	1 - 6 per week	0.141	0.399
	≤3 per month	0.29	0.077
Fatty foods	≥ 1 per day	0.208	0.209
	1 - 6 per week	-0.11	0.512
	≤3 per month	-0.306	0.061
Sweet beverages	≥ 1 per day	0.214	0.197
	1 - 6 per week	-0.118	0.48
	≤3 per month	-0.425	0.008
	No consumption	-0.469	0.003
Fruits and vegetables	1-2 per day	0.068	0.684
	2-4 per day	0.223	0.178
	≥5 per day	-0.048	0.776
Roasted foods	≥ 1 per day	-0.289	0.078
	1 - 6 per week	-0.23	0.164
	≤3 per month	0.261	0.113

correlation test with p-value below 0.05 showed that there was a meaningful relationship between dietary patterns and the prevalence of hypertension. The strength of the relationship with the Pearson correlation test was assessed from the correlation coefficient or r value. The correlation coefficient may result in positive (+) and negative (-) numbers. If the number of positive correlations means the relationship is unidirectional. Unidirectional means that if the independent variable is large, the dependent variable is getting bigger. If the result is negative, the relationship is not unidirectional. Not unidirectional means that if the value of the independent variable is large, the dependent variable is getting smaller. Correlation numbers ranged from 0-1. However, the value of r can only be read if the p-value shows a significant relationship ($p < 0.05$).

There are three variables tested that have a p-value below $\alpha < 0.05$, namely the habit of eating salty foods one time every day (p=0.021), the habit of drinking sweet drinks three times per month (p=0.008), and the habit of not consuming fruits and vegetables (p=0.003). The three variables showed a significant relationship with the prevalence of hypertension. Based on the value of r, the strong relationship between predictor variables and prevalence in order from the largest to the smallest is the habit of not consuming fruits and vegetables (r=-0.469), the habit of drinking sweet drinks three times per month (r=-0.425), and salty eating habit once a day (r=-0.372). A positive r value indicates that this variable is associated with an increasing prevalence of hypertension. Meanwhile, a negative r value indicates that this variable is associated with a decrease in the prevalence of hypertension. In addition to the aforementioned variables, another 13 independent variables have p values above the value ($\alpha > 0.05$). These variables do not show a significant relationship with the prevalence of hypertension (Table 2).

Multivariate analysis

Based on the bivariate statistical test, it is known that the risk factor variables: eating salty foods once a day, drinking sweet drinks three times per month, and not consuming fruits and vegetables showed p-value < 0.05, so these variables can be continued. Multiple linear regression multivariate analysis. In addition, several other factors that became confounding variables, such as the history of diabetes mellitus, smoking habits, and central obesity, were included in the multivariate analysis. The multivariate multiple linear regression analysis with a confidence level of 95 = 0.05 showed a significant influence between salty eating habits once a day (p=0.013) on the prevalence of hypertension. Meanwhile, the habit

Table 3. Multivariate Analysis based on the Risk Factor Variables on the Prevalence of Hypertension

Variable	B	Std. Error	Beta	p-value
Salty foods ≥ 1 per day	-0.153	0.058	-0.366	0.013
Sweet beverages ≤3 per month	-0.440	0.226	-0.293	0.072
No consumption of fruits and vegetables	-0.242	0.125	-0.302	0.061
Diabetes mellitus	0.942	1.427	0.182	0.514
Smoking	-0.116	0.164	-0.196	0.485
Central obesity	Excluded	Excluded	Excluded	Excluded

of drinking sugary drinks three times per month (p=0.072) and not consuming fruits and vegetables (p=0.061) did not give significant results on the prevalence of hypertension. No significant results were also obtained for the confounding variables analyzed, namely diabetes mellitus (p=0.514), smoking (p=0.485), and abdominal obesity (excluded) (Table 3).

DISCUSSION

The average prevalence of hypertension in East Java based on blood pressure measurements in 29 districts and nine cities in East Java is 36.32% (95% confidence interval 35.81% - 36.84%) (Riskesdas, 2018). This shows that the prevalence of hypertension in East Java is generally higher than the prevalence of national hypertension. Indonesia's basic health survey in 2018 showed that 34.1% (95% confidence interval 33.91% - 34.32%) of adults in Indonesia had hypertension (Riskesdas, 2018). Correspondingly, as part of the International Society of Hypertension initiative, the May Measurement Months (MMM) screening campaign in Indonesia in 2018 showed 34.5% of adults had hypertension (Turana, 2020). In Indonesia, low levels of awareness are reported more among men and those living in rural areas (Riskesdas, 2018). Therefore, the efforts to raise awareness and monitor blood pressure should reduce mortality and morbidity (WHO, 2013).

Three variables tested have significant results, including eating salty foods once a day, drinking sweet drinks three times per month, and non-routine of fruits and vegetable consumption. Based on the r-value, the association between predictor variables and prevalence in order from the largest to the smallest of the habit of not consuming fruits and vegetables (r=-0.469), the habit of drinking sweet drinks three times per month (r=-0.425), and salty eating habits once a day (r=-0.372).

The relationship between sodium intake and changes in blood pressure has been discussed over for decades. Hypertension is commonly observed in populations with a mean sodium chloride intake of >100 mmol/day and rarely in populations consuming <50 mmol/day (Adrogué, 2007). A meta-analysis of randomized trials lasting at least four weeks concluded that reducing the amount of sodium by 50 mmol per day reduced systolic blood pressure by an average of 4.0 mmHg and diastolic blood pressure by an average of 2.5 mmHg in hypertensive subjects. Meanwhile, decreased mean systolic blood pressure of 2.0 mmHg and diastolic blood pressure of 1.0 mmHg on average in normotensive subjects (He, 2003). Most people remain normotensive, although individual sodium intake in most populations worldwide exceeds 100 mmol per day. Sodium intake of over 50 to 100 mmol per day is still necessary, but insufficient to cause primary hypertension (Adrogué, 2007). This may result in a difference between the results of the analysis of this study and those of previous studies. Measurement of dietary patterns using the Riskesdas questionnaire only looked at the number of salty foods the respondents consume, divided into three groups, namely one time per day, 1-6 times per week, and three times per week or month.

Several epidemiological studies have assessed the association between intake of sugar-sweetened beverages and the risk of hypertension. Consumption of at least one sugar-sweetened beverage per day had a higher risk of developing hypertension (HR 1.13; 95% CI, 1.09–1.17) compared to those who did not consume sugar-

sweetened beverages. The relationship between the intake of sugar-sweetened beverages and hypertension is stronger in carbonated drinks than non-carbonated drinks (Cohen, 2012). Research results on the effect of consuming sugar-sweetened beverages in Asian populations have also shown an increased risk of hypertension, especially in obese populations (Kwak, 2019).

Biologically, sugar-sweetened beverages have a detrimental effect on hypertension, because there is strong evidence that consumption of sugar-sweetened beverages is associated with weight gain and obesity among adults (Malik, 2013). In addition, a previous dose-response meta-analysis study has shown moderate to high-quality meta-evidence for an association between sugar-sweetened beverages and an increased risk of type 2 diabetes, coronary heart disease, stroke, heart failure, and all causes. Dead (Schwingshackl, 2017). This finding is also assisted with evidence from randomized controlled trials where overweight participants consumed large amounts of sugar-sweetened beverages (1 liter per day for six months) had significantly higher blood pressure values (Maersk, 2012).

CONCLUSION

Dietary patterns of eating salty foods once a day and drinking sweet drinks three times per month is associated with a decrease in the prevalence of hypertension. In contrast, the habit of not consuming fruits and vegetables is associated with a reduction in the prevalence of hypertension. Multivariate analysis shows that eating salty foods once a day is associated with the prevalence of hypertension.

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