

Multilevel Analysis: The Contextual Effect Village on The Risk Hypertension in Magelang, Central Java

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ABSTRACT

Background: Hypertension affects one billion people worldwide. Death due to hypertension in the world is estimated at 9.4 million people every year. Factors related to lifestyle can increase the risk of hypertension. In addition, demographic and topographic factors of residence also affect the risk of hypertension. This study aimed to analyze the contextual effect of the village on the risk of hypertension.

Subjects and Method: This study was an observational analytic research study with a cross-sectional approach. This study was conducted in July 2020. A sample of 200 patients who treated at the health center was selected by purposive sampling. The dependent variable was hypertension. The independent variables were obesity, smoking habit, salt consumption, genetic history, age, physical activity, low fiber diet, and stress. Blood pressure was measured with a sphygmomanometer, obesity was measured by body mass index measured by weight scales and stature meters, and other variables with questionnaire. The data analysis used multivariate multiple logistic regression using Stata 13.

Results: The risk of hypertension increased with obesity (BMI ≥ 25 kgBW/m²) (OR= 5.33; 95% CI= 1.81 to 15.74; p= 0.002), smoking habit (OR=

6.28; 95% CI= 2.05 to 19.30; p= 0.001), excessive salt consumption (OR= 2.84; 95% CI= 0.99 to 8.11; p= 0.051), genetic history (OR= 3.95; 95% CI= 1.37 to 11.44; p= 0.011), age ≥ 45 years (OR= 17.71; 95% CI= 5.81 to 53.99; p < 0.001), lack of physical activity (OR= 3.49; 95% CI= 1.19 to 10.17; p= 0.022), low fiber diet (OR= 12.42; 95% CI= 1.87 to 82.49; p= 0.009), and stress (OR= 7.59; 95% CI= 2.22 to 25.89; p= 0.001). Village had contextual effect on the risk of hypertension with ICC= 21.65%.

Conclusion: The risk of hypertension increases with obesity, smoking habit, excessive salt consumption, genetic history, age ≥ 45 years, lack of physical activity, low fiber diet and stress. Village has contextual effect on the risk of hypertension.

Keywords: contextual effect, village, hypertension

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BACKGROUND

The major risk factor for cardiovascular disease is hypertension. Hypertension affects one billion people worldwide and increases the risk of heart attack and stroke. Due to hypertension in the world, deaths are estima-

ted at 9.4 million people each year (WHO, 2015).

Hypertension in Magelang in 2018 ranks first for non-communicable diseases in both inpatient and outpatient visits. The prevalence of hypertension in Magelang in 2018 in the adult population was 12.4%, and

this figure is greater than the prevalence of hypertension in Indonesia in 2018, which was 8.4% (Magelang District Health Office 2019).

Blood pressure tends to increase with age, so everyone is at risk for hypertension. Lifestyle-related factors can increase the risk of hypertension. These behaviors include consuming too much salt (sodium), not consuming enough potassium (from fruits and vegetables), being overweight, not getting enough exercise, drinking alcohol, and smoking. Hypertension can also be caused by heredity because people can inherit genes that make them more at risk for hypertension (Sudaryanto et al., 2019).

Factors that increase the prevalence of hypertension in adults in Lucknow, India are rapid urbanization, changes in lifestyle, changes in diet, including the use of fast food and salt intake (Khanam et al., 2019)

A study from Istyanto et al. (2019) showed that hypertension in patients at Dr. Moewardi hospital is directly and positively affected by anxiety, stress, poor sleep quality, body mass index (BMI), consumption of coffee and soft drinks. Stress levels have a direct effect on blood pressure. They can also affect sleep quality and body mass index. There was a positive correlation between stress and poor sleep quality. Poor sleep quality increases with stress. There is a positive correlation between stress and body mass index. The body mass index increases with stress.

Hypertension is also affected by demographic and topographic factors where a person lives. Living in urban areas increases the risk of hypertension by 1.33 times compared to rural Indians (Bhansali et al., 2015)

Based on this, the researcher was interested in conducting a study on "Biological and psychological factors as well as the village contextual effect on the risk of hypertension in Magelang Regency."

SUBJECTS AND METHOD

1. Study Design

This was a cross-sectional study conducted at Magelang District Health Center, Central Java, Indonesia, in July 2020.

2. Population dan Sample

The source population was the population aged 18 - 69 years in the Magelang area. The study sample was 200 people, selected by purposive sampling technique. The study subjects were patients who came for treatment at the health centers with exclusion criteria: being pregnant, using hormonal contraceptives, taking anti-hypertensive drugs, people with diabetes mellitus, people with kidney disease, and consuming alcohol.

3. Study Variables

The dependent variable of the study was hypertension. The study's independent variables were obesity, smoking habit, salt consumption, genetic history, age, physical activity, low fiber diet, and stress.

4. Operational Definition of Variables

Hypertension was the measurement of TDS ≥ 140 mmHg and TDD ≥ 90 mmHg. A continuous data scale for analysis purposes was then converted into a dichotomy.

Obesity was the percentage of fat abnormalities expressed in Body Mass Index (BMI) ≥ 25 kg/m². A continuous data scale for analysis purposes was then converted into a dichotomy.

Smoking habit was the behavior of burning tobacco in a roll of paper in the shape of a stick, smoked by mouth and done every day. The data scale was categorical.

Excess salt consumption was a high-sodium diet of more than 2,000mg or the equivalent of 1 teaspoon (tsp) of salt/person/day, which was characterized by a Preference for foods that tend to be saltier. The data scale was categorical.

Genetic history was a family history of the same child, namely father, mother, grand-

father, grandmother who has hypertension. The data scale was categorical.

Age was the life span measured from birth to the time of data collection. A continuous data scale for analysis purposes was then converted into a dichotomy.

Lack of physical activity was any movement of the body produced by skeletal muscles and requires energy expenditure as measured by a short-form IPAQ questionnaire. The results were low. The data scale was categorical.

A low-fiber diet is consuming less than five servings of fruits and vegetables per day. The data scale was categorical.

Stress was a condition that was an internal thing, which could be caused by physical demands (body), or the environment, and social situations, which were potentially damaging and uncontrollable. It was measured by the DASS questionnaire with a value > 18. The scale of continuous data for analysis purposes was converted into a dichotomy.

Village was the geographical and demographic conditions in the administrative area under the sub-district.

5. Study Instruments

The study instrument used for data collection was a questionnaire that had been tested for validity and reliability. Digital weighing scale

with an accuracy of 0.1 kg, a stature meter with an accuracy of 0.1 cm. Sphygmomanometer and stethoscope were used to measure blood pressure.

6. Data Analysis

Univariate analysis was used to determine the distribution of frequencies and percentages of the characteristics of study subjects. Bivariate analysis was carried out between the dependent and independent variables to determine the correlation between the two variables. This bivariate analysis used the chi-square test with a significance level of $p < 0.05$ and an odds ratio calculation with a 95% confidence level. Multivariate analysis used logistic regression analysis with a multilevel approach to determine the village contextual effect on hypertension risk.

7. Research Ethic

Ethical clearance in this study was published by the Health Research Ethics Commission of Dr. Moewardi, Surakarta, with number 318/-II/HREC/2020 on March 02, 2020.

RESULTS

A. Sample Characteristics

Characteristics of study subjects for continuous data are shown in Table 1. The characteristics of the categorical data study subjects are shown in Table 2.

Table 1. Characteristics of study subjects (continuous data)

Characteristics	N	Mean	SD	Min.	Max.
Age (year)	200	36.89	13.81	18	69
Systolic blood pressure (mmHg)	200	114.08	15.88	85	170
Diastolic blood pressure (mmHg)	200	76.94	9.76	60	100
Body mass index (kgBB / m2TB)	200	23.27	4.29	15.20	38.40

Table 1 shows that the number of study subjects was 200 people; the average age was 36.89 years. The youngest was 18 years old and the oldest was 69 years old. The mean systolic blood pressure of the study subjects was 114.08 mmHg. The lowest systolic blood pressure was 85 mmHg and the highest was

170 mmHg. The mean diastolic blood pressure of the study subjects was 76.94 mmHg. The lowest systolic blood pressure was 60 mmHg, and the highest was 100 mmHg. Body mass index (BMI) averaged 23.27 kg/m². The lowest BMI was 15.20 kg/m², and the highest was 38.40 kgBW/m².

Table 2. Characteristics of study subjects (categorical data)

Variable	N	%
Hypertension		
No	157	78.50
Yes	43	21.50
Obesity		
Not obese (BMI <25 (kg/m ²))	139	69.50
Obesity (BMI ≥25 (kg/m ²))	61	30.50
Smoking habit		
Did not smoke	162	81.00
Smoke	38	19.00
Salt Consumption		
Not excessive	113	56.50
Excessive	87	43.50
Genetic history of hypertension		
No	151	75.50
Yes	49	24.50
Age		
Age<45 years	137	68.50
Age≥45 years	63	31.50
Physical activity		
Enough physical activity	141	70.50
Lack of physical activity	59	29.50
Fiber diet		
Enough fiber diet	35	17.50
Low fiber diet	165	82.50
Stress		
No	176	88.00
Yes	24	12.00

Table 2 shows the prevalence of hypertension by 21.5%. The prevalence of risk of hypertension and obesity was 30.50%, smoking 19.00%, excess salt consumption 43.50%, genetic history 24.50%, age ≥45 years 31.50%, lack of physical activity 29.50%, 82.50% low fiber diet and stress 12.00%.

B. The result of bivariate analysis

Bivariate analysis was used to see the independent variable's effect on the dependent variable using the chi-square test. The bivariate analysis of the results of this study can be seen in Table 3.

C. The result of multivariate analysis

Multiple logistic regression analysis with multivariate approaches explained the effect of more than one independent variable (obesity, smoking habit, salt consumption, genetic history, age, physical activity, fiber diet,

and stress) on the dependent variable (hypertension). The results of multilevel multiple logistic regression analysis can be seen in Table 4.

The results of the multivariate analysis showed that obesity affected the risk of hypertension. People who had a Body Mass Index (BMI) ≥ 25 had a risk of hypertension 5.33 times than people who had a BMI <25 (OR= 5.33, 95% CI= 1.81-15.73, p= 0.002).

Smoking habits affected the risk of hypertension. People who had a smoking habit had a risk of 6.28 times than non-smokers (OR= 6.28, 95% CI= 2.05-19.30, p= 0.001).

There was an effect of salt consumption on the risk of hypertension. People who have an eating habit of eating salty food had a risk for hypertension by 2.84 times than people

who have no eating habits of eating salty food (OR = 2.84, 95% CI = 0.99-8.11, p = 0.051).

Genetic history of hypertension increased risk of hypertension. People who

had a family history of hypertension had a risk of hypertension 3.95 times than people without a family history of hypertension (OR= 3.95, 95% CI= 1.37 to 11.44, p <0.012).

Table 3. The results of the bivariate analysis of hypertension risk factors in Magelang

Independent Variable	Hypertension				Total		OR	95% CI	p
	No		Yes		N	%			
	n	%	n	%					
Obesity									
BMI <25 (kg/m ²)	119	85.6	20	14.4	139	100	3.60	1.24–7.27	<0.001
BMI ≥25 (kg/m ²)	38	62.3	23	37.7	61	100			
Smoking habit									
No	133	82.1	29	17.9	162	100	2.68	1.24–5.79	0.012
Yes	24	63.2	14	36.8	38	100			
Salt Consumption									
Not excessive	96	84.9	17	15.1	113	100	2.41	1.21–4.80	0.013
Excessive	61	70.1	26	29.9	87	100			
Genetic history									
No	128	84.8	23	15.2	151	100	3.84	1.86–7.90	<0.001
Yes	29	59.2	20	40.8	49	100			
Age									
<45 years	124	90.5	13	9.5	137	100	8.67	4.07–18.46	<0.001
≥45 years	33	52.4	30	47.6	63	100			
Physical Activity									
Enough	117	83.0	24	17.0	141	100	2.32	1.15–4.67	0.019
Lack	40	67.8	19	32.2	59	100			
Fiber diet									
Enough	32	91.4	3	8.6	35	32	3.41	0.99–11.75	0.052
Low	125	75.8	40	24.2	165	125			
Stress									
No	148	84.1	28	15.9	176	100	1.11	1.05–1.17	<0.001
Yes	9	37.5	15	62.5	24	100			

Table 4. Multilevel multiple logistic regression analysis on the effect of biological, psychological, and contextual village factors on the risk of hypertension

Independent Variable	OR	95% CI		p
		Lower limit	Upper limit	
Fixed Effect				
Obesity	5.33	1.81	15.73	0.002
Smoking habit	6.28	2.05	19.30	0.001
Salt consumption	2.84	0.99	8.11	0.051
Genetic history	3.95	1.37	11.44	0.011
Age	17.71	5.81	53.99	<0.001
Physical activity	3.49	1.19	10.17	0.022
Fiber diet	12.43	1.87	82.49	0.009
Stress	7.59	2.22	25.89	0.001
Random Effect				
Var (Constanta)	0.909			
N observation= 200				
N group= 25				
Log Likelihood= -54.761646				
p< 0.001				
Intraclass Correlation (ICC)= 21.65%				

DISCUSSION

1. The effect of obesity on hypertension

Obesity statistically affects hypertension. A body mass index measures this study's obesity category (BMI) greater than or equal to 25 m²/kg.

This study's results are in line with a study conducted by Amanda et al. (2018), which shows that respondents with obesity have a higher risk of developing hypertension than normal respondents in patients at Sidoarjo health center.

A high body mass index increases the risk of hypertension in Chinese children. Obesity significantly increases hypertension in Chinese children after controlling for age, race, and type of insurance (Xu et al., 2018).

As the body mass increases, the blood volume needed to supply oxygen and food to body tissues increases. As a result, the artery walls will get greater pressure, which causes an increase in blood pressure. In addition, being overweight also increases heart rate (Arifin et al., 2016)

The condition of obesity is associated with increased intravascular volume and cardiac output. Heart pump power and circulating blood volume in obesity will be higher than normal body weight. Weight loss is the element that plays a role in the prevention and treatment of hypertension (Rohkuswara and Syarif, 2017).

2. The effect of smoking habit on hypertension

Smoking habit statistically affects hypertension. A study conducted by Susi (2019) showed that smoking habits have a risk of developing hypertension 2,496 times than people with no smoking habit in men aged > 18 years in Bekasi.

The meta-analysis results on cigarette consumption and hypertension in the police and military circles show that cigarette consumption is a risk factor for hypertension.

Cigarette consumption can increase the risk by 1.45 times compared to not consuming cigarettes (Pardosi et al., 2020).

Smoking can increase blood viscosity, stimulate the adrenergic nervous system, and contribute to microvascular and macrovascular diseases. Smoking habits are still considered a major risk factor for hypertension worldwide (Wu et al., 2018).

3. The effect of salt consumption on hypertension

Excessive salt consumption affects hypertension. Salt consumption has a significant correlation with the incidence of hypertension in the Bualu Traditional Village community. Respondents who often consume salt are 7.4 times more likely to suffer from hypertension than those who rarely consume salt (Wijaya, 2017).

Excessive salt consumption (more than 5 grams of sodium per day) has resulted in a significant increase in blood pressure. Increased salt consumption can trigger water retention, causing high flow conditions in the arteries (Grillo et al., 2019).

4. The effect of genetic history on hypertension

Genetic history has a statistically significant effect on hypertension. This genetic history of hypertension was obtained from parents (father or mother) and grandparents who had hypertension.

This study's results are in line with a study conducted by Kurnianingsih et al. (2017), which showed that adolescents with a family history of hypertension had a higher risk of hypertension by 1.93 units compared to adolescents who did not have a history of hypertension. A study on an elderly Chinese population living in rural Beijing shows a strong association between family history of first-degree relatives and hypertension (Liu et al., 2015).

The effect of family history of hypertension on hypertension increases with kinship

closeness, where the parental history of hypertension has a higher risk than the history of grandparents. The risk of hypertension increases if you have more than one hypertensive family member (Alhawari et al., 2018).

5. The effect of age on hypertension

The age factor significantly affects hypertension. More than or equal to 45 years has a risk of hypertension by 21.44 times than those aged less than 45 years.

A study conducted by Ismail et al. (2016) explained that increasing age is a major risk factor for increasing blood pressure in coastal populations in South India.

The increased risk of hypertension at age ≥ 45 years occurs due to atherosclerotic changes with age so that the arteries and arterioles become less elastic. Arteries and arterioles that are not elastic cause an increase in blood pressure. The prevalence of hypertension is found to continue to increase with age. The lowest prevalence of hypertension was seen in the 18-25 age group, and in the 56 to the 60-year age group, the prevalence of hypertension increased with a statistically significant difference (Laxman, 2018).

As you get older, your blood pressure will also increase. The arterial walls will experience thickening caused by the buildup of collagen substances in the muscle layer, resulting in blood vessels narrowing and becoming stiff after the age of 40 (Amanda and Martini, 2018).

Another condition that supports the incidence of hypertension in old age is that telomeres are known to shorten with age. Telomere shortening is progressive with aging and is associated with cardiovascular disease. Short telomeres increase the risk of hypertension (Zgheib et al., 2018).

6. The effect of physical activity on hypertension

Physical activity affects the occurrence of hypertension. People with a lack of physical

activity have 3.88 times the risk for hypertension than people who have enough physical activity.

These results are in line with a study conducted by Amra et al. (2020), which stated that parents in Aceh Singkil, namely people who lack physical activity, have a risk of hypertension 2.86 times who have enough activity.

Isotonic and regular exercise can reduce peripheral resistance, lower blood pressure in people with hypertension, and train the heart muscle so that it becomes accustomed to when the heart has to do heavier work. Lack of physical activity will increase the likelihood of obesity. Inactive people also tend to have a higher heart rate, so the heart muscle has to work harder with each contraction (Wijaya, 2017).

The mechanism by which physical exercise can affect blood pressure is the regulation of endothelial function. Vascular homeostasis relies on endothelial activity, which is a fundamental regulator of vasomotor response and vascular resistance. Hypertension is characterized by microvascular refinement caused by impaired angiogenesis. Constant physical exercise has been shown to induce blood vessels and increase blood flow (Gambardella et al., 2020).

7. The effect of fiber diet on hypertension

A low-fiber diet increases the risk of hypertension. People who eat fruits and or vegetables < 5 servings per day have a risk for hypertension by 10.27 times than people who eat fruits and or vegetables ≥ 5 servings per day.

A prospective cohort study of women and men in the United States suggests the long-term intake of total fruit is associated with a reduced risk of hypertension. Raisins, grapes, apples, pears, blueberries, and avocados, when consumed ≥ 4 servings/week, can reduce hypertension risk (Borgi et al., 2016).

A prospective cohort study of adults in Korea found that frequent fruit consumption (4 servings/day) reduced the risk of hypertension 56% to 67% lower than fruit consumption <1 serving/day. Fruit is rich in many nutrients with anti-oxidant properties, such as flavonoids, anthocyanins, polyphenols, fiber, vitamin C, potassium, and magnesium, associated with lowering blood pressure (Kim et al., 2018).

Vegetables and fruit are a group of foods rich in potassium. High potassium intake can lower blood pressure. Potassium's mechanism in preventing narrowing of blood vessels (atherosclerosis) is by keeping arterial artery walls elastic and optimizing their function, so they are not easily damaged by high blood pressure. Potassium's mechanism is opposite to sodium, which tends to draw fluid from the extracellular part and reduce blood pressure (Leo et al., 2020).

8. The effect of stress on hypertension

Stress factor has a statistically significant effect on hypertension. People who experience stress have an increased risk of hypertension by 6.15 times than people who are not stressed.

This study's results are in line with a study conducted by Arifin et al. (2016), which stated that there is a significant correlation between stress levels and the incidence of hypertension in the elderly in Badung, Bali. Stress is an independent risk factor for hypertension in adults. Stress has a chance of hypertension 2.49 times (Bhelkar et al., 2018).

A study in Wisconsin, United States, showed individuals with high hair cortisol were twice as likely to develop hypertension as those with low hair cortisol. Increased systemic cortisol can cause vascular endothelial dysfunction. High cortisol levels inhibit the expression of induced nitric oxide synthase, decrease the availability of endothelial nitric oxide, and increase regional vascular

resistance, leading to increased blood pressure and hypertension (Bautista et al., 2019).

Stress can stimulate the kidneys to release the hormone adrenaline. The hormone adrenaline can increase blood viscosity and cause blood pressure to increase. The hormone adrenaline also plays a role in accelerating the heart rate and affects blood vessels' constriction. As a result, the heart will beat stronger to increase blood pressure (Arifin et al., 2016).

9. The effect of the contextual village on hypertension

The results of this study obtained an Intra Class Correlation (ICC) value of 17.31%, which means that the context of the village in Magelang affects the risk of hypertension. The variations in the villages in this study include area topography and population density.

Villages that are in the lowlands with high population density have the highest prevalence of hypertension. The highest risk factors in the densely populated lowland village group are genetic history, age ≥ 45 years, excess salt consumption, obesity, lack of physical activity, and stress.

Lowland villages with high population density have a typology similar to urban areas. A study conducted by Khanam et al. (2019) on differences in the prevalence and determinants of rural-urban hypertension in adults in Bangladesh stated that the prevalence of hypertension in urban areas is 32.6% and in rural areas 23.6%. Several risk factors, such as obesity, diabetes, and wealth status, are more concentrated in urban areas so that urban residents have a higher risk of hypertension.

A study conducted by Daştan et al. (2017) concerning urban and rural differences in risk factors for hypertension in Turkey found that the factors that contribute to the risk of hypertension show some variation

based on urban and rural areas. This study found that the factors associated with hypertension in urban areas were marital status, type of work, and lifestyle, including diet. Psychological factors have also been found to be associated with hypertension.

The conclusion obtained from the study is that there is a significant effect between obesity, smoking habit, excessive salt consumption, the genetic history of hypertension, age ≥ 45 years, lack of physical activity, low fiber diet, and stress on the risk of hypertension. Variation in the village shows a contextual effect on the risk of hypertension.

AUTHOR CONTRIBUTION

Wawan Diyantana as the main researcher and research implementer, collected study data, prepared articles of the study, and processed data. Dono Indarto played a role in the preparation of the background and discussion of the study. Bhisma Murti played a role in formulating a study framework of thinking and analyzing research data.

CONFLICT OF INTEREST

There is no conflict of interest in this study.

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