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RESEARCH ARTICLE

Characteristics of body mass index and sodium intake of adults with hypertension family history in Yogyakarta

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ABSTRACT

Hypertension is a progression of prehypertension due to the accumulation of several non-genetic risk factors (environmental factors) that occur together (common underlying risk factors) or genetic factors or the interaction between the two. Risk factors for hypertension that can be controlled include high sodium intake, lack of physical activity, obesity, smoking, and alcohol consumption, while risk factors that cannot be controlled include increasing age, gender, and a family or genetic history of hypertension. This study aimed to determine the characteristics of Body Mass Index (BMI) and sodium intake in adults with a family history of hypertension in Yogyakarta. This study used a case-control design. Subjects studied were healthy individuals with a family history of hypertension as case subjects (n = 42), and control subjects were individuals without a family history of hypertension (n = 41). Body mass index (BMI) was measured with anthropometry, and sodium intake was measured using a quantitative food frequency questionnaire. Independent Sample T-test and Chi-Square test analyzed the data with a significance level of $p < 0.05$. The average BMI and sodium intake are higher in the case group than in the control group. There was no significant association between BMI and sodium intake and risk factors of hypertension ($p>0.05$). Body mass index and sodium intake in the case and control group were not significant differences ($p>0.05$). The BMI values and sodium intake levels were higher in the group of individuals with a family history of hypertension compared to those without a family history of hypertension, but not statistically significant.

1. Introduction

Hypertension, or high blood pressure, is a worldwide health issue. The burden of overcoming hypertension is the same for all countries, whether they have a high, middle, or low income. World Health Organization reported that the prevalence of hypertension in people aged 18 and over is 22.1% worldwide, with a male-to-female ratio of 24.1 % : 20.1 % (WHO, 2015).

Hypertension is a significant non-communicable disease in Indonesia. With 15 million people suffering, only 4% of them have their blood pressure under control. Adults have a prevalence of 6–15%, and half of them are unaware that they have hypertension because they do not recognize the indicators or risk factors that could have prevented it from becoming severe. As a result, it was preventable and progressed to severe hypertension, with essential hypertension accounting for 90% of cases (Kementerian Kesehatan, 2011). The prevalence of hypertension in Indonesia increased from 25.8% to 34.1% in 2013 and 2018 (Kementerian Kesehatan

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Republik Indonesia, 2013, 2018).

Hypertension is caused by multiple risk factors and develops from prehypertension, which is defined as a systolic blood pressure of 120 -139 mmHg or a diastolic blood pressure of 80 to 89 mmHg. Prehypertension comprises several long-term cardiovascular risk factors and can progress to hypertension over time (Li *et al.,* 2008). Prehypertension affects 25-50% of adults. It indicates a higher risk of cardiovascular disease and a rise in blood pressure (Egan & Stevens-Fabry, 2015). At the age of 55, people who are not hypertensive have a 90% chance of acquiring hypertension (Chobanian, 2003; Yang *et al.,* 2015). According to the Framingham Heart Study, those with prehypertension are 3.5 times more likely than people with normal blood pressure to suffer a heart attack (Xu *et al.,* 2016). Any increase in systolic or diastolic blood pressure of more than 20/10 mmHg doubles the risk of cardiovascular disease (Churniawati *et al.,* 2015).

By 2025, the goal is to achieve a 25% relative reduction in the prevalence of high blood pressure or a 25% relative reduction in the prevalence of high blood pressure depending on national circumstances, a 10% relative reduction in the prevalence of insufficient physical activity, a 30% relative reduction in mean population salt/sodium intake, and a 10% relative reduction in the harmful use of salt/sodium. There is a 30% reduction in current cigarette use in those over the age of 15, and at least half of those who are eligible receive medication therapy and counseling to prevent heart attacks and strokes (WHO, 2013).

High blood pressure is produced by increased sodium consumption in the body, which causes bodily fluids to be retained, increasing blood volume and forcing the heart to work harder to push the blood through progressively narrow areas, resulting in hypertension (Kautsar *et al.,* 2014). This is in line with Hafid's (2014) research in Banteang Regency, Makassar, which claims that sodium intake during the diffusion and osmosis process can influence high blood pressure because excess sodium can hold water, which causes the heart to work harder to pump blood. After all, it can increase blood pressure (Hafid, 2015).

In addition to sodium intake, another factor that affects hypertension is body mass index (BMI). BMI might be one of the risk factors for hypertension in teenagers. According to Anyaegbu *et al.,* 2014, having a higher BMI is directly proportional to having a higher risk of hypertension (Anyaegbu & Dharnidharka, 2014).

The incidence of hypertension in Indonesia is 25.8%, according to the 2013 Basic Health Research (Riskesdas) results (Ministry of Health, 2013). Yogyakarta comes third with a figure of 12.8%, much higher than the average for Indonesians (Ministry of Health of the Republic of Indonesia, 2014).

In Indonesia, urban areas have more excellent rates of hypertension than rural ones (Aisyiyah, 2009). The prevalence of hypertension was 5.1% in urban areas and 5.6% in rural areas, according to the Basic Health Research (Riskesdas) study (Ministry of Health, 2013). This results from the poor utilization of health facilities in metropolitan areas (Aizawa & Helble, 2016). This research aims to determine the characteristics of BMI and sodium intake in adults with a family history of hypertension in Yogyakarta.

2. Materials and Methods

2.1 Study design

The research design was a case-control study, part of research entitled "Aldosterone synthase polymorphism -344T/C and plasma aldosterone levels in individuals with a family history of hypertension." The Medical and Health Research Ethics Committee of the Faculty of Medicine Universitas Gadjah Mada approved the study, with registration number KE/FK/646/EC. All participants signed an informed consent form indicating their willingness to participate in this study.

The research subjects were individuals with a family history of hypertension and without hypertension based on the medical record data of their parents who underwent outpatient treatment at Rajawali Citra Hospital, Yogyakarta, from January 2012 to August 2014. The case group is individuals who must meet the inclusion criteria, namely male or female aged 19 - 40 years, appear healthy, have a family history of hypertension, and are of Javanese ethnicity (at least three generations). Case subjects were excluded if they were pregnant, smokers, alcohol consumption, and the use of hormonal contraceptives. Subjects for the control group were individuals who had the same inclusion and exclusion criteria as the case subjects but did not have a family history of hypertension. Initially, 98 subjects were recruited. however, 15 subjects were excluded, resulting in a total respondent of 83 (42 cases and 41 controls). Simple random sampling is used for sampling, calculated by equations 1-3 (Sastroasmoro & Ismael, 2002).

BMI was calculated by the subject's weight (kg) divided by the square of height (m). The auscultation method was used to measure systolic and diastolic blood pressure on the left upper arm in a sitting position after resting for at least 15 minutes using a sphygmomanometer. According to the American Heart Association, hypertension is defined as a mean systolic blood pressure of 140 mmHg and a mean diastolic blood pressure of 90 mmHg. A modified Semi-Quantitative Food Frequency questionnaire (SQ-FFQ) was used to

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The research subjects consisted of case and control groups.

$$n1 = n2 = \frac{\left(Z\alpha\sqrt{2PQ} + Z\beta\sqrt{P_1Q_1 + P_2Q_2}\right)^2}{(P_1 - P_2)^2} \quad \text{.....(1)}$$

$$n1 = n2 = \frac{\left(1{,}96\sqrt{2.0{,}45.0{,}55} + 0{,}842\sqrt{0{,}60\,.0{,}40 + 0{,}30.\ 0{,}70}\right)^2}{(0{,}60 - 0{,}30)^2} \quad \text{.....(2)}$$

$$n1 = n2 = 41{,}64 \approx 42 \text{ peoples} \quad \text{.....(3)}$$

calculate the sodium intake of the respondents. Then calculate the daily nutrient intake using the weight of the material food per day using Nutri Survey Application (Arisman, 2010; Shabrina, 2017). The differences in BMI, sodium intake, and blood pressure were analyzed by T-Test or Mann-Whitney Test. The Spearman test was used to analyze the relationship between BMI, sodium intake, and blood pressure.

3. Results

Most of the respondents in the case and control groups were female, aged 19-26. Based on occupation, 59,5% of respondents in the case group were employed, and in the control group, only 4.9% were unemployed. Most of the respondents in both groups were well-educated (Table 1). Table 2 shows the BMI between the case and control group was not significantly different (p>0.05). Systolic blood pressure in the case group was significantly higher (p<0.05) than in the control group.

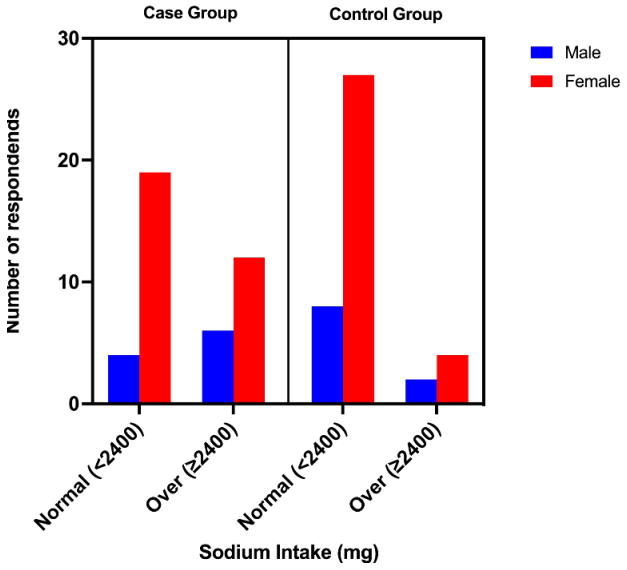

Figure 2. The distribution of sodium intake based on sex in case and control groups

Table 1. Characteristics of subject study

Characteristics	Case (n, %)	Control (n, %)
Sex		
• Male	11 (26.2)	10 (24.3)
• Female	31 (73.8)	31 (75.7)
Age		
• 19-26	25 (59.5)	21 (51.2)
• 27-34	17 (40.5)	20 (48.8)
Occupation		
• Civil servant/Privately /self-employed	23 (54.7)	39 (95.1)
• Housewife	19 (45.3)	2 (4.9)
Education		
• Middle-High School	16 (38.1)	2 (4.8)
• Diploma/Bachelor	26 (61.9)	39 (95.2)

Table 2. Body mass index (BMI), blood pressure, and sodium intake in case and control groups

Characteristics	Case (n =42)	Control (n =42)	p (CI 95%)
Antopomethry			
• Body weight (kg)	52.23 ± 8.47	52.65 ± 8.39	0.821#
• Body height (cm)	158.76 ±8.93	159.90 ± 7.73	0.536#
• BMI (kg/m^2)	20.63±2.04	20.48 ± 1.8	0.725#
Blood pressure			
• Systolic (mmHg)	110 (90-130)	100 (90-110)	0.725#
• Diastolic (mmHg)	70 (60-80)	70 (60-70)	0.114*
Average of Sodium intake (mg)	2405.18	2398.23	

Note: #Independent Samples T-Test; *Mann-Whitney U Test

The average sodium intake in the case group is higher than the control group. Based on the category of sodium intake, a female who consumed more than 2400 mg/day was higher than those in the control group (Figure 2). The Spearman test showed there was no significant relationship between sodium intake and blood pressure as a risk factor for hypertension (p>0.05). BMI did not significantly correlate to blood pressure as a risk factor for hypertension (p>0.05).

4. Discussion

Hypertension is a non-communicable disease that causes biological to economic impacts. Hypertension is known as the "silent killer" since it kills people without being noticed. Smoking, obesity, salt and fat consumption, alcohol, stress levels, and a lack of physical activity are risk factors for high blood pressure. Heredity, ethnicity, age, and gender are strict in controlling predisposing factors. Genetic propensity, for example, if both parents have hypertension, the likelihood of developing hypertension is 45%. The danger of heart and blood vessel damage in a person increases as their blood pressure rises. Uncontrolled hypertension can lead to heart disease, stroke, renal disease, retinopathy, peripheral vascular disease, and nerve and brain issues (Kemenkes RI, 2019). Hypertension becomes increasingly common as people get older, and males are more likely than women to have it (Maulana, 2009).

The study was conducted on teenagers and young adults to prevent hypertension, particularly in individuals with a family history of hypertension. The prevalence of childhood arterial hypertension in 2015 ranged from 4.32% among children aged six years to 3.28% among those aged 9 years and peaked at 7.89% among those aged 14 years (Song *et al.,* 2019). Excessive salt consumption is correlated with a higher incidence of arterial hypertension at the population level. The relationship between obesity and salt sensitivity has been explored. They discovered that the blood pressure of obese teenagers is responsive to salt consumption in the diet and that this responsiveness could result from the interaction of hyperinsulinemia, hyperaldosteronism, and heightened sympathetic nervous system activity: all signs of obesity (Roccini *et al.* in 1989)

Having high blood pressure runs in the family raises the likelihood of developing hypertension (AHA, 2014). According to a study conducted in China's Miyun province, a person with a family history of hypertension is 4 times more likely to acquire hypertension (Liu *et al.,* 2015). A family medical history records diseases and health problems in the family. Family medical history might also reveal the likelihood of developing rare diseases caused by gene abnormalities. Each family member will have the same genes, environment, and way of life (NIH, 2020).

Ayukhaliza's research (2020) shows that a family history of hypertension is the most significant risk factor for hypertension in Tanjung Tiram's coastal area. According to the multivariate study results, a family history of hypertension has a strong link with the occurrence of hypertension (p-value 0.000; OR 11.387). People who come from a hypertensive family are 11.387 times more likely to get hypertension than those who do not come from a hypertensive family (CDC, 2019).

This study indicates that there was no significant relationship between sodium intake, BMI, and blood pressure as a risk of hypertension incidence. This result aligns with Fitriani's (2012) and Sapitri's (2016) study, which found no link between sodium intake and heart disease. This could be related to the respondents' educational levels, both in the case and control groups, with the majority having received a university degree and being more aware of the significance of reducing sodium consumption (Ayukhaliza, 2020; Fitriana *et al.,* 2012). People with university degrees were revealed to be protective against hypertension (OR=0.16; 95% CI: 0.04-0.57) (Sapitri *et al.,* 2016).

No statistically significant difference existed between the case and control groups' BMI and systolic-diastolic blood pressure. Although the case group's BMI and blood pressure are higher than the control group, it can be seen that the case group's BMI and blood pressure are normal. The higher the BMI, the higher the prevention of hypertension in senior high students in urban areas (Indriawati *et al.,* 2020). However, another study found that a BMI above average increases the risk of hypertension in rural areas and ages above 30. The different results due to the background of respondents.

Obesity has been linked to an increase in blood pressure in several studies (Aripin *et al.,* 2015). Obesity triggers various mechanisms in the body, including dyslipidemia and atherosclerosis, contributing to high blood pressure (Dua *et al.,* 2014). Being overweight or obese caused the heart and circulatory system, potentially leading to significant health issues, including hypertension.

The average sodium intake in the case group is higher than the control group. The daily diet of individuals in a family environment with a history of hypertension tends to like foods that contain high sodium. According to the research conducted by Johnson *et al.* (2017), Indian people consume more salt. Patients suffering from hypertension consuming more sodium than required by the body in both urban and rural areas need to pay more attention as it may lead to further complications. The World Health Organization

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recommends that adults consume sodium no more than 2 g/day (equal to 5 g of salt) (Jiang *et al.,* 2016). The Ministry of Health recommends sodium consumption restrictions of no more than 2000 mg or 5 g of salt/ day (equivalent to 1 teaspoon) (WHO, 2012).

When sodium intake is excessive, it negatively influences the body (Jiang *et al.,* 2016). The most significant contributor to salt consumption is the community's cultural environment and food consumption habits (Setditjen Farmalkes, 2013). High sodium intake and high blood pressure are linked to water retention, peripheral system resistance, sympathetic activity modification, and autonomic nerve modulation in the circulatory system (Prihatini *et al.,* 2016).The World Health Organization (WHO) is concerned about sodium intake to reduce various health problems, including hypertension. Reduced salt consumption has been linked to improved health. If worldwide salt consumption were decreased to recommended limits, it is projected that 2.5 million fatalities may be avoided each year (Grillo *et al.,* 2019). Based on the results of research showing the characteristics of BMI and sodium intake, it is expected that someone with a family history of hypertension will pay more attention to diet and maintain BMI values in the normal range.

5. Conclusion

Adults with a family history of hypertension had higher BMI and total sodium intake than individuals without a family history of hypertension. However, there is no relationship between sodium intake and BMI and blood pressure as a risk factor for hypertension. Long-term prospective studies with larger samples are needed to corroborate the study's findings.

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Conflict of interest

The author has no conflict of interest in this article.

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