HYPERTENSION AND RISK FACTORS: A CASE CONTROL STUDY

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ABSTRACT

Hypertension is a global health issue. It is the leading cause of morbidity and mortality. Therefore, the management and reduction of risk factors are essential to prevent and control the incidence of hypertension. The research aims to find out the risk factors associated with the incidence of hypertension in Puskesmas Matiti, Humbang Hasundutan District. This study is a correlation analytic study with a case control approach.. The population case is all the people with hypertension and the population control is the people without hypertension at Puskesmas Matiti. The research samples are composed of 32 people with hypertension and 64 people without hypertension. The samples are obtained using simple random sampling technique. Data are collected using questionnaires and analyzed using logistic regression test. The result indicates that sodium consumption (0.007<0.05) and obesity (0.025<0.05), both have a significant correlation with the incidence of hypertension. While smoking (0.054>0.05) and alcohol consumption (0.558>0.05), both have no significant correlation with hypertension incidence. The research concludes that the risk factors associated with the incidence of hypertension in Puskesmas Matiti are sodium consumption and obesity, with sodium consumption being the dominant factor. It is recommended to practice a healthy lifestyle by limiting the consumption of high sodium foods and maintaining the ideal weight by exercising and maintaining a healthy diet.

Keyword: Alcohol Consumption; Hypertension; Obesity; Smoking; Sodium Consumption

1. INTRODUCTION

Hypertension is a major global health problem because it is a pathway or risk factor for diseases like heart disease, stroke and kidney failure (P2PTMKemenkesRI, 2019). A person is diagnosed with hypertension if the results of blood pressure measurements show systolic pressure (the first number) $\geq$ 140 mmHg and/or diastolic pressure (the second number) $\geq$ 90 mmHg at more than 1 visit (WHO, 2021).

The prevalence of hypertension is increasing every year (WHO, 2021). Over the past 30 years, the number of adults with hypertension has increased from 650 million to 1.28 billion and is projected to increase to 1.56 billion by 2025(Singh et al., 2017; WHO, 2021). InUnited States, approximately 116

million adults suffer from hypertension (CDC, 2021a). In the European Union, 22% of the population over 15 years old have hypertension (Eurostat, 2021). In Southeast Asia, 33.3% of adults live with hypertension (Nawi et al., 2021). And, In Indonesia, hypertension prevalence increased from 25.8% in 2013 to 34.1% in 2018.(P2PTMKemkesRI, 2021).

Hypertension is recognized as a risk factor for cardiovascular disease and one of the leading causes of death around the world(WHO, 2021). It is estimated that 7.7-10.4 million people die from hypertension each year(Zhou et al., 2021). Hypertension is also a burden both financially, due to lost productivity from its complications, and on the health care system (Hafiz et al., 2016). In United States, the cost of treating hypertension is estimated to be

between $131 billion and $198 billion each year. This amount does not include lost productivity due to hypertension-related morbidity(CDC, 2021b). In Eastern Europe and Central Asia, hypertension accounts for 22.6% of all health care costs(Mills et al., 2020). Data from the Health Social Security Organizing Agency (BPJS) indicate that the cost of hypertension services increased annually, by Rp2.8 trillion in 2016 and Rp3 trillion in 2018.(P2PTMKemenkesRI, 2019).

Considering the impact of hypertension, WHO targets a 33% reduction in prevalence between 2010-2030 (WHO, 2021). Management and reduction of risk factors are recommended for the prevention of hypertension (Mills et al., 2020). Risk factors for hypertension are divided into non-modifiable and modifiable risk factors. Non-modifiable risk factors include heredity, gender, race and age, family history of hypertension, age > 65 years, and the presence of other co-morbidities, including diabetes and chronic kidney disease(Allameh et al., 2022; Nawi et al., 2021). Modifiable risk factors include diet, exercise, alcohol and smoking, stress, and obesity(Allameh et al., 2022; Nawi et al., 2021). Knowing the factors associated with high blood pressure will hopefully enable the community to change their lifestyles to prevent hypertension, and for patients with hypertension themselves, to support blood pressure control to prevent the progression of the disease to other organs and to improve quality of life. Therefore, prevention and control programs based on risk factors are a necessity (Allameh et al., 2022).

Puskesmas Matiti is a health center with the highest number of hypertension patients in Humbang Hasundutan Regency, whose number of hypertension patients has been increasing, in 2019, there were 5330 hypertension patients and it increased to 5646 in 2021. The Batak people, who are in the habit of eating sodiumy food, drinking tuak (a traditional alcoholic drink) and smoking, mainly live in the working area of Puskesmas Matiti. Considering this phenomenon and the increasing prevalence of hypertension, Hypertension and its risk factors need to be studied in Puskesmas Matiti..

2. METHOD

This research is a correlation analytical study with a case-control approach. The population of the study cases were residents of Puskesmas Matiti working area who were diagnosed with hypertension while the control population were residents who were not diagnosed with hypertension. The number of samples was determined using the sample size formula of Lwanga &Lameshow (α 5% and β 20%). The values of p1 = 0.35 and p2 = 0.55 were obtained from the study of Arum (2019). Thus, the sample size obtained is 32 people, so the ratio of cases and controls is 1: 2. That is, the sample for the case is 32 people and the sample for the control is 64 people. Thus, the total sample size is 96. The samples were taken using simple random sampling technique. A visit was made to the home of the case sample, whose address was obtained from medical records, while the control sample was a neighbor of the case, whose house was closest to the case sample's house.

$$n = \frac{\left\{ z_{1-\alpha} \sqrt{2\overline{P}(1-\overline{P})} + z_{1-\beta} \sqrt{P_1(1-P_1) + P_2(1-P_2)} \right\}^2}{\left(P_1 - P_2 \right)^2}$$

Data were collected through interviews using a questionnaire to determine smoking, alcohol consumption, sodium consumption, and obesity. The collected data were first subjected to Chi-square test. If the test results obtained a p-value <0.25, the variable is analyzed multivariately with logistic regression test.

3. RESULT

Table 1 shows that the gender of the majorityof males in both hypertension and non-hypertension groups, the age of the majority of 55-64 years in both hypertension and non-

hypertension groups, the education in the hypertension group is mostly junior high school and in the non-hypertension group is mostly high school, the occupation of the majority of farmers in both hypertension and non-hypertension groups.

Table 1. Description of Responden Demographics in Puskesmas Matiti

Demographics	Hypertension		F	%
	Yes	No		
Sex				
Man	19	36	55	57,3
Woman	13	28	41	42,7
Age				
25-34	0	4	4	4,2
25-44	4	11	15	15,7
45-54	12	21	33	34,3
55-64	16	28	44	45,8
Level of Education				
Elementary School	5	9	14	14,6
Junior High School	12	19	31	32,3
Senior High School	9	24	33	34,4
Higher Education	6	12	18	18,7
Work				
Housewife	6	11	17	17,7
Civil Servant	3	8	11	11,4
Private Employee	4	5	9	9,4
Self-employed/Trader	5	9	14	14,6
Farmer	14	31	45	46,9

Table 2 shows that based on the Chi-square test, smoking (0.029<0.05), sodium consumption (0.039<0.05) and obesity (0.003<0.05) have an association with hypertension, while alcohol consumption (0.558>0.05) has no association with hypertension.

Table 2. Relationship of Variable With Hypertension Incidence

Variable	Hypertension		P	OR	95%CI
	Yes	No			
Smoking					
Yes	23	31	0,029	2,7	1,09-6,78
No	9	33			
Alcohol Consumption					
Yes	20	36	0,558	1,29	0,54-3,09
No	36	28			
Sodium Consumption					
High	27	41	0,039	3,02	1,02-8,94
Low	5	23			
Obesity					
Yes	18	16	0,003	3,8	1,57-9,47
No	14	48			

Table 3 shows that after the binary logistic regression test, it can be seen that the variables associated with hypertension in Puskesmas Matiti in 2023 are sodium consumption and obesity (p < 0.05), while the variable smoking is not associated with hypertension (p> 0.05).

The dominant variable is the consumption of sodium (OR = 3.8).

Tabel 3. Result of RegresiLogistik Binary Test

Variabel	B	P	OR	95% C.I.
Merokok	0,968	0,054	2,63	0,98-7,04
Konsumsi Garam	1,335	0,025	3,8	1,18-12,22
Obesitas	1,329	0,007	3,77	1,44-9,84
Constant	-2,810	0,000	0,06	

The value of the Negelkerke R square shows the coefficient of determination. The value was 0.237, which means that 23.7% of the influence of all independent variables on the dependent variable, which significantly influenced the variables of sodium consumption and obesity. This shows that hypertension is a multifactorial disease.

Table 4. KoefisienDeterminan

Step	-2 Log likelihood	Cox & Snell R Square	Nagelkerke R Square
1	104.259[a]	.171	.237

4. DISCUSSION
Demographics

The results showed that the majority of respondents with hypertension were male. In a study by Amanda & Martini (2018), it was found that the incidence of hypertension was 1.754 times higher in the male sex than in the female sex. Men are more likely to be at risk for elevated blood pressure because the male sex does not have the hormones found in the female sex, such as the hormone estrogen, so men do not have protection against hypertension and its complications. The estrogen hormone itself is obtained by women during menstruation each month and continues to be renewed. However, when a woman reaches menopause, estrogen hormone decreases and the risk of hypertension increases. The hormone estrogen plays a role in increasing high-density lipoprotein (HDL) levels. It also makes blood vessels more elastic(Rahmadhani, 2021).

The results also showed that the majority of respondents were in the 55-64 year age category. A study by Arum (2019) also found that the majority of people with hypertension were in the 55-64 year age category. Another study by Amanda & Martini, (2018) concluded that the risk of developing hypertension increases with age. Generally, hypertension occurs in people over the age of 40. After 40 years of age, individuals over 40 years of age will lose elasticity in the walls of blood vessels. This will result in increased blood pressure due to the blood continuing to be pumped without the blood vessels dilating. Aging causes changes in the normal function of organs, such as collagen buildup in the tunica media of blood vessels. This causes a narrowing of the lumen of the blood vessels. This is also due to an increase in cardiac output, as well as a decrease in sensitivity to action potentials in response to blood pressure in the arteries, resulting in decreased filtration of blood flow in the glomerulus. Changes in blood pressure from adolescence to adulthood are most likely to be hypertensive, with increased blood pressure and impaired circulation in the blood vessels, whose structure in the blood vessel wall hardens and thickens with age (Arum, 2019).

Most of those surveyed were middle-educated. Notoatmodjo says a person's level of education affects their ability to receive information and process it before it becomes good or bad behavior. The higher the level of education, the easier it will be to receive information, and ultimately the more knowledge an individual will have. Knowledge or cognition is an important area for the formation of a person's actions. The increase in the patient's knowledge about hypertension will encourage a person to have better behavior in the control of hypertension so that his blood pressure remains under control. Good habits are lifestyle changes like limiting fatty foods, reducing sodium, abstaining from smoking, regular exercise and avoiding stress. Patients' knowledge about hypertension also affects their adherence to treatment (Mayasari et al., 2019).

In this study, the majority of respondents with hypertension worked as farmers. Everybody experiences stress in the workplace. Working in the fields from morning to night can affect this. Farmers work hard every day. Work that takes a long time. Meanwhile, farmers sometimes have a low economic status, which triggers hypertension (Livana et al., 2017).

The Association between smoking and hypertension in Puskesmas Matiti, 2023

The study results based on chi-square test showed that there was a significant relationship between smoking habits and hypertension incidence. Other studies have also found that smoking has a significant relationship with the incidence of hypertension (Setyanda et al., 2015). The mechanism underlying the relationship between smoking and hypertension is the inflammatory process, in smokers there is an increase in the count of C-reactive proteins, including natural inflammatory proteins, resulting in an inflammatory process in the endothelium, resulting in endothelial cell dysfunction, damage to blood vessels and stiffening of the arterial wall, leading to increased peripheral vascular resistance.

Nicotine stimulates the sympathetic nervous system, which releases the stress hormone norepinephrine, which immediately binds to the alpha-1 hormone receptor. This is a hormone that travels in the blood vessels all over the body. It causes the heart to beat more quickly and the blood vessels to narrow. In addition, it will cause the blood vessels to narrow and block the normal flow of blood, causing blood pressure to rise (Tawbariah et al., 2014).

In addition to nicotine, the role of carbon monoxide, which has the ability to bind hemoglobin contained in red blood cells, is stronger than oxygen, so every time there is tobacco smoke, in addition to the reduced oxygen levels in the air, plus red blood cells will increasingly lack oxygen because what is being transported is CO and not oxygen, forcing the heart to meet the body's oxygen needs (Umbas et al., 2019).

However, the smoking variable was found to have no relationship with the incidence of hypertension based on the logistic regression test. This is supported by the study of Arifin et al (2016), who also found that smoking behavior had no relationship with hypertension. The results of this study show the opposite relationship to the above theories. This may be influenced by the type of cigarette, the duration of smoking and the number of cigarettes consumed by the respondents (Setyanda et al., 2015). The nicotine content of unfiltered cigarettes is higher than filtered cigarettes, so the risk they pose is greater (Setyanda et al., 2015). Filter cigarettes can reduce the amount of nicotine entering the body. The filter acts as a filter for the cigarette smoke that is being smoked so that not too many chemicals enter the lungs later. In addition, research by Tawbariah et al (2014) said that the higher the degree of smoking of a person, the higher the risk of hypertension. Inflammatory agents from cigarettes can cause damage to the vascular endothelium, which is a risk for hypertension and cardiovascular disease. The level of cigarette chemicals in the blood is directly

determined by the amount of cigarettes consumed. The more the number of cigarettes consumed per day, the more severe the hypertension suffered by the community (Tawbariah et al., 2014).

The Association Between Alcohol Consumption and Hypertension in Puskesmas Matiti, 2023

The results showed that alcohol consumption was not associated with the incidence of hypertension. The results of this study are consistent with the research of Arum (2019), which states that alcohol consumption is not associated with the incidence of hypertension. In contrast to the research of Mayasari et al (2019) that there is a relationship between alcohol consumption and the incidence of hypertension. People who consume excessive alcohol have a 7.917 times higher risk of developing hypertension compared to people who consume less than one glass per day (Jayanti et al., 2017).

When alcohol is consumed over a long period of time, cortisol levels in the blood increase. Cortisol increases the activity of the renin-angiotensin-aldosterone system (RAAS), a hormonal system that regulates blood pressure and fluid balance in the body. In addition, when a person consumes alcohol, the volume of red blood cells in the body increases. This increases the viscosity of the blood, which can increase blood pressure(Jayanti et al., 2017).

The habit of consuming alcohol in Puskesmas Matiti has been a culture adopted by the community for generations. People recognize alcoholic beverages as drinks that can warm the body. From the study, it can be seen that more than half of the respondents consume alcoholic beverages, namely 58.3% of the respondents. In this study, the researchers assume that alcohol consumption is not significantly related to the incidence of hypertension in the working area of Puskesmas Matiti because the respondents consume alcohol in amounts that do not exceed normal

limits so as not to increase the risk of developing hypertension.

People in Puskesmas Matiti mostly consume tuak, which has a low alcohol content. Several studies have found that the alcohol content of tuak is around 4%-20% (Manurung, 2011; Siahaan & Gultom, 2019; Suryanto & Nurbaya, 2016). This is supported by research findings that the type of alcohol consumed affects the incidence of hypertension (Jayanti et al., 2017). At different levels of alcohol consumption, the rate of absorption in the body is also different (Memah et al., 2019). Consumption of class C alcohol (20-55%) has a faster effect on hypertension than consumption of class A (1-5%) or class B (5-20%) alcohol. The higher the volume of high ethanol drinks consumed, the higher the risk factors for hypertension (Komaling et al., 2013).

Reducing excessive alcohol consumption can lower systolic blood pressure by about 5.5 mmHg and diastolic blood pressure by about 4 mmHg (Jimenez, 2021). People with hypertension should not drink or avoid alcohol. For healthy people, alcohol consumption does not exceed the limit of one glass per day for women and two glasses per day for men. One glass is equal to 360 ml of beer, 120 ml of wine, 45 ml of 40% alcoholic beverages, or 30 ml of 50% alcoholic beverages (AHA, 2016).

The Association Between Sodium Consumption and Hypertension in Puskesmas Matiti, 2023

The results showed that consumption of foods high in sodium was associated with the incidence of hypertension. The results of this study are consistent with the findings of Astuti (2017) who stated that consumption of foods high in sodium can trigger hypertension. Those who consume sodium have a 5.598 times higher risk of developing hypertension than those who do not consume sodium (Aryatiningsih & Silaen, 2018). Sodium is one of the main triggers of hypertension, its sources are close to people's lives such as sodium chloride (table

sodium), flavoring or MSG (micin), various other ingredients containing preservatives, soy sauce, sauce, sambal sachets, snacks, snacks and others. In 2014, the Joint National Committee (JNC) VIII recommended that sodium or sodium consumption should not exceed 100 mmol per day (<6 grams of sodium chloride), equivalent to one teaspoon. In reality, overconsumption is due to our society's cooking culture, which is generally wasteful with sodium.

The results also showed thatsodium consumption of the respondents was high, but there were respondents who did not have hypertension. This may be related to family history of hypertension. Respondents whose parents (mother, father, grandmother or grandfather) do not have a history of hypertension are not at risk of developing hypertension compared to people whose parents have hypertension. While respondents with a low level of sodium consumption, but still found respondents experiencing hypertension, this kind of incident is mostly found in the group of respondents who have female gender and have more weight or obesity. This is because hypertension is a multifactorial disease in which sodium consumption is not the main factor causing hypertension.

With excessive sodium intake, there is an increase in sodium levels in the blood. This increase in sodium leads to a hypertonic state. Water cannot be excreted by the kidneys. This, if left unchecked, can lead to an increase in blood volume in the body. Excess blood volume is not a good condition, so the arterial blood vessels adapt by thickening to accommodate the increase in blood volume so that there is no disturbance in circulation. Unfortunately, this arterial thickening has the side effect of narrowing the lumen of the blood vessels (vasoconstriction). Initially, this vasoconstriction has no significant consequences. However, over time, the presence of vasoconstriction with high blood volume will cause an increase in blood pressure.

This is one of the causes of high blood pressure (Arum, 2019). According to JNC VIII, systolic blood pressure can be reduced by 2-8 mmHg by limiting daily sodium intake.

The Relationship Between Obesity and the Incidence of Hypertension in Puskesmas Matiti, 2023

The results showed that the respondents with hypertension were mostly obese, while the majority of the respondents without hypertension were not obese. The results of this study indicate that each increase in IMT is followed by an increase in blood pressure. This means that the higher a person's BMI, the greater the chance of developing hypertension. This is also supported by the results of research by Bjertness et al (2016) who found that obesity or a person's high BMI number has a risk of hypertension. Epidemiological studies have proven that obesity is a characteristic of the population with hypertension (Ramadhani & Sulistyorini, 2018).

The results showed that obesity has a significant relationship with the incidence of hypertension. Respondents who are obese are 3.77 times more likely to suffer from hypertension than those who are not obese. Similarly, a study by Ramadhani & Sulistyorini (2018) found that people who are obese have a risk of 2.869 times to suffer from hypertension compared to people who are not obese. Previous research has also mentioned a significant correlation between obesity and hypertension (Rohkuswara & Syarif, 2017).

Obesity can cause hypertension both directly and indirectly. Directly, obesity can cause cardiac output to increase because the more body mass, the more blood circulates, causing cardiac output to increase. More weight means more blood is needed to deliver oxygen and nutrients. This causes the heart to work harder and increases blood pressure. Indirectly, it is known that there is a close relationship between obesity and hypertension through hyperinsulinemia, namely, hyperinsulinemia

increases sympathetic activity and increases the reabsorption of sodium and water in the kidneys (Tiara, 2020).

Stimulation of the sympathetic nervous system and renin-angiotensin-aldosterone system (RAAS) activity by mediators such as hormones, cytokines, adipokines, and so on. One of these is the hormone aldosterone, which is closely associated with water and sodium retention, resulting in increased blood volume. Leptin, which is secreted from adipose cells, binds to receptors on the hypothalamus and increases the excretion of sodium and water by the kidneys, which can alter vasoactive substances such as nitric oxide in the blood vessels. Leptin's main function is to interact with hypothalamus to control body weight and fat storage through appetite suppression and increased metabolism (Kembuan et al., 2016).

The results of the study also found that obese respondents did not experience hypertension, and vice versa for respondents who were not obese experienced hypertension. This shows that hypertension is a disease caused by multifactors such as stress, genetic history, smoking, sodium consumption and the presence of diseases that play a role in increasing blood pressure that is difficult to control because it has not been diagnosed with certainty, such as hepatic insufficiency and glucose intolerance.

Obesity is a risk factor for hypertension, so losing weight is the most important element in preventing and treating hypertension. People with hypertension should have weight loss if they are obese, and this will have an effect on the lowering of blood pressure. For every 1 kg increase in body weight, the risk ratio for hypertension is 1.36 (95% CI: 1.29-1.45). In addition, based on the results of previous research, each kilogram of weight loss can reduce systolic blood pressure by 1.05 mmHg and diastolic blood pressure by 0.92 mmHg (Rohkuswara & Syarif, 2017).

5. CONCLUSIONS

The conclusion of this study is that sodium consumption and obesity are factors associated with the incidence of hypertension in Puskesmas Matiti, with sodium consumption being the dominant factor. Therefore, it is hoped that the community will always check nutrition labels, especially sodium content when purchasing packaged foods, maintain ideal body weight through regular exercise and healthy diet. For patients with hypertension, it is expected to check blood pressure regularly and take medication as recommended by the doctor, to avoid foods with high sodium content by identifying or finding out the hidden sodium content in many processed products and foods, and to maintain an ideal body weight. For Puskesmas Matiti, it is expected to further improve the activities of early detection of risk factors for hypertension so that hypertensive patients can be known early and promote community activities at Puskesmas Matiti with a family approach and conduct counseling on the DASH diet (Dietary Approaches to Stop Hypertension).

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