

The Role of Nutritional Status, Age, Genetic Factors, and Lifestyle on the Hypertension Prevalence among Community in Indonesian Coastal Area

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Abstract— Hypertension is one of cardiovascular disease which has the highest mortality rate. This study aims to determine the risk factors of hypertension among the community in the coastal area of Medan Labuhan in Medan city, Indonesia. The study population was the population who live in the coastal area of Medan Labuhan district in Medan City. The number of participants in this study was 108 people recruited by continuous and consecutive sampling method. Assessment of nutritional status was based on body mass index (BMI) that calculated from the body weight and height which measured at the same day of the interview; blood pressure measurements were performed twice with a 5-minute interval by using a calibrated blood pressure meter. The assessment of smoking habits, coffee consumption, consumption of fruits and vegetables, physical activity, and mental stress was using a valid and reliable questionnaire. The data analysis was using the chi-square test with SPSS computer program. The confidence interval was 95%, and a p-value of <0.05 was considered significant. This study found significant relationships between hypertension with a genetic factor, smoking habits, regular consuming coffee, fruits, and vegetable consumption, and less physical activity ($p < 0,05$). Based on this study, the health practitioner mainly family doctors could conduct health promotions that could improve the awareness of society on prevention of hypertension, they also conduct a proper regular treatment of hypertension especially community in the coastal area, because they have more risks become hypertension.

Keywords— the risk of hypertension; nutritional status; age; genetic factors; coastal area.

I. INTRODUCTION

Hypertension is a condition of increased blood pressure in the arteries. In general, hypertension is an asymptomatic condition, where abnormal high pressure in the arteries causes an increased risk of stroke, heart failure aneurysms, heart attack, and kidney damage [1]. Hypertension is one of the highest cardiovascular diseases. But there still needs more research to identify the relationship between several risk factors with the incidence of hypertension. Factors that influence the occurrence of hypertension are grouped into two major groups, namely the inherent or irreversible factors such as gender, age, genetics and modifiable factors (lifestyle) such as physical exercise habits, nutritional status, excessive sodium consumption, fat consumption, consumption of vegetables and fruit, coffee consumption, excessive alcohol consumption, smoking, stress, and blood lipid levels. For the occurrence of hypertension need the role of these risk factors together (common underlying risk factor), in other words, one risk factor alone is not enough to cause hypertension [2]-[13].

Residence and lifestyle also influence the consumption pattern. The previous studies show more prevalence of hypertension in coastal areas than in mountainous regions [3], this was due to the high consumption of sodium and cholesterol in coastal communities, this was related to the habit of coastal communities often salting food and some studies stated that the cholesterol content of freshwater fish tissue is generally lower than sea fish [1], [3]. The habit of consuming foods with high salt and high cholesterol in coastal communities has become a risk factor for the incidence of hypertension [3].

Medan Belawan sub-district is one of the sub-districts in Medan City, and one of the poor sub-districts in Medan city located on the edge of the coast with the majority livelihood is fishermen. Medan Belawan sub-district becomes one of the target areas and education fields of the students of the medical faculty of Universitas Sumatera Utara, so the monitoring of public health problems has been carried out continuously. Based on existing data, it is known that the prevalence of undetected hypertension is higher than detected cases which got treatment at the primary health care. The purpose of the study was to analyze the effect of risk

factors such as: nutritional status, age, genetic factors, and lifestyle (fruits and vegetable consumption, smoking habits, coffee consumption, stress, and physical activity) in the prevalence of hypertension at Medan Labuhan Primary Care (PHC) in Medan city, Indonesia.

II. MATERIALS AND METHOD

The study design was a cross-sectional study. The study population was the population who live in the coastal area of Medan Labuhan district in Medan City, with sample calculation determined using the formula for the hypothesis of the population proportion. This is adjusted to the research objectives, namely, to determine the prevalence of hypertension and its risk factors in the population of the community in Medan Labuhan district in Medan City with cross-sectional design. Based on the formula, it is known that the number of samples is 103 people; in the end, the number of research samples was fulfilled to be 108 (estimated dropout samples). Sampling was carried out by convenience sampling using the inclusion and exclusion criteria. The inclusion criteria were adult patients at the Primary Health Care (PHC) in Medan Labuhan and are willing to participate in this research. While the exclusion criteria were patients with underlying diseases that can cause secondary hypertension such as kidney failure, autonomic nerve disorders, and thyroid disease as documented in the medical records.

The data collection process of this study was conducted from 31 July until 16 August 2017. The participants were voluntary, signing the inform consent. The data sources were primary data obtained by interviewing the participants by interview protocol and providing a questionnaire to fill out. Assessment of nutritional status was based on body mass index (BMI) that calculated from the body weight and height which measured at the same day of the interview; The IMT value is obtained from the weight in kilograms divided by the square of the height in meters (kg / m^2). Then classified into: Underweight ($<18.5 \text{ kg} / \text{m}^2$), Normal ($18.5 - 22.9 \text{ kg} / \text{m}^2$), Pre-obesity ($23.0 - 24.9 \text{ kg} / \text{m}^2$) and Obesity ($\geq 25, 0 \text{ kg} / \text{m}^2$). Blood pressure measurements were performed twice with a 5-minute interval by using a calibrated blood pressure meter. The measurement results are then classified as follows: Hypertension ($\geq 140 / \geq 90 \text{ mmHg}$) and No Hypertension ($<140 / <90 \text{ mmHg}$) (according to JNC-8) [14].

To measure the nutritional status based on Body mass index (BMI) with a calculation of the number of a person's weight and height. The IMT value is obtained from the weight in kilograms divided by the square of the height in meters (kg / m^2). Then classified into: Underweight ($<18.5 \text{ kg} / \text{m}^2$), Normal ($18.5 - 22.9 \text{ kg} / \text{m}^2$), Pre-obesity ($23.0 - 24.9 \text{ kg} / \text{m}^2$) and Obesity ($\geq 25, 0 \text{ kg} / \text{m}^2$).

Assessment of smoking habits, using a questionnaire used in Indonesian Basic Health Research (Riskesdas 2007) consists of seven questions. These questions are: (1) Have you smoked since last month? (2) At what age did you first smoke? (3) How many cigarettes did you smoke every day? (4) what type of cigarette did you like? (5) Who was another person you smoke with at home? (6) How old were you when you first smoke? (7) At what age did you stop smoking?

From the results of these answers can be categorized as smokers and nonsmokers [15]. Assessment of coffee

drinking habits data was taken using a questionnaire used by Indonesian Basic Health Research (Riskesdas 2007), consisting of three questions. These questions are: (1) Do you have the habit of drinking coffee every day? (2) How much coffee do you consume every day? (3) What type of coffee do you usually consume every day?. From the results of these answers, they can be categorized as coffee drinkers and non-coffee drinkers [15].

Assessment of fruit and vegetable consumption is based on the Indonesian Basic Health Research (Riskesdas 2007) that consists of four questions, from the results of these answers can be categorized as enough consumption and less consumption. These questions are: (1) What is the average portion you eat fresh fruit in one day? (2) In 1 week, how many days do you eat fresh fruits? (3) Usually in 1 week, how many days do you eat vegetables? (4) What is the average portion you eat vegetables in one day? [15].

Daily physical activity was measured using the Baecke Physical Activity Scale questionnaire. This scale is a combination of the index of work time, exercise time, and leisure time. In the questionnaire used, each question has an answer based on five scale points. The five points are 1 = never, 2 = rare, 3 = sometimes, 4 = often, and 5 = very often. Calculation of scores for physical activity is carried out after getting all three index values; after that, it is categorized into, mild, moderate, and heavy [16]. Variable stress states were measured using the Holmes scale (1967). Each question has its score. Then, each score is calculated to get a total score, then in the total score is categorized into 3, mild, moderate, and severe stress [17]. The data analysis was using the chi-square test with SPSS computer program. The confidence interval was 95%, and a p-value of <0.05 was considered significant.

III. RESULTS AND DISCUSSION

The number of participants who had fulfilled the inclusion and exclusion criteria in this study was 108 people in Medan Labuhan. Table 1 showed the characteristics of the participants.

A. Basic Characteristics of The Participants

In the table below we describe the characteristics of the participants' research and the risk factors for hypertension found in them which include: sex, age, hypertension genetic factors, blood pressure, nutritional status, smoking habits, coffee consumption habits, fruit and vegetable consumption, physical activity and stress experienced. This study found that most of the participant were female (69,4%) and aged 45-65 years old (66,7%). Sixty-two percent had a family history of hypertension. More than half (59,3%) had obesity, as stated by their Body Mass Index (BMI). In the lifestyle assessment, the majority of participants did not have a smoking habit, did not have a habit of consuming coffee, 77.8%, and 68.5% respectively, and only nine participants (8.3%) who consumed fruits and vegetables every day in their meal. Based on physical activity, most participants have moderate physical activity (68.5%), and 98.1% have mild mental stress. For more details, can be seen in Table 1 below:

TABLE I
BASIC CHARACTERISTICS OF THE PARTICIPANTS

Characteristics	n	%
Gender		
Male	33	30.6
Female	75	69.4
Age		
45-65 years old	72	66.7
> 65 years old	36	33.3
Genetic Factors		
Yes	67	62.0
No	41	38.0
Blood pressure		
Hypertension	81	75.0
No Hypertension	27	25.0
Nutritional Status (BMI)		
Underweight	3	2.8
Normal	23	21.3
Pre-Obesity	18	6.7
Obesity	64	59.3
Smoking habit		
Yes	24	22.2
No	84	77.8
Coffee Consumption		
Yes	34	31.5
No	74	68.5
Consumption of Fruits and Vegetables		
Enough	9	8.3
Less	99	91.7
Physical Activity		
Mild	14	13.0
Moderate	74	68.5
Heavy	20	18.5
Mental Stress		
Mild	106	98.1
Moderate	2	1.9
Severe	0	0

B. The relationship Between Age with Hypertension

The results of this study showed that the proportion of hypertension is indicated in Table 2. Table 2 shows that the hypertension proportion was more prevalent in the age group of 45-65 years old as many as 53 people (73.6%). However, the statistic test showed no significant relationship between ages with hypertension ($p > 0.05$). The result was discordance to other studies that had demonstrated the statistically significant correlation between age and incidence of hypertension. Aging causes decreased the elasticity of blood vessel so that blood pressure tends to rise at the elderly [18].

The absence of an association between age and hypertension in this study could occur because other factors directly affect blood pressure such as dietary intake, taking into account that the study site was a coastal area close to the sea where the intake of foods with high sodium was higher. Studies showed that a high intake of sodium, potassium, and magnesium are known to contribute to elevated blood pressure [12], [19], [20]. There is a relationship between sodium, potassium, and magnesium intake with blood pressure in older adults. Excessive consumption of sodium causes the concentration of sodium in the extracellular fluid

increase. The increased volume of extracellular fluid causes increased blood volume in the body. Thus the heart must pump more vigorously, so that blood pressure rises [20].

TABLE II
THE RELATIONSHIPS BETWEEN RISK FACTOR WITH HYPERTENSION

Risk factor	Hypertension				p	PR
	Yes	%	No	%		
Age						
45-65 years old	53	73.6	19	26.4	0.814	1.0
> 65 years old	28	77.8	8	22.2		
Genetic Factors						
Yes	61	91.0	6	9.0	0.0001	1.86
No	20	48.8	21	51.2		
Nutritional Status (BMI)						
Underweight	2	66.7	1	33.3	0.380	-
Normal	14	60.9	9	39.1		
Pre-Obesity	16	88.9	2	11.1		
Obesity	49	76.6	15	23.3		
Smoking habit						
Yes	22	91.7	2	8.3	0.035	1.3
No	59	70.2	25	29.8		
Coffee Consumption						
Yes	32	94.1	2	5.9	0,002	1.4
No	49	66.2	25	33.8		
Fruits and Vegetable Consumption						
Enough	79	79.8	20	20.2	0.001	3.6
Less	2	22.2	7	77.8		
Physical Activity						
Mild	13	92,9	1	7,1	0.0380	-
Moderate	56	75,7	18	24,3		
Heavy	12	60	8	40		
Stress						
Mild	79	74,5	27	25,5	0.203	-
Moderate	2	10,0	0	0		
Severe	0	0	0	0		

Potassium intake also affects blood pressure, and increased potassium intake makes lower systolic and diastolic blood pressure [12], [20]. High potassium levels can increase sodium excretion, thereby lowering blood volume and blood pressure [12], [20]. Magnesium is one of the essential nutrients for heart health. In addition to sodium and potassium intake, magnesium also affects blood pressure. The primary role of magnesium is to help the heart muscle for relaxation. If the need for magnesium not fulfill, there would be a decrease in blood pressure that would cause abnormal heartbeat [20]-[24]. These conditions can cause participants who lived in the coastal area to have a higher risk of hypertension at a young age compared to other people in different places of residence.

C. The Relationship between Genetic Factors with Hypertension

The result showed that 61 participants (91.0%) who had a family history of hypertension also had hypertension, hypertension in a family member is thought to be a genetic factor. And statistically, the genetic factor had a significant relationship with the incidence of hypertension ($p < 0.05$) with PR value was 1.86. The genetic factors are one determinant of hypertension. The proportion of hypertension in the group with a family history of hypertension is higher than those without a family history of hypertension [3], [21]-[22]. Family history (parents, grandparents, and siblings) with hypertension is the most influential risk factor for someone to develop hypertension in the future. It is associated with unfavorable lifestyle in the family, especially about diet, if someone applies a good diet, he or she would have the chance to avoid hypertension [1], [3].

Role of family history in hypertension can be explained genetically; the genetic pattern of hypertension in the family has been reported in [6], [22]. A study suggests that the polymorphism of deletion-insertion angiotensin-converting enzyme (ACE D/I) is the cause of blood pressure disorders, and this trait is genetically inherited which mean that if parents have this polymorphism, it would be passed on to their children [6].

D. The Relationship between Nutritional Status (BMI) with Hypertension

The result showed that more than half (59.3%) participants were obese, and 49 of them (76.6%) had hypertension. Whereas from 23 participants with good nutritional status, only nine participants (39.1%) who did not have hypertension. Bivariate analysis using chi-square demonstrated no significant correlation between nutritional status and hypertension ($p > 0,05$).

The results of this study were by other studies that suggest there is a relationship between the nutritional status with hypertension and the theories that support those relationships [23]-[25]. Nutritional status has been shown to affect morbidity and mortality. The relationship between death and Body Mass Index (BMI) as one indicator of nutritional status is exponential (J-Shaped). Diseases that commonly associated with high BMI values (overweight, $\geq 23 \text{ kg/m}^2$), such as cardiovascular disease and renal impairment, are found to be associated with high blood pressure. Obesity can cause hypertension by increasing cardiac output. Because the higher the body mass, the more the amount of blood in circulation, so that cardiac output increases [5], [25].

The WHO reports that 65% of cases of hypertension worldwide has associated with obesity [26]. Obese individuals are 3.5 times more likely to develop hypertension [25]. Even the association between adiposity with blood pressure is not so apparent in hypertensive individuals compared to the general population; it does not mean that nutritional status factor does not determine the occurrence of hypertension.

This situation explains that other factors influence the occurrence of hypertension is modulated by other factors, such as environmental and genetic factors [27]. The results of this nonsignificant relationship can be caused by the fact that Medan Labuhan environment is close to the coastline,

where the population has a high salt consumption rate. It could be one of the factors causing no significant relationship between nutritional status with hypertension [7], [27]-[28]

E. The Relationship Between Smoking Habits with Hypertension

The result identified that of 108 participants, 24 people (22.2%) had a smoking habit which 22 people (91.7%) had hypertension. The conclusion was that there is a significant relationship between smoking habit and hypertension ($p < 0.05$). Participants with smoking habits have a 1.4 folds' risk of developing hypertension (PR 1.4). There is an increase in blood pressure on the participants who smoke. Nicotine in cigarettes can affect blood pressure by releasing hormones epinephrine and norepinephrine or through the effects of CO in the increasing of red blood cells and also harmful substances in cigarettes can contribute to elevated blood pressure [2].

Nicotine in tobacco causes an increase in blood pressure immediately after the first inhalation. Like other chemicals in cigarette smoke, nicotine is absorbed by tiny blood vessels in the lungs and circulated into the bloodstream. In just a few seconds, nicotine has reached the brain. The brain reacts to nicotine by giving a signal to the adrenal gland to release epinephrine (adrenaline). This powerful hormone would constrict blood vessels and force the heart to work harder due to higher pressure. By smoking, a cigarette would have a significant influence on the rise in blood pressure. Smoking behavior was a risk factor for hypertension with 6.9 times the risk of hypertension, and a study found that there was a relationship between the number of cigarettes and the incidence of hypertension in patients [3].

Nicotine and carbon dioxide contained in cigarettes would damage the endothelial vascular artery layer; the elasticity of the blood vessels is reduced that lead to increased blood pressure [31]. Vasoconstriction of peripheral blood vessels and blood vessels in the kidneys due to smoking would increase blood pressure 10- 25 mmHg systolic pressure and increases heart rate 5-20 times per minute [29]-[30]

F. Relationship between Consumption Coffee with Hypertension

The result showed there were 34 participants (31.5%) had a habit of drinking coffee, which 32 of them (94.1%) had hypertension. The result of the chi-square analysis concluded that there was a significant relationship between coffee consumption with hypertension ($p < 0.05$). Participants who had the daily consumption of coffee had 1.4 times the risk of hypertension (PR 1.4).

Previous meta-analysis results revealed an increase in systolic blood pressure of 1.2 mmHg and diastolic blood pressure of 0.5 mmHg. Caffeine can increase plasma levels of some stress hormones such as epinephrine, norepinephrine, and cortisol, which can cause an increase in blood pressure that depends on the concentration of coffee and individual sensitivity. It can conclude that the amount of caffeine content in instant coffee is lower than that of black coffee caused by different processing methods.

Black coffee is a direct extraction of boiling coffee beans filtered without any additions. Instant coffee comes from

dried and granulated coffee beans. Instant coffee is obtained by mixing the ground coffee beans and boiling it with hot water. The boiled water is vaporized and then sprayed with high pressure, which would eventually leave fine coffee powder [9], [31]. Consumption of coffee 1 cups/day can increase the systolic blood pressure of 0.19 mmHg and diastolic 0.27 mmHg. Besides, the risk of hypertension is higher in those who have coffee consumption of 3-4 cups/day compared to those who have coffee consumption of ≥ 5 cups/day in the first consumption [28], [32].

G. Relationship between Consumption of Fruits and Vegetables with Hypertension

The result showed that prevalence of participants who consumed enough fruits and vegetables every day was 8.3%, chi-square test showed a significant relationship between fruit and vegetable consumption with hypertension ($p < 0.05$) Participants with less fruit and vegetable consumption had 3.6 times the risk of hypertension (PR 3.6).

There was a meta-analysis conducted studying hypertension related to the consumption of fruits and vegetables; it is concluded that vegetables and fruits are protective factors of hypertension [7]. Some servings per day consumption of fruits and vegetables have antioxidant effects that can protect blood vessels from damage that can cause hypertension. Fruits and vegetables contain lots of water and fiber, by consuming it would increase satiety that reduces the intake of calories and in the long term can lose bodyweight that would impact on health ideal body weight and avoid obesity. Obesity can be a risk factor for metabolic disorder and hypertension [5].

Fruits and vegetables also contain micronutrients such as electrolytes potassium, sodium, and calcium that can affect blood pressure. Calcium intake is less associated with the occurrence of hypertension. The results of previous studies stated that there is a relationship between calcium intake and blood pressure where reduced calcium intake would increase blood pressure (systolic and diastolic blood pressure) and vice versa a high consumption can prevent the occurrence of hypertension [33]-[34].

Epidemiological studies show that a low intake of potassium results in increased blood pressure and renal vascular remodeling, which indicates resistance blood vessels in the kidneys. High potassium intake lowers blood pressure. The mechanism of action of potassium in preventing narrowing of vessels blood (atherosclerosis) is to keep the arterial artery wall elastic and optimize its function so that it is not easily damaged by high blood pressure. With the reduced risk of atherosclerosis, this potassium activity would also play a role in the prevention of coronary heart disease and stroke. Conversely, an increase in sodium levels can stimulate renin secretion and result in a narrowing of peripheral blood vessels, which lead to increased blood pressure.

Consumption of vegetables and fruits containing fiber (cellulose, hemicellulose, pectin, and lignin) would reduce the risk of cardiovascular disease. Fiber can reduce cholesterol levels in the blood by reducing the absorption of cholesterol, fatty acids, bile acids, and by modifying the metabolism of cholesterol and lipids as a result of a decrease in the activity of 3-hydroxy-3-methyl glutaryl

coenzyme reductase and by modifying hormone concentrations that affect lipid metabolism [35]-[38].

H. The relationship between Physical Activity with Hypertension

The result showed that about 14 participants had mild physical activity category (13.0%), 13 of them (92.9%) had hypertension. While from 20 participants who had heavy physical activity category (18.5%), 8 of them (60.0%) had hypertension. Statistical analysis demonstrated that there was a significant relationship between physical activity with hypertension ($p < 0.05$).

Lack of physical activity can increase the risk of hypertension through increasing the risk of being overweight. Physically less active people also tend to have a higher heart rate so that the heart muscle has to work harder at each contraction. The harder and more frequent the heart muscle has to pump, the higher the pressure placed on the arteries. Physical activity is a movement carried out by the body muscles and supporting systems. During physical activity, muscles need the energy provided by metabolism to move, while the heart and lungs need additional energy to deliver nutrients and oxygen throughout the body and to remove remnants from the body.

Physical/aerobic exercise would help health improvement of the body because physical exercise would increase fat metabolism, and reduce weight [8], [26]. Physical activity dramatically affects blood pressure stability. In people who are not active in physical activity tend to have a higher heart rate. The higher heart rate causes the heart muscle to work harder on each contraction. The harder the heart muscle attempts in pumping blood, the higher the pressure imposed on the artery wall, thus increasing the peripheral resistance that causes an increase in blood pressure [39]-[40].

This study showed that the majority of participants have medium to heavy daily physical activity as they work as fishermen and construction workers, while only a few have light physical activity.

I. Relationship Mental Stress with Hypertension

The result showed 106 participants had mild mental stress category, 79 of them (74.5%) had hypertension, Chi-square test demonstrated no significant relationship between the state of mental stress with hypertension which was accordance to other studies that found the same conclusion [23].

Individuals with mild, moderate, and severe mental stress have a chance of illness or subsequent health changes of 35%, 50%, and 80%, respectively. The higher the level of mental the higher the person's chances of illness or health change [11]. The effect of mental stress on the occurrence of hypertension is believed through the involvement of the sympathetic nervous system response, in which the catecholamine release would increase heart rate, cardiac output, and blood pressure. The sympathetic response to acute stress has documented widely, but the process by which stress contributes to persistent increases in blood pressure is not fully understood. However, be due to repetitive activation of the sympathetic nervous system, failure of a return to normal conditions of increased blood pressure, failure to adapt to recurrent blood pressure, or a

combination of those mechanisms leading to hypertension [11].

The difference between the results of the study and the available theories may be due to the role of other risk factors such as the diet of the sub-district of Medan Labuhan located in coastal areas. A study showed that hypertension was more common in coastal areas than in mountain areas. The results of the analysis showed that the highest sodium intake was a coastal area in marinating processed seafood. The highest sodium intake leads to a trend of hypertensive events in coastal areas where sodium intake plays a role in the incidence of hypertension. The habit of eating foods high in salt and high cholesterol in the coastal community has unwittingly become a risk factor for the prevalence of hypertension. The consequences of this lifestyle led to the tendency for hypertension in coastal areas [41]-[42].

IV. CONCLUSIONS

Based on the study result and the discussion, we conclude that there is a significant relationship between genetic factor, smoking habit, regular consuming coffee, fruits and vegetable consumption, and physical activity with hypertension. Controlling the risk factors which most parts of lifestyle can reduce the occurrence of hypertension. From several risk factors causing the presence of hypertension in Medan Labuhan, the majority of risk factors are preventable. For those doctors who work in primary care (family doctors) improving the healthy behavior of the community as an effort of health promotion and can prevent hypertension disease, since prevention is better and more economical than treatment or medication.

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