



The Effect of Smoking Habits and Diet on Prehypertension Among Young Adults in Pekanbaru City

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Abstract

The prevalence of prehypertension on adults in the world is 36 percent while in Indonesia it is 48.4 percent. Prehypertension increases the risk of hypertension in the future if not managed properly. This study aims to analyze the influence of smoking habits, sodium intake and fat intake on the incidence of prehypertension in adults in Pekanbaru City. This research used a cross-sectional design with a sample of 184 people obtained using a

multiple random sampling technique. The research instruments used were questionnaires, digital sphygmomanometers, body scales, microtoises and food model books. Research results showed that 53.3 percent of adults experienced prehypertension. The results of bivariate analysis using a simple logistic regression test showed that there was smoking habits ($p < 0.001$), sodium intake ($p < 0.001$) and fat intake ($p < 0.001$) showed a relationship with the incidence of prehypertension in adults in Pekanbaru City. Multivariate results using multiple logistic regression tests showed that the smoking variable most influenced the incidence of prehypertension ($p = < 0.001$; $\text{Exp}(B) = 7.79$; 95% CI: 3.28-18.46). People are expected to reduce smoking habits and carry out regular blood pressure checks. Health workers are expected to make POSBINDU's work program more effective in providing health promotion regarding the impacts of smoking.

Keywords : prehypertension, young adults, smoking habits

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Introduction

Non-communicable diseases (NCDs) are diseases caused by changes in function or damage to body structure that occur gradually and last a long time (Hamzah, 2021). NCDs are a serious health problem in industrialized and developing countries because they affect the quality of life and productivity of individuals and cause a high economic burden on society and governments. The global economic burden due to NCDs is estimated at 47 trillion dollars from 2010 to 2030 (Bloom, Chen, Kuhn, McGovern, Oxley & Prettner, 2020).

The proportion of deaths due to NCDs in the world ranks highest at 41 million out of 55.4 million deaths (74%). The main causes of death include coronary heart disease, cerebrovascular disease and hypertension with 17.9 million deaths (32.3%), cancer with 9.3 million deaths (16.7%), chronic respiratory disease with 4.1 million deaths (7, 4%) and diabetes two million deaths (*World Health Organization*, 2022).

The proportion of deaths due to NCDs in the Southeast Asia (ASEAN) region, namely Brunei Darussalam is 1,360 people out of 1,600 deaths (85%), Vietnam 422,730 people out of 549,000 deaths (77%), Malaysia 113,960 people out of 154,000 deaths (74%), Singapore 20,720 people out of 28,000 deaths (74%), Thailand 398,860 people of 539,000 deaths (74%), Indonesia 1,359,990 people of 1,863,000 deaths (73%), Myanmar 292,400 people of 430,000 deaths (68%), Philippines 444,210 people of 663,000 deaths (67%) and Cambodia 59,520 people out of 93,000 deaths (64%) (WHO, 2022).

One of the PTMs that is the world's attention is hypertension. As many as 1.28 billion people aged 30-79 years worldwide suffer hypertension and almost half of it No aware suffer disease the . Hypertension No own symptom Specific so that many people ignore it will this disease and if No handled quick cause resulting complications _ death (WHO, 2023).

Before being diagnosed with hypertension, a person will experience prehypertension. Prehypertension is an early indicator of cardiovascular disease (Doumas, Katsiki, & Mikhailidis, 2019). Over a period of four years, almost two-thirds of people diagnosed with prehypertension



developed stage one hypertension because they did not change their lifestyle to a healthier lifestyle. The risk of experiencing hypertension is higher in prehypertensive people than in people with normal blood pressure (*Relative Risk* (RR) = 2.9, 95% CI: 2.3-3.7) (Rafan, Zakaria, Ismail, & Muhamad, 2018).

The causes of prehypertension are multifactorial, arising from a combination of non-modifiable risk factors, namely age, gender and genetics, as well as modifiable risk factors such as smoking, lack of physical activity, unhealthy eating patterns and obesity. These risk factors will cause physiological changes in the body so that blood pressure increases (Doumas, Katsiki, & Mikhailidis, 2019).

Cigarettes are one of the biggest health problems in the world. Active smokers have 1.67 times the risk of developing prehypertension compared to non-smokers (Song et al., 2018). A cigarette contains more than 4,000 types of chemicals that are harmful to the body, such as carbon monoxide (CO), lead, tar and nicotine. The presence of CO gas in the blood causes damage to blood vessels. Tar causes spots on the lungs, while nicotine causes addiction and stimulates the production of the adrenaline hormone so that the heart beats faster and works harder (Hermawati, Pratiwi, & Lathifah, 2023).

The burden of smoking is shifting from high-income countries to low- and middle-income countries. Indonesia has the highest prevalence of smoking among adults in the world at 37.6 percent, followed by India 27.2 percent, Russia 26.8 percent, the European Union 26.4 percent and China 25.6 percent. The prevalence of smoking among young adults in Indonesia increased from seven percent in 2013 to nine percent in 2018 (Ritchie & Roser, 2022).

Eating foods high in fat and salt also contributes to a significant increase in blood pressure. Foods high in saturated fat and high in cholesterol can affect blood cholesterol levels, especially *Low Density Lipoprotein* (LDL) levels. Cholesterol will stick to the walls of blood vessels, forming plaque. Plaque clogs blood vessels, thereby affecting the flexibility of blood vessels. People with high fat intake are 3.8 times more likely to experience prehypertension than people with moderate and low fat intake (Kartika, Afifah & Suryani, 2017).



Excessive salt intake triggers water retention which causes expansion of circulating volume, increased cardiac output and increased renal perfusion. When renal perfusion pressure increases, the glomerular filtration rate increases and sodium excretion increases to restore fluid balance in the body. Reducing salt intake is one step to lower blood pressure. Limiting salt to 4.4 grams per day can reduce an average of systolic blood pressure by 4.2 mmHg and diastolic blood pressure by 2.1 mmHg (Youssef, 2022).

The global average salt intake is 10.8 grams per day, twice as high as the WHO recommendation of five grams per day. Average salt consumption varies in different countries. The daily salt intake of adults in Europe is 10-13 grams of salt. The high salt content on the European continent mostly comes from processed foods, while on the African continent it comes from bread, salted fish and salt added during cooking and seasonings (WHO, 2023).

Current health policies have not yet achieved effective outcomes for reducing dietary sodium in the population. Only nine countries (Brazil, Chile, Czech Republic, Lithuania, Malaysia, Mexico, Saudi Arabia, Spain and Uruguay) have comprehensive policies reducing sodium intake. These policies include reformulating food to contain less salt, setting sodium targets in food, limiting salt-rich foods in public institutions such as hospitals and schools, labeling on the front of packaging that helps consumers choose products that are lower in sodium as well as mass media campaigns to reducing salt consumption (WHO, 2023).

Based on a preliminary survey conducted on 20 early adults in Pekanbaru City, it was found that seven people were detected with prehypertension (35%). All respondents stated that they had not had their blood pressure checked in the last three to six months. The proportion of active smokers was six people (30%), three of whom were detected as prehypertension. The number of cigarettes smoked per day varies from five to 20 cigarettes per day. The description of the problem above is the background for researchers to conduct research on the factors that influence the incidence of prehypertension in early adults in Pekanbaru City.

Methods



This type of research is quantitative with a *cross-sectional design*. The *cross-sectional* research design studies the correlation between risk factors (independent) and effects (dependent) where data collection is carried out simultaneously at one time (*point time approach*). Study held start January to November 2023 in Pekanbaru City in 30 percent of the total sub-districts as many as five out of 15 sub-districts .

Population and Sample

The population study includes all mature residents aged 25-34 years living in five selected sub-districts in Pekanbaru City, totaling 22,412 people (BPS Pekanbaru City, 2023). The research sample comprises a subset of mature residents aged 25-34 years residing in these five sub-districts. The sampling technique employed is multistage random sampling, chosen because of the extensive and comprehensive nature of the population under investigation, as well as the broad geographical scope of the study. The sample is selected gradually in a random manner at each stage, firstly in clusters and secondly in shared sampling units, in a proportional way. This process resulted in a total of 184 samples being obtained

Variables and Operational Definitions

Variable. Variables are characteristics or traits that someone or something has to differentiate them from one another. Variables are divided into two, namely independent variables and dependent variables. The independent variables of this study are smoking habits, sodium intake and fat intake, while the dependent variable is the incidence of prehypertension as seen from blood pressure.

Operational definition. Operational definition is the definition of variables that will be researched operationally in the field to facilitate data collection.

Prehypertension. Prehypertension is a condition where the systolic blood pressure is 130-139 mmHg or the diastolic blood pressure is 85-89 mmHg after taking two measurements with an



interval of one to two minutes. Diastolic blood pressure is the basis for making a decision to diagnose prehypertension (JNC, 2003).

Smoking habit. Respondents' habit of smoking cigarettes in daily life.

Sodium intake . The amount of sodium consumed per day is recorded on the *food recall form* by asking about the food consumed in the last 24 hours using a food photo book to find out the estimated weight of the food .

Fat intake. Consumption of the amount of fat in a day is recorded on the *food recall form* by asking about the food consumed in the last 24 hours using a food photo book to find out the estimated weight of the food .

Method of collecting data

Before data collection was carried out in the field, the researcher was assisted by the head of the RT and community leaders in the selected areas as well as one enumerator and two midwives who acted as health workers to equate the perceptions and objectives of the research carried out. Next, the researcher conveyed the aims and objectives of the research and asked for permission from the selected respondents. If willingness was obtained, the researcher collected BMI data using a body meter and weight scales and conducted interviews using a questionnaire. Blood pressure measurements are carried out using a digital blood pressure monitor by health workers.

Secondary data is also used to support data completeness. Secondary data was obtained from the Pekanbaru City Health Service report to explain data regarding risk factors related to prehypertension and the publication of the Pekanbaru City BPS report to determine the population, regional map, area area and other information relevant to the research objectives.

Data analysis method

The data have been collected, processed, and analyzed using computer software through stages of editing, coding, entry, and cleaning. The analysis employed includes univariate, bivariate, and multivariate analyses. The statistical test utilized is logistic regression



Results

Univariate Analysis

Univariate analysis is used to obtain a description of the frequency distribution or the significant percentage of each variable covering incidents of prehypertension, respondents' characteristics, smoking habits, and sodium and fat intake.

Incidents of Prehypertension. The measurement results for blood pressure indicate that 98 people (53.3%) have prehypertension, while 86 people (46.7%) have normal blood pressure. The lowest systolic blood pressure recorded for respondents was 102 mm/Hg, and the highest was 139 mm/Hg. The average systolic blood pressure after two measurements was 121 mm/Hg. The lowest diastolic blood pressure recorded was 63 mm/Hg, and the highest was 89 mm/Hg, with an average diastolic blood pressure of 78.5 mm/Hg after two measurements.

Characteristics of Respondents. Table 1 reveals that the majority of respondents fall within the 25-29 age group, totaling 115 people (62.5%). The majority are male, with 100 men (54.3%). Regarding education, the highest proportion holds a high school education, amounting to 163 people (88.5%). The majority are married, totaling 98 people (53.3%). The most prevalent ethnic group is Minang, with 57 people (31%), and the majority are employed, with 140 people (76.1%) currently working.

Table 1

Distribution Frequency Based on Characteristics Respondent

Characteristics Respondent	n=184	%
Age		
25-29	115	62.5
30-34	69	37.5
Gender		
Man	100	54.3
Woman	84	45.7



Education

Low (Primary and Middle School)	21	11.5
High (high school and college)	163	88.5

Marital status

married yet	82	44.6
Marry	98	53.3
Divorced / divorced _ dead	4	2.1

Ethnic group

Malay	45	24.5
Minang	57	31.0
Java	52	28.2
Batak	19	10.3
Other	11	6.0

Job Status

Doesn't work	44	23.9
Work	140	76.1

Characteristics variable. Based on table 2, it is known that the highest proportion of smoking habits among people who do not smoke is 111 people (60.3%). The highest proportion of sodium intake was in people who consumed high sodium intake, namely 95 people (51.6%). The average sodium intake consumed was 1457 mg. The lowest sodium intake was 341.7 mg and the highest sodium intake was 3655.5 mg. The highest proportion of fat intake in people who consumed a high fat intake was 98 people (53.3%). The average consumption of fat intake was 75.2 g. The lowest fat intake was 24.4 g and the highest fat intake was 195.5 g.

Table 2

Distribution Frequency Based on Characteristics Variable

Respondent Characteristics	n=184	%
Smoke		
Yes	73	39.7
No	111	60.3
Sodium Intake		
High	95	51.6
Normal	89	48.4
Fat Intake		
High	98	53.3
Normal	86	46.7



Bivariate Analysis

Bivariate analysis was carried out to determine whether there was a significant relationship between the variables of smoking habits, sodium and fat intake and the incidence of prehypertension in early adults in the city of Pekanbaru using a simple logistic regression test. Based on table 3, it is known that smoking habits, sodium intake, fat intake obtained a *p-value* <0.001 ($p < 0.05$), which means there is a relationship between smoking habits, sodium intake, fat intake and the incidence of prehypertension. Detailed test results can be seen in table 3.

Table 3
Bivariate Analysis Results Using Simple Logistic Regression

Variable	<i>p-value</i>	Exp(B)	95%CI	
			<i>Lower</i>	<i>Upper</i>
Smoking habit	<0.001	4,832	2,510	9,303
Sodium intake	<0.001	6,793	3,558	12.97
Fat intake	<0.001	3,835	2,079	7,074

Multivariate Analysis

Multivariate analysis is used to identify the most influential variable in incidents of prehypertension. Bivariate analysis results indicated that smoking habits, sodium intake, and fat intake qualified for multivariate analysis based on certain criteria. All variables were tested together, and those with *p-values* >0.05 were gradually excluded, starting with the variable having the highest *p-value*. The analysis results reveal that the most influential variable in incidents of prehypertension is the habit of smoking. The Exp(B) value for smoking habits is 7.793, indicating that the risk of experiencing prehypertension is almost eight times higher in people who smoke compared to those who do not smoke.



Table 4

Multivariate Analysis Results Using Multiple Regression Logistics

Variable study	B	S.E	p-value	Exp (B)	95%CI	
					Lower	Upper
HT family history	1,335	0.406	0.001	3,802	1,716	8,421
Smoking habit	2,053	0.440	<0.001	7,793	3,288	18.46
Sodium intake	1,595	0.398	<0.001	4,928	2,258	10.75
Fat intake	1,451	0.422	0.001	4,267	1,866	9,759
BMI	1,184	0.410	0.004	3,267	1,464	7,294

Discussion

The Influence of Smoking Habits on the Incident of Prehypertension

Smoking habits have the most significant effect on the incidence of prehypertension in early adults in Pekanbaru City with $p\text{ value} = <0.001$ and $\text{Exp (B)} = 7.793$, which means the risk of prehypertension is almost eight times greater in people who smoke than in people who do not smoke.

Each cigarette contains more than 4,000 types of chemicals that are harmful to the body. Four hundred of them have toxic effects while 40 of them cause cancer. Chemicals such as nicotine and carbon monoxide inhaled through cigarettes can increase both systolic and diastolic blood pressure. Nicotine damages the endothelial lining of the arteries which causes arteriosclerosis so that the heart rate increases and the need for oxygen supplied to the heart muscle increases (Hermawati, 2023)

Apart from nicotine, carbon monoxide (CO) contained in cigarettes is also detrimental. CO gas causes the oxygen supply to tissues to decrease so that cells lack oxygen. This happens because CO has the ability to bind Hb contained in red blood cells. Hb should bind to oxygen which is important for the respiratory system of body cells. If this process continues for a long time and continuously, the blood vessels will be very easily damaged (Hermawati, 2023).

Research by Song et al. (2018) on 1,777 adults in China found that smoking had a significant effect on the incidence of prehypertension and had a 1.67-fold risk of developing



prehypertension compared to non-smokers (95% CI: 1.22 – 2.29). Widyatama's research (2020) found that there was a significant relationship between smoking duration and increased blood pressure. The longer the smoking habit is maintained, the higher the risk of experiencing an increase in blood pressure, so that the length of time a person smokes contributes to the incidence of prehypertension.

These results are not in line with research by Limbong (2019) which showed that there was no significant relationship between smoking status and the incidence of prehypertension in the working area of the Padang Bulan Health Center, Medan City. Respondents who smoke and who do not smoke have the same tendency to experience prehypertension.

Apart from smoking habits, exposure to cigarette smoke received by passive smokers from active smokers also increases blood pressure. The increase in blood pressure in passive smokers depends on the length and type of exposure to cigarette smoke received. Based on interviews in the field, the majority of female respondents were passive smokers. If you live with members who have a smoking habit, you will be exposed to cigarette smoke for longer.

Janah's research (2017) states that someone who is exposed to cigarette smoke tends to experience prehypertension more easily than those who are not exposed to cigarette smoke. Research by Vozoris (2018) found that passive smokers had a 20 percent chance of suffering from prehypertension compared to those who did not. Exposure to cigarette smoke received by passive smokers for five minutes will cause changes in the arteries and heart so that the longer a person is exposed to cigarette smoke, the impact will be on disrupting the function of the arteries which can cause prehypertension.

The Effect of Sodium Intake on the Incidence of Prehypertension

Based on the research results, sodium intake has a significant effect on the incidence of prehypertension in early adults in Pekanbaru City with p value = <0.001 and Exp value (B) = 4.982. This means that the risk of prehypertension is almost five times greater in people who consume high sodium intake than those who consume sodium within normal limits. These results



are also in accordance with research by Zainuddin (2019) in Kendari which shows that there is a relationship between sodium intake and the incidence of prehypertension.

Sodium is the main cation in extracellular fluid which functions to maintain the body's chemical balance, regulate fluid volume and help contract muscle tissue, including the heart muscle. Sodium does not only come from table salt but is also found in food ingredients such as instant spices, processed meat, cheese and so on. The sodium consumed will bind with water so that water is absorbed intravascularly which causes an increase in blood volume. As blood volume increases, blood pressure also increases (Zainuddin, 2019).

Based on the results of interviews, the source of high sodium intake most frequently consumed by respondents came from fast food high in *Mono Sodium Glutamate* (MSG) such as bread and instant noodles, salted fish, fizzy drinks, snacks containing additional food ingredients, cooking spices including table salt, soy sauce, sauces, shrimp paste and instant seasonings.

Instant noodles are practical and easy to cook, so they are liked by many people, especially adults or those who don't have much time to cook. However, what you need to know is that the nutritional content of instant noodles is not complete, so other food ingredients need to be added so that the nutritional value is better. Apart from that, the MSG contained in instant noodles is quite high, amounting to 1000 – 2400 mg.

Apart from instant noodles, types of ready-to-eat food (*fast food*) such as fried chicken, pizza and burgers are also in great demand among young adults. *Fast food* has high sodium, calorie, fat and cholesterol content. Based on Rahmi's research results (2019), a portion of *fried chicken* breast contains 2520 mg.

The Effect of Fat Intake on the Incidence of Prehypertension

Fat intake has a significant effect on the incidence of prehypertension with a *p value* = 0.001 ($p < 0.05$) and an Exp (B) value of 4.267. This means that the risk of prehypertension is four times greater in people who consume a high intake of fat compared to those who consume fat within normal limits.



Based on the results of the interview, it is known that unbalanced eating behavior occurs. Almost every respondent consumes side dishes that are processed through frying, consumes a lot of fried foods, foods with coconut milk, fast food, soft drinks, skips breakfast and consumes less vegetables and fruit.

Fat intake functions as a building source, but it becomes a problem when the intake is excessive. Eating foods high in fat can increase the risk of prehypertension. Increased fat intake causes a buildup of saturated fatty acids in the blood vessels which causes plaque to form in the blood vessels resulting in blockages.

Zainudin's (2019) research results show that there is a relationship between fat intake and increased blood pressure. The proportion of prehypertension was higher in respondents who consumed fat that exceeded the nutritional adequacy rate (RDA). Sugiharto's (2017) research in Karanganyar also showed a significant relationship between fat consumption and prehypertension.

Consuming saturated fat increases the risk of atherosclerosis which is related to blood pressure. Atherosclerosis increases the resistance of blood vessel walls and triggers an increase in heart rate. An increase in heart rate can increase the volume of blood flow which has the effect of increasing blood pressure.

Conclusion

Based on the results of the analysis, it was determined that smoking, sodium intake, and fat intake influence the incidence of prehypertension, with smoking being the most influential variable in adults in Pekanbaru City. It is expected that the community will reduce smoking habits and undergo regular blood pressure checks. Health workers are encouraged to make the POSBINDU work program effective by providing health promotion information regarding the impact of smoking



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