

The Association Between Smoking Behaviour And Hypertension: A Case-Control Study

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Abstract— Hypertension prevalence increased globally, especially in middle-income and lower-income countries. Smoking was one of the risk factors for triggering the non-communicable disease. Smoking behavior prevalence in Indonesia increased from 12,3% in 2013 to 24,35% in 2018. This study conducted to determine the relationship between smoking behavior and the incidence of hypertension in the medical ward at RSAU M. Salamun Bandung. The research method used was a case-control analytic survey method, which was retrospective in nature. Sampling was purposive sampling, with a total of 28 respondents. Data analysis used the chi-square test showed that there was significance between smoking behavior ($p = 0.005$, $OR = 6,923$) and the incidence of hypertension. The hospital needed to increase health education about the negative effect of smoking by campaigning and distributing leaflets or other mass health promotion media.

Keywords: Smoking behavior, hypertension

INTRODUCTION

High blood pressure is still a global health problem. High blood pressure is noted to cause 10.4 million deaths per year [1]. The prevalence of hypertension and its negative impact on cardiovascular morbidity and mortality continue to increase globally [2]. The increase in adult hypertensive sufferers is predicted to reach 1.56 billion by 2025 [3] [4].

The trend of high blood pressure is shifting from high-income countries to low-income and middle-income countries. Mills et al. [5] obtained data that countries with high income have 349 million sufferers of high blood pressure, while in countries with middle and low income, there are as many as 1.04 billion sufferers of high blood pressure. The number of adults with high blood pressure increased from 594 million in 1975 to 1.13 billion in 2015, the highest increase in low-income and middle-income countries [6].

Indonesia is a middle-income country with a high prevalence of high blood pressure. The World Bank's latest classification in 2020, states that Indonesia is included in the category of middle-income countries. High blood pressure is second only to smoking as a major cause of cardiovascular disease in Indonesia [7]. The prevalence rate of Hypertension in Indonesia increased from 25.8% in 2013 to 34.11% in 2018, with the highest prevalence in the Provinces of South Kalimantan, West Java, and East Kalimantan [8].

High blood pressure or hypertension is defined as the blood pressure in the arteries that increases abnormally [9]. Hypertension is a condition in which systolic blood pressure is ≥ 140 mmHg and / or diastolic blood pressure is ≥ 90 mmHg [9] [8] [10] [11]. Isolated systolic Hypertension or Isolation Systolic Hypertension is also hypertension characterized by systolic blood pressure ≥ 140 mmHg and diastolic blood pressure < 90 mmHg [11].

95% of hypertensive patients are primary hypertensive patients [12], while the other 5-10% is secondary hypertension [13] [14]. Primary Hypertension or essential Hypertension generally appears in adulthood or the elderly as a result of the interaction between lifestyle and genetics [15]. The

causes of primary hypertension consist of 2 factors, namely unchangeable factors and changeable factors. Unchangeable factors consist of family history, increasing age, and gender. Changeable factors consist of an unhealthy diet, overweight/obesity, stress, low physical activity, and smoking behavior [10].

Smoking is one of the risk factors for hypertension. Kartikasari et al. [16], in a study that concluded smoking increases the risk of developing hypertension by up to 9x greater than that of non-smokers. The more and longer a person smokes cigarettes, the higher the chance of developing hypertension. Smoking can increase the heart's oxygen demand and various other damages [17].

Smoking behavior is still widely practiced by the community. Smoking behavior in Indonesia has increased from 12.3% in 2013 to 24.35% in 2018 [8]. A follow-up study was conducted with the subjects of internal medicine polyclinic patients RSAU.Dr.M. Salamun Bandung. 5 out of 10 people interviewed were hypertensive patients, and 5 patients were not hypertensive. 4 out of 5 people with hypertension have a history of smoking. Of the four patients, it was found that one person had smoked in 1-10 years, and three others had smoked ≥ 11 years. The smoking degree of the four patients was at the light smoking degree, which was in the range 1-10 cigarettes/day. For this type of cigarette, 3 patients smoke with filter cigarettes and one person who smokes with filter cigarettes. Whereas in 5 non-hypertensive patients, there were no patients who had a history of smoking. This study was conducted to determine the relationship between smoking behavior and the incidence of hypertension.

METHOD

This study used an analytical survey method, namely a case control study, and was retrospective. The location of this research is the Internal Medicine Polyclinic of the RSU. Dr. Salamun Bandung on 6 and 9 May 2016. This research has obtained permission from the Bandung City Health Office. The population in this study was 624 patients, and the sample in this study was 56 respondents. Researchers used a purposive sampling technique in sampling. The research instrument was a questionnaire, and data collection used a guided interview method to respondents. Researchers also used secondary data as additional data in this study. The data analysis performed was univariate analysis and bivariate analysis using the Chi-Square test.

RESULT

The demographic data of respondents are shown in Table 1. The majority of respondents are elderly (60.7%), female (75%), and educated at the primary school level (44.6%). Table 2 shows that 33.9% of respondents in this study had a history of smoking. Table 3 shows that of all respondents who had a history of smoking, 14 people (73.7%) were new smokers (smoking for less than 11 years). Table 4 shows that of all respondents with a history of smoking, 15 people (78.9%) were heavy smokers (smoking more than 11 cigarettes/day). Table 5 shows that as many as ten people (52.6%) of respondents who have a history of smoking have consumed non-filter cigarettes.

Table 1. Demographic Characteristics

Characteristics	Blood Pressure				Total	
	Hypertension		Non-Hypertension		(f)	(%)
	(f)	(%)	(f)	(%)		
Age						
Young Adults	0	0	1	1.8	1	1.8
Intermediate Adult	0	0	1	1.8	1	1.8
Pre-Elderly	7	12.5	13	23.2	20	35.7

Elderly	21	37.5	13	23.2	34	60.7
Gender						
Man	8	14.3	6	10.7	14	25
Woman	20	35.7	22	39.3	42	75
Education						
Primary school	17	30.4	8	14.3	25	44.6
Junior High School	5	8.9	8	14.3	13	23.2
Senior High School	3	5.4	8	14.3	11	19.6
Diploma	1	1.8	1	1.8	2	3.6
Bachelor	2	3.6	3	5.4	5	8.9

Table 2. Frequency Distribution of Smoking Behavior

Smoking Behavior	Frequency (n)	Percentage (%)
Smoking	19	33.9
Do not smoke	37	66.1
Total	56	100

Table 3. Frequency Distribution of Duration of Smoking

Duration of Smoking	Frequency (n)	Percentage (%)
Old (≥11 Years)	14	73.7
New (< 11 Years)	5	26.3
Total	19	100

Table 4. Frequency Distribution of Smoking Degrees

Smoking Degrees	Frequency (n)	Percentage (%)
Light Smoker (1- 10 cigarettes / day)	4	21.1
Heavy Smoker (≥11 cigarettes / day)	15	78.9
Total	19	100

Table 5. Frequency Distribution of Types of Cigarettes

Types of Cigarettes	Frequency (n)	Percentage (%)
Cigarette Filter	9	47.4
Non-filter cigarettes	10	52.6
Total	19	100

The univariate test results are shown in Table 6 to Table 9. Table 6 shows the data that as many as 15 people (78.9%) of respondents who smoked had a history of hypertension. In comparison, as many as four people (21.1%) of respondents who smoked had no history of hypertension. Based on the results of the Chi-Square analysis, the results of the P-Value value of 0.005, which is smaller than alpha ($\alpha = 0.05$), shows that there is a significant relationship between smoking behavior and the incidence of hypertension with an odds ratio of 61, which is 6,923, which means someone who smokes is 6.9 times at risk. To develop hypertension than non-smokers.

Table 7 shows that as many as 13 people (92.9%) of respondents who had been smoking for a long time (≥11 years) had a history of hypertension, while for new respondents (<11 years), two people (40%) had a history of hypertension. Based on the results of the Chi-Square analysis, the P-Value value was 0.037, which is smaller than alpha ($\alpha = 0.05$), indicating a significant relationship

between smoking duration and the incidence of hypertension with an odds ratio of 19,500, which means that the longer a person smokes, 19.5 times. Greater risk of suffering from hypertension.

Table 8 shows that as many as 14 people (93.3%) of respondents who were heavy smokers (≥ 11 cigarettes/day) had a history of hypertension, while for light smokers (1-10 cigarettes/day) as many as one people (25%) had a history of hypertension. Based on the results of the Chi-Square analysis, it was found that the P-Value was 0.016. Based on the results of the Chi-Square analysis, the P-Value was 0.016 ($p < \alpha = 0.05$), which indicated a significant relationship between smoking degrees and the incidence of hypertension. With an odds ratio of 42,000. It shows that the more a person smokes, the 42X more likely to suffer from hypertension.

Table 9 shows that as many as eight people (80%) of respondents who smoked non-filter cigarettes had a history of hypertension. In comparison, as many as seven people (77.8%) of respondents who smoked filter cigarettes also had a history of hypertension. Based on the results of the Chi-Square analysis, it was found that the P-Value value was 1,000, which was greater than alpha ($\alpha = 0.05$), indicating that there was no significant relationship between the type of smoking and the incidence of hypertension.

Table 6. The Relationship between Smoking Behavior and Hypertension Incidence

Smoking Behavior	Hypertension		Frequency	P-Value	Odds Ratio (CI 95%)
	Hypertension	Non-Hypertension			
smoking	15 (78.9%)	4 (21.1%)	19 (100%)	0,005	6.923 <i>CI(1.900 – 25.227)</i>
Do not smoke	13 (35.1%)	24 (64.9%)	37 (100%)		
Total	28 (50%)	28 (50%)	56 (100%)		

Table 7. Relationship of Duration of Smoking and Incidence of Hypertension

Duration of Smoking	Hypertension		Frequency	P-Value	Odds Ratio (CI 95%)
	Hypertension	Non-hypertension			
Old (≥ 11 years)	13 (92.9%)	1 (7,1%)	14 (100%)	0.037	19.500 <i>CI (1.299-292.750)</i>
New (< 11 years)	2 (40%)	3 (60%)	5 (100%)		
Total	15 (78.9%)	4 (21.1%)	19 (100%)		

Table 8. Correlation of Degree of Smoking and Incidence of Hypertension

Degree of Smoking	Hypertension		Frequency	P-Value	Odds Ratio (CI 95%)
	Hypertension	Non-Hypertension			
Light Smoker (1- 10 cigarettes / day)	14 (93.3%)	1 (6.7%)	15 (100%)	0.016	42.000 <i>CI (2.010 -877.471)</i>

Heavy Smoker			
(≥11 cigarettes / day)	1 (25%)	3 (75%)	4 (100%)
Total	15 (78.9%)	4 (21.1%)	19 (100%)

Table 9. Relationship between Types of Smoking and Incidence of Hypertension

Types of Smoking	Hypertension		Frekuensi	P-Value
	Hypertension	Non-Hypertension		
Non-Filter	8 (80%)	2 (20%)	10 (100%)	1.000
Filter	7 (77.8%)	2 (22.2%)	9 (100%)	
Total	15 (78.9%)	4 (21.1%)	19 (100%)	

DISCUSSION

Smoking Behavior

The results of the univariate analysis showed that as many as 37 people (66.1%) of respondents had no history of smoking. As many as 19 people (33.9%) of other respondents had a history of smoking. Smoking behavior is one of the risk behaviors of Non-Communicable Diseases (PTM) along with less consumption of vegetables and fruit, low physical activity, and excessive salt consumption [8]. Smoking is risky behavior that contributes to worsening hypertension and hypertensive complications [18]. Lifestyle, including smoking, is the cause of the increasing prevalence of non-communicable diseases, which can worsen the quality of life and productivity [19].

Several factors cause a person to smoke, including external factors, namely the environment. The environment can affect a person's smoking behavior. A person who was a non-smoker can become a smoker if he interacts in an environment with the majority of smokers. It may be due to the invitation, curiosity, and desire to try smoking. So that after trying, that person can get used to it and become a smoker too. Pakidi&Widadi [20] in their research showed a strong relationship between peers, environment, and education on smoking behavior. So it can be concluded that the environment plays a role in creating a person's smoking behavior.

Duration of Smoking

The analysis showed that as many as 14 respondents who smoked (73.3%) had smoked for more than 11 years. Respondents of the study were elderly, as many as 35.7% were pre-elderly (45-59 years), and 60.7% were elderly (≥60 years). Respondents with smoking duration more than 11 years ago tend to smoke from a young or adult age. Research by Thomson et al. [21] shows that respondents who smoke from a young age (15-19 years or ≥20 years) increase the risk of death in later decades. Thomson et al. [21] Respondents who quit smoking before the age of 40 were more likely to avoid the risk of premature death than described respondents who still smoked after the age of 40.

One of the reasons a person keeps smoking for a long time is because of the nicotine content in cigarettes. Nicotine, which is an addictive substance in cigarettes, can make a person addicted to smoking continuously. Repeated nicotine exposure will tolerate the effects of nicotine and induce the emergence of addiction or withdrawal symptoms [22]. Withdrawal symptoms are symptoms that

appear when a person stops smoking, namely irritability, feelings of depression, anxiety, difficulty concentrating, easy hunger, difficulty sleeping, and a strong desire to smoke again [23].

Also, age can affect the calculation of the length of time a person smokes. The length of time a person smokes can be seen from the time a person starts smoking. Based on the results of the analysis, it was found that as many as five people (26.3%) of smoker respondents were in the new smoking category (<11 years). It is probably because the age of a smoker is still relatively young, so the period from first starting to smoke to when the time to smoke is calculated is still <11 years.

Degree of Smoking

Based on the results of the analysis, data showed that as many as 15 people (78.9%) of respondents were heavy smokers (≥ 11 cigarettes/day), as many as four people (21.1%) of respondents were light smokers (1-10 cigarettes/day). The number of cigarettes a person consumes every day is probably due to the increased need for nicotine levels in the body. Benowitz [22] says that as nicotine exposure increases, the body develops nicotine tolerance. As a result, the pleasant effect that appears will be reduced; this makes smokers tend to increase the number of cigarettes smoked.

Light smokers or heavy smokers are still at risk for health problems. Light smokers or intermittent smokers (smoking only at certain events or times) have nearly the same risk of cardiovascular disease as heavy smokers [24] [25]. Light smokers who smoked 4-7 cigarettes/day had a 70% effect on heavy smokers who smoked more than 23 cigarettes/day [25]. Heavy smokers who smoke 21-30 cigarettes/day can increase the risk of developing cancer [26], smoking 20-39 cigarettes/day increases the risk of developing breast cancer [27].

Type of Smoking

Based on the results of the analysis, it was found that as many as ten people (52.6%) of smoker respondents consumed cigarettes without filters and as many as nine people (47.4%) of respondents who smoked consumed filter cigarettes. Unfiltered cigarettes contain more tar and nicotine than filter cigarettes. Nicotine's calming effect is one of the reasons why unfiltered cigarettes are chosen. However, this does not mean that the use of filter cigarettes does not pose a health hazard. In the 1950s, the concept developed that the less tar produced by cigarettes, the fewer health risks caused by smoking. It makes cigarette factories reduce tar in cigarettes, one of which is by adding filters to cigarettes [28]. However, in 2014, it was found that reducing tar on cigarettes can increase the risk of adenocarcinoma in the lungs [28]. The shift from smoking from non-filter to filter cigarettes only changed the number of lung cancer types into a larger number, from carcinoma squamous to adenocarcinoma [29]. The filters in cigarettes are of no use in reducing harm to smokers [30].

The Relationship of Smoking Behavior and Incidence of Hypertension

Based on the analysis, it was found that as many as 15 people (78.9%) of respondents who smoked had a history of hypertension, while four people (21.1%) had a history of hypertension. After the researchers performed the Chi-square test, a P-Value was obtained of 0.005, which is smaller than alpha ($\alpha = 0.05$), which indicates that there is a significant relationship between smoking behavior and the incidence of hypertension. Based on the results of the analysis, the odds ratio for these two variables is 6,923, which means that the risk of suffering from hypertension is 6.9x greater in someone who smokes than in someone who does not smoke.

Hypertension is an abnormality in arterial blood pressure in which systolic blood pressure is ≥ 130 mmHg, and diastolic blood pressure is ≥ 80 mmHg [31], or systolic blood pressure is ≥ 140 mmHg and/or diastolic blood pressure ≥ 90 mmHg [9] [8] [10] [11]. Hypertension occurs due to several mechanisms, such as increased salt absorption resulting in volume expansion, disruption of the renin-angiotensin-aldosterone system (RAAS), and increased activation of the sympathetic nervous system. Some of these changes will lead to increased peripheral resistance and increased cardiac afterload,

ultimately leading to increased pressure in the arteries [31]. Hypertension itself based on its causes is divided into two major groups, namely essential Hypertension or Primary Hypertension and Secondary Hypertension. According to Smeltzer et al. [32], essential Hypertension is Hypertension that has no identifiable medical cause. This condition is said to be polygenic multifactorial. In contrast, secondary hypertension is characterized by an increase in blood pressure accompanied by a specific cause, such as narrowing of the renal arteries, renal parenchymal disease, and hyperaldosteronism.

In this study, all respondents were respondents with essential or primary hypertension. There are two types of factors that trigger this type of hypertension, including other factors that cannot be controlled, and factors that can be controlled. Smoking behavior itself is a factor that can be controlled.

Husaini [33] said that smoking includes the act of burning tobacco and inhaling the smoke from burning tobacco. Tobacco, the main ingredient of cigarettes, contains hundreds of chemicals. Smoking can cause various health problems, such as blockage of blood vessels in the skin and muscles, metabolic disorders, and hormonal changes.

Someone who consumes cigarettes can be very at risk for developing hypertension. Substances contained in cigarettes can affect the work of the adrenal hormone and trigger atherosclerosis. It is what can cause a person to suffer from Hypertension [17]. Diyan et al. [34] said the incidence of hypertension has a significant relationship with smoking behavior.

Smoking makes hypertension worse and increases the risk of developing more severe cardiovascular disease. Smoking causes 22% of deaths from ischemic heart disease and 16% of deaths from stroke [35]. Cigarettes contain toxic compounds such as carbon monoxide, polycyclic aromatic hydrocarbons, nicotine, and heavy metals, which greatly affect the endothelial tissue of blood vessels, fat in the blood, and blood clotting factors that will cause atherosclerosis. This effect will precipitate adverse cardiovascular conditions, such as myocardial infarction, stroke, and aortic dissection [36].

Based on the explanation above, the researchers concluded that there was a significant relationship between smoking behavior and hypertension in the internal medicine clinic Dr. M. Salamun Bandung.

Relationship duration of smoking and the incidence of hypertension

Based on the results of the analysis, data shows that as many as 13 respondents who smoked ≥ 11 years (92.9%) had a history of hypertension. In comparison, the new respondents (< 11 years) smoked as many as two people (40%) who had a history of hypertension. After the researchers performed the Chi-square test, the P-value was 0.037, which was smaller than alpha ($\alpha = 0.05$), indicating a significant relationship between smoking duration and the incidence of hypertension. Based on the results of the analysis, the odds ratio for these two variables is 19,500, which means that the longer a person smokes, the 19.5x more risk of suffering from hypertension.

Someone who started smoking at a young age will find it difficult to quit smoking. It is due to the presence of nicotine in cigarettes, which is addictive [22]. This substance is what causes a person to continue smoking for a long time. The body has a tolerance level to nicotine. The more nicotine is exposed to, the more a person needs nicotine [21]. It is also supported by Nurpalah [37] that health problems due to smoking will appear in the next 10-20 years. So someone who has been smoking for a long time (≥ 11 years) will begin to show the impact of smoking itself.

Based on the theory and the results of this study, the discussion has supported the research conducted by the researchers; it can be seen that there is a significant relationship in the duration of smoking and the incidence of hypertension in the internal medicine department of RSAU Dr. M. Salamun Bandung.

Relationship Degree of Smoking with Incidence of Hypertension

Based on the results of the analysis, it was found that as many as 14 people (93.3%) of respondents who were heavy smokers (≥ 11 cigarettes/day) had a history of hypertension. In contrast, one person (25%) had a history of light smokers (1- 10 cigarettes/day). Hypertension. After the researchers performed the Chi-square test, a P-value of 0.016 was obtained, which is smaller than alpha ($\alpha = 0.05$), which indicates a significant relationship with a smoking degree and the incidence of hypertension. The strength of the relationship between smoking degree and hypertension can be seen from the odds ratio. Based on the results of the analysis, the odds ratio for these two variables is 42,000, which means that the more a person smokes each day, the 42x more risk of suffering from hypertension.

Continuous nicotine exposure can have a devastating effect on the cardiovascular system. Nicotine stimulates atherosclerosis, which will cause thickening of the neointima layer and trigger plaque formation and ischemia, increasing the incidence of hypertension and cardiovascular disorders [38]. Continuous stimulation of nicotine can lead to acute myocardial ischemia, which contributes to coronary vascular disease (CVD) [39].

Nicotine and carbon monoxide affect the balance of oxygen demand in the tissues. Nicotine provides sympathetic stimulation that increases myocardial oxygen demand. As a result, heart rate increases, blood pressure increases, and the myocardium contracts, simultaneously decreasing myocardial supply due to vasoconstriction and endothelial dysfunction [40]. This condition is followed by stiffness in the peripheral arteries that are mediated by catecholamines; this will increase the myocardial workload. This process results in ischemia that can continue without symptoms and end in angina or heart attack [36]. Carbon monoxide will exacerbate ischemia because it binds more easily to hemoglobin, which interferes with oxygen supply to tissues [41] [36].

Based on the description that has been presented, it can be seen that there is a significant relationship in the duration of smoking and the incidence of hypertension in the internal medicine department of Dr. M. Salamun Bandung.

Relationship between types of smoking and incidence of hypertension

Based on the results of the analysis, data showed that as many as 14 respondents who were heavy smokers (≥ 11 cigarettes/day) (93.3%) had a history of hypertension. In contrast, one person (25%) had a history of hypertension. After the researcher conducted the Chi-square test, the P-Value was obtained of 1,000, which was greater than alpha ($\alpha = 0.05$), indicating that there was no significant relationship between the type of smoking and the incidence of hypertension.

These results are supported by Pauly et al. [42] and Harris [30], who stated that the presence of cork in filter cigarettes functions as a filter to neutralize nicotine and tar. But that does not mean filter cigarettes can be an option so that the effects of smoking are lost. The filter in cigarettes slows down the burning time. It results in incomplete combustion of tobacco, which allows changes in the composition of cigarette smoke and increases levels of toxic compounds [28]. Filters allow smokers to inhale a higher volume and inhale more frequently than non-filter cigarettes [43]; this allows more toxic compounds to be inhaled into the lungs. Nicotine and carbon dioxide are inhaled more will worsen the balance of oxygen demand [36] and have a bad impact on the heart.

CONCLUSION

Smoking behavior has a significant relationship with the incidence of Hypertension in RSAU Internal Medicine Polyclinic Dr. M. Salamun Bandung; this shows that smokers are more at risk of developing hypertension. The high risk of developing hypertension is influenced by the duration of smoking and the number of cigarettes consumed. Meanwhile, the type of cigarette smoked had no significant relationship with the incidence of hypertension.

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