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The Association Between Cigarette Smoke Exposure and Hypertension Incidence in Managaisaki Public Health Center, Tolitoli District

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ABSTRACT

Cigarette smoking is closely linked to cardiovascular illnesses and is a huge public health concern worldwide. This study aimed to analyze the relationship between cigarette smoke exposure and hypertension incidence among residents in the working area of Managaisaki Public Health Center, Tolitoli District. This observational analytic study employed a cross-sectional design with 40 respondents. Independent variables included duration of exposure, type of cigarette, and carbon monoxide (CO) levels in the body, while hypertension incidence was the dependent variable. A p-value less than 0.05 was deemed statistically significant when the chi-square test was used to evaluate the data. The results showed that 60% of respondents had high smoke exposure, 55% were exposed to unfiltered cigarettes, and 45% had hypertension. Bivariate analysis revealed no significant relationship between duration of exposure (p=0.080) and type of cigarette (p=0.307) with hypertension. However, CO levels were significantly associated with hypertension (p=0.006), where respondents with high CO exposure were more likely to have hypertension. In conclusion, cigarette smoke exposure, particularly elevated CO levels, increases the risk of hypertension. These findings emphasize the importance of tobacco control measures and monitoring CO exposure as a preventive strategy against hypertension.

Keywords: Cigarette smoke, Hypertension, Carbon monoxide.

Introduction

In many nations, smoking has become an epidemic. Among people aged 15 and up, 1.3 billion smoke cigarettes; 942 million are men and 175 million are women. According to the 4th edition of the Tobacco Control Atlas ASEAN Region, 36.3% of smokers between the ages of 25 and 64 (66.3%) and 6.7% of female smokers make Indonesia the ASEAN nation with the highest smoking rate (Drope et al., 2018; Tan & Dorotheo, 2018).

Cigarettes produce smoke that is highly harmful to the health of both the smoker (active smoker) and those around them (passive smokers). Tobacco contains 4,000 toxic chemicals, more than 69 of which are carcinogenic. Therefore, tobacco and tobacco smoke contaminated with the environment can be hazardous to health. Another potential cause of hypertension is smoking, either due to direct cigarette use or exposure to secondhand smoke(Rea & Leung, 2018). Several previous studies have found that exposure to cigarette smoke, both active and passive, is a contributing factor to hypertension(Qaiser, 2023); Linardatou, 2020; Sulistyoningrum & ..., 2023; Nuraini, 2020; Ni'mah, 2019)

Worldwide, hypertension is responsible for 17 million fatalities annually, or 55.2% of all cardiovascular disease-related deaths. The brain (stroke), the heart's blood arteries (coronary heart disease), and the heart muscle (left ventricular hypertrophy) are persistent symptoms of hypertension (Unger, T., Borghi, C., Charchar, F., Khan, N. A., Poulter, N. R., Prabhakaran, D., Ramirez, A., Schlaich, M., Stergiou, G. S., Tomaszewski, M., Wainford, R. D., 2020)

Year after year, hypertension rises in prevalence. The World Health Organization (WHO) reported in 2015 that around 1.13 billion individuals, or one-third of the global population, are living with hypertension. About 9.4 million individuals will lose their lives to hypertension or its complications by 2025, and 1.5 billion people will be living with hypertension by that year. A rise from 25.8% to 34.1% in the prevalence of hypertension was noted in Indonesia's 2018 Basic Health Research (Riskesdas). This increase in prevalence occurred in almost all provinces in Indonesia (Riskes, 2018).

Researcher set out to do this study to determine the effect of cigarette smoke exposure on the incidence of hypertension.

Methodology

This investigation made use of a cross-sectional observational analytic study design. Forty people were chosen to take part in the study, which took place at the Managaisaki Health Center in the Tolitoli District.

A total of 40 respondents were recruited using purposive sampling based on predetermined inclusion and exclusion criteria. The inclusion criteria comprised active smokers aged ≥18 years who were willing to participate in the study, while respondents with severe illness or incomplete data were excluded. The minimum sample size was estimated using the Lemeshow formula for cross-sectional studies,

Due to the limited number of eligible participants during the data collection period, 40 respondents were ultimately included in the analysis.

The dependent variable was the incidence of hypertension, which was defined as blood pressure ≥140/90 mmHg, whereas the independent factors were the duration of smoking exposure, kind of cigarette, and CO level in the body. A chi-square test with a 95% confidence level was used for both univariate and bivariate analyses of the data. Variables were deemed statistically significant if p-value < 0.05.. Our institution's ethics committee gave their stamp of approval.

Result and Discussion

1. Research Results

   Tolitoli Regency's Managaisaki Community Health Center (Puskesmas) was the target of this study, which sought to establish a correlation between secondhand smoke and the prevalence of hypertension in the region. The results are described as follows:

   a. Univariate Analysis

   Respondent characteristics were tested using univariate analysis to determine the distribution of research variables, including gender and age, cigarette smoke exposure, and hypertension status.

   The results related to these research variables are shown in Table 1:

Table 1. Distribution of Respondents Based on Research Variables (n = 40)

Characteristics Percentage	Frequency	Percentage (%)
Gender		
Male	22	55
Female	18	45
Age		
36–45	10	25
46–55	15	37.5
56–65	15	37.5
Exposure to Cigarette Smoke		
High (>10 years)	24	60
Low (<10 years)	16	40
CO Levels		
Green Zone (<1 ppm)	12	30
Orange Zone (1–<2 ppm)	10	25
Red Zone (>2 ppm)	18	45
Types of Cigarettes		
High Risk (no filter)	22	55
Low Risk (with filter)	18	45
Hypertension Incidence		
Hypertension (≥140/90 mmHg)	18	45
Non-Hypertension (<140/90 mmHg)	22	55

Source: Primary Data (2025).

According to the data in Table 1, the gender breakdown of the responders is as follows: 22 men (or 55%) and 18 women (or 45%). The number of responders in the 46-55 and 56-65 age groups was 15 each, making up 37.5% of the total. In cigarette smoke exposure, 24 people (60%) were in the high category (≥140/90 mmHg) and 16 people (40%) were in the low category (<10 years). In the CO level category, the study's findings revealed that most participants, 18 people (45%), were in the Red Zone with high CO levels, indicating significant exposure to cigarette smoke. For exposure based on cigarette type, the majority of respondents, namely 22 people (55%), were exposed to cigarette smoke from unfiltered cigarettes, thus having a high risk of health problems. Meanwhile, 22 respondents (55%) with hypertension status did not suffer from hypertension (BP: <140/90 mmHg) and 18 people (45%) suffered from hypertension (BP: ≥140/90 mmHg).

b. Bivariate Analysis

To find out how the independent factors (length of time exposed to cigarette smoke, CO levels, and cigarette type) affected the dependent variable (hypertension incidence), bivariate analysis was used. At a 95% confidence level, the chi-square test was employed as the statistical test. Table 2 displays the outcomes of the chi-square test.

Table 2. Bivariate Analysis with the Chi-Square Test

Variable	Category	Hypertension Incident				Total		*p-value*
		Hypertension		Non Hipertension				
		N	%	N	%	n	%	
Exposure to Cigarette Smoke	High (>10 years)	14	35	10	25	24	60	0,080
	Low (<10 years)	4	10	12	30	16	40	
Amount		18	45	22	55	40	100	
Types of Cigarettes	High Risk (no filter)	12	30	10	25	22	55	0,307
	Low Risk (with filter)	6	15	12	30	18	45	
Amount		18	45	22	55	40	100	
Co Levels	Red Zone	2	5	10	25	12	30	0,006
	Orage Zone	3	7,5	7	17,5	10	25	
	Green Zone	13	32,5	5	12,5	18	45	
Amount		18	45	22	55	40	100	

Source: Primary Data (2025).

In bivariate analysis using the Chi-Square test, it was discovered that cigarette smoke exposure was related with an elevated risk of hypertension in the high exposure group (14 persons, or 35% of the total) compared to the low exposure group (only 4 people, or 10% of the total) (Table 2). There did not appear to be a statistically significant relationship between exposure to cigarette smoke and the development of hypertension among this study's participants, since the Chi-Square test produced a p value of 0.080, which is more than 0.05. Furthermore, the type of cigarette variable also shows a similar trend. Respondents exposed to unfiltered cigarette smoke (high risk) experienced hypertension as many as 12 people (30%), while respondents exposed to filtered cigarette smoke (low risk) experienced hypertension as many as 6 people (15%). Although exposure to unfiltered cigarette smoke is more dangerous in terms of proportion, the results of the Chi-Square test showed a p value of 0.307 > 0.05. Therefore, it can be claimed that there is no significant association between cigarette type and the incidence of hypertension.

The CO levels variable showed different results. Only 2 respondents (5%) in the green zone (low CO levels) experienced hypertension, while 13 (32.5%) in the red zone (high CO levels) experienced hypertension. The decision was reached that there is a significant association between body CO levels and the occurrence of hypertension, as the chi-square test generated a p-value of 0.006 < 0.05. This suggests that the likelihood of hypertension increased as the CO levels found in the participants' bodies rose.

Only CO levels, out of the three examined, were significantly related to the prevalence of hypertension. Secondhand smoke exposure and cigarette type did not show a significant association, although both showed a trend toward increased risk.

2. Discussion

a. Exposure to Cigarette Smoke

This study showed a trend that respondents with high cigarette smoke exposure had a higher proportion of hypertension than those with low exposure, but the results did not reach statistical significance (p = 0.080).

In theory, the vasoconstriction, increased heart rate, and sympathetic nervous system activation caused by nicotine, carbon monoxide, and free radicals in cigarette smoke are real effects. A rise in blood pressure and an increase in peripheral resistance result from this sympathetic activation (WHO, 2023). These findings align with research by Cao et al (Cao, S., Cheng, Z., Koch, K., Fang, J., Du, R., 2024), who reported that exposure to secondary cigarette smoke increases the likelihood of hypertension in the general population. These results were also supported by Chen et al (Jareebi, 2024) in a systematic review, which found a positive association between smoking behavior and hypertension. However, these results differ from a cohort study in Indonesia by Andriani et al (Andriani et al., 2020), which emphasized that long-term changes in smoking status have a greater impact on blood pressure than simply the duration of exposure.

b. Cigarette Type

Although the proportion of hypertension was higher in the group exposed to unfiltered cigarettes (54.5%) compared to filtered cigarettes (33.3%), the result was not significant (p=0.307). Ideally, the lack of a filter layer in unfiltered cigarettes makes it possible to inhale more harmful particles like tar, nicotine, and carbon monoxide. Atherosclerosis is a major contributor to the onset of hypertension, and this exposure can hasten damage to the endothelium of blood vessels and raise the likelihood of its development (Jareebi, 2024).

Research by Chen et al(Jareebi, 2024), supports this biological hypothesis by showing variations in the risk of hypertension based on smoking type and intensity. But there is little and contradictory epidemiological data on the effects of filtered vs unfiltered cigarettes on hypertension rates. Therefore, although the results of this study were not significant, the emerging trend is consistent with theory and previous research highlighting the dangers of unfiltered cigarettes.

c. Carbon Monoxide (CO) Levels

There was a strong correlation between CO levels and hypertension (p=0.006). Respondents with high CO levels (red zone) had a greater risk of developing hypertension compared to those with low CO levels. In theory, carbon monoxide binds to hemoglobin to form carboxyhemoglobin, which reduces the blood's oxygen-carrying capacity. This tissue hypoxia triggers compensatory vasoconstriction, oxidative stress, and endothelial dysfunction, all of which contribute to increased blood pressure(Yang, Liyan MB1; Yuan, Zhi MB1; Miao, Lin MPH1; Lin, 2025).

These findings align with those of Yang et al(Yang, Liyan MB1; Yuan, Zhi MB1; Miao, Lin MPH1; Lin, 2025), who found that both the diastolic and systolic blood pressures were found to be elevated in those exposed to CO in the environment. Furthermore, Du et al (Du, S. Y. Kou, W. Du, W. Ye. L. Qin, 2024). reported that CO plays a key mediator in the development of hypertension through oxidative stress mechanisms. Therefore, the results of this study have a strong theoretical and empirical basis and confirm that CO levels are a more sensitive biological indicator for assessing hypertension risk than relying solely on questionnaire data.

3. Study Limitation

Several limitations should be considered when interpreting the findings of this study. First, the cross-sectional design only measured exposure and outcome simultaneously; therefore, causal relationships between cigarette smoke exposure and hypertension cannot be definitively established. Second, the relatively small sample size may limit the generalizability of the findings and reduce the statistical power of the study. Third, important confounding variables such as age and sex were not adequately controlled in the bivariate analysis because multivariate logistic regression analysis was not performed. As a result, the observed association between cigarette smoke exposure and hypertension may still have been influenced by these uncontrolled confounding factors

Conclusion

Cigarette smoke exposure, particularly increased carbon monoxide levels, is significantly associated with hypertension incidence. In order to lessen the impact of hypertension, these results emphasize the significance of programs to limit tobacco use and routine CO monitoring.

Declaration of Competing Interest

There were no financial or business ties between the author and the study's subjects that would be considered a conflict of interest, the author states.

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