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ORIGINAL RESEARCH

RELATIONSHIP BETWEEN EXPOSURE TO CIGARETTE SMOKE IN HOUSES AND THE INCIDENCE OF HYPERTENSION IN HOUSEWIVES

Hubungan Paparan Asap Rokok dalam Rumah dengan Kejadian Hipertensi pada Ibu Rumah Tangga

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ABSTRACT

Background: Hypertension is still a major health problem in the world. One of the factors causing hypertension is exposure to cigarette smoke. **Purpose:** The aim of this study was to analyze the relationship between cigarette smoke exposure and the incidence of hypertension in housewives in houses in Dampit village. **Methods:** This research adopted an analytical observational approach. This was a cross-sectional design study. The population for this study was all housewives in Dampit village in March 2020. A total number of 115 housewives was selected using the cluster proportional random sampling technique. The dependent variable was the incidence of hypertension; the independent variables were the duration of cigarette smoke exposure in houses, the number of instances contact was made by being in close proximity to smokers, and the contact duration with smokers. Data collection was done by interviewing respondents using a questionnaire. Data analysis was carried out using frequency tables and Epi Info. **Results:** The study indicated that there was a relationship between the duration of cigarette smoke exposure (over 33 years) in houses with the incidence of hypertension in housewives (p=0.01; OR=3.52; 95%CI=1.53–8.05). Similarly, there was a relationship established between the number of occasions contact was made by being in close proximity to smokers every day (over three times every day) (p=0.01; OR=36; 95%CI=7.64–168.76) and the contact duration with smokers (p=0.01; OR=8.09; 95%CI=3.13–20.87) with the incidence of hypertension in housewives. **Conclusion:** There was a link between the duration of cigarette smoke exposure in houses, the number of instances of being in close proximity to smokers every day, and the contact duration with smokers with the incidence of hypertension in housewives in Dampit village.

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ABSTRAK

Latar belakang: *Hipertensi masih menjadi masalah kesehatan utama di dunia. Salah satu faktor penyebab hipertensi adalah paparan asap rokok.* ***Tujuan:*** *Penelitian ini bertujuan untuk menganalisis hubungan paparan asap rokok dalam rumah dengan kejadian hipertensi ibu rumah tangga di Kelurahan Dampit.* ***Metode:*** *Penelitian ini merupakan jenis penelitian observasional analitik dengan rancang bangun penelitian cross-sectional. Populasi penelitian ini seluruh ibu rumah tangga di Kelurahan Dampit pada bulan Maret 2020. Jumlah sampel sebanyak 115 ibu rumah tangga yang diambil dengan teknik cluster proporsonal random sampling. Variabel terikat adalah kejadian hipertensi, sedangkan variabel bebas adalah lama paparan asap rokok dalam rumah, dekat dengan perokok setiap harinya, dan lama setiap kali dekat dengan perokok. Data diperoleh melalui wawancara dengan alat bantu kuesioner. Analisis data menggunakan tabel frekuensi dan epi info.* ***Hasil:*** *Penelitian ini menunjukkan bahwa ada hubungan antara lama paparan asap rokok dalam rumah lebih dari 33 tahun (p=0,01;OR=3,52;95%CI=1,53-8,05), dekat dengan perokok lebih dari 3 kali tiap harinya (p=0,01;OR=36;95%CI=7,64-168,76), dan lama setiap kali dekat dengan perokok lebih dari 10 menit (p=0,01;OR=8,09;95%CI=3,13-20,87) dengan kejadian hipertensi.* ***Kesimpulan:*** *Terdapat hubungan antara lama paparan asap rokok dalam rumah, dekat dengan perokok setiap harinya, dan lama setiap kali dekat dengan perokok dalam rumah dengan kejadian hipertensi pada ibu rumah tangga di Kelurahan Dampit.*

INTRODUCTION

Hypertension is a circulatory disorder that causes an increase in blood pressure to be above normal. Someone is said to have hypertension if their systolic blood pressure is ≥130 mmHg or if their diastolic blood pressure is ≥80 mmHg (Whelton et al., 2018). Nowadays, hypertension has become a major health issue in many countries, including Indonesia. The number of hypertension patients around the globe reached 1.13 billion in 2015, and this number is expected to increase each year (Zhou et al., 2017). The prevalence of hypertension in the East Java province increased by 10.30% from 2013 to 2018. Malang district has the second highest prevalence of hypertension in the East Java province. This was based on doctors' diagnoses carried out in the age population ≥18 years, which was 10.10% (Ministry of Health RI, 2018a).

Risk factors affecting hypertension are classified into two categories: unchanging and changing. Age, sex, and genetics are unchanging risk factors. Risk factors that can be changed are smoking habits, sodium consumption, excessive weight or obesity, low-fiber diet, physical activity, alcohol consumption, dyslipidemia, and stress (Ministry of Health RI, 2018c).

One of the factors that causes hypertension is cigarette smoking. National smoking prevalence in the age group ≥10 years in 2018 was 28.80%. In East Java province, this number was 28.11%. Smoking prevalence in the age group ≥10 years in the Malang district was 30%, which meant that 23.91% of the population were in the age group between 10 and 18 years and were active smokers every day (Ministry of Health RI, 2018b).

Cigarettes not only impact active smokers but also impact passive smokers. Exposure to cigarette smoke can cause various health complications. One of them being an increase in blood pressure or hypertension. This can be explained by several biological effects caused by the exposure to cigarette smoke in passive smokers, e.g., vasoconstriction mediated by nicotine-induced catecholamine release, endothelial dysfunction,

and decreased production of nitric oxide (Tamura et al., 2018).

Passive smokers in our neighborhoods are increasing. Close to 78.40% of the population (133.30 million) are exposed to tobacco smoke at home. About 85% of the households in Indonesia are exposed to cigarette smoke, with a total of 30,222,071 of the male population classified as passive smokers, and a total of 66,729,826 of the female population classified as passive smokers (Ministry of Health RI, 2018b).

Based on an interview conducted with the village chief of Dampit (conducted before this research took place), it was revealed that many housewives in Dampit village did not work outside the house. Many activities were done inside the house. This is the reason why housewives are most likely exposed to cigarette smoke inside the house: Husbands or family members smoke inside the house.

Previous research that was conducted in Indonesia, specifically in West Borneo, indicated that the duration of cigarette smoke exposure was not related to the incidence of hypertension in passive smokers (p=0.06). The population of respondents who were exposed to cigarette smoke (aged≥24.29 or <24.29 years) and experienced hypertension was about 44.20% of the population, and the population of respondents who were exposed to cigarette smoke (aged<24.29 years) and experienced hypertension was around 25.70% of the population (Mustolih, Trisnawati, & Ridha, 2015). These results were not in line with the study carried out by (Tamura et al., 2018), which suggested that exposure to cigarette smoke was related to the incidence of hypertension. This difference in findings from both the above research studies serves as the background for carrying out this research. This research aims to analyze the relationship between exposure to cigarette smoke inside houses with the incidence of hypertension in housewives in Dampit village.

METHODS

This research was an analytical observational study and used a cross-sectional design approach. The population of this research was all housewives in Dampit village. The sample group for this research was 115 housewives in Dampit village. The inclusion criteria was housewives who did not smoke, people who had families that smoked indoors, people aged <60 years, people who did not work outside, and people who were willing to participate in this study by signing an informed consent form. The sampling method employed for this research was a cluster proportional random sampling technique. This research was conducted in five locations in March 2020: West Dampit, East Dampit, Sumberkembar, Ngelak, and Polaman. These places were located in Dampit village, Dampit regency, Malang district, and East Java.

Respondents' characteristics consisted of age, highest education level attained, marital status, and family income. Based on the average age of the respondents, age was grouped into two categories: individuals who were >41 years and those ≤41 years. Highest education level attained was again grouped into two categories: low (if no education), elementary school, and junior high school; and high (if senior high school or college). Marital status was grouped into two categories: married and widowed. Based on the average family income of the respondents, family income was grouped into two categories: individuals whose income was Rp>1,842,000.00 and those who earned Rp≤1,842,000.00. The dependent variable was the incidence of hypertension in housewives of Dampit village, as observed from their history of antihypertensive medication consumption. The details of the medication being consumed were requested to ensure that the medication was antihypertensive. Consultations with nurses in Dampit village were done. There were three independent variables in this research: the duration of cigarette smoke exposure in houses, the number of instances contact was made by being in close proximity to smokers, and the contact duration with smokers. Based on the average duration of cigarette smoke exposure inside houses, the period of exposure to cigarette smoke was classified into two groups: individuals who were >33 years of age and those who were ≤33 years. Period of exposure to cigarette smoke inside houses was calculated in years, i.e., from the time the respondents lived with the smokers till the time the interviews were conducted. Dropout phases (phases when respondents were not exposed to cigarette smoke at all inside the house) were subtracted from the total time period. Based on the average number of instances where the respondents were in close proximity to smokers every day, the number of times respondents were in close proximity (when smokers were smoking inside the house) was classified into two groups: individuals who made contact >3 times and those who made contact ≤3 times. Based on the average duration of time (calculated in minutes) spent by each respondent when in close proximity to smokers, the duration

of time passed when the respondents were in close proximity to smokers was classified into two groups: individuals who spent >10 minutes and those who spent ≤10 minutes. The data in this research was collected through interviews and with a questionnaire.

Two types of analysis were conducted in this research: univariate and bivariate analysis. Data analysis was carried out using the public domain software called Epi Info. Univariate analysis was performed by analyzing the characteristics of the respondents (age, education, status, and family income). The dependent variable was medication consumed. The independent variables were analyzed descriptively by calculating the frequency percentage distribution of each variable. Bivariate analysis was performed to examine the relationship between the independent variables and the respondents' characteristics. This analysis was also done to examine the dependent variable. The statistical test used was the chi-square test; however, if the requirements were not met, the fisher test was used as an alternative. The relationship between the independent and dependent variables was established when the p value was <0.05. The risk of the independent variables influencing the dependent variable can be observed from the OR value. This research protocol was tested for ethical conduct at the Faculty of Public Health in the Airlangga University and declared ethical. The ethical certificate number is 08/EA/KEPK/2020.

RESULTS

Table 1 indicates the characteristics of 115 respondents. The majority of respondents were in the age group ≤41 years, which amounted to 60 people (52.17%). The youngest age of an individual among the respondents was 21 years and the eldest was 59 years. In terms of education level, most of the respondents were classified as low (85 people, 73.91%). Some respondents did not receive formal education. There were also respondents, who stated college as their highest attained education level. Almost all of the respondents were married (113 people, 98.26%). Two people were widowed because one of their spouses had passed away and the other individual was divorced. Among the respondents, most of the family income was in the range Rp>1,842,000.00; this group was made up of 61 people (53.04%). The lowest family income was Rp300,000.00; the highest was Rp4,000,000.00. Based on the data indicated in Table 1, it can be observed that, out of the 115 respondents, there were 37 people (32.17%) who had hypertension. The most frequently used antihypertensive medication was captopril, which was used by 24 people (64.86%). Most of the respondents were exposed to cigarette smoke for ≤33 years (61 people, 53.04%). The shortest time period of cigarette smoke exposure inside the house was a year, and the longest period of exposure was 59 years. Most of the respondents, 95 people (82.61%), were in close proximity to smokers every day for ≤3 times (when smokers smoked inside the house). There was a respondent who came in close contact with smokers inside the house for 12 times a day. Most of the respondents were in close proximity to smokers inside the house for a duration ≤10 minutes (87 people, 75.65%). The shortest duration of time that someone was in close contact with a smoker (when smoking inside the house) was two minutes; the longest was 45 minutes.

Based on the data indicated in Table 2, it can be observed that, out of the 37 housewives who had hypertension, most of them were in the age group >41 years (24 people). The highest education level attained was low in 32 respondents. The marital status of 35 respondents was married. Family income was Rp>1,842,000.00 in 22 respondents. Among the 37 housewives who had hypertension, most of them were exposed for >33 years to cigarette smoke (25 people). The number of instances when people were in close proximity to smokers (when smoking inside the house) was ≤3 times (19 people). The duration of time that people were in close contact with smokers (when smoking inside the house) was >10 minutes (19 people).

Table 2 indicates the results of the statistical tests. There was a relationship between age and the incidence of hypertension in housewives in Dampit village (95% CI=1.24–6.31, OR=2.79). Housewives >41 years were 2.79 times at risk of developing hypertension compared to housewives ≤41 years. The relationship was statistically significant, and the age of housewives was a risk factor for the incidence of hypertension. Highest level of education attained, education, status, and family income were not related to the incidence of hypertension in housewives in Dampit village. The p values were >0.05, e.g., 0.06, 0.53, and 0.45. The period of exposure to cigarette smoke inside the house was related to the incidence of hypertension in housewives in Dampit village (95% CI=1.53–8.05, OR=3.52). Housewives, whose period of exposure to cigarette smoke inside the house was >33 years, were 3.52 at risk of getting

hypertension compared to housewives who were exposed to cigarette smoke inside the house for ≤33 years. The relationship was statistically significant, and the period of exposure was a risk factor for the incidence of hypertension. Being close to smokers every day was related to the incidence of hypertension in housewives in Dampit village (95%CI=7.64–168.76, OR=36). Housewives who were close to smokers every day in more than three occasions were 36 times at risk of developing hypertension compared to housewives who were close to smokers every day, but in ≤3 instances. The relationship was statistically significant, and being close to smokers each day was a risk factor for the incidence of hypertension. The duration of being close to a smoker was related to the incidence of hypertension in housewives in Dampit village (95%CI=3.13–20.87, OR= 8.09). Housewives, whose duration of being in close contact with smokers was >10 minutes, were 8.09 at risk of developing hypertension compared to housewives whose duration of being in close contact with smokers, was ≤10 minutes. The relationship was statistically significant, and the duration of being in close contact with smokers was a risk factor for the incidence of hypertension.

DISCUSSION

The majority of the respondents who suffered from hypertension were in the age group >41 years. Both systolis and diastolic blood pressure were increased with age. Arterial stiffness arises due to structural and functional changes. Hypertropic walls, calcification, atheromatous lesions, and changes in the extraxellular matrix are the main structural determinants of decreasing elasticity and the development of arterial stiffness. Functional changes, such as impaired vascular endothelial functioning and modification of smooth muscle cell reactivity, contribute to the arterial wall hardening, which further contributrd to an increase in blood pressure (Benetos, Petrovic, & Strandberg, 2019).

A community-based cross-sectional research on 418 permanent residents was conducted in Chiro city. The results revealed that people ≥70 years (OR=1.91; 95%CI=1.12–3.27) were at risk of developing hypertension (Shukuri, Tewelde, & Shaweno, 2019). A retrospective study conducted with 170 medical patients, who visited the cardiology department in south India, revealed that the patients in the 51–60 years age group were more susceptible to systemic arterial hypertension (36%) (Padur, Hamdan, Abdullah, Gunalan, & Kumar, 2017). In line with this research, housewives who were >41 years were 2.79 times at risk of developing hypertension compared to housewives who were ≤41 years. Age is an important risk factor that cannot be modified for hypertension. The prevalence of hypertension increases with age; this prevalence is higher in women compared to men (Olack et al., 2015).

Table 1
Characteristic, Incidence of Hypertension, and Exposure to Cigarette Smoke Inside the House in Housewives in Dampit Village

Variables	n	%
Age (Years)		
> 41	55	47.83
≤ 41	60	52.17
Education Level		
Low	85	73.91
High	30	26.09
Marital Status		
Married	113	98.26
Widowed	2	1.74
Family Incomes (Rp)		
≤1,842,000.00	54	46.96
>1,842,000.00	61	53.04
Incidence of Hypertension		
Hypertensive	37	32.17
Not Hypertensive	78	67.83
Antihypertensive Medication		
Amlodipine	13	35.14
Captopril	24	64.86
Period of Exposure (in Years)		
>33	54	46.96
≤33	61	53.04
Instances of Being in Close Contact with Smokers/Day (Times/Day)		
>3	20	17.39
≤3	95	82.61
Duration of Being in Close Contact with Smokers (Minutes)		
>10	28	24.35
≤10	87	75.65
Total	115	100.00

This research indicated that there was a relationship between the period of exposure to cigarette smoke inside houses, being in close contact with smokers every day, and the duration of being in close contact with smokers and the incidence of hypertension in housewives in Dampit village. These result were in line with several previous research findings. A research conducted in Japan suggested that exposure to

cigarette smoke was significantly related to the prevalence of hypertension among non-smokers. People who were exposed on an almost daily basis (4 to <6 hours/day) had a significantly higher risk of developing hypertension, with OR 1.26, 95%CI=1.04–1.54, compared to participants who were exposed occasionally or almost never to cigarette smoke (Tamura et al., 2018). Other research studies conducted in Korea discovered that women >20 years old, who did not smoke but were exposed to cigarette smoke every day (2 hours/day or longer), showed a higher prevalence of hypertension, with OR=1.50, 95%CI=1,10–2.04, compared to those who were not exposed to cigarette smoke (Park et al., 2018). Another research conducted in China found that the duration of daily cigarette smoke exposure was related to wives' hypertension statuses. This research divided people into three duration-of-daily-exposure groups: 0 minutes/day; 1–15 minutes/day; and ≥16 minutes/day (Yang et al., 2017). The results of another study conducted in Beijing revealed that, among the participants who did not take antihypertensive treatment, >2 hours of passive smoking every day was significantly related to higher systolic and diastolic blood pressure. There was a positive relationship between passive smoking and hypertension, with OR=1.38, 95%CI=1.03–1.85 (Wu et al., 2017). In line with the research, housewives who were exposed to cigarette smoke >3 times a day were 36 times more likely to develop hypertension compared to housewives who were exposed ≤3 times a day. Similarly, housewives, whose duration of being in close contact with smokers was >10 minutes, were 8.09 times more likely to get hypertension compared to housewives whose duration of being in close contact with smokers was only ≤10 minutes. A research conducted in Korea suggested that passive smoking inside houses was significantly related to the prevalence of hypertension, with relative risk (RR)=1.01, 95%CI=1.00–1.01 (Lee, Hwang, Choi, & Kim, 2017). A meta-analysis research that was conducted with 192,067 children and adolescents found that exposure to cigarette smoke led to a significant increase in the systolic blood pressure (combined coefficient=0.26; 95%CI=0.12–0.39) (Aryanpur et al., 2019).

Table 2
Statistical Analysis of the Relationship between Exposure to Cigarette Smoke Inside Houses and the Incidence of Hypertension in Housewives in Dampit Village

Variables	Hypertensive		Non-Hypertensive		OR	95%CI	p-value
	n	%	n	%			
Age (years)							
> 41	24	64.86	31	47.43	2.79	1.24–6.31	0.02
≤ 41	13	35.14	47	52.57			
Education Level							
Low	32	86.48	53	67.94	3.01	1.05–8.67	0.06
High	5	13.52	25	32.06			
Marital Status							
Married	36	97.29	77	98.71	0.45	0.02–7.47	0.53
Widowed	1	2.71	1	1.29			
Family Income (Rp)							
≤1,842,000	15	40.54	39	50.00	0.68	0.30–1.50	0.45
>1,842,000	22	59.46	39	50.00			
Period of Exposure (years)							
> 33	25	67.56	29	37.17	3.52	1.53–8.05	0.00
≤ 33	12	32.44	49	62.83			
Instances of Being in Close Contact with Smokers/Day (Times/Day)							
> 3	18	48.64	2	2.56	36.00	7.64–168.76	0.00
≤ 3	19	51.36	76	97.44			
Duration of Being in Close Contact with Smokers (Minutes)							
> 10	19	51.36	9	11.53	8.09	3.13–20.87	0.00
≤ 10	18	48.64	69	88.47			
Total	37	100.00	78	100.00			

The period of exposure to cigarette smoke was related to the incidence of hypertension in housewives in Dampit village. Housewives (>33 years), who were exposed to cigarette smoke, were 3.52 times at risk of developing hypertension compared to housewives who were exposed to cigarette smoke for ≤33 years. If a person is increasingly exposed to cigarette smoke, the risk of adverse health effects will be even greater (Janah & Martini, 2017).

Pharmacologically, nicotine stimulates the sympathetic nervous system in active smokers. Epinephrine and norepinephrine released by nicotine stimulation, with catecholamines, increases myocardial contractility and increases vasoconstriction, which results in an increase in blood pressure. The biological effects of cigarette smoke exposure on blood pressure are extrapolated from the effects of active smoking. In non-smokers, the serum nicotine level increases after exposure to cigarette smoke, and the duration of exposure to cigarette smoke is also important in evaluating the chronic effects of passive smoking (Park et al., 2018). The amount of toxins that accumulate in the body of passive smokers is related to the duration of exposure to cigarette smoke. The substances in cigarette smoke that are inhaled by passive smokers are cumulative, and, at one point, the toxin dosage reaches a toxic point, whereby longer the exposure to cigarette smoke, higher will be the incidence of an individual showing symptoms (Mustolih, Trisnawati, & Ridha, 2015; Torres, Merino, Paton, Correig, & Ramírez, 2018).

Biologically, the relationship between cigarette smoke and high blood pressure is due to the fact that the nicotine in cigarette smoke acts as an adrenergic agonist, which induces the release of local or systemic catecholamines in the neuroeffector or vasopressin release. Vasoconstriction induced by nicotine results in a temporary increase in acute blood pressure, and, in the long run, carbon monoxide (CO) gas can directly cause structural changes and endothelial dysfunction in arterial walls, such as arterial stiffness (Tamura et al., 2018). The outcome of acute exposure to cigarette smoke usually begins with functional changes; however, temporary changes in endothelium and myocardium are also observed in non-smoking individuals or individuals suffering from ischemic heart disease who are exposed to cigarette smoke (Leone, 2015). Exposure to cigarette smoke causes structural and functional changes in the arterial wall, including endothelial dysfunction, increased arterial stiffness, and the development of atherosclerosis. This can cause blood pressure to increase further (Kim et al., 2019).

This research used interviews with the help of questionnaires. Theoretically, exposure to cigarette smoke can be determined by the direct measurement of smoke components in the air. Interviews were conducted with the help of questionnaires or by measuring the biomarkers of body fluids, such as serum, urine, and saliva (Park et al., 2018).

Research Limitations

This research employed a cross-sectional design approach. Thus, it could not conclude a causal relationship between the exposure to cigarette smoke inside houses and the incidence of hypertension in housewives in Dampit village.

CONCLUSION

The majority of respondents were aged ≤41 years, had a low education level, were married, and earned Rp>1,842,000.00. There was a relationship between the duration of cigarette smoke exposure inside houses, being in close proximity to smokers every day, and the duration of being in close proximity to smokers inside houses and the incidence of hypertension in housewives in Dampit village.

CONFLICT OF INTEREST

This research did not receive financial assistance from any party, barring the personal funds received from researchers. The authors declare that there is no conflict of interest between the researchers and any party.

AUTHOR CONTRIBUTION

ALI was assigned as the compiler of research protocols, was responsible for data collection, data processing, data analysis, and the compilation of the article. SM was assigned as the research supervisor.

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