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RISK FACTORS OF HIGH BLOOD PRESSURE IN CHILDREN EXPOSED TO PASSIVE SMOKE

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Abstract

Indonesian awareness about environmental tobacco smoke is so low due to the cultural habit of smokers, according to SDKI 2012, passive smoker in South Sumatra was increase 82,5%. The

previous research was found that under 5 years old children with low birth weight was 6,3%, short stature was 7% and very tiny was 1% (FE-UI 2010). Children exposed to tobacco smoke accompanied by high blood pressure are in greater chance in developing severe cardiovascular disorders in adulthood. This study aimed to determine the effects of secondhand tobacco smoke exposure and other variables that affect blood pressure in passive smoker children in Palembang. This study was conducted with cross-sectional design involving 160 samples age between representing each district. It was found that 100% sample are second hand smoker. This study result was the most dominant risk factors influencing systolic blood pressure were birth weight, with higher incidence of elevated systolic blood pressure (p = 0.024; 95% CI = (- 7.75) - (- 0.511)), followed by tobacco smoke exposure (p = 0.042; 95% CI = 0.093-0.521). every tobacco smoke exposure could increase systolic pressure each 0,608 point, 0,307 point and 1,865 point. Future scope of this research are using spirometry test for better result, more samples and compares it with others future risk factors.

Keywords

Blood Pressure, Systolic, Diastolic, Passive Smokers

1. Introduction

Women and children are susceptible subjects to passive smoking as they live together with other family members who actively smoke. In Bahrain, 45% of children aged 13-15 years were passive smokers. Study done by Juonala (2011) in Germany showed there were 33.4% of samples exposed to secondhand smoke from their parents, and Simonetti (2011) found preschool children as much as 28.5% were exposed to tobacco from their father, 20.7% from their mother, and 11.9% from both parents. Nan (2015) in China, found as many as 30% of female respondents were exposed to tobacco.

Tobacco problems do not halt at active smokers. People living with smokers are in the same state of dangerous exposure as active smokers. In a room exposed to tobacco, PM2.5 residues were found 15 times higher than those unexposed (WHO, 2010). Residue of tobacco smoke exposure can cause various health problems in passive smokers. Substances present in tobacco are responsible for high blood pressure. Nicotine has an effect on heart rate and blood pressure, even on low doses. Nicotine is easily absorbed through the skin. Exposure through the skin causes an increase in heart rate and blood pressure (GmbH, 2014).

Another issue is the discrepancies between the reported data and findings in field study on hypertensive patients in previous years. In previous research, found that secondhand smoke exposure in young children can cause cardiovascular risk that will be established as a relevant when they are adult (Judith A, et al, 2017). Children as a secondhand tobacco smoke exposure on toddlers can be a marker as a blood pressure risk and cardiovascular risk (Washington, 2017).

Palembang, Indonesia, was the most hypertensive city in South Sumatera Province, and the proportion of hypertensive patients was 0.35% in 2011, and 0.46% in 2015 (Palembang Health Department, 2015). The number of hypertensive patients in field study is much bigger than the reported data in Palembang Public Health Office, 17,8% in 2011, elevated to 22,9% in 2015 (Sartik, 2015). Smoking and eating tobacco is a part of cultural activity in Palembang, many of people doesn't aware about the possible harm from smoking and tobacco smoke, especially for children. Therefore, this study aimed to conduct a direct study of the effect of exposure to tobacco smoke on systolic and diastolic blood pressure in children aged 13-18 years in Palembang, Indonesia.

2. Methods

2.1 Study Design and Sampling

This study was quantitative analytical with cross-sectional study design. The population in this study were children aged 13-16 years. The samples were 13-16 years old students attending junior high school in Palembang.

Sampling were done with Multistage Random Sampling technique. The first stage was determining the district with saturated sampling technique (all samples were taken), and the second stage was done with Simple Random Sampling. Palembang had 16 districts. All districts were taken and represented by 1 school, and from each school 10 students were taken. This research has 160 samples as students.

The inclusion criteria were: 1. Aged 13-16 years; 2. Been selected at the school; 3. Resided in selected districts. While the exclusion criteria were: 1. Had history of diseases causing secondary hypertension such as kidney diseases (hematuria, edema, fatigue), heart diseases (chest pain, dyspnea, palpitations), or diseases from other organs (such as endocrinological, rheumatological disorders); 2. Had ever smoked; 3. Consumed drugs that were related to heart and blood vessels.

2.2 Procedures

1. Data collection in destination schools.
    a. Provided informed consent to the students to be given to their parents.
    b. Up to 3 days later the parental consents were returned.
    c. Students who were approved for direct investigation were measured by individual variables such as blood pressure, lung capacity, BMI and individual questionnaire interviews.
2. Blood pressure measurement by sphygmomanometer:
    a. Measurements were done in the morning, on the day that there was no exam schedule.
    b. Students were asked to take a rest for 5-10 minutes, not drinking tea or coffee.
    c. Students were checked without shoes in 3 circumstances i.e. standing, sitting, and lying down. The average value was taken.
3. After the measurements at school, home visit were done for each student, measuring the parents' variables.

2.3 Data Analysis

Two partial statistical tests were performed for analysis. First, independent variables were made into ratio and correlation test of linear R Pearson was performed. Tobacco Smoke exposure scoring was totally from number of smokers in family members, length of stay with smokers, total tobacco consumption per day, frequency of tobacco smoking per week. If the samples score $\geq$ 9 is High tobacco smoke exposure, and if score <9 is low tobacco Smoke exposure.

Second, the independent variables were made categorical and T-test was performed. Simultaneous analysis was done to see the effects of independent variables on the dependent variables together, and to know which independent variable had the greatest influence to dependent variable. Linear regression was performed in analysis.

3. Results and Discussion

The study was done with samples obtained from blood pressure measurement of 13-16 years old non-smokers in Palembang in 2017. From each district, 10 samples were taken to obtain a total of 160. The results were as follows:

Table 1: *Distribution of Environmental Tobacco Smoke Exposure*

Variable	n.	%
Number of Smokers in Family Members		
< 2	149	93.1

≥ 2	11	6.9
Length of Stay With Smokers		
< 1 year	0	0.0
≥ 1 year	160	100.0
Total Tobacco Consumption per Day		
< 10	98	61.3
10-20	60	37.5
> 20	2	1.3
Frequency of Tobacco Smoking per Week		
6-8 times	106	66.3
9-11 times	14	8.8
> 11 times	40	25.0
Air Conditioning		
Air-conditioned	87	54.4
Non air-conditioned	73	45.6
Tobacco Smoke Exposure		
High (score ≥ 9)	62	38.8
Low (score <9)	98	61.3

In categorical variables (Table 1), the proportion of variables with the highest number were the family members who smoked (<2 people), length of stay with smokers (all samples ≥1 year), and the number of tobacco consumption per day (<10 bars), the frequency of tobacco smoking per week (6-8 times), with good air conditioning, and low tobacco smoke exposure. According to WHO (2010) found that the prevalence of smoking differs greatly in every country and different environment (urban vs rural, socioeconomic classes), the number of reproductive woman who smoke is increasing and the prevalence of children who exposed tobacco smoke varies from 10% in Sweden to 60% in Greece, to 40% in the US and to 50-70% in South Asia.

Independent Variables*	**Mean± SD**	**Systolic Blood Pressure**		**Diastolic Blood Pressure**	
		r	***P value***	**r**	***P value***
Body Mass Index (kg/m^2)	21.19	0.283	0.000	0.043	0.589
Birth Weight (kg)	2.91	-0.215	0.006	-0.007	0.928
Length of Paternal Education (years)	5.06	0.170	0.032	0.040	0.616

Length of Maternal Education (years)	5.03	0.107	0.177	-0.009	0.908
Total Parent Revenue (Rp)	4993750± 3424893	0.064	0.420	-0.065	0.413

Table 2: *Characteristics of Respondents in Relation to Blood Pressure*

** n=160, Correlation Analysis*

In numerical variables (Table 2), the mean of age was 14.79 years old, BMI 21.19 kg/m^2, birth weight 2.91 kg, systolic blood pressure 177.15 mmHg, diastolic blood pressure 78.33 mmHg, length of paternal education 14.83 years, length of maternal education 13.68 years, and total parent revenue Rp4993750. Based on the results of bivariate correlation, it was found that variables affecting systolic blood pressure with a value of P-Value <0.005 were Body Mass Index, birth weight, and length of paternal education.

The strength of each correlation relationship was weak (consecutively (r 0.283, r -0.215, r 0.170), whereas for diastolic blood pressure all variables had no significant effect. Groner (2017) found that there is the relationship between controlled for age, sex, body mass index, maternal education and socio-economic. This finding alike with Washington (2017) who found that hair nicotine levels directly correlated with blood pressure and have the correlation remained when controlled for age, sex, body mass index, maternal education and method of payment. The exposure of tobacco smoke has a detectable relationship with several known and it is proven as a cardiovascular risk's marker long before the emergencies of clinical disease (Washington, 2017).

Table 3: *Characteristics of Respondents in Relation to Blood Pressure*

Independent Variables	**Systolic Blood Pressure**		**Diastolic Blood Pressure**	
	Mean± SD	***P value***	**Mean± SD**	***P value***
Gender				
Male	119.04±5.61	0.000	79.04±5.21	0.025
Female	113.63±6.40		77.02±5.19	
Family's History of Hypertension				
Present	118.39±7.33	0.127	79.00±5.67	0.543
Not Present	116.40±5.72		77.93±5.01	

**(n=160, 2 Independent Sample Analysis)*

Bivariate analysis (2 independent samples) obtained the result of variable affecting systolic and diastolic blood pressure with P-Value <0.005 was gender. Male had higher average

systolic blood pressure compared to female. WHO (2010) found that all blood flow and serum cotinine have a positively correlation between systolic/diastolic index, resistance index, pulsatility index, and increased resistance of umbilical blood flow.

Table 4: *Model Prediction of Systolic Blood Pressure on Passive Smoker Children*

Variable	B	t	Sig.	95% CI
Birth Weight	-3.793	-2.283	0.024	(-7.75) - (-0.511)
Body Mass Index	0.608	3.144	0.002	0.226-0.989
Length of Paternal Education	0.307	2.835	0.005	0.093-0.521
Tobacco Smoke Exposure	1.865	2.054	0.042	0.093-0.521
Constant	103.887	14.201	0.000	89.436-118.338

Multivariate analysis found that birth weight was the most contributing factor, followed by tobacco smoke exposure, Body Mass Index, and length of paternal education. The formula of prediction model of systolic blood pressure in passive smoker children was as follows:

$$Y = 103.887 - 3.793X_1 + 0.608X_2 + 0.307X_3 + 0.865X_4, \text{ R square} = 13.7\% \ldots\ldots\ldots (1)$$

From equation 1 above, Y was systolic blood pressure, X1 was birth weight, X2 was Body Mass Index, X3 was length of paternal education, and X4 was tobacco smoke exposure. An increase of 1 kg of birth weight would decrease -3.793 systolic blood pressure. An increase of 1 kg/m^2 in Body Mass Index, 1 year of paternal education, and 1 tobacco exposure, the score would result in an elevation of systolic blood pressure at 0.608 points, 0.307 points, and 1.865 points, respectively.

A study by Buyzzere (2015) in healthy preschoolers, smoking parents were an independent risk of high blood pressure, coupled with other family members and environmental risks including BMI, parental hypertension, and birth weight. Simonetti (2011) found that children born prematurely or with low birth weight showed significant differences in higher systolic rates compared to children born with birth weight of 2500g.

The results of this study were in line with the results found by Hoteit and Maha (2016) that blood pressure correlated with BMI. BMI was influenced by several factors such as social culture, emotions, and genetics. In addition, the results of study conducted by Macia E et al. (2016), also showed that increased body weight would increase the incidence of hypertension and vice versa. High levels of fat (free fatty acids) in the blood of people with high IMT would inhibit the removal of sugar (glucose) by muscle tissue so that blood sugar levels would elevate. If the condition took place for long, then the body would not be able to tolerate it, so it would cause the occurrence of hypertension (Dua S, et al, 2014).

In this study, education, parents and blood pressure of respondents positively correlated. The results of this study were certainly different from existing studies where lower parental education levels were significantly associated with high systolic value in children (Simonetti, 2011). The discrepancies of the present findings were possible because of the relevance of education to the child's BMI. Parents who were well-educated tend to have adequate food supplies at home. This was also supported by Febrianto (2012) that showed the regression coefficient of Parental Education on the child BMI of 0.472 (positive corelation) indicated that every addition of parent education level of 1 unit, the BMI would be elevated by 0.472 units.

In Indonesia, plenty of studies are conducted on the scope of active smokers, but not in passive smokers, though passive smokers are also at risk in their future health. In addition, studies comprising children hypertension in Indonesia and household exposure to tobacco as a risk factor are quite uncommon. Yet on an international scale, non-communicable diseases has become an issue to be studied at the stage of childhood for factors suspected of shifting the pattern of infectious diseases to non-communicable diseases. Suggestion for goverment to strengthen a regulation of the protection of children from exposure to secondhand smoke. Such as smoking ban in the house and at the time children play in the house.

4. Conclusion

There was a statistically significant relationship between the incidence of elevated systolic blood pressure and length of paternal education (p = 0.005; B = 0.307; 95% CI = 0.093-0.521); Body Mass Index (p = 0.002; B = 0.608; 95% CI = 0.226-0.989), tobacco smoke exposure (p = 0.042; B = 1.865; 95% CI = 0.093-0.521), and birth weight (p = 0.024; B = -3.793; 95% CI = (-7.75) - (- 0.511)). Multivariate analysis found that birth weight was the most contributing factor, followed by tobacco smoke exposure, Body Mass Index, and length of paternal education. This

finding alike with Washington (2017) and Groner (2017) who found that hair nicotine levels directly correlated with blood pressure and have the correlation remained when controlled for age, sex, body mass index, maternal education and method of payment.

The limitation of this research was the amount of sample and the lack of facility of spirometry test. For the future scope of this research, it could be use spirometry test for better result, more samples and compares it with others future risk factors. The suggestions are the needs to educate the parents about the possible harms to the children who exposed to second hand smoke will face later in their adulthood life and to increase the children awareness concerning secondhand smoker, it would be better to include the information about the risk in their formal education curriculum.

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