Path Analysis on the Biopsychosocial Factors Associated with Hypertension

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ABSTRACT

Background: Hypertension is a non-communicable disease which may lead to premature death and disability. This study aimed to determine the biopsychosocial factors associated with the risk of hypertension.

Subjects and Method: This was an analytic observational study with a case control design. This study was conducted at Dr. Moewardi Hospital, from September to November 2018. A sample of 225 patients was selected by fixed disease sampling. The dependent variable was hypertension. The independent variables were anxiety, stress, quality of sleep, body mass index (BMI), physical activity, vegetables and fruit, coffee drink, and soft drink consumption. Blood pressure was measured by sphygmomanometer. Body weight was measured by scale. Body height was measured by microtoise. The other data were collected by questionnaire and analyzed by path analysis.

Results: Hypertension directly increased with anxiety (b= 0.26; 95%CI= 0.02 to 0.51; p= 0.037), stress (b= 0.28; 95%CI= 0.04 to 0.53; p= 0.022), poor quality of sleep (b= 0.46; 95%CI= 0.06 to 0.87; p= 0.026), BMI (b= 0.68; 95%CI= 0.051 to 1.31; p= 0.034), coffee drink consumption (b= 1.31; 95%CI= 0.17 to 2.46; p= 0.024), and soft drink consumption (b= 0.38; 95%CI= 0.04 to 0.72; p= 0.029). Hypertension directly decreased with high physical activity (b= -0.04; 95%CI= -0.07 to -0.004; p= 0.027), vegetable and fruit consumption (b= -1.13; 95%CI= -2.07 to -0.19; p= 0.037). Hypertension was indirectly affected by anxiety, physical activity, quality of sleep, and coffe drink consumption through BMI and quality of sleep.

Conclusion: Hypertension is directly and positively affected by anxiety, stress, poor quality of sleep, BMI, coffee drink consumption, and soft drink consumption, but negatively affected by high physical activity, vegetable and fruit consumption.

Keywords: hypertension, biopsychosocial, determinants

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BACKGROUND

Hypertension is a major health problem worldwide due to the high prevalence rate and the number is associated with an increased risk of cardiovascular disease and contributes to the deaths of nearly 9.4 million people each year (World Health Organization, 2013). Hypertension affects around 40% of the world's population over the age of 25 years and is estimated to cause 10.4 million deaths every year worldwide (Garfinkle, 2017). In 2016, the National Health Indicator Survey (Sirkesnas) saw this figure increase to 32.4 percent (RI Ministry of Health, 2017). Basic health research results in 2018 show the prevalence of hypertension nationally (34.1%), when compared with the results of the 2013 riskesdas (25.8%) indicating an increase in prevalence rates, this makes hypertension cases need to be paid attention because hypertension is wrong one major risk factor for degenerative diseases include heart

disease, stroke and other vascular diseases (Ministry of Health, 2018).

Hypertension is related to unhealthy behavior and lifestyle. Hypertension control is carried out with changes in behavior patterns including avoiding cigarette smoke, healthy diet, diligent physical activity and not consuming alcohol (Fuchs, 2018). Measuring blood pressure is one of the important activities in early detection of risk factors for non-communicable diseases such as hypertension, stroke, heart disease, and abnormal kidney function or others. This activity can be carried out at every health facility including public health center or other health clinics. It can also be carried out at the integrated guidance post for non-communicable diseases in the community (Ministry of Health, 2017).

The number of people at risk with the age above 18 years who measured blood pressure in 2016 was 5,292,052 or 20.16 percent. From the results of blood pressure measurements, 611,358 people or 11.55 percent are stated to have hypertension / high blood pressure. Based on the gender, the percentage of hypertension in the female group was 11.85 percent or higher than the one in the male group of 11.16 percent (Ministry of Health of the Republic of Indonesia, 2017.).

Regional General Hospital (RSUD) of Dr. Moewardi Surakarta is a type A teaching hospital and referral hospital in the province of Central Java. Based on the results of measurements of the number of cases of hypertension found in Surakarta amounting to 23.12% and only about 2% difference in national hypertension prevalence and the 9th largest highest in Central Java Province (Central Java Provincial Health Office, 2016) data obtained from registration books in the medical record section of the RSUD Dr. Moewardi Surakarta, it can be seen that the number of

outpatient hypertension patients always increases from year to year.

In 2017, there were 31,279 cases of hypertension and was a disease with the largest number one outpatient index in Dr. Moewardi hospital. Hypertension is in the position of the top five most hospitalized diseases in Dr. Moewardi hospital and has increased every year. The number of hypertensive patients hospitalized in 2017 was 3,143. Hypertension is also the highest disease in the internal medicine department at Dr. Moewardi as many as 17,344 patients in 2017 (Dr. Moewardi hospital, Surakarta, 2017).

Based on this background and the high number of patients suffering from hypertension, the authors are interested in examining further about the factors that influence the incidence of hypertension, especially in analyzing biopsychosocial determinants of the incidence of hypertension in Dr. Moewardi hospital, Surakarta.

The health biopsychosocial model is one type of model that can be practically used to explain biological, psychological and social factors. This is done because in determining a concept of disease determinants based on biological causes alone are not enough to explain the occurrence of internal disease processes (Murti, 2017).

SUBJECTS AND METHOD
1. Stduy design
This was an analytic observational study with a case control design. The study was conducted at Dr. Moewardi hospital, Surakarta, Central Java, from September to November 2018.
2. Population and sample
The source population was hypertensive patients who underwent treatment at Dr. Moewardi Surakarta. The case group was 75 hypertensive patients undergoing treat-

ment at Dr. Moewardi. Meanwhile, the control group was 150 non-hypertension patients in Dr. Moewardi hospital. A sample og 225 was selected by fixed disease sampling.

3. Study variables

The dependent variable was hypertension. The independent variables were anxiety, stress, quality of sleep, body mass index, physical activity, vegetable and fruit consumption, coffee consumption, and of soft drink consumption.

4. Operational definition of variables

Hypertension suffered by patients who have been diagnosed is based on examination by a doctor or nurse at Moewardi General Hospital. Anxiety was defined as a feeling of anxiety, worry and tension that are felt by the respondents before the occurrence of hypertension with the HRS-A questionnaire (Hamilton Rating Scale for Anxiety).

Stress was defined as a negative emotional condition in patients in which patients experience feelings of anxiety, irritability and over react to situation, stress was measured by Perceived Stress Scale (PSS) questionnaire.

Sleep quality was defined as a measure of satisfaction, ease when starting to sleep and in maintaining sleep. Quality of sleep was measured by the Pittsburgh sleep quality index questionnaire (PSQI).

Body mass index (BMI) was defined as a nutritional state of the study subject according to WHO standard.

The physical activity was defined as an exercise carried out routinely 5 times a week within 30 minutes of each physical activity. The consumption of vegetables and fruit was defined as the amount of consumption of vegetables and fruit in 1 week in which it is said to be routine if you consume 4-6 times in 1 week. The coffee consumption was defined as the amount of coffee consumption and a habit in the life of a respondent. It was said to be excessive if you consume more than 3 times a day. The consumption of soft drinks was defined as the amount of soft drink/soft drink consumption and become a habit in the life of a respondent. It was said to be excessive if you consume more than 4 times in 1 month.

5. Study Instrument

The data were measured by questionnaire. The validity tests were in the form of content and face validity. Reliability test was carried out on 20 patients undergoing treatment at Dr. Moewardi hospital Surakarta. Reliability test was done by measuring variables using the SPSS program which can calculate the total item correlations (>0.20) and Cronbach's alpha (≥ 0.70).

6. Data analysis

Univariate analysis was conducted to see the frequency distribution and percentage characteristics of the study subjects. Bivariate analysis was carried out to examine the relationship between the incidence of hypertension and the independent variables by Pearson correlation test. Multivariate analysis used path analysis to determine the direct and indirect effects of the relationships between study variables. Path analysis steps included model specification, model identification, model fit, parameter estimate, and model respecification.

7. Research Ethics

The research ethics include informed consent, anonymity, confidentiality and ethical clearance. The ethical clearance in this study was conducted at the Medical Faculty of Sebelas Maret University with protocol number 01/18/09/282 which was published on September 25, 2018.

RESULTS

1. Sample characteristics

Table 1 showed that most of the study subject had excessive BMI (61.8%), high income (67.1%), junior high school (48.9%), did routine physical activity (65.8%), and did not have family history of hypertension (61.3%).

Table 1. Sample characteristics

Variable	n	%
Hypertention		
Yes	75	33.3
No	150	66.7
Anxiety		
Mild	132	58.7
Acute	93	41.3
Stress		
Mild	131	58.2
Acute	94	41.8
Quality of sleep		
Good	133	59.1
Poor	92	40.9
Body Mass Index		
Normal	86	38.2
Excessive	139	61.8
Family history		
Yes	87	38.7
No	138	61.3
Physical activity		
Routine (at least 150 minutes/week)	148	65.8
Not routine	77	34.2
Smoking Status		
No smoking	115	51.1
Smoking	110	48.9
The consumption of vegetable and fruit		
Not routine	145	64.4
Routine (4-6 times/week)	80	35.6
The consumption of coffee		
Normal	130	57.8
Excessive (>3 times/day)	95	42.2
The consumption of Soft drink		
Excessive (2-6 times/week)	70	31.1
Normal (0-4 times/month)	155	68.9
Family Income		
Low	74	32.9
High	151	67.1
Education		
No formal education	17	7.6
Primary school	13	5.8
Junior high school	110	48.9
Senior high school	46	20.4
College	39	17.3

2. Bivariate analysis

Table 2 showed the results of bivariate analysis. Table 2 showed that risk of hypertension increased with age (r= 0.12; p= 0.086), anxiety (r= 0.57; p<0.001), stress (r= 0.57; p<0.001), sleep quality (r= 0.63;

p<0.001), BMI (r= 0.50; p<0.001), income (r= 0.22; p= 0.001), smoking (r= 0.25; p<0.001), coffee consumption (r= 0.48; p<0.001), and soft drink consumption (r= 0.58; p<0.001). Risk of hypertension decreased with physical activity (r= -0.55; p<0.001) and vegetables consumption (r= -0.51; p<0.001).

Table 2. The results of bivariate analysis

Independent Variable	r	p
Age	0.12	0.086
Anxiety	0.57	<0.001
Stress	0.57	<0.001
Sleep quality	0.63	<0.001
Body mass index	0.50	<0.001
Physical activity	-0.55	<0.001
Smoking	0.25	<0.001
Fruit and vegetable consumption	-0.51	<0.001
Coffee consumption	0.48	<0.001
Soft drinks consumption	0.58	<0.001
Income	0.22	0.001

3. Path analysis

Figure 1 depicted path model with estimate. The number of measured variables in Figure 1 was 12, the endogenous variables were 3, the exogenous variables were as 9, and degree of freedom (df)= 6 (over identified).

Table 3 showed the results of path analysis on the determinants of hypertension. Table 3 showed that there was a positive and direct relationship between the quality of sleep and hypertension. Risk of hypertension increased with poor quality of sleep (b= 0.46; 95% CI= 0.06 to 0.87; p= 0.026).

There was a positive and direct relationship between BMI and the hypertension. Risk of hypertension increased with BMI (b= 0.68; 95% CI= 0.05 to 1.31; p= 0.034).

There was a positive and direct relationship between coffee consumption and hypertension. Risk of hypertension increased with coffee consumption (b= 1.31; 95% CI= 0.174 to 2.45; p= 0.024).
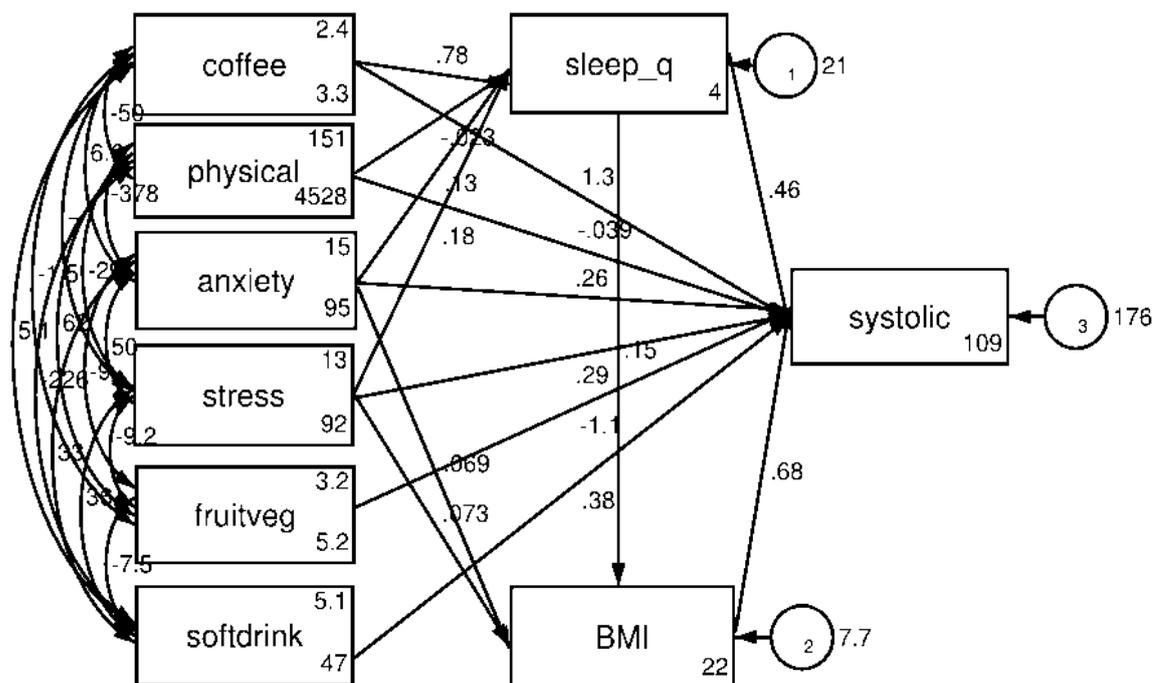

Figure 1. Path model with estimate

There was a positive and direct relationship between anxiety and hypertension. Risk of hypertension increased with anxiety (b= 0.26; 95% CI= 0.02 to 0.51; p= 0.037).

There was a positive relationship between stress and hypertension. Risk of hypertension increased with stress (b= 0.28; 95% CI= 0.04 to 0.53; p= 0.022).

There was a positive and direct relationship between soft drink consumption and hypertension. Risk of hypertension increased with soft drink consumption (b= 0.38; 95% CI= 0.038 to 0.72; p= 0.029).

There was a negative and direct relationship between physical activity and hypertension. Risk of hypertension decreased with physical activity (b= -0.04; 95% CI= -0.07 to -0.004; p= 0.027).

There was a negative and direct relationship between vegetables and fruits consumption and hypertension. Risk of hypertension decreased with vegetables and fruits consumption (b= -1.13; 95% CI= -2.07 to -0.19; p= 0.018).

There was positive relationship between coffee consumption and quality of sleep. Coffee consumption increased poor quality of sleep (b= 0.78; 95% CI= 0.39 to 1.15; p<0.001).

Table 3. The results of path analysis on the determinants of hypertension

Dependent Variable		Independent Variable	b*	95% CI		p	β**
				Lower Limit	Upper Limit		
Direct effect							
Blood	←	Sleep quality	0.46	0.06	0.87	0.026	0.15
Pressure	←	Body mass index	0.68	0.05	1.31	0.034	0.12
	←	Coffee consumption	1.32	0.17	2.45	0.024	0.12
	←	Anxiety	0.26	0.02	0.51	0.037	0.13
	←	Physical activity	-0.04	-0.07	-0.004	0.027	-0.13
	←	Stress	0.29	0.04	0.53	0.022	0.14
	←	Vegetables and fruits consumption	-1.13	-2.07	-0.19	0.018	-0.13
	←	Soft drink	0.38	0.04	0.72	0.029	0.13
Indirect effect							
Sleep	←	Coffee consumption	0.78	0.39	1.15	<0.001	0.21
Quality	←	Anxiety	0.12	0.05	0.21	0.002	0.19
	←	Physical activity	-0.02	-0.03	-0.01	<0.001	-0.24
	←	Stress	0.18	0.10	0.26	<0.001	0.26
BMI	←	Sleep quality	0.15	0.07	0.21	<0.001	0.28
	←	Anxiety	0.07	0.02	0.11	0.004	0.19
	←	Stress	0.07	0.03	0.12	0.003	0.21

n Observation=225
Log Likelihood =-6529.4134   TLI= 0.835
RMSEA= 0.124   SRMR= 0.035
CFI= 0.953   CD= 0.67
NFI= 0.97
GFI= 0.98
b*= Unstandardized path coefficient
β**= Standardized path coefficient

There was a positive relationship between anxiety and poor quality of sleep. Poor quality of sleep increased with anxiety (b= 0.13; 95% CI= 0.05 to 0.21; p= 0.002).

There was a negative relationship between physical activity and poor quality of sleep. Poor quality of sleep decreased with physical activity (b= -0.023; 95% CI= -0.03 to -0.01; p<0.001).

There was a positive relationship between stress and poor quality of sleep. Poor quality of sleep increased with stress (b= 0.18; 95% CI= 0.01 to 0.25; p= 0.006).

There was a positive relationship between poor quality of sleep and BMI. BMI increased with poor quality of sleep (b= 0.15; 95% CI= 0.07 to 0.21; p< 0.001).

There was a positive relationship between anxiety and BMI. BMI increased with anxiety (b=0.07; 95% CI= 0.02 to 0.11; p= 0.004).

There was a positive relationship between stress and BMI. BMI increased with stress (b=0.07; 95% CI= 0.03 to 0.12; p= 0.003).

DISCUSSION

1. The relationship between sleep quality and hypertension

The result of this study showed that there was a positive relationship between the quality of sleep and the incidence of hypertension. The result of this study was in line with a study by Lo et al. (2018) which stated that poor quality of sleep increased blood pressure level (OR= 1.48; p= 0.010). People with poor quality of sleep were 1.48 times more likely to experience hypertension compared to people with good sleep quality.

2. The relationship between coffee consumption and hypertension

There was a positive relationship between coffee consumption and the incidence of hypertension. The result of this study was not in accordance with a study by Xie et al. (2017) and Grosso et al. (2017) which stated that there was no significant relationship between coffee consumption and the inci-

dence of hypertension. The study showed that coffee consumption was a protective factors on hypertension.

Coffee consumed by the community was not a pure coffee. The meaning of impure was it contained less than 20% of coffee. These coffees contained more other ingredients such as sugar, cream, sweeteners, coloring, and coffee flavour. At the time of the data collection, the author asked the type of coffee drinks that were often consumed by the study subject. After that, the author looked for the composition of each coffee that was often consumed by study subjects by looking at the composition of the coffee container listed. The fact was that the coffee they drink was coffee that has been mixed with other ingredients while the pure coffee content was less than 20%.

3. The relationship between physical activity and hypertension

The result of this study showed that there was a negative relationship between physical activity and hypertension. The result of this study was in line with a meta-analysis study by Khalil et al. (2017), Liu et al. (2017) which stated that regular physical activity could decrease the risk of hypertension (RR= 0.94; 95% CI= 0.92 to 0.96). Over the past 4 to 5 decades, it has been stated that regular physical activity can be a step to prevent chronic diseases such as heart disease, diabetes, stroke, and hypertension. Therefore, physical activity was classified as one of the main protective factors in controlling and preventing high blood pressure (Puspita et al. 2017). Physical activity can be improved by providing health education regularly (Haryani et al. 2016).

4. The relationship between anxiety and hypertension

The result of this study showed that there was a positive relationship between anxiety

and hypertension. This study was in line with a study done by Hamrah et al.,(2018) which showed that there was high prevalence of anxiety among patients who experienced high blood pressure. Anxiety prevalence in hypertensive patient was 42.3%.

5. The relationship between stress and hypertension

The result of this study showed that there was a positive relationship between stress and the incidence of hypertension. The result of this study was in line with a study by Liu et al. (2017) which stated that individuals who experienced stress were 2.4 times more likely to have hypertension compared to those who did not experience stress (OR = 2.40, 95% CI = 1.65 to 3.49; p<0.001).

6. The relationship between vegetables and fruits consumption and hypertension

The result of this study showed that there was a negative relationship between vegetables and fruits consumption and hypertension. The result of this study was in line with a study by Kim and Kim (2017) which stated that regular fruits consumption could decrease the risk of hypertension by 56% among men and 67% among women. Among the many risk factors, diet played an important role in the development of hypertension. A diet to stop hypertension was characterized by a high intake of vegetables and fruits.

7. The relationship between soft drink consumption and hypertension

The result of this study showed that there was a positive relationship between soft drink consumption and hypertension. The result of this study was in line with a study by Souza et al. (2016). Soft drinks that were rich in sugar have received attention because they were a source of calories, and these drinks were associated with the

incidence of weight gain and obesity as reviewed by (Hu, 2013). The positive relationship between sweet drinks with high blood pressure and hypertension has also been documented among adults and adolescents according to (Malik et al., 2014).

Additional sweeteners usually found in soft drinks were artificial sweeteners containing fructose and glucose, but the most influential in increasing the risk of blood pressure was fructose. Fructose itself was a derivative of sugar cane or beet which was often found in vegetables and fruits. In line with the development of technology, fructose was made in the form of High Fructose Corn Syrup (HFCS) (Keim et al., 2006). Products in the form of HFCS tasted very sweet and they were cheap, so the use of HFCS in the beverage industry has increased. The increase in the number of soft drink consumption with the use of fructose in the form of HFCS has a close relationship with the increase in blood pressure (Gallagher, 2008; Johnson et al., 2009).

8. The relationship between BMI and the hypertension

The result of this study showed that there was a positive relationship between body mass index and hypertension. The result of this study was in line with a study by Peltzer (2018) which stated that there was a relationship between BMI and hypertension. BMI >25 increase the risk of hypertension. Obesity was the main characteristic of hypertensive patients. The work of the heart and circulation of blood volume of patients with hypertension who were obese was higher than hypertensive patients who were not obese (Ramadhani and Sulistyorini, 2018).

In obesity, peripheral resistance was reduced or normal, while sympathetic activity was increased with low plasma renin

activity. Through aerobic physical exercise for 30-45 minutes/day, it can reduce peripheral resistance which would decrease blood pressure (Houston, 2009). Lack of exercise could increase the risk of obesity, and if salt intake increased, the risk of developing hypertension would also increase. Obesity was closely related to the hobby of consuming foods which contained high fat (Yusrizal et al., 2016).

Obesity increased the risk of hypertension due to several reasons because the greater the body mass, the more blood was needed to supply oxygen and food to the body's tissues (Wong, 2015). This mean that the volume of blood circulating through the blood vessels was increased, and it gave greater pressure to the arterial wall. Obesity increased heart rate and blood insulin levels. Increased insulin caused the body to hold sodium and water (James et al., 2015). Obesity can be prevented by good self-perception, perceived benefits, and perceived threat on the incidence of hypertension (Setiyaningsih et al.,2016).

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