Associations of Individual Characteristics and Nutritional Status with Hypertension in Adults

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ABSTRACT

Background: Hypertension is a significant health problem and a modifiable risk factor for cardiovascular diseases. The prevalence of hypertension in adults continues to increase at a global and national level. Information regarding determinants of hypertension is critical for preventive measures, especially in adults. This study examined the associations of individual characteristics and nutritional status with hypertension in adults in East Ciputat, South Tangerang.
Method: A cross-sectional study was conducted to 400 adults aged ≥35 years old. Data on their blood pressure and nutritional status (body mass index) were obtained by measurement, and data on individual characteristics, food consumption, and lifestyle were collected through an interview using a structured questionnaire. A multivariate analysis was performed using a logistic regression test.
Results: The proportion of hypertension was 54%. The multivariate analysis results showed that older age, low education level, a family history of hypertension, overweight/obese status, and consumption of sweet foods for >3 times/week increased the risk of hypertension (Odds Ratio 2.37-11.28). In conclusion, people aged ≥65 years were at the greatest risk of hypertension. This study highlights the importance of increasing health promotion on the modifiable risk factors of hypertension such as food consumption patterns, weight control, and knowledge about hypertension.

INTRODUCTION

Hypertension is a modifiable risk factor for the development of cardiovascular diseases. The prevalence of hypertension continues to increase. Globally, nearly 1.13 billion people have hypertension, and two thirds of them are in developing countries.[1] In Indonesia, the prevalence of hypertension rises. The Indonesia Basic Health Research reported that the prevalence of hypertension based on blood pressure among people aged ≥18 years was 34.1% in 2018.[2] In Banten Province, it was reported to have also increased from 23.0% in 2013 to 29.5% in 2018. Specifically in South Tangerang City, Banten Province, it increased from 22.1% in 2013 to 27 .5% in 2018.[2, 3]

Previous studies have reported that individual characteristics such as age, gender, marital status, occupation, education level, and family history of hypertension are risk factors for hypertension.[4, 5] Individuals who retired had a 3.66 times possibility of having hypertension, while those who had a history of hypertension in their family were 2.95 times likely to develop hypertension.[5] Obesity and lack of physical activity are also risk factors associated with the development of hypertension.[6, 7] Less physical activity was associated with a 1.19 times possibility of having hypertension, and overweight or obesity was associated with a 1.98 times risk of having hypertension.[6]

Consumption of high-sodium food is associated with a higher systolic blood pressure in men, while consumption of fruits and vegetables is associated with a lower systolic blood pressure in both men and women.[8] In fact, the cohort study found that overweight or obesity with a combination of unhealthy lifestyles was associated with an increased risk of hypertension.[9] A previous study reports that sleep duration was associated

with the development of hypertension in both men and women.[11] Men who slept ≥10 hours had a higher risk of developing hypertension than those who slept 7-8 hours, and the risk of hypertension was also higher in women aged ≥60 years who had a long sleep duration.[10] Other studies also showed that adults who slept <7 hours were at higher risk for developing hypertension.[11, 12]

The risk of hypertension increases with age. The 2018 Basic Health Research showed that hypertension in groups aged ≥35 years reached 31%.[2] The current study was conducted in East Ciputat, South Tangerang City where a high number of adult population age ≥35 years old (41. 0%) had a high prevalence of hypertension[2,13]. In relation to hypertension, information regarding individual characteristics and nutritional status in adults in East Ciputat is limited. This study aimed to determine the associations between individual characteristics and nutritional status with the risk of hypertension among adults in East Ciputat.

METHOD

This study used a cross-sectional design, and details of methodological issues have been previously described.[14] In brief, the study was conducted in September-October 2019 in Rengas and Pondok Ranji Villages of East Ciputat Sub-district, South Tangerang City, selected purposively from six villages. The study protocol was approved by the Ethics Committee of Faculty of Health Sciences of UIN Syarif Hidayatullah Jakarta with a letter number of Un.01/F.10/KP.01.1/KE.SP/09.00.001/2019. A written consent was obtained from all respondents to participate in the survey.

The 2018 Basic Health Research showed the prevalence of hypertension was higher in individuals aged ≥35 years than those aged <35 years.[2] Thus, the research respondents were female and male adults aged ≥35 years who resided in those two villages. Exclusion criteria were pregnant women and individuals working in shifts. A purposive sampling technique was used to select 400 respondents.

Blood pressure was measured using a 2019-calibrated Riester Nova mercury sphygmomanometer and a stethoscope. At the time of measurement, the respondents were in a state of rest and calm. Blood pressure measurements were performed according to the World Health Organization's protocols, in which three blood pressure measurements were taken every at least 5-10 minutes between each measurement. The average measurements were used for analysis. Hypertension was classified according to the 7th Joint National Committee on Prevention, Detection, Evaluation, and Treatment of High Blood Pressure (JNC VII), i.e., mean systolic blood pressure of ≥140 mmHg and /or mean diastolic blood pressure of ≥90 mmHg or currently taking hypertension medication.[15]

Information on individual characteristics (age, gender, ethnicity, marital status, education, and occupation), family history of hypertension, and lifestyle (smoking, physical activity, and sleep duration) were obtained through an in-person interview using a structured questionnaire. Age was grouped into 35-44 years, 45-54 years, 55-64 years, and ≥65 years. Marital status was categorized into married and single/widowed/divorced. Ethnicity was categorized into Javanese, Sundanese, Betawinese, and others, following a patrilineal line. Education was categorized as low education for elementary school, middle education for high school, and university for college or university. Occupation was categorized as working if the respondent has a job and not working if she/he does not have a job or retires, and housewife. Family history of hypertension defined as presence of hypertension in first degree relatives. Smoking behavior is measured using a question "Have you ever smoked in the past year?", and the answers are made into categories of ever and never smoke. The Food Frequency Questionnaire (FFQ) was used to obtain information about weekly food consumption, including vegetables, fruits (bananas, mangoes, and papayas), fried foods, instant noodles, and sweet foods. The frequency of food consumption was categorized into 0 time/week, 1-3 times/week, and >3 times/week. Sleep duration was categorized as good for 6-8 hours per day and poor for 6-8 hours per day.

Physical activities were assessed using a questionnaire from the short version of the International Physical Activity Questionnaire (IPAQ) for the last seven days (IPAQ-S7S). Physical activities were categorized as low, moderate, and heavy according to the total MET-minutes/week. Low physical activity is a condition where the total score of MET-minutes/week of walking activity was <600; moderate physical activity had the total score of MET-minutes/week of 600-3000; and heavy physical activity had the

total score of >3,000. Data of anthropometric were obtained by measuring height and weight. Body weight was measured using a digital AND scale UC-321 series with an accuracy of 0.01 kg and height measurement with a GEA Medical SH-2A stature meter with an accuracy of 0.1 cm. Body Mass Index (BMI) was calculated by dividing body weight (kg) by height (m^2). BMI was grouped into underweight/normal if the BMI $\leq$25 kg/m^2, and overweight/obese if the BMI >25 kg/m^2.

Categorical variables were presented in proportion. The bivariate analysis was performed using a chi-square test between the dependent variable (hypertension status) and the independent variables with two categories (individual characteristics, family history of hypertension, smoking, physical activity, sleep duration,

nutritional status, and frequency of food consumption) and using a bivariate logistic regression test for independent variables with more than two categories. In addition, multivariate analysis was conducted using a logistic regression test with the enter method to assess the risk factors for hypertension. Variables with a p-value of <0.25 in the bivariate analysis were entered into the first multivariate model. Furthermore, variables with a p-value of <0.05 in the first model were continued for the final multivariate analysis. Odds Ratio (OR) values and 95% Confidence Interval (CI) were used to evaluate the risk of hypertension at a significance level of <0.05.

RESULTS AND DISCUSSION

Table 1. Characteristics of respondents by hypertension status

Variable	Hypertension		No hypertension		OR (95% CI)	P-value
	n (=216)	%	n (=184)	%		
Age (years)						
35-44	25	35.2	46	64.8	1.00 (Reference)	-
45-54	79	47.6	87	52.4	1.67 (0.94-2.97)	0.080
55-64	77	64.7	42	35.3	3.37 (1.82-6.24)	<0.001
$\geq$65	35	79.5	9	20.5	7.16 (2.97-17.25)	<0.001
Gender						
Male	44	52.4	40	47.6	1.00 (Reference)	-
Female	172	54.4	144	45.6	1.09 (0.67-1.76)	0.832
Marital status						
Married	167	51.1	160	48.9	1.00 (Reference)	-
Single/widowed/divorced	49	67.1	24	32.9	1.96 (1.15-3.34)	0.018
Ethnicity						
Javanese	88	50.3	87	49.7	1.00 (Reference)	-
Sundanese	32	61.5	20	38.5	1.58 (0.84-2.98)	0.155
Betawinese	88	58.3	63	41.7	1.38 (0.89-2.14)	0.149
Others	8	36.4	14	63.6	0.57 (0.23-1.41)	0.223
Education level						
University	11	42.3	15	57.7	1.00 (Reference)	-
Middle school	75	44.6	93	55.4	1.10 (0.48-2.54)	0.824
Low	130	63.1	76	36.9	2.33 (1.02-5.34)	0.045
Occupation						
Not working	88	61.1	86	38.9	1.00 (Reference)	-
Working	11	50.6	7	48.4	0.65 (0.24-1.76)	0.397
Housewife	117	56.3	91	43.8	0.82 (0.31-2.19)	0.270
Family history of hypertension						
No	102	44.5	127	55.5	1.00 (Reference)	-
Yes	114	66.7	57	33.3	2.49 (1.65-3.76)	<0.001
Nutritional status						
Underweight/normal	71	45.2	86	54.8	1.00 (Reference)	-
Overweight/obese	145	59.7	98	40.3	1.79 (1.20-2.69)	0.006

This study found the proportion of adults with hypertension was a 54% out of 400 adult respondents in East Ciputat. Characteristics of respondents according to hypertension status are presented in Table 1. Hypertension tends to be higher in older respondents than younger respondents. Hypertension was higher in female (54.5%), single/widowed status (67.1%), Sundanese ethnicity (61.5%), low education level (63.1%), non-working status (61.1%), a family history of hypertension (66.7%), and overweight/obese status (59.7%). There were significant associations between age, marital status, education level, a family history of hypertension, and nutritional status with the risk of hypertension. Meanwhile, gender, ethnicity, and occupation were not significantly associated with the risk of hypertension (Table 1).

Table 2. Frequency of food consumption and lifestyle by hypertension status

Variable	Hypertension		No hypertension		OR (95% CI)	P-value
	n = 216	%	n = 184	%		
Green vegetables (times/week)						
>3	115	51.8	107	48.2	1.00 (Reference)	-
1-3	74	53.6	64	46.4	1.08 (0.70-1.65)	0.737
0	27	67.5	13	32.5	1.93 (0.95-3.94)	0.070
Fried food (times/week)						
0	30	48.4	32	51.6	1.00 (Reference)	-
1-3	94	53.4	82	46.6	1.22 (0.68-2.18)	0.496
>3	92	56.8	70	43.2	1.40 (0.78-2.52)	0.256
Fruits (times/week)						
>3	116	55.5	93	44.5	1.00 (Reference)	-
1-3	79	53.4	69	46.6	1.22 (0.69-2.18)	0.918
0	21	48.8	22	51.2	1.40 (0.78-2.52)	0.765
Instant noodle (times/week)						
0	117	57.6	86	42.4	1.00 (Reference)	-
1-3	94	50.5	92	49.5	0.75 (0.50-1.12)	0.161
>3	5	45.5	6	54.5	0.61 (0.18-2.07)	0.431
Sweet foods (times/week)						
0	97	51.9	90	48.1	1.00 (Reference)	-
1-3	81	50.3	80	49.7	0.94 (0.62-1.43)	0.771
>3	38	73.1	14	26.9	2.52 (1.28-4.96)	0.007
Physical activity						
Heavy	21	43.8	27	56.3	1.00 (Reference)	-
Moderate	162	55.3	131	44.7	1.59 (0.86-2.94)	0.139
Low	33	55.9	26	44.1	1.63 (0.76-3.52)	0.211
Smoking						
Never	197	54.4	165	45.6	1.00 (Reference)	-
Ever	19	50.0	19	50.0	0.84 (0.43-1.64)	0.727
Sleep duration						
Good	113	51.6	106	48.6	1.00 (Reference)	-
Poor	103	56.9	78	43.1	1.24 (0.83-1.84)	0.337

The frequency of food consumptions and lifestyle according to hypertension status are presented in Table 2. The proportion of hypertension was higher in those who consumed no green vegetables in a week (67.5%), higher in those who had fried foods for >3 times/week (56.8%), and higher in those who had sweet foods >3 times/week (73.1%). It was also higher in those who had low physical activity (55.9%) and had poor sleep duration (56.9%). This study showed a significant association between the consumption of sweet foods and risk of hypertension, while the consumptions of green vegetables, fried foods, fruit, and instant noodles were not significantly associated with the risk of hypertension. In addition, this study showed no significant associations between physical activity, smoking behavior, and sleep duration with the risk of hypertension (Table 2).

Table 3 shows the multivariate analysis results on the determinants of hypertension in adult respondents in East Ciputat Sub-district. The first model of multivariate analysis showed that gender and marital status were not significantly associated with hypertension, and thus they were not continued to the second model of multivariate analysis. In the second model, the OR (95% CI) showed that respondents with an older age, lower education level, a family history of hypertension, overweight/obese status, and consumption of sweet foods for >3 times/week had increased risk of hypertension. For example, respondents aged 65 years had the greatest risk of hypertension.

Table 3. Odds ratio (95% CI) associated with determinants of hypertension

Variables	OR_1 (95% CI)	OR_2 (95% CI)
Age (years)		
35-44	1.00 (Reference)	1.00 (Reference)
45-54	2.15 (1.13-4.08)*	2.20 (1.16-4.17)*
55-64	3.49 (1.73-7.05)***	3.91 (1.97-7.76)***
≥65	9.72 (3.59-26.31)***	11.28 (4.24-30.04)***
Gender		
Male	1.00 (Reference)	-
Female	0.81 (0.46-1.41)	
Marital status		
Married	1.00 (Reference)	-
Single/widowed/divorced	1.60 (0.83-3.04)	
Education level		
University	1.00 (Reference)	1.00 (Reference)
High school	1.33 (0.54-3.33)	1.35 (0.55-3.34)
Elementary	2.80 (1.11-7.06)*	2.77 (1.12-6.85)*
Family history of hypertension		
No	1.00 (Reference)	1.00 (Reference)
Yes	3.02 (1.90-4.82)***	2.99 (0.61-1.57)***
Nutritional status		
Underweight/normal	1.00 (Reference)	1.00 (Reference)
Overweight/obese	2.51 (1.57-4.03)***	2.37 (1.49-3.79)***
Consumption of sweet foods (time/week)		
0	1.00 (Reference)	1.00 (Reference)
1-3	0.98 (0.61-1.58)	0.98 (0.61-1.57)
>3	2.80 (1.31-5.99)**	2.75 (1.23-5.85)**

Note: OR_1: Odds ratio of the first model; OR_2: Odds ratio of second model; *P-value of <0.05; **P-value of < 0.01; ***P-value of <0.001

This study showed similar findings to several previous studies reporting a high prevalence of hypertension in adults.[16-18] For example, 44% proportion of hypertension was found in Sidi Kalang Village, Dairi District,[19] while individuals aged ≥45 years in Sigaol Village, Samosir District showed a higher proportion of hypertension (62%).[20] This study found a slightly higher proportion of hypertension (35.2%) in individuals aged 35-44 years than respondents in the same age group (31.6%) participating in the 2018 Basic Health Research.[2]

This study also showed that the risk of hypertension increased with advancing age, and the highest risk of hypertension was found in individuals aged ≥65 years with a 11.28 times possibility. This finding is in line with the 2018 Basic Health Research[2] and some previous studies as well.[21-23] The increase in blood pressure in older age is generally due to stiffening of the arteries and arterioles, decrease in the baroreceptor sensitivity, increase in the sympathetic nervous system stimulus response, changes in the renal and sodium metabolism, and changes in the renin-aldosterone relationship.[24]

This study found that individuals with a low education level and a family history of hypertension have a higher risk of hypertension. The current findings were similar to the results of several previous studies reporting the risk of hypertension was associated with education level and a family history of hypertension.[25, 26] Lower education level was reported to increase the risk of low income, unstable work status, and unhealthy lifestyle behaviors such as smoking, lack of physical activity, and an unhealthy diet; hence, it increased the risk of hypertension.[27] Previous studies have shown that having a parent with hypertension is an important risk factor for hypertension. In addition, having one or more siblings, or one or more grandparents with hypertension increases the risk of hypertension.[28]

This study found an association between the frequency of sweet foods consumption and the risk of hypertension. A previous review showed that sugar consumption plays an important role in manipulating blood pressure.[29] Glucose can increase the flow of water from cells to blood vessels which then make fluid load improve. In addition, excessive consumption of fructose can cause insulin resistance and lipogenesis. Insulin resistance activates sympathetic tone through the renin-angiotensin system (RAS), thereby increasing sodium (Na) reabsorption which then raises the blood pressure.[30] This study did not find any associations between the frequency of vegetables, fruit, fried foods, and instant noodles consumption, and smoking behavior with hypertension. A previous study also reported no association between the frequency of vegetables and fruit consumptions with hypertension.[26] Another study conducted in Medan also showed that the frequency of instant noodles consumption and smoking behavior were not associated with the risk of hypertension.[31] The negative effects associated with the consumptions of vegetable, fruit, fried food, and instant noodles, and smoking behavior might be generated from homogeneous data, causing to detect a small association between hypertension and these factors. For example, the majority of respondents in this study were never smoking (90.5%) and consumed green vegetables for >3 times/week (55.5%).

The negative association between physical activity and the risk of hypertension in this study was also found in previous studies.[32, 33] Many respondents (52%) in this study were women who were housewives, and thus they carried household chores as physical activities. A previous study reported that a physical activity related to housework was not significantly associated with the risk of hypertension.[34] Housework activities are often carried out in a short time (10 minutes or more) to practice cardio respiration or metabolic adaptation. Household activities usually consist of non-dynamic movements that do not increase cardiac output or metabolism.[34] A previous study similarly reported no association between sleep duration and the risk of hypertension.[35]

Despite the significant findings in the discipline, this study has some limitations. We could not establish a cause-effect association between individual characteristics or nutritional status and hypertension risk as it used a cross-section design. In addition, potential risk factors associated with hypertension were limited as it used a secondary analysis adjusting to available data. For example, the frequency of high-sodium food consumption in association with hypertension was not examined because the data on this factor were not available. Self-selection bias may occur due to more female respondents participating in this study. Meanwhile, blood pressure and anthropometry data were the advantages of this study to reduce recall bias and subjectivity of respondents.

CONCLUSION

The proportion of hypertension was quite high (54%) in adults in East Ciputat of South Tangerang City. Individulas with older age, low education, a family history of hypertension, nutritional status of overweight/obesity, and the frequency of sweet foods consumption for >3 times/week had the increased risk of hypertension. Individuals at the age of ≥65 years had the greatest risk of hypertension. Promotion on healthy food consumption, weight control, and knowledge related to hypertension needs to be improved to prevent hypertension cases. This can be accomplished by utilizing integrated development posts to increase community participation in the

prevention and early detection of non-communicable disease (NCD) risk factors.

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