Hypertension as a Common Comorbidity in Patients with Diabetes: Occurrence based on Eating Habits and Other Determinants in Jakarta, Indonesia

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Abstract

Patients with diabetes have an increased risk of high blood pressure than individuals with normal blood sugar levels. Diabetes and hypertension are comorbid conditions that can lead to complications and can be associated with lower quality of life. This study aimed to determine the differences in occurrence of hypertension based on sociodemographic, nutritional, and health status as well as behavior and lifestyle factors in patients with diabetes at the Jatinegara Community Health Clinic, East Jakarta, in 2017. This study included 133 patients with diabetes aged 25–64 years and was conducted using a cross-sectional design and purposive sampling technique. The proportion of hypertension among patients with diabetes was 52.6%. Our findings indicated that obesity, sodium intake, fat intake, and vegetable consumption were significantly associated with hypertension in patients with diabetes. Providing information through community or individual counseling is crucial to modify the lifestyle factors, such as eating behavior and body weight monitoring that are expected to control blood pressure, and also prevent comorbidity in patients with diabetes.

Introduction

Hypertension is a major risk factor for cardiovascular disease. Long periods of high blood pressure may cause atherosclerosis and therefore decrease the supply of blood and oxygen toward the heart, leading to cardiovascular disease.[1] In 2008, it was estimated that cardiovascular disease accounted for approximately 17 million deaths, nearly one-third of total deaths, worldwide.[2]

In diabetes, insulin resistance and hyperinsulinemia cause an increase in peripheral resistance and the contraction of blood vessels due to the excessive response to norepinephrine and angiotensin II, which may lead to hypertension.[3] Studies in India have demonstrated that patients with diabetes were 1.5 to 3 times more likely to have high blood pressure than individuals with normal blood sugar levels.[4] A study conducted at

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Jatinegara Community Health Clinic reported a high prevalence (81.8%) of hypertension in patients with diabetes.[5] Therefore, the present study aimed to determine the differences in occurrence of hypertension based on sociodemographic, nutritional, and health status as well as behavior and lifestyle factors in patients with diabetes. This study was expected to provide information on the risk of comorbidity in patients with diabetes in terms of hypertension. To date, few studies have reported on risk factors for hypertension in diabetes.

Materials and methods

Study design and patients

The present study was a cross-sectional, community-based study conducted at Jatinegara Community Health Clinic in East Jakarta, Indonesia. Data collection was conducted in May 2017. The purposive sampling technique was used as well as inclusion criteria of patients aged 25–64 years who were registered for the Diabetes Prolanis Program at Jatinegara Community Health Clinic and were able to communicate well. Exclusion criteria were patients with chronic

disease, such as stroke, cancer, and chronic kidney disease, and those who were pregnant. The minimum number of samples required for this study was obtained using the two-sample test by proportion calculation, and the design effect was also taken into account, giving a total of 122 subjects. Ethical approval of this study was obtained from the Research Ethics Commission of the Faculty of Public Health, University of Indonesia (98/UN2.F10/PPM.00.02/2017). All patients provided consent prior to participating in this study.

Data collection

Patients were interviewed using a pretested questionnaire about sociodemographic information, awareness of hypertension and diabetes, family history of disease, duration of diabetes, and eating and smoking habits. Food intake was assessed using 24-h food recall, whereas a food frequency questionnaire was used to determine patients' eating habits. Physical activity was measured using the World Health Organization's Global Physical Activity Questionnaire.[6] Perceived Stress Scale 10 was used to acquire patients' stress data.[7] Stress scores were classified as low stress for scores of 0–13, moderate stress for scores of 14–26, and high stress for scores of 27–40.[8] Anthropometric measurements such as weight, height,[9] and waist circumference[10] were measured using a Seca weighing scale, microtoise for height, and a measuring tape for waist circumference. Cholesterol levels were measured using Autocheck.

Blood pressure was measured using a mercury sphygmomanometer, which is the gold standard for measuring blood pressure. The cutoff level for hypertension was ≥140 and ≥90 mmHg for systolic and diastolic blood pressure, respectively. Patients were also classified as hypertensive if they were taking any hypertensive medication. All equipment was calibrated before use. The enumerators were students and alumni of the Department of Public Health Nutrition, University of Indonesia and were trained for consistency in measurements.

Statistical analysis

Statistical analysis was performed using SPSS statistical program version 22 and included univariate and bivariate analyses. The chi-square test and independent t-test were used for bivariate analysis. $P<0.05$ was considered statistically significant.

Results

In total, 174 patients were available for data collection. However, this number was reduced after screening for age, chronic disease such as stroke, and available complete data. As shown in Table 1, a final total of 133 patients were included for statistical analysis. The proportion of hypertension in patients with diabetes was 52.6%. Patients were predominantly female, late adults (age, 45–64 years), had an education level lower than high school, not working/housewife, and married. The patients' sociodemographic, nutritional, and health status as well as behavior and lifestyle categories are shown in Table 1.

Bivariate analysis using the chi-square test showed that obesity and vegetable consumption were significantly associated with hypertension in patients with diabetes (P < 0.05) (Table 2). Patients with obesity were associated with a 2.14-fold increased risk of hypertension compared with that of patients with a normal body mass index. Patients who consumed fewer than two portions of vegetables per day had an increased risk of hypertension (by 3.49 times) compared with that of patients who consumed two or more portions. Results of the independent t-test showed that sodium and fat intake were also significantly associated with hypertension in patients with diabetes ($P< 0.05$). The mean values for sodium and fat intake were found to be higher in hypertensive patients than in normotensive patients (Table 3).

Discussion

Hypertension is the most common comorbidity in diabetes.[11] In the present study, 52.6% patients with diabetes had hypertension. Among all independent variables, obesity was most significantly associated with hypertension in patients with diabetes; this finding was consistent with that of a study by Berraho et al.[12] This could be explained by the increased levels of leptin and angiotensinogen in obese patients. Leptin stimulates the sympathetic nerve system, whereas angiotensinogen is a precursor of angiotensin II and renin. The

combined effect of leptin and angiotensinogen may lead to higher blood pressure.[13,14]

Consumption of two or more portions of vegetables was found to be a protective factor for hypertension. Vegetables, particularly leafy greens, are rich in antioxidants such as vitamin C and carotenoids that can provide defense against reactive oxygen species. In other words, antioxidants possess antiarteriosclerotic effects.[15]

Association between sodium consumption and hypertension

In the present study, the mean value of sodium consumption was significantly higher in hypertensive patients than in normotensive patients ($P< 0.05$). This may be because high sodium intake causes the intracellular fluid to exude into the extracellular fluid compartment, thereby increasing the blood volume and pressure.[16] However, the mean values for sodium consumption in both hypertensive and normotensive patients were much lower than the recommendations of the Institute of Medicine for daily sodium consumption, i.e., 1500 mg for adults aged 19–50 years and 1300 mg for adults aged 51–64 years.[17] Sodium intake was found to be underestimated and may be a result of the method used. The 24-h food recall was found to underestimate sodium and potassium intake by 30%–50%. The gold standard for estimating sodium and potassium intake is 24-h urine collection.[18]

Association between fat intake and hypertension

Our study also found that the mean value of fat intake was higher in hypertensive patients than in normotensive patients. Fat intake, particularly saturated fat, can trigger plaque development within blood vessels. Plaques may reduce the elasticity and diameter of blood vessels, resulting in increased blood pressure.[19]

Limitations

The main limitation of this study was that the samples were not quite representative of the population and could not show significant differences for some variables. Therefore, a sampling method better than purposive sampling is required for further studies. Despite this, the present study demonstrated numerous independent variables that were associated with hypertension in diabetes.

Conclusions

There was a high prevalence of hypertension in patients with diabetes at the Jatinegara Community Health Clinic. Therefore, providing information via counseling and posters may help to increase awareness of the risk factors of hypertension. among those with diabetes and may lead to lifestyle modifications such as better eating habits and body weight management.

It is also crucial to provide patients with information on diabetes management, such as lifestyle modification, and not solely on medication. Another important recommendation is medication for hypertension should be regularly consumed and not only when the patient experiences symptoms. We found that only 41.4% of the study patients answered these questions correctly for each topic.

Declaration of Interest

The authors report no conflict of interest.

Acknowledgment

Variables	Category	n	%
Hypertension	Hypertensive	63	47.4
	Normotensive	70	52.6
Sociodemographic Factors			
Age (years)	Early adult (age, 25–44)	120	90.2
	Late adult (age, 45–64)	13	9.8
Sex	Male	22	16.5
	Female	111	83.5
Education level	<High school graduate	92	69.7
	≥High school graduate	40	30.3
Employment	Not working/housewife	94	70.7
	Working	28	21.1
	Retired	11	8.3
Marital status	Unmarried	4	3.0
	Married	110	82.7
	Divorced	19	14.3
Knowledge	Score ≤ mean (73)	76	57.6
	Score > mean (73)	56	42.4
Nutritional and Health Status			
Obesity	Yes	85	63.9
	No	48	36.1
Abdominal obesity	Yes	113	85.0
	No	20	15.0
Hypercholesterolemia	Yes	38	33.0
	No	77	67.0
Duration of diabetes	>15 years	8	6.0
	11–15 years	13	9.8
	6–10 years	28	21.1
	≤5 years	84	63.2
Family history of cardiovascular disease	Yes	37	27.8
	No	96	72.2
Family history of hypertension	Yes	60	51.3
	No	57	48.7
Behavior and Lifestyle Factors			
Sodium-rich food consumption	≥once/day	2	1.5
	3–6 times/week	10	7.5
	1–2 times/week	32	24.1
	≤2 times/month	46	34.6
	Never	43	32.3
Foods containing preservative consumption	≥once/day	2	1.5
	3–6 times/week	10	7.5
	1–2 times/week	31	23.3
	≤2 times/month	48	36.1
	Never	42	31.6
Foods containing seasonings consumption	≥once/day	59	44.4
	3–6 times/week	22	16.5
	1–2 times/week	30	22.6
	≤2 times/month	10	7.5
	Never	12	9.0
Fruit consumption	<2 portions/day	111	83.5
	≥2 portions/day	22	16.5
Vegetables consumption	<2 portions/day	118	88.7
	≥2 portions/day	15	11.3
Coffee consumption	≥once/day	19	14.3
	3–6 times/week	13	9.8
	1–2 times/week	8	6.0
	≤2 times/month	11	8.3
	Never	82	61.7
Other caffeinated drinks consumption	3–6 times/week	4	3.0
	≤2 times/month	8	6.0
	Never	121	91.0
Smoking	Smoker	10	7.5
	Ex-smoker	16	12.0
	Non-smoker	107	80.5
Physical Activity	Not active	28	21.1
	Active	105	78.9
Stress	Moderate	65	50.4
	Low	66	49.6

Table 1. Categorical Distribution of Study Variables among Patients.

Variables	Category	Hypertensive (%)	Normotensive (%)	Total n (%)	P OR (95% CI)	*P*-value
Sociodemographic Factors						
Employment	Not working	55 (52.4%)	50 (47.6%)	105 (100%)	0.95 (0.41–2.20)	1
	Working	15 (53.6%)	13 (46.4%)	28 (100%)		
Marital status	Married	59 (53.2%)	52 (46.8%)	111 (100%)	1.14 (0.45–2.83)	0.82
	Unmarried	11 (50%)	11 (50%)	22 (100%)		
Knowledge	Score ≤ mean (73)	44 (57.9%)	32 (42.1%)	76 (100%)	1.59 (0.79–3.18)	0.29
	Score > mean (73)	26 (46.4%)	30 (53.6%)	56 (100%)		
Nutritional and Health Status						
Body mass index	Underweight	2 (66.7%)	1 (33.3%)	3 (100%)	0.91 (0.08–10.79)	0.94
	Obese	39 (45.9%)	46 (54.1%)	85 (100%)	2.14 (1.02–4.50)	0.05*
	Normal	29 (64.4%)	16 (35.6%)	45 (100%)		
Abdominal obesity	Yes	57 (50.4%)	56 (49.6%)	113 (100%)	0.55 (0.20–1.48)	0.33
	No	13 (65%)	7 (35%)	20 (100%)		
Hypercholesterolemia	Yes	20 (52.6%)	18 (47.4%)	38 (100%)	0.98 (0.45–2.13)	1
	No	41 (53.2%)	36 (46.8%)	77 (100%)		
Duration of diabetes	>5 years	27 (55%)	22 (44.9%)	49 (100%)	1.59 (0.36–7.08)	0.72
	≤5 years	43 (51.2%)	41 (48.8%)	84 (100%)		
Family history of cardiovascular disease	Yes	28 (46.7%)	32 (53.3%)	60 (100%)	0.73 (0.36–1.52)	0.46
	No	31 (54.4%)	26 (45.6%)	57 (100%)		
Family history of hypertension	Yes	20 (54.1%)	17 (45.9%)	37 (100%)	1.08 (0.51–2.32)	0.85
	No	50 (52.1%)	46 (47.9%)	96 (100%)		
Behavior and Lifestyle Factors						
Sodium-rich food consumption	Ever	47 (52.2%)	43 (47.8%)	90 (100%)	0.95 (0.46–1.97)	1
	Never	23 (53.5%)	20 (46.5%)	43 (100%)		
Foods containing preservative consumption	Ever	48 (52.7%)	43 (47.3%)	91 (100%)	1.02 (0.49–2.11)	1
	Never	22 (52.4%)	20 (47.6%)	42 (100%)		
Foods containing seasonings consumption	Often	42 (51.9%)	39 (48.1%)	81 (100%)	0.92 (0.46–1.90)	0.86
	Infrequently	28 (53.8%)	24 (46.2%)	52 (100%)		
Fruit consumption	<2 portions	57 (51.4%)	54 (48.6%)	111 (100%)	0.73 (0.30–1.85)	0.64
	≥2 portions	13 (59.1%)	9 (40.9%)	22 (100%)		
Vegetable consumption	<2 portions	66 (55.9%)	52 (44.1%)	118 (100%)	3.50 (1.05–11.60)	0.03*
	≥2 portions	4 (26.7%)	11 (73.3%)	15 (100%)		

Coffee consumption	Ever	26 (51%)	25 (49%)	51 (100%)	0.90 (0.45–1.81)	0.86
	Never	44 (53.7%)	38 (46.3%)	82 (100%)		
Other caffeinated drinks consumption	Ever	3 (25%)	9 (75%)	12 (100%)	0.27 (0.07–1.04)	0.07
	Never	67 (55.4%)	54 (44.6%)	121 (100%)		
Smoking	Smoker	7 (43.8%)	9 (56.3%)	16 (100%)	0.67 (0.23–1.91)	0.60
	Non-smoker	63 (53.8%)	54 (46.2%)	117 (100%)		
Physical activity	Not active (<600 METs)	18 (64.3%)	10 (35.7%)	28 (100%)	1.84 (0.77–4.35)	0.20
	Active (≥600 METs)	52 (49.5%)	53 (50.5%)	105 (100%)		
Stress	Moderate (Score 14–26)	36 (55.4%)	29 (44.6%)	65 (100%)	1.32 (0.66–2.62)	0.49
	Low (Score 0–13)	32 (48.5%)	34 (51.5%)	66 (100%)		

Table 2. Chi-square Analysis of the Association of Sociodemographic, Nutritional, and Health Status and Lifestyle and Behavior with Hypertension in Patients with Diabetes. OR: odd ratio; CI: confidence interval; MET: metabolic equivalent; *P-value <0.05

Variable		n	Unit	Mean	SD	SE	*P*-value
Behavior and Lifestyle Factor							
Sodium intake	Hypertension	70	mg	383.66	452.66	54.1	0.021*
	Normotension	63		260.72	416.39	52.46	
Potassium intake	Hypertension	70	mg	1136.09	996.99	119.16	0.853
	Normotension	63		1153.10	1140.03	143.63	
Carbohydrate intake	Hypertension	70	% total energy	54.29	9.92	1.19	0.292
	Normotension	63		55.05	11.63	1.46	
Protein intake	Hypertension	70	% total energy	14.65	3.99	0.48	0.671
	Normotension	63		15.32	4.85	0.61	
Fat intake	Hypertension	70	% total energy	31.85	8.86	1.06	0.034*
	Normotension	63		30.79	13.92	1.75	

Table 3. Independent *t*-test Analysis of the Association of Eating Habit with Hypertension in Patients with Diabetes. *P-value < 0.05

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