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Prevalence and Risk Factors of Hypertension and Diabetes Mellitus among Indonesian Elderly

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Abstract

Background: Epidemiological and demographic transitions lead to the emergence of non-communicable diseases (NCD) among the elderly. This study aimed to examine the risk factors of hypertension and diabetes mellitus (DM) among the elderly by using secondary data (Basic Health Research 2018).

Methods: Secondary data from Basic Health Research (N = 88,911) were used. Cut-off values for measurement were WHO standard of 126 mg/dl for fasting and 200 mg/dl for non-fasting for DM and 140 mmHg for systole and 90 mmHg for diastole for hypertension. Univariate, bivariate, and multivariate (binary logistic regression) analyses were conducted using STATA version 15.

Results: The prevalence of hypertension and DM among the elderly was about 22.30% and 5.39%, respectively. Age, sex, educational level, marital status, place of residence, and employment status were substantially associated with hypertension and were risk factors for DM.

Conclusions: There is significant correlation between hypertension and DM are risk factors of one another and therefore show a relationship. Various sectors must develop appropriate programs, including community and family support, to address this situation.

Keywords: diabetes mellitus, elderly, hypertension

INTRODUCTION

Epidemiological transition has occurred worldwide, including in Indonesia. This phenomenon leads to an increase in the number of non-communicable diseases (NCDs) and remains a concern in communicable diseases.[1] Indonesia still focuses on diarrhea, but the prevalence of hypertension and diabetes mellitus (DM) is sharply increasing. Indonesia also faces a demographic transition where the elderly population is sharply increasing.[2] Population aging occurs when the elderly constitutes 9% of the total population. Therefore, the diseases related to the elderly must be examined to improve the quality of life and prevent the high dependency ratio.

DM is an important public health problem because its healing process takes a long time and thus incurs a large cost.[3,4] DM affects as many as 422 million people in low- and middle-income countries and is one of the leading causes of death in the world.[5] WHO estimated that 366 million people in the world will live with DM in 2030.[6] Although it can be prevented by diet and exercise, the incidence of this chronic metabolic disorder is on a global rise.[7] Although this disease no longer affects the elderly, many cases have been recorded in adolescents.[8,9]

DM occurs when the level of sugar (glucose) in the blood is extremely high, and the pathogenesis of diabetic macrovascular and microvascular complications is affected by hypertension.[10] Glucose stays in the blood because the amount of insulin hormone in the body is not sufficient to convert glucose into energy.[5] Glucose levels in the blood can be reduced with drug therapy and physical activity (exercise).[7–9] The elevated mortality rate in Indonesia is predominated by NCDs, such as stroke, hypertension, high glucose, obesity, and cancer.[11] As dangerous as DM, hypertension is the other leading NCD that contributes 4.5% of the global disease burden.[12]

The dual burden of DM and hypertension has become a major public health concern worldwide and in

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Indonesia.[13] DM has a globally increasing prevalence and is also in the top 10 diseases that cause death.[14] However, studies examining the risk factors of DM and hypertension are lacking. DM and hypertension are NCDs with the highest risk for the elderly.[15] The lack of research simultaneously examining the risk factors of DM and hypertension might be due to some confounding factors that could influence the correlation.[10] Pregnancy-induced hypertension, also known as gestational DM, contributes to the high number of old people with hypertension.[16] However, DM is not exclusively correlated with hypertension. One study found that DM is a factor leading to heart failure, periphery artery disease, and coronary heart disease.[15]

Other risk factors besides medical reasons have also been reported. One study found that socio-environment, cultural environment, knowledge, and behavior are correlated with DM.[17] Understanding the intercorrelation of NCDs is needed to arrange appropriate programs for preventing NCD complications. The present study aimed to examine the factors correlated with hypertension and DM among the elderly by testing the data from Indonesia Basic Health Research 2018.

METHODS

Data were taken from Basic Health Research or Riset Kesehatan Dasar organized by the Ministry of Health 2018. This cross-sectional study brought two models that vary according to their dependent variables: Model 1 used DM as the dependent variable and Model 2 used hypertension as the dependent variable. In this study, DM was defined according to the standard fasting blood glucose levels of > 126 mg/dl or postprandial blood glucose levels of >200 mg/dl. Individuals categorized as having with DM were those diagnosed by medical professionals. Hypertension was categorized based on elevated blood pressure with a cut-off of 140 mmHg for systolic and 90 mmHg for diastolic.[12] This study included some sociodemographic factors, such as age, sex, marital status, educational level employment status, and place of residence, into the model to control the main predictor. The original survey used the probability proportional to size sampling and targeted 300,000 households from 30,000 census blocks. The Basic Health Research used linear systematic sampling with two-stage sampling. The subjects were old people aged ≥60 years.[18] Age was categorized into three groups of 60–74, 75–90, and > 90 years. The elderly were selected as the subject because they have highest risk for NCDs, including DM. The total number of eligible old people was 88,911.

Statistical analysis consisted of univariate, bivariate, and multivariate. Univariate analysis showed the frequency and percentage (for categorical variable) and minimum number, maximum number, and mean (for continuous variable) of each variable to determine the characteristic of respondents. Bivariate analysis was conducted using Chi-square test and t-test to calculate the crude odd ratio (COR) of each independent variable to all dependent variables. Binary logistic regression was adopted to examine the adjusted odd ratio all independent variables to the dependent variable in the two models. Statistical software STATA of Mahidol University, licensed version 15, was used for data analysis. This study was approved with ethical clearance from the Health Research Ethics Committee, Faculty of Public Health, Sriwijaya University, Indonesia No. 019/UN9.1.10/KKE/2020.

RESULTS

Table 1 describes the general characteristics of the respondents. In terms of sex, an equal proportion was observed between males and females. The prevalence of hypertension and DM among the elderly was 22.30% and 5.39%, respectively.

Table 2 presents the Chi-square test results between each independent variable and all dependent variables. The independent variables significantly correlated with DM were diagnosed hypertension, sex, age group,

TABLE 1. Prevalence of diabetes mellitus (DM) and hypertension and the general characteristics of the respondents (N = 88,911)

Variables	Frequency	Percentage
Diagnosed DM		
No	84,117	94.61
Yes	4,794	**5.39**
Diagnosed hypertension		
No	69,080	77.70
Yes	19,831	**22.30**
Sex		
Male	41,868	47.09
Female	47,043	52.91
Age group		
60–74 years old	69,212	77.84
75–90 years old	18,748	21.09
> 90 years old	951	1.07
Marital status		
Single	1,477	1.66
Married	54,335	61.11
Divorced	33,099	37.23
Education levels		
Uneducated	18,427	20.73
Elementary	51,852	58.32
High school	14,957	16.82
University	3,675	4.13
Employment status		
Employed	49,233	55.37
Unemployment	39,678	44.63
Place of residence		
Rural	36,314	40.84
Urban	52,597	59.16

education level, working status, and place of residence with COR of 2.74, 1.28, 0.54, 1.91, 1.78, and 0.37, respectively. However, marital status was not significantly correlated with DM. The independent variables that were significantly associated with hypertension were diagnosed DM, sex, age group, education level, working status, marital status, and place of residence.

Table 3 describes the binary logistic regression results between all independent variables and dependent variables (DM and hypertension). Model 1 used DM as a dependent variable and diagnosed hypertension as the main independent variable. After other independent variables were controlled, hypertension diagnosis was statistically correlated with DM in the elderly, that is, old people diagnosed with hypertension were 2.34 times more likely to being diagnosed with DM compared with those without hypertension. Females were significantly associated with DM and were 1.21 times more likely to develop DM compared with males.

TABLE 2. Distribution and chi-square analysis between independent variables and diabetes mellitus (DM)

Variables	Model 1 (Diagnosed DM)				COR (95% CI)	Model 2 (Diagnosed Hypertension)				COR (95% CI)
	No		Yes			No		Yes		
	n	%	n	%		n	%	n	%	
Diagnosed Hypertension					2.74*** (2.58–2.91)					-
No	66,319	96.00	2,761	4.00						
Yes	17,798	89.75	2,033	10.25						
Diagnosed DM					-					2.74*** (2.58–2.91)
No						66,319	78.84	17,798	21.16	
Yes						2,761	57.59	2,033	42.41	
Sex					1.28*** (1.21–1.36)					1.69*** (1.64–1.74)
Male	340	68.30	158	31.70		34,503	82.41	7,365	17.59	
Female	313	60.30	206	39.70		34,577	73.50	12,466	26.50	
Age group					0.54*** (0.50–0.58)					1.08*** (1.04–1.11)
60–74 years old	65,062	94.00	4,150	6.00		54,049	78.09	15,163	21.91	
75–90 years old	18,117	96.63	631	3.37		14,247	75.99	4,501	24.01	
>90 years old	938	98.63	13	1.37		784	82.44	167	17.56	
Marital Status					0.96 (0.91–1.02)					1.34*** (1.30–1.38)
Single	1,422	96.28	55	3.72		1,235	83.62	242	16.38	
Married	51,308	94.43	3,027	5.57		43,237	79.57	11,098	20.43	
Divorced	31,387	94.83	1,712	5.17		24,608	74.35	8,491	25.65	
Education levels					1.91*** (1.84–1.98)					1.18*** (1.15–1.20)
Uneducated	17,912	97.21	515	2.79		14,703	79.79	3,724	20.21	
Elementary	49,518	95.50	2,334	4.50		40,677	78.45	11,175	21.55	
High school	13,542	90.54	1,415	9.46		11,061	73.81	3,896	26.05	
University	3,145	85.58	530	14.42		2,639	71.81	1,036	28.19	
Employment status					1.78*** (1.67–1.88)					1.82*** (1.76–1.88)
Employed	47,223	95.92	2,010	4.08		40,538	82.34	8,695	17.66	
Unemployed	36,894	92.98	2,784	7.02		28,542	71.93	11,136	28.07	
Place of residence					0.37*** (0.35–0.39)					0.68** (0.66–0.71)
Rural	33,253	91.57	3,061	8.43		26,785	73.76	9,529	26.24	
Urban	50,864	96.71	1,733	3.29		42,295	80.41	10,302	19.59	

Note: *$p < 0.05$, **$p < 0.01$, ***$p < 0.001$
COR: Crude Odd Ratio

TABLE 3. Results of binary logistic regression with the two models

Variables	Model 1 (DM as dependent variable)		Model 2 (Hypertension as dependent variable)	
	p	AOR (95% CI)	*p*	AOR (95% CI)
Diagnosed Hypertension				
No		Ref		-
Yes	0.000***	2.34 (2.20–2.49)		
Diagnosed DM				
No		-		Ref
Yes			0.000***	2.32 (2.18–2.47)
Sex				
Male		Ref		Ref
Female	0.000***	1.21 (1.13–1.30)	0.000***	1.49 (1.43–1.55)
Age group				
60–74 years old		Ref		Ref
75–90 years old	0.000***	0.56 (0.51–0.61)	0.003**	1.06 (1.02–1.11)
> 90 years old	0.000***	0.28 (0.16–0.48)	0.000***	0.70 (0.59–0.83)
Marital Status				
Single		Ref		Ref
Married	0.001**	1.63 (1.24–2.15)	0.000***	1.47 (1.28–1.70)
Divorced	0.011*	1.44 (1.09–1.90)	0.000***	1.56 (1.35–1.80)
Education levels				
Uneducated		Ref		Ref
Elementary	0.000***	1.52 (1.37–1.67)	0.000***	1.18 (1.13–1.24)
High school	0.000***	2.62 (2.35–2.92)	0.000***	1.44 (1.36–1.53)
University	0.000***	4.16 (3.63–4.76)	0.000***	1.60 (1.47–1.75)
Employment status				
Employed		Ref		Ref
Unemployment	0.000***	1.65 (1.55–1.77)	0.000***	1.51 (1.45–1.56)
Place of residence				
Rural		Ref		Ref
Urban	0.000***	0.53 (0.50–0.57)	0.000***	0.82 (0.79–0.85)

Note: *$p < 0.05$, **$p < 0.01$, ***$p < 0.001$
Model 1, Pseudo $R^2 = 0.0822$
Model 2, Pseudo $R^2 = 0.0340$

Compared with those aged 60–74 years old, those aged 75–90 years had a 44% probability of having DM, and those aged > 90 years old had a 72% probability of having DM. In terms of marital status, compared with single elderly, the married elderly were 1.63 times more likely to have DM, and the divorced elderly with low significance level were 1.44 times more likely to have DM after the adjustment for other independent variables. In terms of education, the elderly who attended elementary school were 1.52 times more likely to have DM, followed by high school and university attendees who were 2.62 and 4.16 times more likely to have DM, respectively. In terms of working status, the elderly who are not working were 1.65 times more likely to have DM compared with the working elderly. In terms of place of residence, the elderly living in urban areas had a 47% probability of having DM compared with the elderly living in areas after the other independent variables were controlled.

In Model 2, hypertension is a dependent variable, and having DM is the main predictor. The results revealed that DM diagnosis was significantly associated with hypertension. In particular, the elderly with DM were 2.32 times more likely to have hypertension compared with the elderly without DM. Compared with males, females were 1.49 times more likely to have hypertension. In terms of age, compared with the elderly

aged 60–74 years old, those aged 75–90 years old were 1.06 times more likely to have hypertension, and those aged > 90 years had a 30% probability of developing hypertension. According to marital status, those who were married or divorced were 1.47 or 1.56 times more likely to have hypertension compared with those who were single. Educational level was found to be significantly associated with hypertension. The elderly who graduated from elementary school, high school, and university were 1.18, 1.44, and 1.60 times, respectively, more likely to have hypertension compared with those without any educational level. The unemployed elderly were 1.5 times more likely to have hypertension compared with those who were employed. Living in urban areas decreased the probability of hypertension by 18% compared with living in rural areas.

DISCUSSION

NCDs are diseases related to lifestyle. Several factors, including consuming biscuit and low physical activities, might influence DM and hypertension.[19] Another study found DM as the risk factor for tuberculosis (TB).[20] The risk factors for DM among individuals diagnosed with TB are sex, age, urban residence, tobacco smoking, sedentary lifestyle, poor glycemic control, having a family history of TB, and DM illness.[13] A study in Nigeria revealed that the risk factors for DM are family history of DM, urban-dwelling, unhealthy dietary habits, cigarette smoking, old age, physical inactivity, and obesity.[21] The risk factors of age, marital status, and hypertension in the present work were in line with those in the study in North India.[22] A similar research analyzed the Basic Health Research 2013 and found that DM prevalence increases with age, especially among those aged 65–74 years.[23] In terms of gender tendency, the present findings were in line with the previous study revealing that females have a higher risk of having DM than males.[24] A systematic review and meta-analysis study in Caribbean found that obesity is the main mediator between gender and DM: females are likely to be obese, making this condition a risk factor of DM.[25] Another study examined different data and found similar factors related to DM, such as high cholesterol, overweight, and hypertension.[17] A research in Rural Indonesia revealed that low education level and low income are related to DM prevalence.[26]

The intercorrelation of each NCD must be addressed to arrange the appropriate prevention programs. The correlation between hypertension and DM (and vice versa) is important to plan the corresponding preventive programs, such as antihypertensive therapy in patients with DM.[10] In terms of age, one type of DM is the leading cause of blindness, also known as diabetes retinopathy, and tends to have a high risk among the working age population.[27] In terms of place of residence, those who live in rural areas have a higher risk of developing DM compared with those who live in urban areas according to a study in China.[27] Another work found that physical activity is correlated to diseases among the elderly.[28,29] One report described the pathophysiology of the correlation between hypertension and DM and explained that blood pressure influences the circulation of fluid volume and peripheral vascular resistance.[30,31] Hypertension and living in urban areas are the factors that might increase the possibility of having DM.[31,32] One study in Papua found that the duration of employment has a significant association with NCDs.[33]

Programs related to NCDs have been established in some countries. CANagliflozin Cardiovascular Assessment Study is a program for patients with type 2 DM and cardiovascular risks, such as hypertension,[34] that involves interventions to reduce failure and disease outcomes, such as amputation.[35] This program has been implemented in Iran and New York and showed a significant effect in reducing the risk of DM in patients with cardiovascular diseases.[35,36] In Indonesia, NCD screening (including blood pressure and glucose test) among the elderly was implemented by POSBINDU mostly on a monthly basis. [37]

This study examined two NCDs that might intercorrelate with each other. Including other independent variables might be useful to determine the risk factors of various NCDs and prevent complications. Nevertheless, the results are beneficial in arranging programs specific for these NCDs. The findings of this study could be generalized to other developing countries, specifically in all provinces in Indonesia, to arrange screening and prevention programs.

CONCLUSIONS

The risk factors for hypertension and DM were sex, age, marital status, education level, employment status, and place of residence. Hypertension and DM were positively correlated with each other. Intervention and prevention programs, including community and family support, must be implemented for both NCDs.

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CONFLICT OF INTEREST

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