Hypertension among Diabetes Population in Malaysia and its Associated Risk Factors: Findings from National Health and Morbidity Survey 2015

Ismail H, Saminathan TA, Omar MA, Mat Rifin H, Robert Lourdes TG, Rodzlan Hasani WS, Ling Miaw Yn J, Ab Majid NL, Ahmad A, Mohd Yusoff MF

Centre for Non-Communicable Diseases Research, Institute for Public Health, National Institutes of Health, Ministry of Health Malaysia, Selangor, Malaysia

ABSTRACT

INTRODUCTION: The prevalence of hypertension and diabetes continues to rise globally. This study examined the national prevalence of hypertension among the diabetes population in Malaysia and its associated risk factors. **MATERIALS AND METHODS**: A sub-analysis of data from the National Health and Morbidity Survey (NHMS) 2015 was conducted among 4229 respondents with diabetes. The data was obtained from respondents aged 18 years and above. Diabetes was defined as those who self-reported to have diabetes or had fasting capillary blood glucose of ≥ 6.1 mmol/L or non-fasting blood glucose of >11.1 mmol/L. Hypertension was defined as one who has systolic and diastolic blood pressure of ≥ 140 mmHg and ≥ 90 mmHg, respectively. **RESULTS**: The prevalence of hypertension among respondents with diabetes was 57.9% (95% CI : 55.8,60.0). The prevalence of hypertension among diabetes was higher among females (58.7%), ≥ 60 years old (80.1%), Chinese (61.1%), those with primary education (69.6%), widow/widower/divorce (75.4%), not working (67.7%), rural residents (60.6%), non-smokers (60.1%), non-drinkers (58.1%), those who were obese (66.0%) and with abnormal cholesterol level (63.5%). Multiple logistic regression analyses revealed that age group, working status, obesity and cholesterol were associated with hypertension among respondents with diabetes. **CONCLUSION**: Prevalence of hypertension among diabetes population in Malaysia is high. Early detection of hypertension should be an integral part of diabetes management.

INTRODUCTION

Numbers of diabetes mellitus cases have increased significantly globally. In 2014, the World Health Organization (WHO) has estimated that adults living with diabetes was 422 million, which was a fourfold increment compared to the year of 1980. The prevalence of diabetes has nearly doubled since 1980 in the adult population, rising from 4.7% to 8.5%.[1]

In Malaysia, the number of cases with diabetes is also increasing. The National Health and Morbidity Survey (NHMS) in 2006[2] reports that the prevalence of diabetes among adults in Malaysia was 11.6%. This figure increased to 15.2% and 17.5% in NHMS 2011[3] and NHMS 2015, respectively.[4] The data from NHMS also show a high prevalence of hypertension in Malaysia; 32.7% in NHMS 2011[3] and 30.3% in NHMS 2015.[4] Diabetes and hypertension frequently coexist, with a study showing that those with diabetes have double the risk to get hypertension compared to the non-diabetic group.[5]

Hypertension and diabetes, when occurring together, increase the risk of development and progression of vascular complications.[6-8] Combining these two diseases leads to cardiovascular disease (CVD) and renal disease.[9-10] Also, hypertension in those with diabetes significantly increases CVD risks, retinopathy and nephropathy.[11-13] More worryingly, if hypertension and diabetes coexist, CVD risk increases by 75%. This condition increases the overall morbidity and mortality of an already high-risk population.[11,14]

Fasting blood glucose, high blood pressure, dyslipidemia, obesity, old age and particular ethnicity were identified as risk factors for diabetes.[15] Hypertension in particular, which is strongly associated with CVD, is rapidly emerging as the leading risk factor for diabetes.[16]

Diabetes and hypertension also have similar risk factors such as obesity, high blood pressure (BP) and dyslipidemia, which strongly relates to metabolic syndrome.[17,18] Hypertension in a person with diabetes is associated with microalbuminuria, central obesity, insulin resistance, dyslipidemia, hyper-coagulation, increased inflammation and left ventricular hypertrophy.[19]

In Malaysia, few studies were conducted on a large-scale concerning hypertension and diabetes. This study was conducted to determine the national prevalence of hypertension among the adult diabetes population in Malaysia and its associated risk factors.

MATERIALS AND METHODS

We followed the methods of Hasimah Ismail et al. 2016.[20] This study used the secondary data from the National Health and Morbidity Survey (NHMS) 2015. NHMS 2015, conducted in 2015 by the Institute for Public Health (IPH), Ministry of Health Malaysia, was a household survey; multi-stage stratified sampling design was applied, proportionate to the respective state's population size in Malaysia. The target population was the residence of non-institutionalized living quarters (LQ) in both urban and rural areas.

Malaysia was geographically divided into 75,000 Enumeration Blocks (EB); out of which 869 Enumeration Blocks (EB) were selected for this study (random selection of 536 EBs from urban areas and 333 EBs from rural areas). Within each selected EB, 12 LQs are randomly chosen, and all members of every household in the selected LQs were surveyed.[20]

A bi-lingual questionnaire, which was designed, pre-tested, and validated before data collection was used to interview sociodemographic characteristics and health status. The data collection team's face-to-face interviews were done using mobile devices with a specially developed system for NHMS 2015. Completed questionnaires were sent through the NHMS server in IPH to the data management team. Dataset will be rechecked for quality control, especially on the respondent ID, outliers or incorrect data.

The structured questionnaires in this survey include general household, socio-demography and specific health problems domains, blood glucose level, and blood pressure measurements. Trained research assistants measured the clinical anthropometric measurements. The qualified nurse performed the finger prick biochemistry tests and measured the blood pressure. Overall, 10,433 LQs were successfully visited, and 29,606 individuals were interviewed with a response rate of 89.2% and 96.9%, respectively. Signed informed consent was taken from the respondents before administrating the questionnaire. Medical Research and Ethics Committee (MREC), Ministry of Health Malaysia approval were obtained to conduct the study.

This study targeted respondents aged 18 years old and above. Fasting blood glucose was performed on respondents who claimed not to have been previously diagnosed as DM, using the portable CardioChek blood test system (finger-prick method).

The respondent's blood pressure was measured using Omron Digital Automatic Blood Pressure Monitor Model HEM-907. The respondent was in a seated position with the arm at the heart level and after 5 minutes' rest. Three readings were taken for both systolic and diastolic blood pressure, with a gap of 15 minutes, with the average readings of the three used as blood pressure values. Respondents were considered hypertensive if self-reported to be hypertension, or their average reading was ≥140 mmHg for systolic and /or ≥90 mmHg for diastolic blood pressure.

The research assistants measured anthropometric measurements (weight and height). The respondent's weight was measured in kilograms using a digital weighing machine (TANITA HD-319), and height was measured in centimeters using Seca 206 Body meter. Body Mass Index (BMI) was calculated by dividing the weight in kilograms

by the square of the respondents' height in meters. Respondents with a BMI of 30.0 kg/m^2 or more were classified as obese.[21]

The International Physical Activity Questionnaire (IPAQ) -short form was used to assess the respondents' physical activity level. Respondent was classified as physically active if his combination of vigorous-intensity, moderate-intensity and walking activities achieved a minimum of 600 metabolic equivalents of task (MET)-minute/week.[22] In our study, a respondent who is still smoking during the interview was classified as a smoker.

STATISTICAL ANALYSIS

The data were analyzed by using SPSS Version 20. Categorical variables were presented as frequencies and percentages. Meanwhile, continuous variables were presented as means with a 95% confidence interval (CI). Finally, multivariate analysis was performed using binary logistic regression and logistic regression, which was expressed as an odds ratio and 95% CI.

RESULTS

SOCIODEMOGRAPHIC

The total number of respondents with diabetes was 4,229, with 54.9% females and 80% of the respondents were 40 years and above. The majority of the respondents were Malays (65.0%), followed by Chinese (13.7%) and Indians (10.3%). Overall, 56.1% of respondents were from the urban area. More than 74.3% of respondents had their education up to primary and secondary levels. The majority (75.4%) of the respondents were married, and more than 50.0% were not working (Table 1).

PREVALENCE OF HYPERTENSION WITH DIABETES.

Hypertension prevalence among respondents with DM was 57.9% (n=2,625). Gender, age group, residence, ethnic group, educational level, marital status, occupation status, smoking status, physical activity level, obesity status and hypertensive status showed significant statistical

Table 1: Sociodemographic characteristics of the respondents. (N=4229)

Sociodemographic characteristic		N	%
Gender			
	Male	1908	45.1
	Female	2321	54.9
Age Group (years)			
	18 – 39	848	20.1
	40 – 59	1918	45.4
	60 & above	1463	34.6
Residence			
	Urban	2368	56.1
	Rural	1861	44.0
Ethnic group			
	Malays	2748	65.0
	Chinese	578	13.7
	Indians	434	10.3
	Other Bumiputera	290	6.9
	Others	179	4.2
Educational Level			
	No Formal Education	436	10.3
	Primary Education	1409	33.3
	Secondary Education	1736	41.0
	Tertiary Education	609	14.4
	Unclassified	36	.9
Marital Status			
	Single	380	9.0
	Married	3187	75.4
	Widow/widower/divorcee	662	15.7
Occupation status			
	Working	2017	47.7
	Not working	2212	52.3

differences. However, alcohol consumption was not significant statistically.

FACTORS ASSOCIATED WITH HYPERTENSION IN DIABETES

Each significant variable found in this study's univariate analysis was then tested in multivariate logistic regression (Table 2). Adjusted Odd Ratio (aOR) of the associated factors for hypertension with diabetes is shown in Table 3; statistically significant associations were found in the age group 40-59 years (aOR 2.82 (95% CI: 2.15-3.69); 60 years old and above aOR 6.92 (95% CI: 4.83-9.92), not working (aOR 1.28 (95% CI: 1.03-1.58), obese aOR 2.25 (95% CI: 1.81-280) and high cholesterol (aOR 1.57 (95% CI: 1.27-1.93). No significant association was found in gender, residence, marital status, ethnic group, educational level, smoking status, alcohol consumption and physical activity level.

DISCUSSION

The coexistence of hypertension and diabetes is common. Our study also showed similar findings as more than half of diabetic respondents in Malaysia have hypertension.

Table 2: Prevalence of Hypertension by Socio-Demographic Characteristic in Diabetes Population in Malaysia

Sociodemographic characteristic	Hypertension		
	N	% (95% CI)	p-value*
National	2625	57.9 (55.8,60.0)	
Gender			
Male	1126	57.2 (54.1,60.2)	0.648
Female	1499	58.7 (58.9,61.5)	
Age Group (years)			
18 – 39	250	31 (27.1,35.4)	**<0.001**
40 – 59	1196	61.4(58.3, 64.4)	
60 & above	1176	80.1 (77.0,82.8)	
Residence			
Urban	1414	57.2 (54.7,59.6)	0.122
Rural	1211	60.6 (57.0,64.1)	
Ethnic group			
Malays	1733	58.2 (55.4,60.9)	0.015
Chinese	367	61.1 (55.9,66.1)	
Indians	262	59.9 (54.0,65.6)	
Other Bumiputera	73	57.1 (51.2,62.8)	
Others	90	43.4 (33.2,54.2)	
Educational Level			
No Formal Education	318	68.5 (61.3,74.8)	**<0.001**
Primary Education	1026	69.6 (65.8,73.2)	
Secondary Education	965	52.8 (49.5,56.1)	
	296	46.5 (41.3,51.8)	
Marital Status			
Single	133	31.8 (26.0,38.3)	**<0.001**
Married	1990	59.6 (57.1,62.1)	
Widow/widower/ divorcee	502	75.4 (70.8,79.6)	
Occupation status			
Working	1046	49.7 (46.8,52.5)	**<0.001**
Not working	1579	67.7 (64.9,70.3)	
Smoking Status			
Smoker	387	49.9 (45.1,54.7)	**<0.001**
Non-smoker	2237	60.1 (57.8,62.3)	
Alcohol consumption			
Yes	87	54.3 (44.3,63.9)	0.459
No	2455	58.1 (55.9,60.3)	
Physical Activity			
Active	1526	54.3 (51.6,57.0)	**<0.001**
Inactive	1074	63.9 (60.7,67.0)	
Obesity			
Obese	1224	66.0 (62.8,69.1)	**<0.001**
Non-obese	1225	51.8 (48.8,54.8)	
Total Cholesterol			
High	1956	63.5 (61.1,65.9)	**<0.001**
Normal	669	47.4 (43.7,51.0)	

Table 3: Factors associated with hypertension in Type 2 Diabetes Population in Malaysia (using Logistic Regression)

Sociodemographic characteristic	OR (95% CI)	P-value	aOR (95% CI)	p-value*
Gender				
Female	1.06 (0.90,1.26)	0.468	0.78 (0.61,1.00)	0.052
Male	1.00	-	1.00	-
Age group (years)				
18 – 39	1.00	-	1.00	-
40 – 59	3.52 (2.81,4.41)	<0.001	2.82 (2.15,3.69)	**<0.001**
60+	8.91 6.84,11.61)	<0.001	6.92 (4.83,9.92)	**<0.001**
Residence				
Urban	1.00	-	1.00	-
Rural	1.15 (0.96,1.38)	0.119	1.09 (0.87,1.37)	0.432
Ethnic group				
Malays	1.00	-	1.00	-
Chinese	1.13 (0.89,1.44)	0.325	0.95 (0.69,1.30)	0.742
Indians	1.08 (0.83,1.40)	0.582	1.14 (0.81,1.61)	0.446
Other Bumiputera	0.96 (0.73,1.26)	0.758	1.48 (0.98,2.23)	0.061
Others	0.55 (0.35,0.86)	0.010	0.86 (0.53,1.40)	0.550
Educational Level				
No Formal Education	2.50(1.70,3.67)	<0.001	1.28 (0.80,2.06)	0.309
Primary Education	2.64 (1.99,3.50)	<0.001	1.39 (0.97,1.97)	0.060
Secondary Education	1.29 (0.99,1.66)	<0.001	0.98 (0.73,1.30)	0.870
Tertiary Education	1.00	-	1.00	-
Marital Status				
Single	1.00	-	1.00	-
Married	3.16 (2.33,4.28)	<0.001	1.35 (0.91,1.99)	0.133
Widow/widower/ divorcee	6.58 (4.51,9.61)	<0.001	1.44 (0.88,2.35)	0.145
Occupational Status				
Working	1.00	-	1.00	-
Not working	2.12 (1.80,2.50)	<0.001	1.28 (1.03,1.58)	0.026
Smoking Status				
Smoker	0.66 (0.53,0.82)	<0.001	1.01 (0.72,1.40)	0.975
Non-smoker	1.00	-	1.00	-
Alcohol consumption				
Yes	0.87 (0.57,1.29)	0.459	1.22 (0.74,2.00)	0.443
No	1.00	-	1.00	-
Physical Activity				
Inactive	1.49 (1.26,1.76)	<0.001	1.15 (0.94,1.42)	0.174
Active	1.00	-	1.00	-
Obesity				
Obese	1.81 (1.49,2.19)	<0.001	2.25 (1.81,2.80)	<0.001
Non-obese	1.00	-	1.00	-
Total Cholesterol				
High	1.94 (1.63,2.31)	<0.001	2.25 (1.81,2.80)	<0.001
Normal	1.00	-	1.00	-

Notes: p ≤ 0.05 was considered statistically significant

Our study also found that hypertension is significantly associated with age, not working, obese and high cholesterol. Ageing and population growth are attributable to this high coexistence of hypertension and DM. Other behavioural risk factors, such as excessive body weight, harmful alcohol use, unhealthy dietary practice (e.g., high sodium food), lack of physical activity, and persistent stress, also contribute to this condition.[23] Comparatively, other studies had shown an even higher prevalence of hypertension among respondents with diabetes, such as in Morocco, which had 70.4% prevalence reported and Jordan which had a prevalence of 72.4%.[24,25]

Compared to some European studies, the prevalence of hypertension among diabetes in our study is also lower compared to the 74% found among the UK Caucasian[26] and the 73% among Spanish[27] population respectively. Furthermore, a comparison with other Arab populations shows that the prevalence of hypertension is lower than our study; 44% in Oman diabetic[28] and 38% in Bahraini diabetic populations.[29]

Our study showed that hypertension prevalence among diabetes in Malaysia increases with age and is significantly higher among those of 40 -59 years and 60-year-old and above. Hypertension among diabetes mellitus type 2 is known to be age-related. Our finding is similar to a study done by Addisu Y. M in Botswana, Africa. The result showed the risk of hypertension increased when the

person with diabetes got older due to age-related insulin insensitivity β- cell which dysfunctions leads to glucose intolerance.[30] Other studies also found an association between old age and hypertension.[31,32]

This study also showed that obesity is strongly associated with hypertension, similar to other studies.[33,34]

In terms of occupational status, hypertension prevalence among diabetes was high among those not working, and it was statistically significant too. This is expected as many of those who are not working are elderly retirees. Our studies show that the prevalence of hypertension is not uncommon among old age. Most of the elderly are retirees, and many have some chronic diseases. About half of the elderly are inactive due to health limitations. This could be the reason those with diabetes and not working have hypertension.

This study showed a higher prevalence of hypertension with diabetes among obese individuals, similar to another study.[35] Obese diabetics were more likely (2.25 times) to have hypertension. Obese individuals have a large abdominal fat store which increases the release of free fatty acids and other signaling factors which affects insulin metabolism and increases insulin resitance.[36]

This study also found that diabetic respondents with high cholesterol levels were more likely (1.57 times) to have hypertension. A study in Hong Kong on single nucleotide polymorphisms (SNPs) found that SNPs predict the development of diabetes and be able to predict the development of hypertension [37-39]. In genome scans in Hong Kong Chinese individuals, the genome region associated with diabetes was also associated with metabolic syndrome, including hypertension as a component.[40-41]

This study has its limitations. First, the secondary data obtained from NHMS 2015 had limited information regarding other possible risk factors of hypertension among diabetes in Malaysia. Also, with few studies related to hypertension among diabetes on a large scale, it was quite challenging to compare our results.

CONCLUSION

More than half of the T2DM population had hypertension coexistence in this study. Age, obesity, occupation status and hypercholesterolemia were associated risk factors for hypertension within this population. Patient education and behavioural intervention programs should encourage lifestyle modification, physical activity, dietary changes, and medication compliance. Diabetes management should include early detection of hypertension. Healthcare settings, especially at the primary care level, should adhere to clinical practice guidelines and perform timely screening for hypertension among diabetes patients routinely.

DATA AVAILABILITY

Data are not available in the public domain because they are currently being analyzed in related papers. However, data will be made accessible upon request from the corresponding author.

CONFLICT OF INTEREST

The authors declare that they have no conflict of interest

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