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Research Article

A comparative study of hypertension, diabetes mellitus and obesity among Malaysians in urban regions - A cross sectional study

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ABSTRACT

The objective is to study the relationship between age, gender and race with the prevalence of hypertension, diabetes mellitus (DM) and obesity in the urban population. Relationships of these three main diseases in the country were also studied. A cross sectional study was conducted among 862 Malaysian citizens in Kuala Lumpur and Selangor region who were 10 years old and above. Standard procedure of blood pressure (BP) measurement was used based on the American Heart Association guidelines. Fasting blood glucose was measured using glucometer and Body Mass Index (BMI) was also calculated. Throughout the study, health awareness was the lowest among urban Chinese and highest among younger age group, 10-30 (46.06%). The mean BP classification was 2 (pre-hypertension) according to the JNC VII classification. 15.7% of the participants have hypertension. Percentage of hypertension in Malays, Chinese and Indians are 17.1%, 11.1% and 10.6% respectively. Males have higher percentage of hypertension, 23.2% compared to females with 11.51%. A growing trend of younger age group having hypertension was noted in age groups 10 – 19 (2.96%) and 20 – 29 (8.25%). Fasting blood glucose level showed 20.65% of the total participants were diabetic. The Malays recorded highest percentage of DM, which is 22.14%, meanwhile Chinese, 17.78% and Indians, 15.23%. The younger generation comprising age groups 10–19 and 20–29 prevalence of DM were 6.9% and 6.7% respectively. 25.5% of males have DM compared to females, 17.99%. The overall percentage of obese participants is 18.56%. The participants' BMI were classified according to the WHO criteria. Malays were found to have the highest percentage of obesity with 79.375%, followed by Indians, 13.75% and Chinese, 6.25% out of overall participants affected by obesity. In the study, 19.93% of male participants and 17.81% of female participants were obese. Age group of 50–59 years showed highest percentage of obese participants. Among the participants, 24.7% who have hypertension also have DM. 30% of the hypertensive participants and 33.75% of diabetic participants were obese. Variables such as age and gender are related to the three diseases were studied. Thus, more health awareness should be conducted in the urban regions targeting the high risk groups.

Keywords: Cross sectional study; Hypertension; Diabetes Mellitus; Obesity

INTRODUCTION

Hypertension is quantitatively the largest risk factor for cardiovascular diseases (CVD). CVDs are the leading cause of death worldwide, with higher frequency in the economically developed countries, but also in the developing world (Kaplan, 2011). Cardiovascular related diseases are one of the leading causes of death in Malaysia (Ding, 2000). Hypertension is defined as a systolic BP of 140mmHg or greater and/or diastolic BP of 90mmHg or greater (Chobanian, 2003). The World Health Organisation (WHO) estimates that over one billion of the world's population suffers from hypertension. This figure is expected to increase to 1.56 billion by 2025 (WHO, 2011). The National Health and Morbidity Survey (NHMS) III in 2006 showed that the number of people afflicted with hypertension has increased from 33% to 41% in 1996 (Mohammad Nor *et al*., 2008).

Globally rising diabetes mellitus (DM) represents increasing concerns and importance of addressing public health issues. The prevalence of diabetes for all age groups worldwide was estimated to be 2.8% in 2000 and 4.4% in 2030 (Wild, 2004). Impaired glucose tolerance and impaired fasting glycaemia are risk categories for future development of DM and CVD (WHO, 2011). CVD is the major cause of premature mortality in patients with type II DM and hypertension is a major contributor to the development of CVD and renal disease in these patients (Sowers, 2004).

Obesity is also one of the main concerns of public as it is one of the risk factors for DM, hypertension and CVD. WHO defines a BMI greater than or equal to 25 as overweight and a BMI greater than or equal to 30 as

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Table 1: Frequencies of parameters

Parameters		Number of Subjects	Percent (%)
Race	Malay	664	72.6
	Chinese	45	4.9
	Indians	151	16.5
	Others	2	0.2
Gender	Male	306	33.4
	Female	556	60.8
Age (yrs)	10-19	203	22.2
	20-29	194	21.2
	30-39	149	16.3
	40-49	141	15.4
	50-59	116	12.7
	60-69	47	5.1
	70-79	12	1.3
BMI	Underweight (<18.5)	82	9.0
	Normal weight (18.5-24.9)	366	40.0
	Overweight (25-29.9)	254	27.8
	Obese (≥30)	160	17.5
Blood Pressure	Normal	365	39.9
	Prehypertension	362	39.6
	Stage 1 hypertension	118	12.9
	Stage 2 hypertension	17	1.9
Blood Glucose Level	<7.0mmol/L	684	74.8
	≥7.0mmol/L	178	19.5
	Total	862	94.2
Missing	System	53	5.8
Total		915	100.0

Table 2: Demographic Statistics

	Race[a]	Age (yrs)[b]	Gender[c]	BMI[d]	Blood Pressure[e]	Blood Glucose Level[f]
Mean	1.41	2.96	1.65	2.571	1.75	1.21
Median	1.00	3.00	2.00	2.000	2.00	1.00
Mode	1	1	2	2.0	1	1
Skewness	1.492	0.444	-0.607	0.163	0.718	1.453
Std. Error of Skewness	0.083	0.083	0.083	0.083	0.083	0.083
Std. Deviation	0.779	1.607	0.479	0.8986	0.761	0405
Range	3	6	1	3.0	3	1

Based on the SPSS codes

[a]Malay = 1, Chinese = 2, Indians = 3, others = 4.

[b]10-19 = 1, 20-29 = 2, 30-39 = 3, 40-49 = 4, 50-59 = 5, 60-69 = 6, 70-79 = 7.

[c]Male = 1, Female = 2.

[d]Underweight = 1, Normal weight = 2, Overweight = 3, Obese = 4.

[e]Normal = 1, Prehypertension = 2, Stage 1 hypertension = 3, Stage 2 hypertension =4.

[f]<7.0mmol/L = 1, ≥7.0mmol/L = 2.

obese. 65% of the world's population were overweight and obesity kills more people than being underweight (WHO, 2011). The prevalence of overweight and obesity were highest in the WHO Region of the Americas which is 62% of overweight in both sexes, and 26% for obesity and lowest in the WHO Region for South-East Asia (Alwan Ala *et al.,* 2011).

The Malaysian national prevalence of normal BMI (BMI 18.5-24.9 kg/m^2) was 48.4% [47.7–49.0]. The prevalence of underweight (BMI <18.5 kg/m^2) was 8.5% [8.2–8.9], being higher in rural areas (9.8% [9.2–10.4]) than in urban areas (7.8% [7.4–8.3]) (Mohammad Nor *et al*., 2008).

The aim of the present work is to study the relationship between age, gender and race with the prevalence of hypertension, DM and obesity in the urban population. Relationships of these three main diseases in the country were also studied among urban residents. The rationale of this study will provide baseline data regarding the current health status among the urban residents in Malaysia.

Table 3: Blood pressure and blood glucose level cross tabulation

			Blood Glucose Level		Total
			<7.0mmol/L	≥7.0mmol/L	
Blood Pressure	Normal	Count	320	45	365
		Expected Count	289.6	75.4	365.0
	Prehypertension	Count	273	89	362
		Expected Count	287.2	74.8	362.0
	Stage 1 hypertension	Count	81	37	118
		Expected Count	93.6	24.4	118.0
	Stage 2 hypertension	Count	10	7	17
		Expected Count	13.5	3.5	17.0
Total		Count	684	178	862
		Expected Count	684.0	178.0	862.0

Table 4: Chi-square tests of blood pressure and blood glucose

				99.5% Confidence Interval					
				Monte Carlo Sig.					
				(2-sided)			(1-sided)		
	Value	df	Asymp. Sig. (2-sided)	Sig.	Lower Bound	Upper Bound	Sig.	Lower Bound	Upper Bound
Pearson Chi-Square	31.472[a]	3	0.000	0.000[b]	0.000	0.001			
Likelihood Ratio	31.785	3	0.000	0.000[b]	0.000	0.001			
Fisher's Exact Test	32.197			0.000[b]	0.000	0.001			
Linear-by-Linear Association	30.559[c]	1	0.000	0.000[b]	0.000	0.001	0.000[b]	0.000	0.001
N of Valid Cases	862								

[a]1 cells (12.5%) have expected count less than 5. The minimum expected count is 3.51.
[b]Based on 10000 sampled tables with starting seed 677935123.
[c]The standardized statistic is 5.528, df – degree of freedom, Asymp – Asymptote, Sig – significant value.

Table 5: Blood glucose level and BMI cross tabulation

			BMI (kg/m^2)				Total
			Underweight (<18.5)	Normal weight (18.5-24.9)	Overweight (25-29.9)	Obese (≥30)	
Blood Glucose Level	<7.0 mmol/L	Count	74	317	187	106	684
		Expected Count	65.1	290.4	201.5	127.0	684.0
	≥7.0 mmol/L	Count	8	49	67	54	178
		Expected Count	16.9	75.6	52.5	33.0	178.0
Total		Count	82	366	254	160	862
		Expected Count	82.0	366.0	254.0	160.0	862.0

METHODOLOGY

Data collection

The details of the subjects were taken from the registration forms collected in the medical check up camp at various urban regions in and around Kuala Lumpur and Klang Valley, Malaysia in the month of August 2011 conducted by Masterskill University College of Health Sciences, Malaysia. All subjects were asked to give an informed consent before starting the medical check up. The anonymity of the participants was assured. The socio-demographic characteristics that were reviewed included age, gender and race. The physical examination included were height, weight, blood pressure, and fasting blood glucose level.

The participants' BMI were determined by calculating the ratio between the body weight (kg) and height (m^2). The WHO guideline was used to determine the

Table 6: Chi-Square Tests of Blood Glucose Level and BMI

				95% Confidence Interval					
				Monte Carlo Sig.					
				(2-sided)			(1-sided)		
	Value	df	Asymp. Sig. (2-sided)	Sig.	Lower Bound	Upper Bound	Sig.	Lower Bound	Upper Bound
Pearson Chi-Square	39.562[a]	3	0.000	0.000[b]	0.000	0.000			
Likelihood Ratio	39.681	3	0.000	0.000[b]	0.000	0.000			
Fisher's Exact Test	39.225			0.000[b]	0.000	0.000			
Linear-by-Linear Association	37.509[c]	1	0.000	0.000[b]	0.000	0.000	0.000[b]	0.000	0.000
N of Valid Cases	862								

[a]0 cells (.0%) have expected count less than 5. The minimum expected count is 16.93.
[b]Based on 10000 sampled tables with starting seed 624387341.
[c]The standardized statistic is 6.124, df – degree of freedom, Asymp – Asymptote, Sig – significant value.

Table 7: Blood pressure and body mass index cross tabulation

			BMI (kg/m^2)				
			Under weight (<18.5)	Normal weight (18.5-24.9)	Overweight (25-29.9)	Obese (≥30)	Total
Blood Pressure	Normal	Count	56	200	78	31	365
		Expected Count	34.7	155.0	107.6	67.7	365.0
	Prehypertension	Count	21	144	116	81	362
		Expected Count	34.4	153.7	106.7	67.2	362.0
	Stage 1 hypertension	Count	5	21	49	43	118
		Expected Count	11.2	50.1	34.8	21.9	118.0
	Stage 2 hypertension	Count	0	1	11	5	17
		Expected Count	1.6	7.2	5.0	3.2	17.0
Total		Count	82	366	254	160	862
		Expected Count	82.0	366.0	254.0	160.0	862.0

participant's category whether underweight (<18.5 kg/m^2), normal (18.5 – 24.9 kg/m^2), overweight (25-29.9 kg/m^2) or obese (≥30 kg/m^2) (Kaplan, 2010).

The procedure used to measure BP was based on the American Heart Association guidelines (American Heart Association, Inc., 2011). BP was measured in the sitting position using a mercury sphygmomanometer. BP was measured only for one screening and a diagnosis of hypertension was made when BP was ≥140 mmHg systolic or ≥90 mmHg diastolic. The BP type was classified as Normal (<120/<80), Prehypertension (120-139/80-89), Stage 1 hypertension (140-159/90-99) or Stage 2 hypertension (≥160/ ≥100).

Blood glucose level of the fasting participants were measured and classified according to the ADA guidelines with blood glucose <7.0 mmol/L where they are normal and blood glucose ≥7.0 mmol/L are diabetic (American Diabetes Association, 2011). Fasting blood glucose was measured using ACCU-CHEK Aviva glucometer. The glucose meter is turned on and a test strip is inserted into it. A drop of blood was obtained from the participant's finger which was priorly cleaned with an alcohol swab. The blood is placed on the glucose meter strip and the blood sugar reading obtained is recorded. Fasting blood glucose measured is ≥7.0 mmol/L or when the patient is having a history of diabetes mellitus (DM) confirms the diagnosis of having DM. (Alwan Ala *et al.,* 2011).

Statistical analysis

Analysis was done using Statistical Package for Social Science (SPSS) version 17.0. Demographic data were expressed as mean ± SD. Distributions and frequencies of the independent variable were examined. Data exploration was undertaken to include descriptive statis-

Table 8: Chi-Square tests of blood pressure and BMI

				95% Confidence Interval					
				Monte Carlo Sig.					
				(2-sided)			(1-sided)		
	Value	df	Asymp. Sig. (2-sided)	Sig.	Lower Bound	Upper Bound	Sig.	Lower Bound	Upper Bound
Pearson Chi-Square	125.401[a]	9	0.000	0.000[b]	0.000	0.000			
Likelihood Ratio	132.123	9	0.000	0.000[b]	0.000	0.000			
Fisher's Exact Test	128.022			0.000[b]	0.000	0.000			
Linear-by-Linear Association	109.150[c]	1	0.000	0.000[b]	0.000	0.000	0.000[b]	0.000	0.000
N of Valid Cases	862								

[a]2 cells (12.5%) have expected count less than 5. The minimum expected count is 1.62. [b]Based on 10000 sampled tables with starting seed 957002199.

[c]The standardized statistic is 10.448, df – degree of freedom, Asymp – Asymptote, Sig – significant value.

Table 9: Participation of public in the study according to race

Parameters		Percentage of Subjects (%)	Percentage in Malaysia's Total Population* (%)
Race	Malay	77.03	67.4
	Chinese	5.22	24.6
	Indian	17.52	7.3
Gender	Male	35.5	49.0
	Female	64.5	51.0

*Estimated Malaysian population in 2010 is 28.3 million. Statistics obtained from Department of Statistics, Malaysia

tics for each variable. Frequencies and percentages for independent variable were calculated. In simple logistic analysis, each independent variable was analyzed to look at any significant association with dependent variable. Chi square test was used to analyze the relationship between the variables. $p<0.05$ was considered statistically significant.

RESULTS AND DISCUSSION

The collected data and results were tabulated (Table 1 - 11) from the cross-sectional study according to the parameters and diseases. Throughout the study, health awareness among the Chinese was found to be lower compared to the Malays and Indians in the urban setting. However, the study garnered the least support from the Chinese community and it was tempting to associate it with the hectic lifestyle of the city. The awareness among the females was found higher than their male counterparts (Table 1 and 9). Participation of the age group of 10-19 and 20-29 showed an astounding turnout of 46.06% in total. This percentage shows that health awareness is the highest among the younger generation of the participants (Table 1).

The mean systolic BP was 119mmHg and the mean diastolic BP was 74mmHg (Table 2). The mean BP classification was 2 which is classified as prehypertension according to the JNC VII classification among the participants. The standard deviation of systolic BP and diastolic BP were 13.898 and 10.990 respectively. 15.7% of the participants were found to have hypertension and 42.0% were found to be in prehypertensive stage. Malays were found to be the highest suffering from hypertension with the percentage of 17.1% followed by the Chinese with 11.1% and Indians with 10.6%. This is in contrast to the statistics of the NHMS III survey in 2006 which showed Indians having higher percentage of having hypertension. Percentage of participants having hypertension increases with age. A rapid increase in percentage of the participants in the age group of 30 years and above has a higher percentage of hypertension. A growing trend of the younger age group having hypertension was noted whereby the age group 10 – 19 and 20 – 29 have a percentage of 2.96 and 8.25 respectively. Males were found to have higher percentage of hypertension (23.2%) compared to females (11.51%).

20.65% of the total participants have blood glucose level of ≥7.0 mmol/L. This shows that 2 out of 10 of the participants suffer from diabetes. The Malays were found to have the highest percentage (22.14%) of having blood glucose level ≥7.0 mmol/L followed by Chinese (17.78%) and Indians (15.23%). 84.83% of participants who are aged 30 and above are diabetics. A growing trend of younger diabetic patients was observed. The younger generation of age 10 – 19 and 20 – 29 shows prevalence of diabetes with 6.9% and 6.7 %

Table 10: Participant's Body Mass Index (BMI) percentage

Classification	Percentage (%)
Underweight	9.51
Normal	42.46
Overweight	29.47
Obese	18.56

Table 11: Tabulation of parameters against hypertension, diabetes and obesity

Parameters		Hypertension (%)	Diabetes (%)	Obesity (%)
Age	10 – 19	2.96	7.87	4.39
	20 – 29	8.25	7.30	11.86
	30 – 39	19.46	14.04	17.45
	40 – 49	21.28	23.60	29.08
	50 – 59	30.17	28.09	37.93
	60 – 69	31.91	16.29	19.15
	70 – 79	33.33	2.81	16.67
Race	Malay	17.1	22.14	19.12
	Chinese	11.1	17.78	22.22
	Indian	10.6	15.23	14.57
Gender	Male	23.2	25.5	19.93
	Female	11.51	17.99	17.81

respectively. Males were found to have a higher percentage of DM II (25.5%) compared to females (17.99%).

The overall percentage of the participants found to be obese is 18.56% (Table 10). This shows that 2 out of 10 of the participants are obese. Malays were found to have the highest percentage of obesity among obese subjects with 79.38%, followed by Indians with 13.75% and Chinese with 6.25%. The age group of 50-59 is most affected by obesity. It was found that out of 306 male participants, 19.93% were obese while out of 556 female participants, 17.81% were obese.

Prevalence of Hypertension, Diabetes Mellitus and Obesity

In 2006, there was an estimated 4.8 million Malaysians aged 18 years and above living with hypertension (NHMS III). Prevalence of hypertension in the study was 15.7% compared to NHMS III which was 17.8%. Prevalence of hypertension in NHMS III >18 years old is 32.3% and >30 years old is 42.6%. Prevalence of hypertension in the present study showed participants ≥18 years old are 19.58% and ≥30 years old is 24.84% (Table 11).

The percentages obtained in the study were significantly lower than those acquired in NHMS III. This rules out the myth that urban residents are more prone to hypertension. Since 42% of participants are pre-hypertensive, this calls for more health awareness programmes to be conducted in the urban region. Hypertension is the starting path of other CVDs which are one of the major causes of death in Malaysia.

The prevalence of DM is 20.65% in this study. According to NHMS III, prevalence of DM in >18 years old is 11.6 % and >30 years old is 14.9%. The NHMS II survey revealed geographical variations in the observed prevalence of diabetes by states. The highest observed prevalence of known diabetes occurred in the more developed states like Selangor (7.3%, 6.1 - 8.4%) and Penang (7.3%, 5.3 - 9.4%). The prevalence of DM has almost tripled in Selangor region since NHMS II was conducted.

The national prevalence of normal BMI (BMI 18.5-24.9 kg/m^2) was 48.4% (47.7–49.0). The prevalence of underweight (BMI <18.5 kg/m^2) was 8.5% (8.2–8.9). Meanwhile, 29.1% (28.6–29.7) of the adults were overweight (BMI 25.0-29.9 kg/m^2) and 14.0% (13.6–14.5) of the adults were obese (BMI >30.0 kg/m^2). The percentage of overweight participants was 29.47% and obese participants were 18.56% (Table 10). The obesity prevalence in urban region is higher compared to the national prevalence of obesity. This can be attributed to unhealthy diet and no regular exercises due to hectic lifestyle.

Relationship between Hypertension and Diabetes Mellitus II

The hypotheses are BP is independent of blood glucose level (H_o) and blood pressure is dependent of blood glucose level (H_1). The $\chi^2 = 31.472$, df =3 and $\chi^2_{(0.05, 6)} = 7.815$. This can be referred in Table 3 and 4. Hence, the chi square values showed that BP is dependent on blood glucose level. 24.7% of the participants who have hypertension also have diabetes (Table 11). DM is an independent risk factor for coronary artery disease, and the risk is markedly increased when hypertension is present (Kaplan, 2010).

Relationship between Diabetes mellitus II and Obesity

The hypotheses are blood glucose level is independent of BMI (H_o) and blood glucose level is dependent of

BMI (H_1). The χ^2 = 39.562, df = 3 and $\chi^2_{(0.05,3)}$ = 7.815. Hence, the chi square values showed that blood glucose is dependent on BMI. This can be referred at Table 5 and 6. 33.75% of participants who are diabetic were found to be obese indicating there is a link between DM II and obesity (Table 11). According to the earlier study done by Obesity Action Coalition, DM II can be controlled or even cured if there is weight loss. Insulin resistance has been implicated in the pathogenesis of hypertension although the precise mechanism is uncertain (Andrew, 2005). Moderate and sustained weight loss can improve insulin action and decrease fasting glucose concentrations reducing the need for diabetic medications (Joanne, 2005). Diabetes also increases the risk of developing hypertension and other CVDs as it adversely affects the arteries and predisposing them to atherosclerosis (Andrew, 2005).

Relationship between Hypertension and Obesity

The hypotheses are BP is independent on BMI (H_o) and BP is dependent on BMI (H_1). The χ^2 = 125.401, df = 9 and $\chi^2_{(0.05,9)}$ = 16.919. Hence, the chi square values showed that BP is dependent on BMI. 30% of the participants who have hypertension are obese indicating a close relationship between hypertension and obesity (Table 11). Obesity and hypertension are intimately linked as an increase in fatty tissue will increase the vascular resistance and in turn cause the heart to do more work in pumping blood throughout the body (Delaney, 2011). Obesity has a well-recognized effect on BP where mean arterial pressure raises an average of 1mmHg for every kilogram of body weight (Mohammad Nor *et al*., 2008).

CONCLUSION

The present study has showed the targeted groups for health awareness among the urban region population for the most common disease that are faced by the Malaysian urban population today. The myth that urban population are more prone to lifestyle related diseases such as hypertension was proven to be untrue. This is further supported by the NHMS III. Hopefully, these findings would be beneficial for further enhancement of health awareness and educational programmes conducted by the Ministry of Health Malaysia.

LIMITATIONS

The limitations in the present report are found to be the lack of male participants and Chinese race turnout. The use of glucometer is less accurate compared to wet chemistry. Fasting glucose may not be as accurate as two hours post prandial blood glucose.

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