ORIGINAL ARTICLE

A PRELIMENARY RESULT OF THE CARDIOVASCULAR RISK FACTORS INTERVENTION STUDY (PIKOM STUDY): DIABETES MELLITUS, HYPERTENSION AND THEIR ASSOCIATED FACTORS

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Cardiovascular disease (CVD) has been the number one cause of death since the last three decades in Malaysia and diabetes mellitus and hypertension are considered as major risk factors. A study to reduce risk factors for cardiovascular diseases in the community (PIKOM) through education and lifestyle changes was undertaken. The study population was from four different areas in Peninsular Malaysia – Kota Bharu and Bachok in Kelantan ; Raub in Pahang; Gunung Besout in Perak and Felda Palong in Negri Sembilan. The subjects invited to participate in this study ware aged between 30 - 65 years, did not have any debilitating illnesses and no known history of diabetes mellitus, hypertension or cardiovascular disease. Subjects were asked to come to the local clinic in a fasting state and after physical examination, blood was taken for plasma glucose and lipids. Oral glucose tolerance test (OGTT) was then performed. A total of 4,121 subjects participated in the study. The proportion of subjects with diabetes mellitus was highest in Felda Palong area (20.3%) and lowest in Raub area (7.1%). The proportion of subjects with hypertension was also highest in Felda Palong area (38.6%) and lowest in Raub area (29.1%). This could be attributable to the subjects in Felda Palong having the highest mean Body Mass Index (BMI) and Waist-to-Hip Ratio (WHR). There were significant associations between diabetes and hypertension with age and obesity. Subjects with diabetes mellitus and hypertension also had the highest mean age, BMI, WHR and plasma cholesterol.

In conclusion, the proportion of patients with risk factors for CVD was high and intervention studies through education and lifestyle changes were being carried out to see their effectiveness.

Key words : Cardiovascular disease, diabetes mellitus, hypertension, obesity, smoking, cholesterol

Submitted-30.12.2004, Accepted-05.01.2004

Introduction

Cardiovascular disease (CVD) is becoming a major health problem in the developing countries and in Malaysia, it has been the number one cause of death since the last three decades (1). Among the risk factors, diabetes mellitus and hypertension are considered as major risks (2, 3). The National Cholesterol Education Program (NCEP) of the United States, has classified type 2 diabetes mellitus as coronary heart disease equivalent (4). Obesity, smoking and sedentary lifestyle have also been associated with cardiovascular disease (5, 6). Intervention studies have shown that lifestyle modification can decrease the incidence of diabetes mellitus (7, 8) and decrease blood pressure (9, 10). In 1996, the Malaysia 2^{nd} National Health and Morbidity Survey showed that the prevalence of diabetes mellitus was 8.3% of whom 2.5% was previously undiagnosed and the prevalence of

Sex	Age					
	Group	KKM	UKM/UIA	UM/UPM	USM	Total
Male	30-39	18	47	45	86	196
	40-49	222	65	257	134	678
	50-59	257	29	200	139	625
	≥ 60	19	8	20	80	127
Female	30-39	126	87	148	254	615
	40-49	463	71	388	340	1262
	50-59	138	33	114	218	503
	≥ 60	5	11	9	86	111
Total		1248	351	1181	1337	4117*

Table I :Respondents by age, sex, and centre

hypertension was 29.9% (11). In 1998, a multi-centre community based cardiovascular risk factors intervention project (PIKOM) was started. This project was approved and sponsored by Ministry of Science, Technology and Environment Malaysia. The objective of the project was to determine the effect of education and lifestyle changes on cardiovascular risk factors. This paper describes the study population with respect to the cardiovascular risk factors and their association.

Materials and Methods

Survey Procedure

This study was conducted in four different areas and centres in Peninsular Malaysia. The areas were Bachok and Kota Bharu, Kelantan (Universiti Sains Malaysia, USM, as centre); Raub, Pahang (Universiti Kebangsaan Malaysia, UKM / Universiti Islam Antarabangsa, UIA as centre); Gunung Besout, Perak (Kementerian Kesihatan Malaysia, KKM as centre); and Felda Palong, Negri Sembilan (Universiti Malaya, UM / Universiti Putra Malaysia UPM, as centre). Ethical approval for the study was obtained from the respective Ethics Committees of the institutions concerned.

Subjects were invited to enroll for the study. All respondents age between 30 - 65 years were included in the study. All those with known diabetes mellitus, hypertension or cardiovascular disease (past history of angina, myocardial infarct or stroke) or debilitating illnesses were excluded from the study. Subjects were asked to come in a fasting state after an overnight fast (at least 8 hours) to the local health clinic for examination by the visiting research team. Informed consent was obtained and history taken. Height and weight were recorded and body mass index (BMI) calculated. BMI classification was based on the World Health Organization criteria (12); underweight $< 18.5 \text{ kg/m}^2$, normal 18.5-24.9 kg/m², overweight 25.0-29.9 kg/m² and obese \ge 30 kg/m². Waist and hip circumferences were also measured

Table II: Mean (± s.d.) age, BMI, WHR for the different centres

	KKM	UKM/UIA	UM/UPM	USM	р
Age	46.9 ± 5.9	43.3 ± 8.6	46.1 ± 6.6	46.9 ± 9.5	<0.001
(yrs)					
BMI	25.4 ± 4.4	25.4 ± 4.4	25.8 ± 4.5	24.4 ± 4.5	<0.001
(kg/m ²)					
WHR	0.85 ± 0.07	0.85 ± 0.08	0.87 ± 0.08	0.84 ± 0.10	<0.001

	HT	DM	DM + HT	no DM/HT	р
Age (yrs)	48.4 ± 7.8	46.9 ± 6.9	49.2 ± 7.0	45.1 ± 7.6	p < 0.001
BMI (kg/m ²)	26.0 ± 4.7	25.8 ± 4.6	27.4 ± 4.5	24.1 ± 4.0	p < 0.001
WHR	0.86 ± 0.08	0.88 ± 0.09	0.90 ± 0.08	0.84 ± 0.08	p < 0.001
SBP (mmHg)	145.2 ± 14.8	123.3 ± 8.8	147.8 ± 16.6	119.4 ± 9.7	p < 0.001
DBP (mmHg)	91.9 ± 8.1	78.9 ± 6.3	92.8 ± 9.2	76.9 ± 6.8	p < 0.001
FPG (mmol/L)	5.4 ± 0.7	9.1 ± 4.0	9.4 ± 3.6	5.2 ± 0.7	p < 0.001
2HPG (mmol/L)	6.9 ± 1.6	13.2 ± 6.6	12.8 ± 5.9	6.5 ± 1.6	p < 0.001
Chol (mmol/L)	5.9 ± 1.5	6.0 ± 1.2	6.1 ± 1.2	5.6 ± 1.3	p < 0.001

 Table III :
 Mean (± s.d.) of various parameters for subjects wth hypertension, diabetes mellitus, hypertension and diabetes mellitus and without diabetes mellitus or hypertension.

and waist to hip ratio (WHR) was calculated. Desirable WHR was defined as < 1.00 for men and < 0.85 for women (13). Blood pressure was measured using a mercury sphygmomanometer. If the blood pressure was found to be high, patient was asked to rest for half an hour before another reading was made and the lower of the 2 readings was recorded. Hypertension was defined as systolic blood pressure (SBP) \geq 140 mmHg and/or diastolic blood pressure (DBP) \geq 90 mmHg (14). After a physical examination, blood was taken and oral glucose tolerance test (OGTT) was done. Blood taken was sent for fasting plasma glucose, total cholesterol and 2 hours post-glucose load glucose. Diabetes mellitus was defined as fasting plasma glucose (FPG) \geq 7.0 mm01/L or 2 hours post-glucose load glucose (2HPG) \geq 11.1 mm01/L (15).

Statistical Analysis

Statistical analysis was performed using SPSS statistical software version 11.0. Descriptive statistics of the study subjects was calculated as means \pm SD and compared using ANOVA and t-test for continuous variables and x² test for categorical variables.

Centre	DM	HT	Both DM + HT	no DM/HT
KKM	154	415	77	755
	(12.4%)	(33.3%)	(6.2%)	(60.5%)
UKM/UIA	25	102	10	237
	(7.1%)	(28.8%)	(2.8%)	(67.0%)
UM/UPM	240	456	132	617
	(20.3%)	(38.6%)	(11.2%)	(52.2%)
USM	157	385	60	857
	(11.7%)	(28.8%)	(4.5%)	(64.0%)
TOTAL	576	1358	279	2466
	(14.0%)	(33.0%)	(6.8%)	(59.8%)

Table IV: Proportion of diabetes mellitus and hypertension by centre

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Age Group (yrs)	DM	HT	Both	no
			DM + HT	DM/HT
30-39	66	172	24	598
	(8.1%)	(21.2%)	(3.0%)	(73.6%)
40-49	275	583	125	1210
	(14.2%)	(30.0%)	(6.4%)	(62.3%)
50-59	197	483	109	557
	(17.5%)	(42.8%)	(9.6%)	(49.4%)
> 60	38	120	21	101
	(16.0%)	(50.4%)	(8.8%)	(42.4%)
Total	576	1358	279	2466
	(14.0%)	(33.0%)	(6.8%)	(59.8%)

Table V: Relationship of diabetes mellitus and hypertension with age

Results

A total of 4,121 subjects participated in this study. Of these, 1247 were from KKM centre, 353 from UKM/UIA centre, 1181 from UM/UPM centre and 1338 from USM centre (Table I). The means age, BMI and WHR of the subjects in each centre is shown in Table II. There were significant differences in the mean age, BMI and WHR of the subjects between the centres. The mean age, BMI, WHR, systolic blood pressure (SBP), diastolic blood pressure (DBP), FPG, 2HPG and cholesterol of the hypertensive, diabetic and hypertensive, and nondiabetic/ hypertensive subjects is shown in Table III. The mean age, BMI, WHR and cholesterol was highest in the diabetic and hypertensive subjects compared to the other groups. The proportion of subjects with diabetes was highest in Felda Palong

(20.3%) and lowest in Raub (7.1%) (Table IV). The proportion of subjects with hypertension was also highest in Felda Palong (38.6%) and lowest in Raub (28.8%) (Table IV). Similarly with hypertension and diabetes, the proportion were highest in Felda Palong (11.2%) and lowest in Raub (2.8%) (Table IV). Subjects in the 50 to 59 years age group had the highest proportion of diabetes (17.5%) compared to the other age groups (Table V) whilst for hypertension, subjects in the 60 years or older age group had the highest proportion (50.4%) (Table V) For both hypertension and diabetes, subjects in the 50 to 59 years age group had the highest proportion (9.6%) (Table V). There was a significant association between BMI and diabetes (Table VI); between BMI and hypertension (Table VI) and between BMI and hypertension with diabetes (Table VI). There was also a significant association between WHR and

BMI Status (kg/m ²)	DM	НТ	Both DM + HT	no DM/HT
< 18.5	12	46	1	158
	(5.6%)	(21.4%)	(0.5%)	(73.5%)
18.5-24.9	159	465	65	1316
	(8.5%)	(24.8%)	(3.5%)	(70.2%)
25-29.9	263	570	139	779
	(17.8%)	(38.7%)	(9.4%)	(52.9%)
> 30	142	277	74	213
	(25.5%)	(49.6%)	(8.8%)	(38.2%)
Total	576	1358	279	2466
	(14.0%)	(33.0%)	(6.8%)	(59.8%)

Table VI: Relationship between diabetes mellitus and hypertension with BMI

WHR	DM	НТ	Both	No
Status			DM + HT	DM / HT
Desirable	541	1312	257	2446
	(13.4%)	(32.5%)	(6.4%)	(60.5%)
Undesirable	35	46	22	20
	(44.3%)	(58.2%)	(27.9%)	(25.3%)
Total	576	1358	279	2466
	(14.0%)	(33.0%)	(6.8%)	(59.8%)

Table VII: Relationship between diabetes mellitus and hypertension with WHR

diabetes (Table VII); between WHR and hypertension (Table VII) and between WHR and hypertension with diabetes (VII).

Discussion

As the study was done in subjects with no known history of diabetes or hypertension, the proportion of patients with undiagnosed diabetes or hypertension was high. However, this study might not reflect the true prevalence of undiagnosed diabetes or hypertension in the general population. The nature of this study was to find subjects with risk factors for CVD and it was likely that subjects who thought themselves having risk factors for CVD would attend the screening visit. Thus it was not surprising to find a higher proportion of these subjects having diabetes or hypertension compared to previously reported prevalence rates.

The prevalence of diabetes mellitus and hypertension in the Malaysian 2^{nd} National Health and Morbidity Survey was 8.3% and 29.9%respectively(11). In another study in Kelantan, Malaysia, the prevalence of diabetes was 10.5% (12). Obesity and especially abdominal obesity are significantly associated with diabetes and hypertension (13, 14) and this was also reflected in our study which showed significant association between BMI and WHR with diabetes and hypertension.

The proportion of patients with diabetes or hypertension in this study was highest in Felda Palong area (20.3% and 38.6% respectively). This could be due to this area having subjects with the highest mean BMI (25.8 \pm 4.5 kg/m²) and highest mean WHR (0.87 \pm 0.08) which implied that subjects here were not only more obese but also had more abdominal fat. Subjects with diabetes and hypertension also had the highest mean age, BMI, WHR and plasma cholesterol. There was also a significant association between age and diabetes and also hypertension. This is in keeping with the current knowledge that the prevalence of diabetes and hypertension increases with age (17,18). Type 2 diabetes mellitus and hypertension are considered part of the Metabolic Syndrome or the Insulin Resistance Syndrome and increasing age and obesity are believed to be contributory factors (19).

In conclusion, the proportion of patients with diabetes or hypertension was high. Diabetes and hypertension were significantly associated with age, body mass index and waist-hip ratio. Intervention studies by education and lifestyle changes had begun to study their effectiveness in reducing cardiovascular risks.

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