

PREVALANCE OF OBESITY AND OVERWEIGHT IN NORTHEASTERN PENINSULAR MALAYSIA AND THEIR RELATIONSHIP WITH CARDIOVASCULAR RISK FACTORS

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Abstract. Height and body weight were measured in 2,284 subjects over 20 years old. The subjects were chosen by cluster sampling in 9 districts of Kelantan. Blood was drawn after an overnight fast for measurement of cholesterol (chol), triglyceride (TG), VLDL and HDL-Chol. Oral glucose tolerance test was performed with 75g glucose.

The overall prevalence of overweight [BMI (kg/m²) ≥ 25 - < 30] and obesity (BMI > 30) was 21.3% and 4.5% respectively. The overweight and obese were significantly younger than the lean subjects. The prevalence of hypercholesterolemia (chol > 5.2 mmol/l) in lean, overweight and obese subjects was 65.3%, 70.2% and 74.7%, respectively.

Impaired glucose tolerance was found in 16.6% of the lean, 21.6% of the overweight and 32.0% of the obese subjects. Diabetes mellitus was found in 7.9% of the lean, 10.5% of the overweight and 6.7 of the obese subjects. 10.1% of lean, 13.2% of overweight and 23.3% of obese individuals were hypertensive. In conclusion, the high prevalence of overweight and obesity in Malaysia was associated with adverse lipid and glucose metabolism as well as poor blood pressure control.

INTRODUCTION

Obesity has been found to be related to cardiovascular risk factors. Obesity is certainly important in hypertension and studies have found blood pressure and body weight to be highly independently correlated, for example in Chicago in the general population (Stamler *et al*, 1975a) and in industry (Stamler *et al*, 1975b). Obesity is also associated with ischemic heart disease, though it may act through higher blood pressure, serum lipids and blood glucose. It has been positively associated with total cholesterol and triglyceride, and independently, strongly and negatively with HDL-cholesterol (Glueck *et al*, 1980; Thelle *et al*, 1983; Jacobsen and Thelle, 1987).

The data on obesity level and its relation with cardiovascular risk factor in Malaysia is insufficient. Thus, we undertook a study to determine the prevalence of obesity and its relationship with cardiovascular risk factors amongst population in Kelantan. Kelantan is a state situated in the northeast of Malaysia and can be considered as relatively rural. The population of about 1.2 million are predominantly Malays.

MATERIALS AND METHODS

Sampling was done in 9 districts. A total of 2,284 subjects (687 male and 1,597 female) ≥ 20 years of age were chosen using cluster sampling and there was a 3-stage sampling design (census villages, houses and persons). The survey was conducted between January 1992 and January 1995. All the subjects selected were invited to attend the nearest government clinic. They were instructed not to take food after 2200 hours of the previous night. Early next morning a 10 ml sample of venous blood was drawn for the fasting blood glucose, triglyceride, cholesterol and HDL-Chol. Subjects were given 75 g of glucose anhydrous in 300 ml of water. After 2 hours another 10 ml of venous blood was taken for glucose determination. The glucose was measured using glucose oxidase method while triglyceride, cholesterol and HDL-Chol by enzymatic method. The LDL-Chol was calculated using the Friedewald formula.

Height, weight and blood pressure were also measured and recorded. Obesity was assessed by body mass index (BMI). BMI of more than 25 kg/m² but equal or less than 30 kg/m² was considered

as overweight and a BMI index of more than 30 kg/m² as obesity.

The criteria for diagnosis of diabetes mellitus were based on the recommendation of WHO (1980). A fasting venous plasma glucose level of 7.8 mmol/l and 2 hour venous plasma of ≥ 11.1 mmol/l were diagnostic for diabetes mellitus. Fasting venous plasma glucose of less than 7.8 mmol/l and a 2 hour venous plasma glucose between 7.8 and 11.1 mmol/l were classified as IGT.

The significant different between groups was calculated using Mann Whitney test, ANOVA and chi-squared as appropriate.

RESULTS

As shown in Table 1, the mean age of the subjects studied was 48.9 years, with mean BMI of 22.5 kg/m². The mean total cholesterol and LDL-Chol were above the desired levels (Cholesterol of < 5.2 mmol/l and LDL-Chol of < 3.5 mmol/l).

Table 2 shows the distribution of subjects according to their BMI. The prevalence of overweight and obesity was 21.3% and 4.5% respectively. The prevalence among female population was three times higher than among the male population (female 20.1% vs male 5.7%).

Fasting plasma venous glucose level in normal weight, overweight and obese subjects are shown in Table 3. Both fasting and 2 hour venous plasma glucose were significantly higher in overweight

Table 2

Percentage of populations according to class of BMI.

Group	BMI	n (%)
Underweight	< 18.5	431 (18.9)
Low normal	$> 18.5 - < 20.0$	283 (12.4)
Normal weight	$\geq 20 - \leq 25.0$	980 (42.9)
Overweight	$> 25 - \leq 30$	487 (21.3)
Obese	> 30.0	103 (4.5)

and obese compared to normal weight subjects. Similar statistical significance was also found when overweight and obese subjects were compared. This finding implies that overweight and obese subjects were less tolerant to glucose challenge. The prevalence of IGT was significantly higher in overweight and obese subjects as shown in Table 4. However the prevalence of diabetes mellitus amongst obese subjects was not higher than normal weight or overweight subjects.

Overweight and obese subjects have a less favorable lipid and lipoprotein profile as shown in Table 5. They have high plasma cholesterol, triglyceride and VLDL with low HDL-cholesterol levels. With a cutoff of 5.2 ml for cholesterol 55.0% of normal weight, 70.2% of overweight and 77.0% of obese subjects were hypercholesterolemic (data not shown).

Both systolic and diastolic blood pressure of overweight and obese subjects were significantly higher compared to normal weight subjects. A similar statistical significance was obtained when overweight and obese subjects were compared. The data is shown in Table 6. The prevalence of hypertension *ie* blood pressure of more than 160/90 mmHg in normal weight was 10.1% while in overweight and obese subjects it was 13.1% and 23.3% respectively (Table 7).

DISCUSSION

A population based cross-sectional survey using BMI measurement in Singapore found that the overall prevalence of overweight and obesity was 22.3% and 5.6% respectively. The study also showed that the prevalence of overweight and obesity were

Table 1

Clinical and biochemical characteristic of population in Kelantan.

	Mean \pm SD	Range
Age	48.91 \pm 12.0	20 - 90
BMI (kg/m ²)	22.46 \pm 5.0	15 - 40.42
BP syst (mmHg)	128 \pm 15.0	90 - 260
BP diast (mmHg)	78.13 \pm 10.0	60 - 150
Chol mmol/l	5.60 \pm 1.50	2.7 - 33
TG mmol/l	1.56 \pm 1.0	0.4 - 15
VLDL mmol/l	0.72 \pm 0.52	0.1 - 8.4
LDL mmol/l	4.02 \pm 2.30	1.5 - 35
HDL mmol/l	1.04 \pm 0.37	0.2 - 3

Table 3

Fasting and 2 hours venous plasma blood glucose in normal weight, overweight and obese subjects.

	Normal weight	Overweight	Obese	p
Fasting BG mmol/l (mean \pm SD)	5.4 \pm 2.3	5.6 \pm 2.1	6.0 \pm 3.1	p < 0.03
2 hours OGTT BG mmol/l (mean \pm SD)	7.1 \pm 3.5	7.7 \pm 3.7	8.2 \pm 4.5	p < 0.001

Table 4

Glucose intolerance in normal weight, overweight and obese subjects.

	IGT (%)	DM (%)
Normal weight (NW) n-980	163 (16.6)	78 (7.9)
Overweight (OW) n-487	105 (21.6)	51 (10.5)
Obese (O) n-103	33 (32.0)	7 (6.7)

NW vs OW p < 0.005

NW vs O p < 0.001

significantly higher in the female population (Hughes, 1990). BMI of some 2,626 adult males and 2,111 adult females from 3 ethnic groups were compiled from various studies carried out at the Department of Nutrition, National University of Malaysia. The result revealed that the overall prevalence of overweight and obesity was 21.0%

and 6.3%, respectively. There was a marked difference in the prevalence of obesity between females (11.6%) and males (5.0%) (Osman, 1993). As shown in our study the prevalence of overweight and obesity in Kelantan were not different from the results of prevalence study in Singapore and the study at the National University of Malaysia. The prevalence of overweight and obesity were similarly higher in female subjects and our overweight and obese subjects tend to be younger (data not shown).

The prevalence of diabetes mellitus amongst obese (BMI > 25 kg/m²). Aborigines and Malay subjects was 7.3% compared with 1.6% in non-obese groups (WHO, 1990). When similar criteria were used to diagnose obesity in our study, the prevalence of IGT and diabetes mellitus amongst obese subjects were 53.6% and 12.2% compared to 16.6% of IGT and 7.9% of diabetes mellitus in non-obese subjects. The marked discrepancy between

Table 5

Lipid and lipoprotein profile of normal weight, overweight and obese subjects.

	Normal weight	Overweight	Obese	p
Chol mmol/l (mean \pm SD)	5.76 \pm 1.44	5.96 \pm 1.40	6.05 \pm 1.41	p < 0.001
TG mmol/l (mean \pm SD)	1.58 \pm 0.90	1.95 \pm 1.40	1.89 \pm 1.0	p < 0.001
VLDL mmol/l (mean \pm SD)	0.72 \pm 0.45	0.88 \pm 0.64	0.85 \pm 0.48	p < 0.001
LDL mmol/l (mean \pm SD)	4.10 \pm 2.10	4.2 \pm 3.30	4.50 \pm 3.70	NS
HDL-Chol mmol/l (mean \pm SD)	1.03 \pm 0.30	0.99 \pm 0.31	0.47 \pm 0.30	p < 0.01

Table 6
Blood pressure in normal weight, overweight and obese subjects.

	Normal weight	Overweight	Obese	p
Systolic BP mmHg (mean \pm SD)	128.1 \pm 22.0	133.2 \pm 21.0	140 \pm 23.3	p < 0.001
Diastolic BP mmHg (mean \pm SD)	77.8 \pm 11.6	81.6 \pm 12.5	87.0 \pm 16.6	p < 0.001

Table 7

Prevalence of hypertension in normal, overweight and obese subjects.

	Prevalence (%)
Normal weight (NW) (n = 980)	99 (10.1)
Overweight (OW) (n = 487)	64 (13.1)
Obese (O) (n = 103)	24 (23.3)

NW vs OW p < 0.001

NW vs O p < 0.001

these two sets of data was due to different population with different social demographic backgrounds.

The overall prevalence of hypercholesterolemia \geq 5.2 mmol/l in northeast Malaysia was 55.0% (Mokhtar, 1991). This prevalence increased to 72.0% in overweight and 74.7% in obese subjects. The prevalence of hypertension in northeast Malaysia was 10.2% (data not shown) and our study has shown that the prevalence increases progressively with the degree of obesity.

In summary, this survey found that the prevalence of obesity in Kelantan was similar to data obtained from studies in Selangor and Singapore. Overweight and obesity were strongly associated with cardiovascular risk factors such as hypertension, diabetes mellitus and hypercholesterolemia.

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