Abdominal Obesity in Malaysian Adults: National Health and Morbidity Survey III (NHMS III, 2006)

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ABSTRACT

Abdominal obesity (AO) is an independent risk factor for cardiovascular disease, hypertension and diabetes mellitus in adults. There is a lack of data on the magnitude and socio-demographic profile of AO among Malaysian adults at the national level. In the Third National Health and Morbidity Survey (NHMS III) conducted in 2006, AO of adults aged 18 years and above was determined based on the waist circumference as part of the nutritional status assessment. This article reports the prevalence of AO in relation to socio-economic factors and demographic characteristics of adult subjects. Out of a total of 33,465 eligible individuals 18 years and above, waist circumference was measured in 32,900 (98.3%) individuals. The prevalence of AO was assessed using the cut-off points recommended by World Health Organization. The mean waist circumference in men and women was 84.0cm [95% confidence interval (95% CI): 83.8, 84.3] and 80.3cm (95% CI: 80.1, 80.6) respectively. The national prevalence of AO was 17.4% (95% CI: 16.9, 17.9). The identified risks of AO were women (OR: 4.2, 95% CI: 3.8, 4.6), aged 50-59 years (OR: 5.6, 95% CI: 4.0, 7.7), Indians (OR: 3.0, 95% CI: 2.4, 3.8), housewives (OR: 1.4, 95% CI: 1.1, 1.7), subjects with primary education (OR: 1.3, 95% CI: 1.1, 1.5) and ever married (OR: 1.4, 95% CI: 1.2, 1.6). Being the largest population-based study on AO among Malaysians, these findings have important public health implications. There is an urgent need to revise public health policies and programmes aimed at prevention of abdominal obesity especially in the groups at risk.

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INTRODUCTION

Abdominal obesity (AO) is one of the key indicators of central fat adiposity in adults. It has been strongly linked with the risk of various chronic illnesses such as cardiovascular disease (CVD), diabetes mellitus and breast cancer (Huang *et al.*, 1999; Balkau *et al.*, 2007). The National Cholesterol Education Program Adult Treatment Panel III (NCEP ATP III) (American Heart Association, 2002) and International Diabetes Federation (IDF, 2006) have recommended AO as one of the criteria for diagnosis of metabolic syndrome in adults where individuals with metabolic syndrome are at greater risk for diabetes and cardiovascular disease. Abdominal (central) obesity occurs when the main deposits of body fat (adipose tissue) are localised around the abdomen (intra-abdominal or visceral fat) and the upper body region. The relative contribution of intra-abdominal fat mass to total body fat is influenced by gender, age, ethnicity, level of energy balance, composition of diet, level of physical activity and a variety of social factors including smoking and alcohol intake (Bouchard, Bray & Hubbard, 1990).

There are several ways to determine AO in adults. Anthropometry in terms of waist circumference (WC) and waist-hip ratio (WHR) measurements, bioelectrical impedance, magnetic resonance imaging and computed tomography are the commonly used methods in assessing AO. However, in a large population-based study, WC measurement is the most commonly used method as it is convenient and inexpensive (Han, Sattar & Lean, 2006). In addition, it is a better predictor and is independently associated with risk of cardiovascular disease and diabetes mellitus even in individuals with normal body mass index (Wildman *et al.*, 2005; Balkau *et al.*, 2007).

In terms of measurement technique, a single measurement of WC can be used as a clinical marker to identify individuals who are overweight and abdominally obese (Lean, Han & Morrison, 1995). However taking an average of repeated measurements would improve the accuracy. There are at least 14 measurement sites for WC reported in the literature. After regrouping them into four locations, Wang *et al.* (2003) concluded that results obtained from different sites were not interchangeable and thus, between-study comparisons can only be valid if the same site measurements were used (Wang *et al.*, 2003).

There are different WC cut-offs being used in identifying AO. According to the World Health Organization (WHO, 1998) criteria, AO is defined as WC > 102cm in men and > 88cm in women. However, this definition when applied to an Asian population, underestimates the prevalence of metabolic syndrome due to smaller build of the population, thus, failing to identify many individuals at risk of CVD (Tan *et al.*, 2004). The International Diabetes Federation (IDF) has drawn up pragmatic ethnic-specific cut-offs for South Asians (Malay, Chinese and Asian Indian populations), and its cut-offs are ≥90cm for men and ≥80cm for women (IDF, 2006). In addition, the International Diabetes Institute/Western Pacific World Health Organization/ International Association for the study of Obesity/International Obesity Task Force also recommended modified Asian criteria of WC cut-offs > 90cm for men and >80cm for women (WHO/IASO/IOTF, 2000).

Socio-demographic factors (i.e. gender, age, ethnicity, marital status, residence area, household income and educational level), level of physical activity, dietary intakes and lifestyle have been identified as determinants of AO in adults (Arambepola, Ekanayake & Fernando, 2007; Janghorbani *et al.*, 2007; Erem *et al.*, 2004). Owing to the lack of such data for Malaysians, WC measurement of adults was included in the Third National Health and Morbidity Survey (NHMS III) conducted in 2006, as part of the assessment of nutritional status of the population (Institute for Public Health, 2008a). This

article reports the prevalence and risks associated with AO in adults aged 18 years and above in relation to socio-economic factors (monthly household income and occupation) and demographic characteristics (that is, age, gender, ethnicity, residential area, marital status, level of education).

MATERIALS AND METHODS

Study design and sampling method

Data on WC in this article was collected in the Third National Health and Morbidity Survey (NHMS III) conducted in 2006 based on a nationally representative sample. The NHMS III is a population based cross-sectional study using two stage stratified sampling design proportionate to population size throughout all states in Malaysia. The NHMS III utilised the sampling frame of the Department of Statistics, Malaysia using Enumeration Blocks (EBs). A total of 2150 EBs consisting of 17200 living quarters (LQ) were selected using probability proportionate to size (PPS) linear systematic selection scheme based on the latest updated size measures. The details of the methodology of study have been reported previously (Institute for Public Health, 2008b). This study was approved by the Medical Research and Ethics Committee, Ministry of Health.

Waist circumference was measured in a total of 33,985 eligible adults who were at least 18 years or older. Respondents were excluded if they had increased abdominal
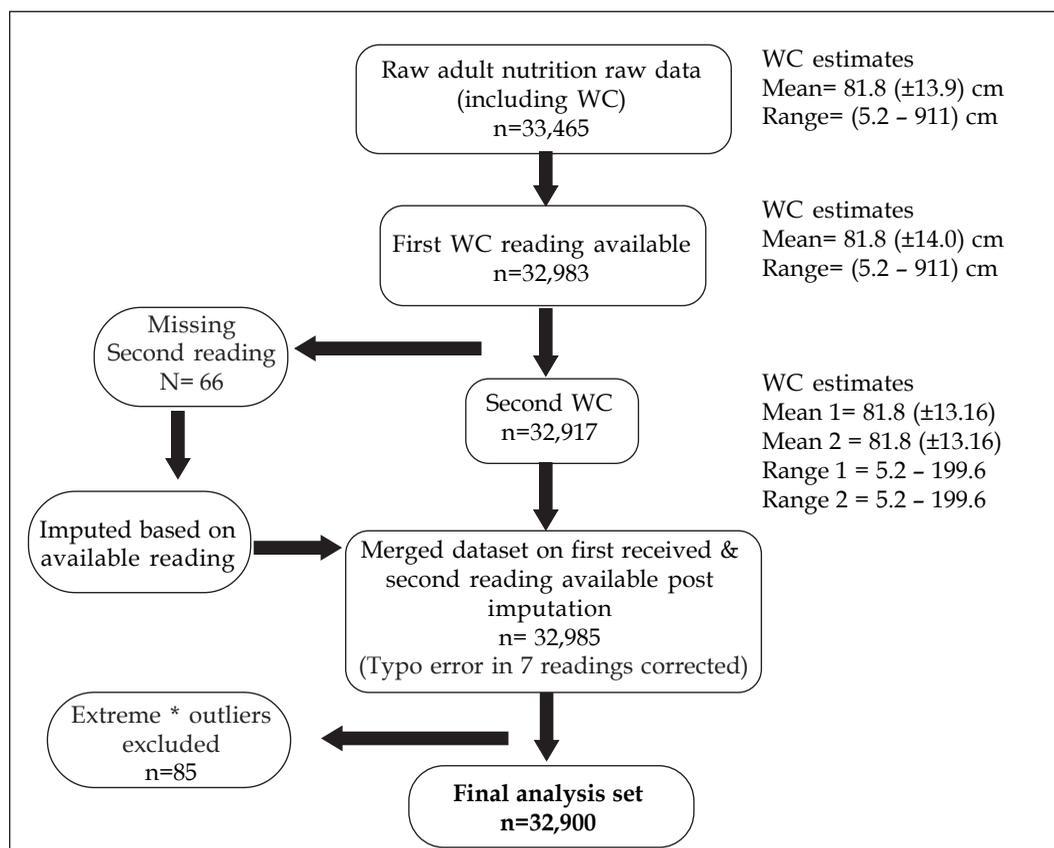

Figure 1: Summary of eligible data for analysis

Note: * extreme defined as a reading with a biologically plausible value of < -3SD

girth not related to increased adiposity (e.g. pregnancy, abdominal ascites, hypo-thyroidism and other debilitating illness), physical disability or mental illness. After data cleaning, a final total of 32,900 records were included in the analysis (Figure 1).

Data collection

The NHMS IIII household survey was conducted from April to August 2006, using a bi-lingual (in Malay and English) questionnaire and WC measurements were taken from adults aged 18 years old and above. Trained data collectors obtained written informed consent from the respondents prior to taking measurements and conduct of interview. The questionnaire included data on socio-demographic characteristics; gender, age, ethnicity, marital status, occupation, household monthly income, educational level and strata (urban or rural areas). Waist circumference was obtained by trained data collectors based on a standard procedure listed in the technical manual of NHMS III (Institute for Public Health, 2006). The measurement site selected was based on the WHO recom-mendation (Lean, Han & Deurenberg, 1996), whereby WC was measured at the mid-point between the inferior margin of the last rib and the iliac crest, using SECA measuring tape ® (SECA, Germany) to the nearest 0.1 centimetre. All measurements were taken and recorded twice. The average value was used for data analysis. The respondent was classified as having AO if WC measured more than 102 cm for men and 88 cm for women based on the cut-off points recommended by WHO (1998).

Data analysis

Analysis of the data was conducted using STATA version 10.0 and SPSS version 15.0. All analyses took into account the complex survey design and unequal selections of NHMS III. Findings are reported as the weighted estimates of the prevalence (mean value and mean at 95% confidence interval). To identify risk groups in the population, we studied the association between WC and socio-demographic variables (gender, age, ethnicity, marital status, occupation, household monthly income, and edu-cational level and residential area). To calculate the associations, complex design logistic regression analysis was performed, and the estimate was presented as odds ratio (OR) with a 95% confidence interval (95% CI).

RESULTS

A total of 32,900 adults aged $\geq$18 years (15,039 men, 17,861 women) were measured for WC in the NHMS IIII survey (with a response rate of 98.3%). The ethnic composition of the respondents consisted of Malays (55.0%), Chinese (20.3%), Indians (8.3%), Other Indigenous (11.5%) and Others (5.0%). It was observed that 85.0% of the respondents were aged between 18 and 60 years old. The mean age of the respondents was 41.7 ± 15.6 years. The mean WC for men and women was 84.0cm (95% CI: 83.8 - 84.3) and 80.3cm (95% CI: 80.1 - 80.6), respectively. The distribution of these characteristics of the respondents is summarised in Table 1.

Prevalence of abdominal obesity

The overall national prevalence of AO among Malaysian adults was 17.4%. Table 2 presents the association between the prevalence of AO and socio-demographic variables of respondents. The prevalence was clearly much higher in women (26.0%) than in men (7.2%) (OR: 4.2, 3.8, 4.6). The prevalence of AO increased steadily with age until the age of 50 to 59 years, after which the prevalence declined. The prevalence was higher among the Indians (OR: 3.0, 95% CI: 2.4, 3.8) and Malays (OR: 1.8, 95% CI: 1.5, 2.2) compared to others. With regard to marital status, respondents who were ever married had the higher risk of AO compared to not married (OR: 1.4, 95% CI: 1.2, 1.6). An

Table 1: Characteristics of respondents (n= 32,900)

	Frequency	*Percent (%)*
Gender		
Male	15, 039	45.7
Female	17, 861	54.3
Total	32,900	100
Age		
18-19	1,665	5.1
20-29	7,107	21.6
30-39	6,813	20.7
40-49	7,248	22.1
50-59	5,484	16.6
60-69	2,971	9.0
70-79	1,283	3.9
80+	329	1.0
Total	32,900	100
Ethnicity		
Malays	18,088	55.0
Chinese	6,667	20.3
Indians	2,718	8.3
OtherIndigenous	3,788	11.5
Others	1,639	5.0
Total	32,900	100.0
Religion		
Islam	21,328	64.8
Christian	3,020	9.2
Buddhist	5,768	17.5
Hindu	2,248	6.8
Others	486	1.5
Unclassified	50	0.2
	32,900	100.0

inverse relationship was observed between the level of education and prevalence of AO, in that as education level increased, the prevalence of AO decreased. Respondents who received no formal education had the highest prevalence at 23.7%, followed by those with primary education (21.2%), secondary education (15.2%) and tertiary education (12.1%). However, only primary education was found associated with prevalence of AO (OR: 1.3, 95% CI: 1.1, 1.5). By occupational status, housewives had the highest prevalence of AO compared to other occupations (OR: 1.4, 95% CI: 1.1, 1.7). Among the household income categories, prevalence of AO was higher in all income groups except for households with incomes less than RM1000, compared to households with income of RM5000 and above. Prevalence of AO was not associated with residential areas.

DISCUSSION

The national prevalence of AO (using cut-off points for WC >102 cm for men and >88 cm for women recommended by WHO (WHO, 1998), was 17.4%, with women at higher risk (26.0%) compared to men (7.2%). There have been no nationwide studies conducted in the past to compare using these cut-off points. Nevertheless, this prevalence

Table 2: Prevalence of abdominal obesity by socio-demographic variables (n = 32,900)

Socio-demographic variables	Categories	Waist circumference Abdominal obesity*		
		Prevalence (95% CI)	OR (95% CI)	Adjusted OR# (95% CI)
Gender	Male	7.2 (6.7, 7.6)	1.0† 1.0†	
	Female	26.0 (25.2, 26.8)	4.5 (4.2, 4.9)	4.2 (3.8, 4.6)
Age group (Years)	18-19	4.5 (3.6, 5.6)	1.0†	1.0†
	20-29	9.3 (8.6, 10.1)	2.2 (1.7, 2.8)	2.0 (1.5, 2.8)
	30-39	15.7 (14.8, 16.6)	4.0 (3.1, 5.0)	3.1 (2.2, 4.2)
	40-49	21.3 (20.4, 22.4)	5.8 (4.5, 7.3)	4.3 (3.1, 6.0)
	50-59	25.4 (24.2, 26.7)	7.3 (5.7, 9.3)	5.6 (4.0, 7.7)
	60-69	23.2 (21.7, 24.8)	6.4 (5.0, 8.2)	5.1 (3.7, 7.2)
	70-79	19.0 (16.9, 21.2)	5.0 (3.8, 6.6)	3.9 (2.7, 5.6)
	80+	14.9 (11.4, 19.2)	3.7 (2.5, 5.5)	2.6 (1.6, 4.2)
Ethnicity	Malays	18.6 (17.9, 19.2)	2.1 (1.7, 2.5)	1.8 (1.5, 2.2)
	Chinese	14.1 (13.2, 15.1)	1.5 (1.2, 1.8)	1.1 (0.9, 1.4)
	Indians	28.2 (26.3, 30.1)	3.6 (2.9, 4.4)	3.0 (2.4, 3.8)
	Other Indigenous	12.7 (11.6, 14.0)	1.3 (1.1, 1.7)	1.2 (1.0, 1.5)
	Others	9.9 (8.4, 11.7)	1.0†	1.0†
Marital status	Not married	7.7 (7.1, 8.5)	1.0†	1.0†
	Ever married	20.1 (19.6, 20.7)	4.5 (4.2, 4.9)	1.4 (1.2, 1.6)
Residence areas	Urban	18.0 (17.3, 18.7)	1.1 (1.0, 1.2)	1.1 (1.0, 1.2)
	Rural	16.4 (15.6, 17.2)	1.0†	1.0†
Educational level	None	23.7 (22.2, 25.2)	2.3 (2.0, 2.6)	1.2 (1.0, 1.5)
	Primary	21.2 (20.3, 22.1)	2.0 (1.7, 2.2)	1.3 (1.1, 1.5)
	Secondary	15.2 (14.6, 15.9)	1.3 (1.2, 1.5)	1.1 (1.0. 1.3)
	Tertiary	12.1 (11.0, 13.3)	1.0†	1.0†
Occupation	Professionals & senior official	14.1 (12.8, 15.5)	1.5 (1.2, 1.9)	1.2 (0.9, 1.5)
	Clerical & service workers	15.6 (14.7, 16.5)	1.7 (1.4, 2.1)	1.2 (0.9, 1.4)
	Technical & craft	13.0 (11.9, 14.2)	1.4 (1.1, 1.7)	1.1 (0.9, 1.4)
	Skilled agricultural & machine operator	9.2 (8.4, 10.2)	0.9 (0.8, 1.2)	0.9 (0.7, 1.1)
	Housewife	31.3 (30.2, 32.4)	4.2 (3.5, 5.1)	1.4 (1.1, 1.7)
	Unemployed	17.3 (15.9, 18.7)	1.9 (1.6, 2.4)	1.3 (1.0, 1.6)
	Others	9.8 (8.3, 11.5)	1.0†	1.0†
Household income	< RM 1000	17.3 (16.5, 18.1)	1.3 (1.1, 1.5)	1.1 (1.0, 1.3)
	RM 1000 - < 2000	18.2 (17.3, 19.1)	1.4 (1.2, 1.6)	1.3 (1.1, 1.5)
	RM 2000 - < 3000	18.4 (17.2, 19.6)	1.4 (1.2, 1.6)	1.4 (1.2, 1.6)
	RM 3000 - < 4000	18.3 (16.6, 20.1)	1.4 (1.2, 1.6)	1.4 (1.2, 1.7)
	RM 4000 - < 5000	17.0 (14.9, 19.3)	1.3 (1.1, 1.5)	1.3 (1.1, 1.6)
	RM ≥ 5000	13.9 (12.5, 15.4)	1.0†	1.0†

* Waist circumference cut-offs:>102 cm in men, >88 cm in women;
† Reference group;
# Adjusted for all other variables.

is comparable to that reported by the International Day of Evaluation of Abdominal Obesity (IDEA) from a large international epidemiological study assessing AO in 168,000 primary care patients aged 18 to 80 years in 63 countries (Wittchen *et al.*, 2006). The IDEA study reported an overall prevalence of AO of 22% in women and 6% in men in East Asian (China, Hong Kong, Korea, Taiwan) and South East Asian (Indonesia, Malaysia, the Philippines, Singapore, Thailand, Vietnam) countries by using the similar cut-offs (Bassand, 2006). The latter study also reported that the prevalence of OA ranged from 6 to 20% in men and 22 to 55% in women across Asian countries with the South Asian population (India, Pakistan) reporting the highest prevalence for women at 55.0% and men at 20.0% . The differences among the Asian regions (East, South East and South Asia) may be explained by differences in ethnicity and socio-economic factors in these countries. The IDEA study also reported a higher prevalence of AO in Northwest European countries (that is, Austria, Belgium, Denmark, Finland, France, Germany, Ireland, the Netherlands, Norway, Sweden and Switzerland) compared to the present study. The prevalence of AO reported in these countries was 43.0% in women and 31.0% in men (Bassand, 2006).

The national AO prevalence of Malaysian adults was much lower than that in the United States as reported in the National Health and Nutrition Examination Survey (NHANES, 1999-2000). By using similar cut-offs as in NHMS III, NHANES reported that 59.9% of adult females and 38.3% of adult males in the United States had AO (Okosun *et al.,* 2004).

When AO in the NHMS III data was defined using the cut-off points of the IDF **(**≥90cm for men and ≥80cm for women), a different result was obtained. The prevalence of AO was substantially higher at 39.5% overall with women at 47.3% and men at 30.1%, compared to 17.4% overall, 26% in women and 7.2% in men based on

WHO (1998). However, a study conducted by the Malaysian NCD surveillance 2005/2006 (MyNCDs-1) among 2572 adults aged 25 to 64 using the IDF cut-off points for WC, reported an even higher overall prevalence of AO at 48.6% with 57.1% of women and 40.7% of men (Disease Control Division, Ministry of Health, 2006). The differences may be attributed to the larger sample size and a larger proportion of the younger age groups (18-25 years) in the present study.

When we compared our prevalence of AO among Malaysian adults with other developing countries using similar cut-offs points for WC (≥ 90 cm in men, ≥ 80cm in women), it appears that our prevalence is higher than in these countries. In China, the International Collaborative Study of Cardiovascular in Asia (InterAsia) Survey conducted in 2000-2001 found a prevalence of AO at 37.6% in women and 16.1% in men (Reynolds *et al.*, 2007). In Philippines, the National Nutrition and Health Survey (NNHeS) conducted in 2003-2004 showed prevalence of AO to be 17.7% in men and 35.1% in women among the 4757 adult Filipinos aged 20 years and above (Morales *et al.*, 2008). In a relatively smaller sample size in Sri Lanka of 1400 adults aged 20-64 in the district of Colombo in 2004, prevalence of OA was found to be 44.7% in females and 25.7% in males (Arambepola *et al.*, 2007).

In the present study, a higher prevalence of AO was found in women than in men. Furthermore, regardless of the WC cut-offs used to define AO, there was a consistently higher prevalence among women (Bassand, 2006). Similar gender differences have also been observed in relatively small scale studies carried out in the United States (Okosun *et al.,* 2004), Iran (Janghorbani *et al.,* 2007), Sri Lanka (Arambepola *et al.,* 2007) and Turkey (Erem *et al.,* 2004). Differences in body fat distribution between men and women may explain why women are at higher risk of AO than men (Lemienx *et al.*, 1993; Ross *et al.*, 1994).

In the present study, the age of 20 years or older was associated with higher

prevalence of AO. The prevalence was highest in the 50-59 years age group, then prevalence decreased. Studies show that an increase in prevalence of AO is closely associated with an increase in age (Okosun *et al.*, 2004; Janghorbani *et al.*, 2007). Perhaps, physiological changes (increase in fat adiposity and reduction in lean body mass) associated with older age, together with a sedentary lifestyle may have contributed to an increase in the prevalence of AO (Bouchard *et al.*,1990).

In the NHMS III study, it was found that the risk of AO was higher among Indians, those who were housewives, married or ever married and those having a lower educational level. The high prevalence among Indians is consistent with the findings from the IDEA study. The study showed that prevalence of AO among South Asians (India and Pakistan) was remarkably higher than that of other Asian populations but comparable to those in European countries (Bassand, 2006). Similar finding were also found in the 1998 Singapore National Health survey where AO prevalence was higher among Indians compared to Chinese and Malay (Tan *et al.*, 2004). This finding suggests that there might be predisposing genetic properties that add to the risk of AO. However, we cannot exclude the influence of environmental factors including socio-economic and behavioural patterns.

The remarkably high prevalence of AO among housewives is possibly due to their increased susceptibility to sedentary lifestyles, more accessibility to food and being disadvantaged to health information.

Consistent with other studies, AO was found to be higher among married or ever married individuals than among those who have never married (Ball *et al.*, 2002; Janghorbani *et al.*, 2007; Arambepola *et al.*, 2007). Changes in lifestyle after marriage, less physical activity, psycho-social factors and dietary pattern may contribute to the higher prevalence in this group.

In the NHMS study, prevalence of AO had an inverse relationship with level of education. The results are in line with studies conducted in Australia (Ball *et al.*, 2002), Turkey (Erem *et al.*, 2004), Iran (Janghorbani *et al.*, 2007) and Korea (Yoon *et al.*, 2006). Higher educational attainment may have a positive effect on one's attitude toward body weight control, dietary pattern and healthier lifestyle. In contrast, a study carried out in Cameroon showed OA was not related to educational level (Fezeu *et al.*, 2005).

In our study, we found that there was no association between prevalence of AO and residential areas. It could be explained by the fact that sustained economic growth has resulted in increased household income and accessibility to food, which in turn has resulted in increased food consumption in rural areas. Nevertheless, further studies should be conducted to assess any differences in dietary pattern and energy intakes between respondents residing in urban and rural areas.

Limitations

In the present study, we used WHO criteria (WC > 108 cm for men, and >88cm for women) to define abdominal obesity. However, it may not appropriate since criteria for selection of these cut-off points of abdominal obesity are based on data for white Caucasians who are mostly from European countries. In fact, Asian populations have different body compositions and magnitudes of abdominal adiposity compared to others ethnic groups. Therefore, different cut-off points should be used for Asian populations based on ethnic groups (Misra, Wasir & Vikram, 2005).

WC may be a good indicator of AO and might be used for screening the population, but additional information is needed on the relation between WC and body fat (total and visceral) of respondents under study. In addition, further information is needed about the association between WC and other

health indicators (BMI, serum lipid profile, blood pressure, fasting blood sugar, etc.) of chronic diseases such as cardiovascular diseases and diabetes mellitus.

In our study, multivariate analysis was performed to determine the association between prevalence of AO and socio-demographic variables of interest. However, any effect of interaction existing between variables was not further evaluated and discussed. Hence, the strength of association between risk factors and AO that are attributed to each risk factor cannot be assessed.

CONCLUSION

The prevalence of AO in Malaysian adults is higher than in most other Asian countries, with the exception of the South Asian countries. However, it is less than that for other European countries and the USA as reported in the IDEA study (Bassand, 2006). Despite the inability to compare trends due to non availability of past figures, based on the experience in Western populations, our prevalence is expected to increase (Okosun *et al.*, 2004). Although the prevalence of AO in Asian countries was lower than that in European countries, the prevalence of cardiovascular disease and diabetes mellitus in the Asian population is almost similar or even higher than in Europe (Balkau *et al.*, 2007). Our findings have important public health implications, since cardiovascular disease has emerged as the leading cause of death in Malaysia in the last decade. CVD has been leading cause of death in Malaysia since the 1970s Therefore, there is an urgent need to include WC measurements as a method to identify persons at risk of AO as a part of routine clinical practice, developed and tested for effective intervention packages targeted mainly at those at high risk such as Indians and Malays, women and housewives. Further studies should include the relationship of WC with percentage of body fat and body composition. Studies on better methods of assessment and cohort

studies to determine locally valid cut-offs are recommended.

ACKNOWLEDGEMENTS

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