Waist circumference as a predictor for blood glucose levels among men and women 40 to 60 years of age

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ABSTRACT

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Anthropometric indexes such as body mass index (BMI), waist circumference (WC), hip circumference (HC), and waist hip ratio (WHR), are useful measurements to provide important information on blood glucose concentration. The aim of this study was to determine several anthropometric measurements, in particular BMI, WC, HC and WHR, in their ability to predict the blood glucose levels in men and women 40 to 60 years of age. A cross-sectional study was conducted on 44 men and 127 women aged 40 to 60 who lived in Cipete Selatan subdistrict, South Jakarta. Blood glucose levels were assessed and anthropometric indexes such as BMI, WC, HC, WHR were measured. Multiple linear regression analysis was used to determine the best predictor for blood glucose levels. The study showed that the prevalence of diabetes mellitus (DM) type 2 was 12.9% and higher in men (20.5%) than in women (10.2%). The significant predictive variables in the simple regression analysis were age and WC. Multiple linear regression showed that after adjustment for age, WC was positively associated with blood glucose levels. Standardized β value was 0.172 (p=0.026). WC predicts blood glucose levels, beyond that explained by traditional diabetic risk factors and BMI. The findings support the recommendation that WC be a routine measure for identification of DM type 2 in men and women aged 40 to 60.

Keywords: Anthropometric indexes, blood glucose levels, diabetes mellitus type 2, forty to sixty years

INTRODUCTION

The increase in the number of diabetes mellitus (DM) type 2 patients all over the world has been predicted by the experts.[1] The prevalence rate of DM in the developing world, especially in the Asia-Pacific region was increasing compared to that in other regions. In Thailand, during 2001 the prevalence of DM type 2 among the population aged ≤35 was 9.6%, an increase of 20% over a period of 5 years.[2] According to the survey that was conducted by

the World Health Organization (WHO), Indonesia occupied the 4th place in the number of DM patients in the world after India, China and the United States. During 2000, the prevalence of the DM was 8.4 million and in 2030 it is expected to increase 21.3 million.[1] Data from the Department of Health showed that the number of DM inpatients and outpatients treated in the hospital occupied the highest rate among all endocrine disorders.[3] In developing countries the highest prevalence of DM type 2 was in people 45 to 65 years of age.[4] The complications that could result from DM, including coronary heart disease (CHD), need a larger expenditure for medical treatment.

Therefore, early diagnosis and treatment of DM are very important in preventing the CHD complication after the onset of diabetes. Several factors that could increase incidence of DM type 2 are sedentary habits, obesity, excessive consumption of polyunsaturated fats and refined sugars and smoking. Several studies showed that obesity was correlated with the increase of the prevalence of hypertension, DM and dyslipidemia.[5] Anthropometric indexes such as body mass index (BMI), waist circumference (WC), hip circumference (HC) and waist-hip ratio (WHR) are anthropometric measurements that could give risk information on DM and CHD.[6] The WHO and the National Institute of Health have defined BMI, WC, HC, WHR cut-off levels for White, Black and Hispanic American adults; however, these definitions are not applicable yet to other populations.[7,8] It is beneficial to health care to assess which anthropometric measurement are associated with the presence of DM in different populations. Although it is argued that there is no justification for general population screening, early detection of individuals at risk of diabetes could be beneficial because early intervention has the potential to prevent the development of diabetes and its complications. The identification of individuals at risk of diabetes and treatment of risk factors are therefore relevant to prevent cardiovascular disease and mortality in diabetes.[9] The aim of this study was to determine the ability of anthropometric measurements, in particular BMI, WC, HC, and WHR in predicting risk of type 2 diabetes in people 40 to 60 years of age.

METHODS

Research design

A cross-sectional study was conducted during October to November 2007 among people 40 to 60 years of age.

Study subjects

Study subjects were men and women 40 to 60 years of age who lived in Cipete Selatan subdistrict South Jakarta. A simple randomized sampling design was used to select the subjects. The inclusion criteria were subjects aged 40 to 60 years and no history of diabetes. After exclusion of participants with any history of severe diseases (cancer, liver cirrhosis), mental retardation and lack of communication, information on subject characteristics such as age, gender, level of education, exercise and occupation were collected.

Measurements

The anthropometric measurements used to calculate BMI, by standard procedures, included both height and weight. Height was measured using microtois portable and weight was measured using Sage portable scales to the nearest 0.1 kg. BMI was calculated as the weight (kg) divided by the square of the height (m). WC was taken as the minimum circumference between the umbilicus and xiphoid process and measured to the nearest 0.5 cm. HC was measured as the maximum circumference around the buttocks posteriorly and the symphysis pubis

anteriorly and measured to the nearest 0.5 cm. WHR was then calculated. Blood was taken for measurement of casual plasma glucose (PG). The American Diabetes Association (ADA) criteria were used to diagnose diabetes.[10] Diabetes was defined as a casual plasma glucose > 200 mg/dl (11.1 mmol/l).

Statistical methods

Differences in age, height, weight, BMI, WC, HC, WHR and blood glucose level between men and women were examined by Student's t test. To test the contribution of age, WC, HP, BMI, WHR on casual blood glucose concentration as dependent variable a single regession analysis was used. A multiple step-wise regression analysis, including all variables that were significantly ($p < 0.05$) associated with blood glucose levels, was used to determine the best predictor for blood glucose concentrations. All analyses were performed using SPSS/PC statistical program (version 11.0 for Windows; SPSS, Inc.Chicago,IL).

RESULTS

The subjects consisted of 127 (74.3%) women and 44 (25.7%) men. Among the 171 participants without any signs and symptoms of diabetes, the prevalence of DM type 2 was 12.9%. Their age, anthropometric indexes, blood glucose levels and prevalence of type 2 DM are summarized in Table 1. The means of height, weight and WC were significantly higher in men compared to women. In men, WC (88.3 ± 10.8 cm) was statistically significantly higher compared to women (83.5 ± 9.4 cm) (p=0.005). In women, HC (92.6 ± 9.8 cm) was statistically significantly higher compared to men (92.6 ± 9.4 cm) (p=0041). WHR was also statistically significant higher in men (098 ± 0.06) compared to women (0.93 ± 0.04) (0.000), but blood glucose level was not significantly different between men and women (p=0.197).

Table 2 presents the results of the simple linear regression analysis in which several anthropometric indices were used to predict blood glucose levels. Age and WC had significantly positive association with casual blood glucose levels. BMI, HC, and WHR were not significantly associated with casual blood glucose level. Multiple linear regression models showed that WC was the best predictor for blood glucose levels among men and women 40 to 60 years of age. WC was statistically significantly associated with blood glucose levels (p=0.026) (Table 3).

Table 1. Anthropometry and prevalence of type 2 DM in the studied population

	Men (n=44)	Women (n=127)	p value
Age (yr)	51.3 (6.3)	47.6 (6.1)	0.001
Height (cm)	162.8 (7.0)	151.8 (5.1)	0.000
Weight (kg)	77.6 (10.3)	59.1 (10.1)	0.000
BMI *	25.2 (3.3)	25.7 (4.1)	0.393
WC (cm) **	88.3 (10.8)	83.5 (9.4)	0.005
WH ratio ***	0.98 (0.06)	0.93 (0.04)	0.000
HC (cm) ****	92.6 (9.4)	96.2 (9.8)	0.041
Blood glucose level (mg/dl)	136.6 (70.4)	120.8 (69.6)	0,197
DM §	20.5%	10.2%	0.081

*BMI = body mass index; **WC = waist circumference; ***WHR = waist to hip ratio; **** HC = hip circumference; §DM = diabetes mellitus type 2; ( ) = standard deviation

Table 2. Simple regression analysis of predictors for blood glucose levels in men and women

Predictors	β	p
Age	1.684	0.048
BMI *	0.383	0.827
WC **	1.351	0.011
HC***	0.491	0.303
WHR ****	103.377	0.345

*BMI = body mass index, ** WC = waist circumference, *** HS = hip circumference, *** WHR = waist to hip ratio

Table 3. Multiple linear regression model for age and WC on blood glucose levels

Model	β	Standardized β	p
Age	1.348	0.121	0.115
WC*	1.202	0.152	0.026

*WC = waist circumference

DISCUSSION

In the present study, the prevalence of DM type 2 was 12.9% among men and women 40 to 60 years of age. This result was lower compared to a survey in Mexico, where the prevalence of DM type 2 among men and women over 20 was 26.6%.[11] The prevalence of DM in both genders was higher than that found in the American survey (DM 7.8%), probably because different age groups were not considered.[12]

The primary finding of this study was that WC significantly predicted the levels of blood glucose, beyond that explained by commonly evaluated diabetic risk factors such as weight, BMI and WHR. Conversely, BMI did not predict diabetes after consideration of common diabetic risk factors and WC. A study in Jakarta on men and women of 35 to 55 years, a showed similar result. WC was the best predictor for screening DM type 2 compared to BMI and WHR.[13] The recent consensus statement of the ADA, the Obesity Society, and the American Society for Nutrition questioned the sequence of clinical measures of DM and, more importantly, the relevance of WC measurement in clinical practice.[14]

Schulze et al showed that WC was the strongest associations of single anthropometric measures for DM type 2.[15] Several previous cohort studies[16-19] that compared different anthropometric measurements with regard to diabetes risk predictions suggested that anthropometric measurements that described central fat distribution, in particular WC, may be superior to measurements of general adiposity. A cohort study of 721 Mexican Americans aged 25-64 years who were free of noninsulin dependent diabetes mellitus (NIDDM) at baseline and were followed for an average of 7.2 years, showed that WC was the only significant predictor of NIDDM in models that included other anthropometric variables.[20] But a meta analysis based on published studies from 1996 to 2004 retrieved from PubMed search showed that BMI, WC and WHR have similar associations with diabetes.[21] Waist circumference was also more closely related to potentially atherogenic metabolic disturbances associated with abdominal obesity. Distribution of body fat, especially abdominal localization, is a more important determinant than the total amount of body fat for the development of DM type 2. Increased WC was more consistently associated with the

increased plasma insulin levels.[22] WC alone was strongly related to risk of myocardial infarction and this association remained significant after adjustment for other risk factors.[23] From the clinical perspective, central obesity (approximated by WC or WHR) is known to generate diabetogenic substances and should therefore be more informative than general obesity (BMI).

Lifestyle modification has been proven to effectively prevent and delay the development of diabetes.[24,25] Therefore, early recognition of and intervention for the condition will be beneficial, particularly as cardiovascular complications set in early after the onset of diabetes.[26] Knowledge of the risk of diabetes could enhance people's awareness, leading to lifestyle modification. Among the modifiable risk factors that played a substantial role on DM was obesity, measured by BMI or WC. In the present study, WC was found to increase blood glucose levels. WC was better than WHR and BMI for identifying the blood glucose levels among subjects 40 to 60 years of age.

CONCLUSION

Waist circumference appeared to be a better predictor than any other anthropometric indices among men and women. Generally, measurement of anthropometric indices other than WC had little predictive information on blood glucose levels.

ACKNOLEDGEMENT

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