

## Original Article



## Optimal Waist Circumference Cut-off values for Identifying Metabolic Risk Factors in Middle-aged and Elderly Subjects in Shandong Province of China\*

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### Abstract

**Objective** To study the optimal waist circumference (WC) cut-off values for identifying metabolic risk factors in middle-aged and elderly subjects in Shandong Province of China.

**Methods** A total of 2 873 men and 5 559 women were included in this cross-sectional study. Metabolic syndrome (MetS) was diagnosed according to the definition of Chinese Diabetes Society in 2004. The relation between WC and MetS was analyzed by multivariate logistic regression analysis. The optimal WC cut-off values were identified using the area under the ROC curve and the different diagnostic criteria for central obesity were compared.

**Results** The WC was the risk factor for MetS independent of BMI, blood glucose, blood lipid, and blood pressure. The optimal WC cut-off value was 83.8 cm and 91.1 cm for identifying MetS in women and men, respectively. Compared with 80 cm and 85 cm for women and men, 85 cm and 90 cm had a higher Youden index for identifying all metabolic risk factors and MetS in women and men.

**Conclusion** The appropriate WC cut-off value is 85 cm and 90 cm for identifying central obesity and MetS in women and men in Shandong Province of China.

**Key words:** Waist circumference; Metabolic syndrome; Central obesity

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## INTRODUCTION

**M**etabolic syndrome (MetS) is a clustering of metabolic abnormalities characterized by central obesity, hypertension, dyslipidemia and glucose intolerance that collectively increase the risk of diabetes mellitus (DM), cardiovascular disease (CVD), stroke, and overall mortality<sup>[1-2]</sup>. Although it is unclear whether MetS is attributed to a single cause, central obesity and insulin resistance are considered as its most important risk factors<sup>[3]</sup>.

Obesity, one of the most severe health problems worldwide<sup>[4]</sup>, often leads to chronic diseases such as DM, CVD, and dyslipidemia<sup>[5-6]</sup>. Abdominal fat rather than whole-somatic obesity is considered as a more accurate predictor of CVD, metabolic disorders and death than other anthropometric measures such as body mass index (BMI)<sup>[7]</sup>. As an indirect measure of visceral fat, measurement of waist circumference (WC) is easy, inexpensive, and non-invasive and corresponds to BMI. It is thus considered as a good diagnostic indicator of abdominal adiposity, both in clinical practice and in epidemiological study<sup>[8-9]</sup>.

However, because of ethnic differences, the diagnostic criteria for central obesity are different in different regions. Asian-specific diagnostic criteria for central obesity were adopted in the International Diabetes Federation definition and modified definition of the Third Report of the National Cholesterol Education Expert Panel on Detection, Evaluation, and Treatment of High Blood Cholesterol in Adults (ATPIII)<sup>[10]</sup>: the cut-off value was 80 cm and 90 cm for WC in women and men. In the guide for prevention and control of overweight and obesity in Chinese adults, the cut-off value is 80 cm and 85 cm for WC in women and men<sup>[11]</sup>. Moreover, a recent study showed that the appropriate WC cut-off value is 85 cm and 90 cm for MetS in women and men based on the visceral fat area measured by MRI<sup>[12]</sup>. Thus, no consensus has been reached regarding the diagnostic criteria for central obesity in Chinese population.

The present study aimed to define the optimal WC cut-off values for abdominal obesity and metabolic risk factors in order to establish the unique diagnostic criteria for central obesity in Chinese people.

## METHODS

### Subjects

A population-based cross-sectional survey was

carried out in Shandong Province of China from January to April 2012, during which 10 028 subjects with their age  $\geq 40$  years were recruited from 4 urban communities in Jinan and Jining Cities. Those who lacked of WC values and information for diagnosis of MetS (937), with their diastolic blood pressure higher than systolic blood pressure (40), their fasting plasma glucose (FPG) or 2-h plasma glucose (2hPG)  $\leq 3.9$  mmol/L (360), and had a history of tumors (259) were excluded from the study. However, some factors that may affect the accurate measurement of WC were not considered and included, such as thyroid function, ascites, and glucocorticoid-taking history, etc. Finally, 8 432 subjects (2 873 men) were included for analysis. This study was approved by the Ethics Committees of Shandong University Qilu Hospital and Shanghai Jiaotong University. All subjects provided their informed consent.

### Data Collection

Demographic characteristics and lifestyle of subjects were recorded by face-to-face interview using a standard questionnaire. BMI was calculated as weight (kg) divided by height squared ( $m^2$ ). WC was measured from the midpoint between the lower rib cage border and the anterior superior iliac spine. Blood pressure was measured 3 consecutive times at 1-min interval with an automated electronic device (OMRON Model HEM-752 FUZZY, Omron Company, Dalian, China) after the subjects had sat for at least 5 min. The mean value of the 3 measurements was used for the analysis. After at least 10 h of overnight fasting, venous blood samples were taken for measuring the serum TG, HDL-C, and FPG levels. The 2-h plasma glucose (2hPG) level was measured after the subjects completed their oral glucose tolerance test (OGTT).

### Definition of MetS

Following the 2004 Chinese Diabetes Society (CDS) definition, MetS is defined as the presence of at least 3 of the following components: 1) overweight and/or obesity: BMI  $\geq 25.0$   $kg/m^2$ ; 2) hyperglycemia: FPG  $\geq 6.1$  mmol/L and/or 2hPG  $\geq 7.8$  mmol/L, or previously diagnosed as type 2 DM and received treatment; 3) hypertension: systolic blood pressure/diastolic blood pressure  $\geq 140/90$  mmHg, or previously diagnosed as hypertension and received treatment; and 4) dyslipidemia: triglycerides level  $\geq 1.7$  mmol/L, and/or HDL-C level  $< 0.9$  mmol/L (men) or  $< 1.0$  mmol/L (women)<sup>[13]</sup>.

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