Abstract: Objective: Anthropometric indices to obesity were evaluated as predictors of metabolic syndrome risk factors. Our purpose was to explore an optimal or more reliable anthropometric indicator and optimal cut-off points for obesity on metabolic syndrome in Chinese adults. Participants and methods: The survey was conducted involving 2947 participants, aged 20 or above with cross-sectional study of population. The predictive validity and optimal cut-off values were analyzed by receiver operating characteristic (ROC) curves, area under curve (AUC) and the largest Youden’s index (sensitivity + specificity -1) by gender group, respectively. Kappa value showed diagnostic consistency. Results: (1) According to the criteria of CDS 2004, IDF 2005 and AHA/NHLBI 2005, the prevalence of metabolic syndrome was 10.32%, 9.64% and 16.12% respectively, which indicated that the prevalence was higher in men than in women and increased with age (P < 0.05). (2) The BMI, WC, WHR and WHtR in metabolic syndrome patients were greater than those in healthy volunteers and the indices in men were higher than those in women. (3) With adjusted age and gender, the partial correlation coefficient for BMI-WC, BMI-WHR and BMI-WHtR was 0.7991, 0.5278 and 0.8196, respectively (P < 0.05). (4) The area under curves (AUCs) of receiver operating characteristic (ROC) curves for WHR was larger (P < 0.05) than that for WC and WHR. The cut-point of WHtR was approximately 0.5 in both genders with a satisfactory balance between sensitivity and specificity, where the Kappa (κ) value for WHtR-BMI was higher than that for WHtR-WHR, and WHtR-WC. Conclusions: The results indicated that WHtR might be an optimal anthropometric predictor of metabolic syndrome risk factors and the cut-point of WHtR was approximately 0.50 in both genders of Chinese adults.

Key words: Waist-to-height ratio, obesity, metabolic syndrome, receiver operating characteristics.

Introduction

While body mass index (BMI) is adopted as an index of obesity in metabolic syndrome (MS) criteria in China and its cut-off value is 25kg/m2, many studies have indicated that the pattern of body fat distribution is a more important factor (1, 2), and abdominal or central obesity is regarded as an early link to the development of metabolic syndrome (3). Some studies claimed that waist circumference (WC) might be a better indicator of abdominal obesity and predictor of cardiovascular disease than either BMI or waist-to-hip ratio (WHR). Recent reports, however, proposed that the waist-to-height ratio (WHtR) be the best anthropometric index to predict metabolic syndrome and CVD risk (4, 5). Several reports, mainly from Asia, even argued that the waist-height ratio was superior to waist circumference in identifying cases with cardiovascular risk factors (6-8).

The prospective and cross-sectional studies have failed to find the best and uniform anthropometric index for obesity(9, 10). Studies from the Eastern Mediterranean area do not agree on the best anthropometric index to predict cardiometabolic risk, either (11, 12). All the anthropometric indices mentioned above have been found to be associated with all-cause mortality, morbidity and mortality of diabetes mellitus and cardiovascular diseases in prospective studies (13-15). Measurement of WC is recommended by the US National Cholesterol Education Program (NCEP) for the assessment of central obesity (16), whereas WHR is recommended by WHO for the same purpose. So far, no standard index and cut-point of abdominal obesity is widely accepted. Hence, the index of central obesity and its cut-off point on metabolic syndrome become a recent hotspot.

We have undertaken a project to characterize the distribution of metabolic syndrome in population (17). Based on our study of community population, the objective was to discuss the relationship of BMI, WC, WHR and WHtR with obesity, to compare the cut-off and the ability of the four indices to predict MS by the receiver operating characteristic (ROC) curves and to determine whether WHtR could serve as an optimal index and optimal cut-off value with regard to the detection of metabolic syndrome and abdominal obesity.

Participants and Methods

The cross-sectional population-based survey was conducted among residents of Yunlong and Quanshan districts of Xuzhou, Jiangsu, China. 2947 volunteers (1674 men and 1273 women), aged 20 or above, were selected by multistage cluster random-sampling. This study was approved of with written consent from each volunteer. Survey data collected by trained interviewers included general demographic and socioeconomic characteristics, behavioral, clinical data and physical examinations. Anthropometry included weight, height, waist circumference (WC) and hip circumference (HC), with which the BMI, WHR and WHtR were calculated.

The distribution characteristics of MS or the prevalence of MS components were analyzed by age and gender-specific descriptive profiles. The values of BMI, WC, WHR and WHtR were presented by mean with line figure, and partial correlation analyses were also calculated by adjusted age and gender. The predictive validity and optimal cut-off values were analyzed by ROC curves, area under curves (AUCs) and the largest Youden’s index (sensitivity + specificity -1) by gender, respectively. Kappa value showed diagnostic consistency. The level of significance was set at P < 0.05.

Results

There were 2947 participants enrolled, 1674 men aged 42.48±14.7 yrs and 1273 women aged 41.1±13.8 yrs. The prevalence of MS was 10.3% (304/2947), 9.6% (284/2947) and 16.1% (475/2947) according to the CDS 2004, IDF 2005 and NHLBI-AHA 2005 criteria, respectively. Figure 1 C & D showed the frequency was stratified by age and gender according to CDS 2004, IDF 2005 and NHLBI-AHA 2005. Figure 1 A & B showed that the frequency was stratified by age and gender according to CDS 2004, IDF 2005 and NHLBI-AHA 2005.

Figure 1 C & D showed the frequency of different obesity according to different indices (BMI ≥ 25, WC ≥ 90/80 cm for men/women, WHR ≥ 0.90/0.85 for men/women) by age and gender.

Figure 2 A & B showed the distribution characteristics for BMI, WC, WHR and WHtR. Partial correlation analysis was employed to assess the association of anthropometric indices for BMI-WC, BMI-WHR, BMI-WHtR with adjusted age and gender and the correlation coefficients were 0.7991, 0.5278 and 0.8196, respectively, with significant differences (P < 0.05). The correlation coefficients of BMI-WHtR were higher than the others.

The predictive validity and optimal cut-off values were analyzed by receiver operating characteristic (ROC) curves, area under curves (AUCs) (Figure 3) and the largest Youden’s index (sensitivity + specificity -1) by genders respectively. Kappa values showed diagnostic consistency. The cut-off values for WC, WHR and WHtR matched their sensitivity and specificity, respectively. The AUCs for WC, WHR and WHtR were 0.785, 0.737, 0.794 for men; and 0.881, 0.800, 0.901 for women, respectively. Table 1 summarized the cut-off points for WHtR

Figure 1

Distribution characteristics of MS were described by age groups and genders according to various MS definitions and the frequency of MS in males (A) and females (B) increased with age groups (P < 0.05). The frequency of obesity in males (C) and females (D) was calculated with different indices and the obesity prevalence by BMI was higher than that of WHR and WC.