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Original article

The six obesity indices, which one is more compatible with metabolic syndrome? A population based study

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ABSTRACT

Objectives: The present study was conducted to determine the best discriminators in the diagnosis of the metabolic syndrome (MetS) among six obesity indexes. Furthermore the optimal cutoff points for all obesity indexes were determined.
Methods: The baseline data of 5910 subjects of Haraz cohort study which was conducted in northern Iran were analyzed. Receiver operating characteristic (ROC) analyses were separately performed to determine discriminatory power of six obesity indexes, including, body mass index (BMI), waist circumference (WC), waist to hip ratio (WHR), waist to height ratio (WHtR), abdominal volume index (AVI) and conicity index (CI) for diagnosis of at least two other components of MetS. Youden index was used to determine the optimal cutoff points.
Results: While the optimal cutoff points in men were 26.0 kg/m^2 for BMI, 90 cm for WC, 0.90 for WHR, 0.53 for WHtR, 16.6 (cm^2) for AVI and 1.24($m^{\frac{3}{2}}/kg^{\frac{1}{2}}$) for CI, the optimal values in women were 29.0 kg/m^2 for BMI, 91 cm for WC, 0.86 for WHR, 0.58 for WHtR, 17.0(cm^2) for AVI and 1.23 ($m^{\frac{3}{2}}/kg^{\frac{1}{2}}$) for CI. The prevalence of overweight or obesity was 46.1% to 54.1% in women and 49.5% to 53.6% in men based on various obesity indexes. The area under the ROC curves (AUCs) varied from 0.671(0.651–0.690) for CI to 0.718(0.700–0.736) for WC in men and from 0.668 (0.646–0.690) for BMI to 0.755(0.735–0.774) for WHR and CI in women.
Conclusion: Except for CI in men and BMI in women, other obesity indexes were good discriminator in the diagnosis of the MetS.

1. Introduction

Obesity is considered a great public health challenge in most societies, where it has reached to epidemic level in many countries [1,2]. Obesity related costs were estimated from 1% to 9% of total costs of healthcare in different countries [3,4]. A growing body of evidence supports the association between obesity and non-communicable diseases such as cardiovascular diseases and metabolic syndrome (MetS) [1,5,6] In this context, central obesity has been considered as a main component of MetS [6,7]. Although the body mass index is widely used to evaluate the obesity, it is considered an index of general body mass and no an index of central obesity [8]. Thus other convenient indices are usually used to measure the abdominal obesity, including waist circumference (WC), waist to hip ratio (WHR), waist to height ratio (WHtR) and even sometimes newer indices such as conicity index (CI) or abdominal volume index (AVI) [8–11]. However, there is not a general consensus about the best indices in the discrimination of individuals with MetS [8,12–15]. Thus we carried out the present study to determine the discriminatory ability of six, above mentioned, obesity indices in the diagnosis of MetS in addition to determine a gender based optimal cutoff point of them.

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2. Materials and methods

2.1. Participants

We used the related baseline data of a population based cohort study started in 2008 in Amol, one of the most populated cities of northern Iran. The cohort study was conducted among 6143 subjects aged 10–90 years. Primary healthcare centers were used to collect the data on the population where 25of them serving the rural population and 16 serving the urban population. Sampling was described elsewhere [16]. In the present study, the data of 5312 subjects aged 18–74 years were used to analyze. A schematic diagram of our participants was displayed in Fig. 1.

2.2. Data collection

The anthropometric characteristics, including weight, height, WC and hip circumference (HC) were directly measured by trained healthcare providers. WHR, WHtR, CI and AVI were calculated using the following formulas:

$$\mathrm{WHR} = \mathrm{WC}(cm)/\mathrm{height}(cm),$$

$$WHtR = WC(cm)/height(cm),$$

$$\mathrm{CI} = \mathrm{WC}(m)/0.109 \times \sqrt{weight(kg)/height(m)}$$

$$AVI = \left\{2 \times WC^2(cm^2) + 0.7 \times [WC(cm) - HC(cm)]^2\right\}/1000$$

Blood pressure was determined using a properly fitted cuff when the participants were in the sitting position after at least 5 min of rest. A venous blood sample was drawn from each participant following 10-h fasting to assess fasting blood sugar (FBS) and lipid profiles. Ten percent of the blood samples were re-checked by the Iranian National Reference Laboratory.

2.3. Statistical analysis

In the present study, outcome was defined the concurrent presence of at least two components of MetS, of course except for obesity. In fact, each participant with at least two conditions of a high blood pressure, TG, FBS, or a low HDL, was considered involvement in our outcome. The ability of obesity measures in the discrimination of the patients with our defined outcome was evaluated using ROC curves. To obtain the relevant curves and to calculate the related AUCs, the sensitivities of an infinite number of decision thresholds of obesity measures were plotted versus their false positive rates, separately. An AUC greater than 0.5 usually indicates some discriminatory abilities of the classification variable (obesity indices). The new cutoff points were suggested using maximal Youden index [sensitivity + specificity-1].

We converted the continuous values of each obesity measure to the dichotomous scales, based on their related optimal cutoff points. Thus we calculated the agreement values between obesity indices in the classification of obese people, using the κ statistics.

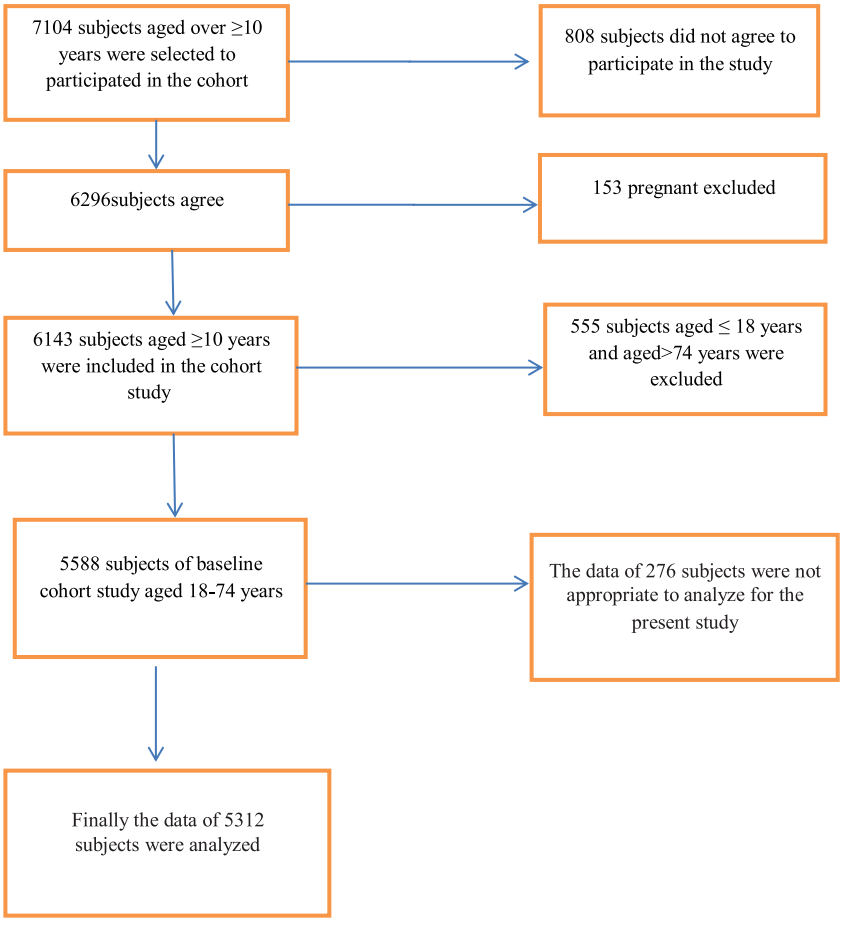

Fig. 1. A schematic diagram of participants.

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