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Comparison of abdominal obesity measures in predicting of 10-year cardiovascular risk in an Iranian adult population using ACC/AHA risk model: A population based cross sectional study

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ABSTRACT

Background: Several abdominal obesity measures have been used for prediction of 10-year cardiovascular disease (CVD) risk but the superiority of these measures remains controversial. The objective of this study was to assess the predictive ability of abdominal obesity measures for risk of CVD events in an Iranian adult population.

Methods: We analyzed the data of population based cross-section study of 567 representative samples of adult population aged 40–70 years in Babol, the north of Iran. The demographic data, the anthropometric measures, lipid profile and cardiometabolic risk factors were measured with standard methods. Waist to hip ratio (WHR), waist to height ratio (WHtR), conicity index(CI), abdominal volume index (AVI) and body mass index(BMI)were calculated. The individual 10-year CVD risk was estimated based on ACC/AHA model. ROC analysis was performed to assess the diagnostic ability of different abdominal obesity measures and body mass index (BMI) in predicting of high risk of CVD events.

Results: About 42.5% of men and 15% of women had at least 10% risk of 10-year cardiovascular events and 21.1% of men and 3.0% of women had ≥20% risk. Except WHR for men, all abdominal obesity measures significant predictors for ≥10% risk CVD risk in both sexes but not BMI. The greater ability of CVD risk prediction was observed by WHtR and CI in both sexes with higher AUC in females compared with men for ≥10% risk.

Conclusion: WHtR and CI are superior indexes in predicting of high risk of CVD events in both sexes.

1. Background

Obesity in particular abdominal obesity measures is the central component of metabolic syndrome [1] that has a major contribution in insulin resistance, type 2 diabetes, cardio vascular disease, stroke and cancer [2,3]. The worldwide epidemic of obesity has been progressively extending to both developed and developing countries(3)with high economic cost of the associated morbidities and induced disabilities [4,5] and it has a negative influence on health related quality of life [6]. Iranian population has been experience of epidemiologic transition state where the high prevalence of obesity and abdominal obesity has been reported in adult population in the recent decades [7] and simultaneously, the incidence of cardiovascular disease and its mortality has been increased dramatically [8,9]. An emerging high prevalence of obesity, abdominal obesity and metabolic syndrome has been demonstrated in Iranian adult population [7,10–12].

Cardiovascular diseases (CVD) remain the main cause of death in worldwide [13–15].Due to epidemiologic disease transition model in developing countries, the incidence and the death rate due to CVD has been increased significantly during two recent decades in developing counties [8,9,13]. In Islamic Republic of Iran, roughly 20% of total death was attributed to CVD death in decades of 1970’s; it was significantly elevated to ≥40% in recent decade [9]. Additionally, its incidence was toward increasing in younger adults under 50 years and the pattern of mean age distribution of its incidence became downward [8]. Thus, the knowledge of associated risk factors in screening for high risk individuals provides a basis for population mass or high risk strategy of interventional program. Population living in urban area in the north of Iran, located in the south of Caspian sea, has a rapid experience of life style transition in two recent decades and thus a high prevalence of obesity and abdominal obesity and metabolic syndrome have been reported in this population [7,12].

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Several CVD risk assessment tools have been developed that the 10-years CVD individual risk can be calculated with a given risk factor profiles [16–22]. Among various risk assessment models, American College of Cardiology/American Heart Association (ACC/AHA) is much more popular model that is based on Cox proportional hazard model [17]. The regression coefficients of risk factors and baseline risk were estimated according to sex specific and ethnicity. However, the components of obesity and abdominal obesity indexes were not included directly in this model but cardio metabolic risk factors such as total cholesterol, HDL, systolic blood pressure, treating or not blood pressure, being diabetes and current smoker and some interaction terms were built in the ACC/AHA risk model. A clear association has been established between obesity and abdominal obesity with cardio metabolic risk factors such as lipid profile and FBS and hypertension and thus metabolic syndrome [23]. The body mass index (BMI) as a measure of general adiposity and waist circumference (WC) as a simple measure of abdominal obesity are linked with CVD risk (24–27)whereas no single measure of abdominal obesity was defined but BMI does not account the visceral fat distribution. Although in definition of metabolic syndrome, BMI was used by World Health Organization (WHO) [28], WC by International Diabetes Federation (IDF), National Cholesterol Education Program(NCEP) Adult Treatment Panel III (ATP III) (29) and American Heart Association (AHA)/National Heart, Lung and Blood Institute (30) and Iranian National committee of obesity (INCO) as well but with different cutoff values [31].Several measures of abdominal obesity such as waist to hip ratio(WHR), waist to height ratio (WHtR) and two recent developed measures, conicity index (CI) and abdominal volume index (AVI) have been suggested [1–34].Among these indexes, WC as a simple measure is a greater interesting for assessment of MetS. The choice of abdominal obesity measures, particularly their optimal cut off values depends on sex, age and ethnicity. Therefore, the superiority of these measures and their optimal cutoff value in predicting cardiovascular risk remains controversial. Despite the high prevalence of general adiposity and abdominal obesity in urban population in the north of Iran among aged 40–70 years, the data of 10-year CVD risk and the superiority of abdominal obesity indexes are sparse. Thus, the objective of this study was to compares the predictive ability of different abdominal obesity measures, BMI and to determine their optimal cutoff values in predicting 10-year cardiovascular risk in Iranian adult population.

2. Methods

2.1. Study design and subjects

We reanalyzed the data of population based cross sectional study of Babol Lipid and Glucose study that primary focused on cardio metabolic risk factors. This study recruited a representative sample of 1000 subjects aged 20–70 years in Babol urban community, in the north of Iran in 2012. The individual samples were dawn randomly using two stage cluster sampling techniques in a family health survey. The description of sampling procedure and recruitment criteria were explained in details elsewhere [12]. In brief, the population under coverage of urban health centers in Babol composed of several urban parochial that we called as clusters. Twenty five clusters were taken randomly using cumulative population size under coverage of different health centers with a systematic sampling method. Then, the center of each cluster was determined and within each cluster 40 subjects (men and women) age 20–70 years were selected in the study. Since ACC/AHA risk model was established for subjects with aged 40 years or older without history of CVA events, thus in present study, a subset of data of 565 subjects with aged 40–70 years in both genders who had not previous history heart attack, myocardial infarction, stroke and any CVA events were extracted for analysis and the pregnant women were excluded. All participants had given a written consent for participation into the study. The study protocol had been approved by Ethical counsel of Babol university of medical sciences.

2.2. Measurements and data collection

The demographic and life style data, history of treating hypertension and diabetes was collected using a design questionnaire by interview. The weight and height were measured to nearest 0.1 kg and 0.1 cm using a digital portable scale and a portable stadiometer respectively by trained staff with standard method, light clothes and without shoes. The body mass index (BMI) was calculated as weight in kg divided by square of height in m^2. The WC was determined at level of midpoint between the lowest coastal ridge and the upper border of the iliac crest while participants keep their breathing and hip circumference (HC) was measured at the largest circumference between waist and knee. Both WC and HC were measured using a non-stretchable type meter with precision of 0.1 cm. The WHtR was calculated as the ratio of WC (cm) to height (cm) and WHR was determined as the ratio of waist (cm) to hip circumference (cm). Also, the two other more recent indexes, conicity index (CI) and abdominal volume index (AVI) was calculated based on weight, height, waist and hip as follows

$$CI = \frac{waist\ (m)}{0.109 \times \sqrt{\frac{weight\ (kg)}{height\ (m)}}},$$

$$AVI = \{2 \times wiast2\ (cm)^2 + 0.7 \times \left[waist(cm) - hip(cm)^2\right]\}/1000$$

Systolic and diastolic blood pressures (SBP, DBP) were also measured by trained staff two times consecutively in an interval of 10 min rest where the subjects were in sitting position using a digital psygmonameter (Model BP101 A named Dr. Axon, made in China). The cuff was placed on over meddle of right arm at head level. The average of two measures of blood pressure was taken in analysis. The reliability of anthropometric and blood pressures measures were assessed in a pilot study with repeated measures on the same subjects using a statistic of coefficient of variation the almost produced less than 1% and 3% for anthropometric and blood pressure measures respectively. All participants were invited to go overnight fasting to 10–12 h they were referred to central lab of Ayatollah Rohani hospital, affiliated to Babol university of medical sciences. A venous blood sample was taken from all participants at sitting position in the morning according to standard protocol for measuring fasting blood sugar (FBS) and lipid profiles. It was immediately centrifuged and transferred under cold chain conditions. Total cholesterol, high density lipoprotein (HDL) cholesterol, low density lipoprotein (LDL) cholesterol and triglyceride and fasting blood sugar (FBS) were measured by auto analyzer using enzymatic method. Subjects with FBS > 126 and/or treating for lower blood sugar were classified as diabetes.

2.3. Statistical analysis

We used SPSS software for data analysis using receiver operator characteristic (ROC) curve analysis. First, the 10-years CVD risk (first severe atherosclerotic cardiovascular disease (ASCVD) event, including coronary heart diseases (CHD), death, fatal myocardial infarction and nonfatal or nonfatal stroke) was calculated at individual level for each participant using Cox proportional hazard model based on the coefficients of ACC/ AHA models and its baseline risk [17]. Since the original ethnicity of our population is

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