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Research Article

Optimal Cutoffs of Cardiometabolic Risk for Postmenopausal Korean Women

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SUMMARY

Purpose: The purpose of the study was to identify the optimal cutoff values of indices for cardiometabolic risk in postmenopausal Korean women. Specifically, we intended to determine the cutoffs of waist circumference, waist-to-hip ratio (WHR), serum lipid profile, and homeostatic model of assessment-insulin resistance (HOMA-IR) for detecting metabolic syndrome (MetS), and metabolic obesity (MO).
Methods: The study participants were 397 postmenopausal women. We defined MetS and MO with the International Diabetes Federation criteria except for waist circumference. A receive operating characteristic curve analysis was used to assess the accuracy of diagnostic indices for identifying MetS and MO. Cutoff values were obtained both from the point on the receive operating characteristic curve which was closest to (0,1) and from the Youden's index.
Results: Among the participants, 34.5% and 73% were classified as having MetS and MO. The optimal cutoff of waist circumference and WHR were 81.9 cm [area under curve (AUC): 0.687, sensitivity: 61.7%, specificity: 68.9%], 0.87 (AUC: 0.660, sensitivity: 64.7%, Specificity: 60.2%) for MetS and 77.4 cm (AUC: 0.655, sensitivity: 65.6%, specificity: 57.8%), 0.86 (AUC: 0.680, sensitivity: 67.0%, specificity: 62.7%) for MO. Triglyceride to high-density lipoprotein ratio for MetS and MO were 2.11 (AUC: 0.838, sensitivity: 71.5%, specificity: 79.6%) and 1.59 (AUC: 0.725, sensitivity: 65.9%, specificity: 68.2%) respectively. The HOMA-IR for MetS was 1.36 (AUC: 0.773, sensitivity: 73%, specificity: 71.9%) and for MO was 1.17 (AUC: 0.713, sensitivity: 64.5%, specificity: 69.2%).
Conclusions: For postmenopausal women, we suggest waist circumference of 81.9 cm and WHR of 0.87 as criteria of MetS. However, women with waist circumference over 77.4 cm and WHR over 0.86 should be monitored for the future development of MetS.

Introduction

Obesity, an increasing problem worldwide, is related to the risk of cardiovascular disease, diabetes mellitus, hypertension, metabolic syndrome and several types of cancer [1–3]. In particular, people with central obesity, an excessive deposit of fat in the abdomen is at high risk of health problems than people with any other types of obesity due to a functional abnormality of adipose tissues and accumulations of triglycerides (TG) [4,5]. Central obesity is considered the leading factor of cardiometabolic risk [5]. Cardiometabolic risk has increased the incidence of cardiovascular disease and mortality rate due to the combined action of abdominal obesity, impaired fasting glucose, dyslipidemia, and elevated blood pressure [6]. Central obesity can be detected directly and indirectly. Computed tomography scan, magnetic resonance imaging, and dual-energy X-ray absorptiometry detect central obesity directly. Even though these methods can detect visceral fats precisely, the costs are quite expensive. Waist circumference or waist-to-hip ratio (WHR) is a convenient indicator of central obesity; however, there is a limit in distinctions between visceral fats and subcutaneous fats.

Waist circumference, the most widely used indices of central obesity is one of the diagnostic criteria for metabolic syndrome. The European Group for the Study of Insulin Resistance defined central obesity as more than 94 cm of waist circumference in male, and more than 80 cm of waist circumference in female [7]. The National Cholesterol Education Program Adult Treatment Panel III defined it as more than 102 cm in male, and more than 88 cm in the female.

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However, in the case of Asians, they presented lower criteria, which are 90 cm in male, 80 cm in female [8]. The criteria of the International Diabetes Federation (IDF) are the same as those of the European Group for the Study of Insulin Resistance (94 cm in male, 80 cm in female), and those of the National Cholesterol Education Program Adult Treatment Panel III (90 cm in male, 80 cm in female) in the Asian group [9]. The Korean Society for the Study of Obesity presented the Korean specific criteria as more than 90 cm in male, and 85 cm in female by the Korean National Health and Nutrition Examination Survey 1998 [10]. However, there are arguments that these criteria are inadequate to identify the cardiometabolic risk [11,12]. In the case of a female, menopausal status, and age, influencing factors on the cardiometabolic risk should be considered in determining central obesity with waist circumference [13,14].

There is a high probability of central obesity in postmenopausal women on account of redistribution of adipose tissues and deficiency of estrogen [15]. Thus, it is important to set the optimal cutoff of waist circumference or WHR for identifying central obesity to predict and to manage the metabolic syndrome or metabolic obesity in postmenopausal women. The prevalence of metabolic syndrome in postmenopausal women is increasing with age, ranging from 19.6% in the 50s to 30.6% in the 60s [16]. Metabolic obesity is the state of increased cardiometabolic risk in consideration of endocrinal function and metabolism independent of external obesity [17]. Metabolic obesity is not a matter of the amount of body fat, but a matter of areas with lipid accumulation, which is distinct from typical obesity; it usually has an association with the increase of visceral adiposity [18].

Moreover, even though serum lipid ratio and the homeostatic model of assessment-insulin resistance (HOMA-IR) are cardiometabolic risks [19–21]. To the best of our knowledge, no studies tried to determine postmenopausal women specific cutoff values of these indices.

The purpose of this study was to identify the optimal cutoff values of various cardiometabolic risk factors in postmenopausal women in South Korea. Specifically, we intended to identify the cutoffs of waist circumference, WHR, serum lipid ratio, and HOMA-IR for detecting metabolic syndrome and metabolic obesity.

Methods

Study design

This is a cross-sectional study of 397 postmenopausal women.

Setting and participants

The participants of the study were the postmenopausal women in their fifties and sixties who helped with hospital chores as volunteers at the Catholic University of Korea St. Mary's hospital in Seoul and St. Vincent's Hospital in Suwon. The study period was from May 2012 to April 2015.

The researchers explained the purpose of the study to 800 volunteers, using volunteer meetings or by telephone. Of these, 485 agreed to participate in the study, and 397 volunteers met the study criteria. Inclusion criteria for the study were as follows: (a) at least 1 year has passed since the last menstruation; (b) those who were not under hormonal treatments; (c) absence of psychiatric problems; and (d) no history of strokes, acute myocardial infarctions, or malignant tumors. A total of 397 women participated in the study.

Ethical consideration

The Catholic University Institutional Review Board approved the content and methods of the study (MC15EISE0094). The study participants understood the purpose of the study, participated voluntarily and knew that they could withdraw their participation at any time according to the informed consent. In addition, the data used for the analysis were encrypted so that the direct personal identity could not be confirmed.

Data collection

For blood sampling, the participants fasted from 12 pm on the night before the hospital visit to 8 or 8:30 am the next day. On the day of the visit, they wrote consent to participate in the study. After the consent, the researchers carried out the examination in the order of waist circumference, hip circumference, blood pressure, and blood test.

A tape measure, marked with units of 0.1 cm, was used to measure waist circumference (Hoechst, Germany). Participant stood straight with both feet together and both arms relaxed by their side; after finding the lower edge of the participant's last rib on their side and the upper edge of their iliac crest, the waist circumference was measured horizontally between these two points. At this time, the participant wore a single layer of light clothing on top and was made to exhale gently. Hip circumference was measured horizontally in a standing position by putting the participant's feet apart and arms at their chest using the same tape measure at the most prominent area of the buttock when seen sideways. Waist-to-hip ratio was calculated as waist circumference (cm) to hip circumference (cm).

Blood pressure was measured three times from the right arm at 5-minute intervals using an automated blood pressure monitor (TM 2655P; A&D, Japan) in a seated position, after resting for at least 5 minutes. The present study defined blood pressure as the mean of the second and third measurements.

A venous blood sample of 4 mL was collected following 8 hours of fasting. For measurement, the enzymatic method (Modular DDP, Roche, Germany) for lipid profile, the glucose oxidase (HITACHI 7600, Roche, Germany) method for fasting blood glucose, and the chemiluminescent microparticle immunoassay (Architect I4000SR, Architect insulin, Abbott, USA) for fasting insulin were applied.

The Friedewald equation, a commonly used method, was used to calculate the low-density lipoprotein cholesterol (LDL). Moreover, a recent study of metabolic syndrome patients proved its usability [22]. The Friedewald equation is as follows: LDL (mg/dL) = Total cholesterol (TC) − High-density lipoprotein cholesterol (HDL) − (TG/5).

HOMA-IR, index for insulin resistance was calculated using following equation: HOMA-IR = [glucose (mg/dL) × insulin (μU/mL)] ÷ 405 [21].

Definitions for the study

Postmenopausal women

The present study defined postmenopausal women as females in whom the last menstruation ceased at least a year ago [16].

Metabolic syndrome

The present study defined metabolic syndrome as the presence of any two of the IDF criteria except central obesity to determine the optimal cutoff value of the cardiometabolic risk including waist circumference [10]. IDF criteria were as follows: TG $\geq$ 150 mg/dL, or specific treatment for this lipid abnormality; HDL < 40 mg/dL in males, HDL < 50 mg/dL in females, or specific treatment for this lipid abnormality; systolic blood pressure (BP) $\geq$ 130 mmHg or diastolic BP $\geq$ 85 mmHg, or treatment of previously diagnosed hypertension; fasting serum glucose: $\geq$ 100 mg/dL, or previously diagnosed type 2 diabetes.