Optimal cut-off point of waist circumference for the diagnosis of metabolic syndrome in Japanese subjects

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ABSTRACT

Metabolic syndrome (MetS) has been redefined by a new criterion in Japan, in which waist circumference cut-off points, that is 85 cm for men and 90 cm for women, are used; however, objections are rising against this criterion. The present study examined the criterion for waist circumference to predict the accumulation of the components of MetS. In the present study, we used data for 5972 Japanese people who received annual health examinations, and 621 men (16.3%) and 51 women (2.4%) were diagnosed as having MetS. A cut-off point as a predictor for two or more components of MetS was evaluated by the sensitivity/specificity and a receiver operating characteristic analysis. The optimal point of waist circumference was estimated as being approximately 84 cm for men and 80 cm for women. We therefore recommend revising the cut-off value for the criterion of MetS in women according to our results and studies from other investigators. (J Diabetes Invest, doi: 10.1111/j.2040-1124.2010.00020.x, 2010)

INTRODUCTION

Metabolic syndrome (MetS), which is defined by multiple risk factors, including central obesity, high blood pressure, dyslipidemia, and high fasting blood glucose; and persons with MetS have an elevated risk of developing cardiovascular disease (CVD), which is correlated with all-cause mortality[1]. Because the morbidity and mortality of CVD is rapidly increasing worldwide[2], establishing appropriate screening for MetS is essential to prevent the initiation and progression of CVD.

To date, internationally recognized definitions of MetS have been released, namely the criteria of the World Health Organization (WHO)[3], the National Cholesterol Education Program's Adult Treatment Panel III (NCEP-ATP III)[4], and the International Diabetes Federation (IDF)[5]. In Japan, a criterion for MetS has been defined as the presence of central obesity (85 cm for men and 90 cm for women) plus any two of the following three factors; (i) dyslipidemia; (ii) high blood pressure; and (iii) impaired fasting glucose[6]. In contrast, the IDF recommended cut-off levels of 90 cm for men and 80 cm for women for central obesity in Asian individuals[5]. There has been controversy as to which of these cut-off points of waist circumference is better for diagnosing central obesity in Japanese men and women. The aim of the present article is to re-evaluate the waist circumference for detecting the risk factor accumulation of MetS in Japanese subjects.

SUBJECTS AND METHODS

The total number of participants in the present study was 5972 (3811 men and 2161 women), aged 20–79 years, who received annual health examinations at Okayama Red Cross General Hospital with informed consent. We measured waist circumference at the umbilical level. MetS was defined among men and women as waist circumferences in excess of 85 cm and 90 cm[6], respectively, in addition to having two or more of the following components: (i) dyslipidemia: triglycerides $\geq$ 150 mg/dL and/or HDL cholesterol <40 mg/dL; (ii) high blood pressure: blood pressure $\geq$ 130/85 mmHg; and (iii) impaired fasting glucose: fasting plasma glucose $\geq$ 110 mg/dL[6]. If an individual was receiving drug therapy for hypertriglyceridemia, low HDL cholesterol, high blood pressure or diabetes mellitus, each item was recorded as a positive finding regardless of the data. To identify the optimal cut-off point of waist circumference as a predictor of the presence of at least two components comprising the MetS, we carried out receiver operating characteristic (ROC) analysis. The statistical software SPSS for Windows (version 8.0; SPSS, Chicago, IL, USA) was used for the analysis.

RESULTS

The mean age of the study subjects was 49.9 ± 10.1 years for men and 48.6 ± 9.4 years for women. Among the 5972 Japanese subjects, 1744 men (45.8%) had a waist circumference in excess of 85 cm and 216 women (10.0%) had a waist circumference

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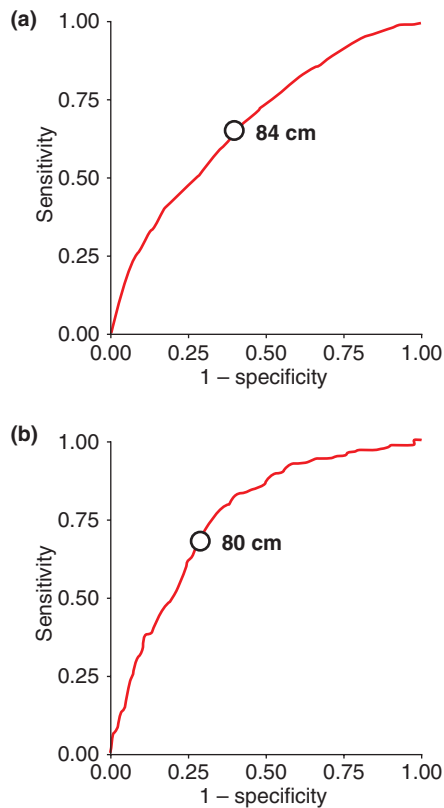
Figure 1 | Receiver operating characteristic (ROC) curve of waist circumference for detecting two or more risk factors of the metabolic syndrome in (a) men and (b) women. O, Cut-off waist circumference yielding the maximal sensitivity plus specificity for predicting the presence of multiple risk factors.

exceeding 90 cm. In addition, the prevalence of MetS according to the Japanese diagnostic criteria was 621 (16.3%) for men and 51 (2.4%) for women.

We investigated the sensitivity and specificity of waist circumference in predicting the association with two or more metabolic risk factors; that is dyslipidemia, high blood pressure and impaired fasting glucose. In men, the sensitivity and specificity of the waist circumference criterion, that is 85 cm, were 64.2% and 60.2%, respectively. However, in women, the sensitivity and specificity of waist circumference criterion, that is 90 cm, were found to be 29.3% and 91.5%, respectively. A cut-off point as a predictor for two or more components of MetS was evaluated by sensitivity/specificity curves, as well as a ROC curve. The optimal point yielding the maximal sensitivity plus specificity for predicting two or more risk factors was estimated to be approximately 84 cm (sensitivity: 66.3%, specificity: 59.4%) of waist circumference for men and 80 cm (sensitivity: 69.0%, specificity: 65.4%) for women (Figure 1). Based on these findings, 1966 men (51.6%) and 718 women (33.2%) had a waist circumference exceeding 84 cm and 80 cm, respectively. In addition, 675 men (17.7%) and 119 women (5.5%) were diagnosed as having MetS by using

84 cm for men and 80 cm for women as the waist circumference criterion.

DISCUSSION

The IDF has used a waist circumference cut-off value of 90 cm for men and 80 cm for women as its diagnostic criteria of MetS for Asians[5]. In contrast, the waist circumference cut-off value for Japanese was 85 cm for men and 90 cm for women, which correspond to 100 cm^2 of intraperitoneal visceral fat in a cross-section at the height of the navel as shown by computed tomography (CT) both for men and women[6]. To address this controversial point, we re-evaluated the cut-off points of waist circumference for the diagnosis of MetS using ROC analysis. We proposed that the optimal cut-off points are 84 cm for men and 80 cm for women for predicting the clustering of the components of MetS. In men, the criterion of waist circumference deduced from the present study was matched to that of the criterion of MetS in Japan. However, in women, the cut-off value of waist circumference in the present study was lower than that of the criterion.

The first report that estimated the waist circumference cut-off value for diagnosis of MetS in Japan was a study of 3574 employees of a telephone company and their family members (2947 men and 627 women). It estimated the optimal cut-off value for the intraperitoneal visceral fat area at the height of the navel, as determined by CT, to be 100 cm^2 for men and 65 cm^2 for women. Based on these findings, the corresponding cut-off value for waist circumference is 86 cm for men and 77 cm for women[7]. Hara *et al.* also calculated the optimal cut-off point of waist circumference among 692 healthy subjects (408 men and 284 women). and the value of 85 cm for men and 78 cm for women yielded the maximal sensitivity plus specificity for predicting the presence of multiple risk factors[8]. Other studies also reported that the optimal cut-off point for men ranges from approximately 85 to 90 cm; however, in women it ranges from 77 to 83 cm, approximately 80 cm overall (Table 1)[9–15].

Table 1 | Reports on optimal cutoff point of waist circumference for the diagnosis of metabolic syndrome in Japan

Author (reference number)	No. subjects	Cut-off point for men (cm)	Cut-off point for women (cm)
Miyawaki T *et al.*[7]	3574	86	77
Hara K *et al.*[8]	692	85	78
Miyatake N *et al.*[9]	3185	85	80
Nishimura R *et al.*[10]	2113	85	81
Eguchi M *et al.*[11]	420	83	78
Narisawa S *et al.*[12]	12,725	87	83
Oka R *et al.*[13]	1870	89	82
Sato A *et al.*[14]	395	87	80
Doi Y *et al.*[15]	2452	90	80
Present study	5972	84	80

Table 2 | Reports on optimal cut-off point of waist circumference for the diagnosis of metabolic syndrome in Asian countries

Country (reference number)	No. subjects	Cut-off point for men (cm)	Cut-off point for women (cm)
Singapore[16]	4723	90	80
India[17]	640	90	80
Korea[18]	6561	85	80
China[19]	1140	90	85
Korea[20]	31,076	83	76
Korea[21]	4677	84–86	78–80

The cut-off points of waist circumference for MetS suggested by the NCEP-ATP III (102 cm for men and 88 cm for women) are accepted in Western countries and there are no studies that consider whether the optimal cut-off value should be revised. In contrast, several studies that were carried out in Asian countries show that the cut-off values should be lower than those of the NCEP-ATP III (Table 2)[16–21]. Although the cut-off values are defined by the IDF for Asian populations as 90 cm for men and 80 cm for women, several studies from Korea[18,20,21] and China[19] suggest that the optimal cut-off points are different from those of the IDF. Taking these findings together with those of the studies from Japan (Table 1) and Asian countries (Table 2), ethnic differences are likely to exist between populations across Asia, and the criteria for defining MetS in Japan needs to be revised.

The present study has potential limitations. First, the subjects enrolled in our study chose to undergo annual health examinations; they were therefore more health-conscious than average, which might have caused some bias in the current study. Second, the cross-sectional study design makes it difficult to infer causality between waist circumference and metabolic risk factors. Finally, it is still controversial whether or not the waist circumference cut-off values of MetS are significant predictors of cardiovascular events. McNeil *et al.* assessed the association between MetS, using the NCEP III definition, and CVD with an 11-year follow-up period, and they reported that waist circumference is not a significant predictor for CVD[22]. Therefore, our findings are not fully applicable to clinical and public health practice settings. Further studies are needed to prospectively relate the accumulation of visceral fat to the presence of risk factors of CVD.

In conclusion, although follow-up studies are required to prove the feasibility of the definition of MetS to predict the development of CVD, the cut-off value of waist circumference as a criterion for MetS in Japan should be 80 cm for women based on the present results and a review of the literature.

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