Original Article

Waist circumference cutoff and its importance for diagnosis of metabolic syndrome in Asian Indians: A preliminary study

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ABSTRACT

Background: There is inconsistency in accepting waist circumference (WC) as mandatory and also regarding its significance for diagnosis of metabolic syndrome (MetS) for different populations. **Aim:** To study the association of individual parameters of MetS with WC cutoffs suitable for South Asian Indians. **Materials and Methods:** From an ongoing hospital-based study on MetS as per the criteria of diagnosis of modified NCEP ATP III, 713 subjects having a minimum three of the four parameters, i.e., dyslipidemia [low high density lipoprotein (HDL), high triglycerides], dysglycemia and hypertension, without regard to cutoffs of WC, were included in the present study. **Results:** Receiver operator characteristic curve analysis of WC cut-off points for males was 90 cm with a sensitivity and specificity of 71% and 96%, respectively, and for females was 85 cm with a sensitivity and specificity of 86% and 93%, respectively, associated with the risk factors of MetS. Multiple logistic regression analysis for low density lipoprotein (LDL) cholesterol concentration of ≥ 3.38 mmol/l showed an odds ratio of 5.03 (95% CI = 1.29–19.5) in males and 3.17 (95% CI = 1.14–8.76) in females which was statistically significant ($P < 0.02$); in addition to higher WC, higher level of triglyceride ($P \leq 0.0001$) and lower level of high density lipoprotein cholesterol ($P \leq 0.02$) were observed. **Conclusion:** This study suggests that WC of 90 cm in males and 85 cm in females should be a mandatory criterion of MetS in our subset of population. LDL may be considered one of the components of MetS along with the currently defined WC cutoffs.

Key words: Asian Indians, low density lipoprotein cholesterol, metabolic syndrome, receiver operator characteristic curve, waist circumference

INTRODUCTION

Subjects with the metabolic syndrome (MetS) have increased risk of development of type 2 diabetes and cardiovascular diseases.[1,2] Various studies suggest abdominal obesity[3,4] and insulin resistance,[5] which are components of this syndrome, as interdependent risk factors for cardiovascular disease (CVD). Subsequent studies on the other components of the MetS showed hypertension, hypertriglyceridemia and low high density lipoprotein (HDL) cholesterol to be independent risk factors for CVD.[6] At present, there are three internationally recognized and most popular definitions of the MetS, namely, those of the World Health Organization (WHO),[7] the National Cholesterol Education Program's Adult Treatment Panel III (NCEP ATP III)[6] and the International Diabetes Federation (IDF).[1] The definition for MetS according to IDF[1] has abdominal obesity as its pre-requisite with ethnicity-specific cut-off values for waist circumference (WC) and that relates to a major difference between IDF[1] and NCEP ATP III[2,6] defined MetS criteria. The IDF has strongly recommended that more extensive investigations should be performed before suitable cut-off levels are established for use in clinical practice.[8] The Indian consensus[9,10] recommends a

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new cutoff of WC but not mandatory for the diagnosis of MetS, similar to modified NCEP ATP III[6,11,12] definition of MetS. In a recent publication, experts associated with IDF have upheld their views that WC might not be mandatory criteria of MetS.[8] We designed the current study to make a cutoff of WC value and its status as mandatory for the diagnosis of MetS in our subset of population.

MATERIALS AND METHODS

The study was approved by the institutional ethics committee. Study subjects included patients and their first-degree relatives visiting endocrine out-patient clinic of the university hospital, located in the northeastern part of India. All individuals enrolled were ≥20 years of age. All participants enrolled were recruited from an ongoing hospital-based study. Detailed clinical data of the participants, including age, sex, anthropometry, family history, duration of complications like diabetes, hypertension, dyslipidemia, previously prescribed drugs for therapy, were noted on a preset proforma. Individuals with the habit of smoking, alcohol consumption, tobacco chewing were excluded from the study. Informed consent was obtained from all the participants. WC was measured as the midpoint between lowest rib and iliac crest in the standing position at the end of a gentle expiration. Mean of two blood pressure (BP) readings taken 5 min apart in resting state was used. An oral glucose tolerance test (OGTT) was done to determine the glycemic status as normal glucose tolerant (NGT), prediabetic (IFG and IGT) and diabetic by the WHO criteria.[7] MetS was screened for dyslipidemia as (a) fasting triglycerides (TG) ≥ 150 mg/dl; (b) HDL < 40 mg/dl in males and <50 mg/dl in females; and (c) hypertension ≥ 130/85 mmHg, and for dysglycemia as fasting plasma glucose (FPG) ≥ 100 mg/dl (5.6 mmol/l) or previously diagnosed diabetes or on specific treatment for the respective abnormality without regard to cutoff of WC. Blood samples were collected after 10 hours of fasting, but before 11 AM for the estimation of plasma glucose, total cholesterol, TG and HDL. Low density lipoprotein (LDL) cholesterol (Freidewald's method) and very low density lipoprotein (VLDL) cholesterol were calculated.[13]

Statistical analysis

Receiver operator characteristic curves were plotted for WC using sensitivity and 1 -specificity to identify the presence of any two out of four above-mentioned CVD risk factor components of MetS definition. Logistic regression analysis was done to associate the variables with factors of MetS. Data were analyzed using SPSS 15.0 (SPSS, Chicago, IL, USA).

RESULTS AND DISCUSSION

A total of 713 subjects (349 males and 364 females)

as per the criteria given in the section "Materials and Methods" were selected from an ongoing hospital-based study, with the mean age of the subjects being 42.5 ± 11.3 (±SD) years. Based on OGTT, 58.6% were found to be NGT, prediabetics, i.e., those with IFG and IGT formed 20.3% and 18.6%, respectively, while 42.3% of the study subjects were found to be diabetic. Low HDL was found in 37.5% and 41% males and females, respectively; raised triglycerides was found in 34.9% and 19.2% males and females, respectively; hypertension was found in 42.6% and 33.4% males and females, respectively; body mass index (BMI) of ≥25 kg/m² was observed in 40.4% and 67.4% males and females, respectively. Demographic and biochemical profile of the enrolled subjects have been shown in Table 1.

In the receiver operator characteristic (ROC) curve analysis [Figure 1], the most predictive cut-off point for WC was

Table 1: Demographic and biochemical parameters of the enrolled subjects			
	Males **(*n* = 349)**	**Females** **(*n* = 364)**	**Total** **(*N* = 713)**
Age (years)	46.1 ± 11.6	39.3 ± 10.2	42.5 ± 11.35
BMI (kg/m²)	27.3 ± 4.4	30.1 ± 5.4	29 ± 5.1
SBP (mmHg)	132.7 ± 16.2	137.4 ± 17.7	135.2 ± 17.13
DBP (mmHg)	88.6 ± 10	88.2 ± 8.4	88 ± 9.13
WC (cm)	95.6 ± 11	94.3 ± 9.1	95 ± 10
FPG (mg/dl)	128.9 ± 59.5	120.5 ± 55.7	124.2 ± 57.4
2h-PG (mg/dl)	211.6 ± 105.1	172.5 ± 84.1	190.4 ± 96
Cholesterol (mg/dl)	174.6 ± 37	179.5 ± 41	177.2 ± 39.1
TGL (mg/dl)	164.6 ± 66.1	177.1 ± 69.5	171.3 ± 68
HDL-c (mg/dl)	36.8 ± 11.4	40 ± 11	38.5 ± 11.3
LDL-c (mg/dl)	106.1 ± 36	105.2 ± 36.9	105.5 ± 36.3
VLDL-c (mg/dl)	33.2 ± 13	35.4 ± 13.9	34.4 ± 13.4

BMI: Body mass index, SBP/DBP: Systolic/Diastolic blood pressure, WC: Waist circumference, FPG: Fasting plasma glucose, TGL: Triglyceride, HDL-c: High density lipoprotein-c, LDL-c: Low density lipoprotein-c, VLDL-c: Very low density lipoprotein
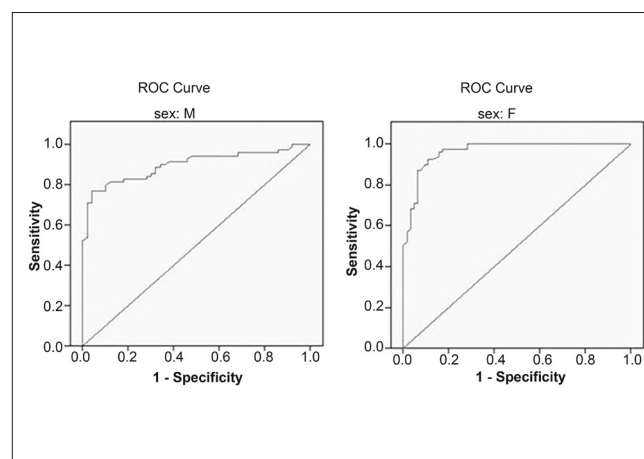
Figure 1: Receiver operator characteristic curve for determination of waist circumference cutoffs in males and females

90 cm for males (71% sensitivity, 96% specificity) while it was 85 cm (86% sensitivity, 93% specificity) for females. A cut-off value of 87 cm in males showed 89% and 66% sensitivity and specificity, respectively, while 83 cm cut-off value in females showed 89% and 90% sensitivity and specificity, respectively, for various parameters of MetS. Multiple logistic regression analysis showed lower level of HDL with an odds ratio (OR) of 2.58 (95% CI = 1.2–5.52; $P \leq 0.02$) in males and higher WC had an OR of 4.16 (95% CI = 2.95–5.85; $P \leq 0.0001$) in females. The remaining parameters showed a similar and significant ($P \leq 0.0001$) pattern of OR in both males and females.

CONCLUSION

Based on the ROC analysis of this study, it is suggested that WC >90 cm in males and >85 cm in females should be a mandatory criterion in making the diagnosis of MetS. Our study showed that the WC cut-off value for men and women should have a minimal difference of 5 cm. Additionally, using these cutoffs, LDL (calculated) level ≥2.6 to ≤3.38 mmol/l has an OR of 1.73 (95% CI = 0.78–3.84) in males and 1.75 (95% CI = 0.76–4.03) in females. Although LDL is not a parameter of MetS according to any of the present definitions, it showed a high OR of 5.03 (95% CI = 1.29–19.5; $P \leq 0.02$) in males and 3.17 (95% CI = 1.14–8.76; $P < 0.02$) in females when the value was ≥130 mg/dl. To our knowledge, the present study of determining WC cut-off values for MetS is the first of its kind considering LDL as one of the determinants of MetS. There is only one caveat to this fact that the LDL was calculated (Friedewald's formula) and not directly measured. We also suggest that LDL (estimated) may be considered as a part of MetS if other parameters are not met in an individual with higher WC cutoff.

There are a few limitations in this pilot study. Measurement of fat distribution in peripheral or visceral region was not performed using Dual energy X-ray absorptiometry (DEXA) or subcutaneous skin fold thickness. This measurement would have given additional information indicating a stronger relation between WC and biochemical profile. A follow-up study considering changes in biochemical profile of MetS in study subjects in relation to WC changes is also proposed in our opinion to substantiate the present observation. Even though these were not possible in this pilot study, the statistical outcome of ORs by multiple logistic regression analysis as well as WC cutoff by ROC curve suggested the importance of WC cut-off value to be redefined. In a very recent publication, the ethnic-specific WC has been suggested to be 83–84 cm in males and females for diagnosis of MetS based on the ROC analysis of the Japanese population.[14]

In conclusion, our study emphasizes WC as an obligatory diagnostic criterion for South Asian Indians, like IDF but not as modified NCEP ATP III definition for MetS. Nevertheless, further population-based studies taking large sample size are required to prepare a more ethnic-specific definition of MetS.

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