Prevalence of metabolic syndrome, its continuous severity score, and correlated cardiovascular risk among postmenopausal women of a rural area of Bangladesh

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ABSTRACT

Background: Our primary objective was to estimate the prevalence of metabolic syndrome (MetS) among postmenopausal women (PMW) and evaluate the correlation of its severity score with the risk of cardiovascular diseases (CVD). In addition, we compared the distribution of CVD risk and risk factors among PMW with or without MetS.

Methods: We recruited 265 PMW of 40–70 years of age from February to December 2016 who had no CVD. The MetS was defined according to modified Adult Treatment Panel III criteria and MetS severity score was constructed using a standardized Z score. CVD risk was assessed using the lab-based Globorisk score.

Results: About 35.1% of the PMW had MetS. The proportion of central obesity, generalized obesity, physical inactivity, diabetes, and hypertension were higher among those with MetS than those without. A highly significant CVD risk score difference ($P<0.001$) was observed between the subjects with or without MetS. Similarly, CVD risk showed a significant linear correlation ($P<0.001$) with the MetS severity score, which was adjusted for several confounders.

Conclusion: One-third of PMW in a selected rural area of Bangladesh had MetS and its severity score showed a significant correlation with CVD risk. A large-scale study is warranted to confirm the current findings with more precision.

Keywords: metabolic syndrome, postmenopausal women, cardiovascular disease risk, Bangladesh

INTRODUCTION

Globally, more than a billion people are now affected by metabolic syndrome (MetS) irrespective of the applied definitions.[1] In Bangladesh, the weighted mean prevalence of MetS was 8.6% (WHO), 24.4% (ATP III) and 11.2% (IDF).[2] These definitions of MetS vary based on several criteria that are not uniform and are considered a dichotomous result (presence/absence).[3, 4] However, the use of dichotomous definition for MetS has several limitations: (i) not coincide with the risk spectrum of MetS which increases progressively (ii) statistically less sensitive and more error-prone (iii) unable to follow up on the chronic changes that occur in individuals with MetS once the therapeutic interventions are in place.[3-5] Considering all of these critiques, a recent joint statement by the American Diabetes Association and the European Association for the Study of Diabetes recommended that one area of necessary research was the definition of the MetS based on continuous variables in a multivariate score system.[6] Hence, we primarily aimed to estimate the prevalence of MetS among postmenopausal women (PMW), statistically develop a continuous severity score, and examine the correlation between the severity score and the risk of cardiovascular diseases (CVD). Besides, we evaluated the difference in CVD risk and risk factors among the subjects who had MetS and who did not.

METHODS

Study design and sample recruitment

This was a cross-sectional study that conveniently recruited 265 PMW from a rural primary health care center from February to December 2016 (Karamtola Christian Hospital) situated in the village Karamtola of Gazipur district, Bangladesh and all the participants

HIGHLIGHTS

1. First study of Bangladesh that reported metabolic syndrome severity score

2. First study that showed a correlation between cardiovascular risk and metabolic syndrome

3. For the first time, cardiovascular risk factors are compared in postmenopausal women with metabolic syndrome or without metabolic syndrome

were free from CVD based on self-report, clinical history, and documented medical records' review. Menopause was confirmed by a doctor as no menstrual bleeding for at least 12 months and no other clinical condition causing amenorrhea. The sample size was determined using a CVD risk prevalence obtained from a study conducted among PMW in Nigeria, another developing country.[7]

Data collection procedures

Data were collected using a pre-tested semi-structured questionnaire adapted from STEP-wise approach to Surveillance of non-communicable diseases risk factors of WHO.[8] The questionnaire collected data on sociodemographic, reproductive, behavioural risk factors and metabolic of chronic diseases. The study design, sample recruitments and data collection procedure are described in a flow diagram **(FIGURE 1)**. The CVD risk was calculated using the country-specific lab-based Globorisk score which included the following variables: country, gender, age from 40–74 years, smoking, diabetes, systolic blood pressure (SBP) and total cholesterol.[9] Subjects with MetS were selected using criteria (at least three out of the five were present) of modified National Cholesterol Education Program Adult Treatment Panel III (NCEP ATP III), including waist circumference (WC) more than 88 cm; triglycerides (TG) level ≥ 150 mg/dL (1.70 mmol/L); high-density lipoprotein cholesterol (HDL-C) levels <50 mg/dL (1.30 mmol/L); BP of at least 130/85 mm Hg; and fasting blood glucose (FBG) levels at least 110 mg/dL (6.10 mmol/L).[10]

Selection of variables to construct a new MetS severity score

We considered some emerging risk factors in combination with conventional variables after review of existing literatures. We included HDL, lipid accumulation product (LAP) and diastolic BP (DBP) to construct the MetS continuous score. Here HDL-C was used because it seemed to be linked to the pre-existing phase of MetS and its level may have the potential to prevent MetS in the early stage.[11] LAP is a by-product of WC and TG that was calculated using the formula (WC [cm] − 58) × (TG [mM]). The rationale to use LAP is that it simultaneously predicts obesity[12], insulin resistance[13] and MetS itself.[14] LAP also supplements the conventional use of WC and FBG. As diabetes or FBG is simultaneously use as a component of Globorisk score and MetS, we used LAP instead of FBG that helped us to seek a valid correlation between MetS severity score and CVD risk. We used DBP instead of SBP as was used by an other study to address MetS.[15]

Statistical analysis

We analyzed data using Statistical Product and Service Solutions version 26.0 for Windows (IBM Corp., Armonk, NY, USA). The MetS severity score was developed following a previous paper[6] in which we generated a standardized Z score (with a mean set to zero and a range from negative infinity to positive infinity) for each component (HDL-C, LAP and DBP) of MetS by regressing them to age. Since standardized HDL-C has inverse protective relationship with cardiovascular risk, it is multiplied by-1. Standardized Z scores for the individual risk factors/components are summed to create the MetS score.

We used descriptive statistics to show the distribution of sociodemographic, reproductive and CVD risk factors among the subjects with or without MetS. Again, association of these factors with MetS was assessed using the Chi-square test. In between two groups (with MetS and without MetS), difference in CVD risk and mean severity score of MetS was assessed using the Mann-Whitney U test. The correlation of CVD risk with the MetS severity score was presented using a scatter

diagram generated by Pearson's partial correlation which was controlled for daily physical activity metabolic equivalent of task, body mass index and low-density lipoprotein cholesterol. All the estimates of precision were presented at a 95% confidence interval, as appropriate. The statistical tests were considered significant (two-sided) at a level of $P<0.05$.

RESULT

Among the 265 participants, 35.1% had MetS as per modified ATP III criteria. The highest prevalence was found among the subjects who were aged (≥60 years) (55.3%), had no formal education (54.8%), experienced the onset of menopause at the age of ≥45 years (63.4%) and duration of menopause ≥6 years (61.3%). The prevalence of several CVD risk factors was higher

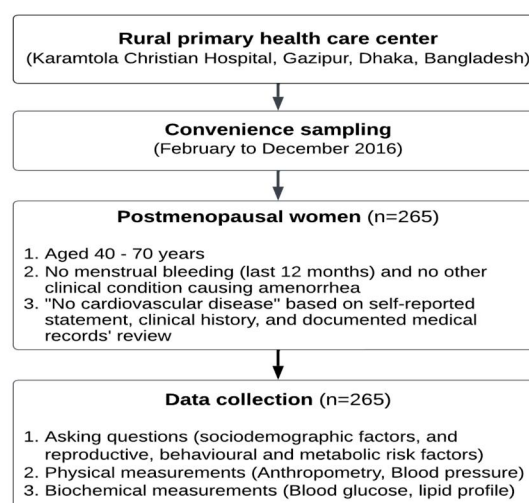
FIGURE1 Flowchart of the study design, sample recruitments and data collection

TABLE 1 Sociodemographic, reproductive and CVD risk profile of the women with or without MetS (n=265)

Population profile	Total (n=265)		With MetS (n=93)		Without MetS (n=172)		P*
	%	95% CI	%	95% CI	%	95% CI	
Age, mean ± (SD)	53.5±(7.5)		54.6±(7.4)		52.9±(7.5)		
40-49 years	25.3	20.1 – 30.5	19.4	11.4 – 27.4	28.5	21.8 – 35.2	
50-59 years	46.0	40.0 – 52.0	44.1	34.0 – 54.2	47.1	39.6 – 54.6	0.07
≥60 years	28.7	23.3 – 34.1	36.6	26.8 – 46.4	24.4	18.0 – 30.8	
Age at onset of menopause (mean ± SD)	44.8±(5.2)		45.0±(4.8)		44.7±(5.4)		
Early menopause (<45 years)	43.0	37.0 – 49.0	36.6	26.8 – 46.4	46.5	39.0 – 54.0	0.12
Menopause at usual age (≥45 years)	57.0	51.0 – 63.0	63.4	53.6 – 73.2	53.5	46.0 – 61.0	
Duration of menopause (mean ± SD)	8.8±(6.4)		9.5±(6.5)		8.4±(6.4)		
<6 years	43.8	37.8 – 49.8	38.7	28.8 – 48.6	46.5	39.0 – 54.0	0.22
≥6 years	56.2	50.2 – 62.2	61.3	51.4 – 71.2	53.5	46.0 – 61.0	
Occupation							
Housewife	90.2	86.6 – 93.8	89.2	82.9 – 95.5	90.7	86.4 – 95.0	0.7
Others	9.8	6.2 – 13.4	10.8	4.5 – 17.1	9.3	5.0 – 13.6	
Education							
No formal education	60.8	54.9 – 66.7	54.8	44.7 – 64.9	64.0	56.8 – 71.2	0.15
Literate	39.2	33.3 – 45.1	45.2	35.1 – 55.3	36.0	28.8 – 43.2	
Smokeless tobacco consumption	44.9	38.9 – 50.9	40.9	30.9 – 50.9	47.1	39.6 – 54.6	0.33
Added salt intake	44.5	38.5 – 50.5	39.8	29.9 – 49.7	47.1	39.6 – 54.6	0.25
OCP use	34.3	28.6 – 40.0	33.3	23.7 – 42.9	34.9	27.8 – 42.0	0.8
Physical inactivity†	58.1	52.2 – 64.0	60.2	50.3 – 70.1	57.0	49.6 – 64.4	0.61
Generalized Obesity (BMI>27.5 kg/m²)	20.4	15.5 – 25.3	40.9	57.1 – 76.3	9.3	2.7 – 10.1	<0.001
Central obesity‡	43.4	37.4 – 49.4	68.8	59.4 – 78.2	29.7	22.9 – 36.5	<0.001
Diabetes§	20.0	15.2 – 24.8	39.8	29.9 – 49.7	9.3	5.0 – 13.6	<0.001
Hypertension‖	28.3	22.9 – 33.7	43.0	32.9 – 53.1	20.3	14.3 – 26.3	<0.001
Hypercholesterolaemia¶	25.7	20.4 – 31.0	33.3	23.7 – 42.9	21.5	15.4 – 27.6	0.04
CVD risk (mean ± SD)**	14.6±(12.2)		20.8±(15.1)		11.3±(8.8)		<0.001
Low risk (<10%)	43.4	37.4 – 49.4	24.7	15.9 – 33.5	53.5	46 – 61	<0.001
Moderate to high risk (≥10%)	56.6	50.6 – 62.6	75.3	66.5 – 84.1	46.5	39 – 54	
MetS severity score (mean ± SD)**	0.0±(0.99)		0.15	-0.06 – 0.36	-0.08	-0.23 – 0.07	0.11

MetS, metabolic syndrome; SD, standard deviation; CI, confidence interval; CVD, cardiovascular disease; OCP, oral contraceptive pills; BMI, body mass index

*All the significant threshold of $P<0.05$ based on Chi-square statistics unless other-wise indicated

†Physical activity=1.0, when 1.0≤physical activity level<1.4 using the Microsoft Excel logic function following the Estimated Energy Requirements equation of the Dietary Reference Intakes Committee

‡Waist–circumference>80 centimeter for women according to International Diabetes Federation cut-offs for South Asians

§Fasting plasma glucose≥7.0 mmol/L (126 mg/dl) or 2-h plasma glucose≥11.1 mmol/ L (200 mg/dl) and self-statement of a person as known diabetic or on anti-diabetic medication

‖ Systolic blood pressure ≥ 140 mmHg or diastolic blood pressure ≥ 90 mmHg

¶Total cholesterol≥6.2 mmol/l

**Mann-Whitney U test applied to assess difference in CVD risk & mean score of MetS severity
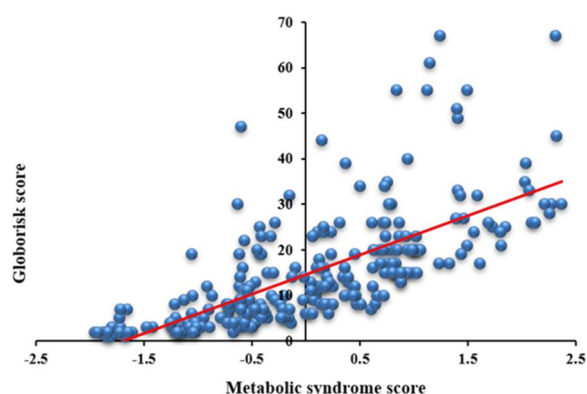
FIGURE 2 Correlation of metabolic syndrome severity score with the risk of cardiovascular disease in postmenopausal women

among those with MetS compared to those without MetS: central obesity (68.8% vs 29.7%, *P*<0.001), generalized obesity (66.7% vs 6.4%, *P*<0.001), physical inactivity (60.2% vs 57%, *P*=0.61), hypertension (43% vs 20.3%, *P*<0.001), and diabetes (39.8% vs 9.3%, *P*<0.001). A highly significant CVD risk difference was observed between the subjects with MetS and without MetS (*P*<0.001) **(TABLE 1)**.

The correlation between the MetS severity score and the Globorisk CVD score was found to be linear and positive in direction **(FIGURE 2)**. This indicates with the increase in the Z-score of the severity of MetS, the CVD risk had increased linearly. The strength of the correlation is strong (*r*=0.69) which is statistically significant (*P*<0.001).

DISCUSSION

Using the modified NCEP-ATP III criteria, the prevalence of postmenopausal MetS in this study was 35.1%, which is close to a previous rural study of Bangladesh (39.3%) and very similar to the global pooled estimate of MetS (37.17%) among PMW.[16, 17] The current study also found a high prevalence of several CVD risk factors among participants with MetS than those without MetS. This is also supported by a systematic review that postulated several contributing factors behind the profile of the less favorable CVD risk factors profile of South Asians with MetS.[2]

In this study, the MetS severity score was higher among participants with MetS than among those without MetS

and is consistent with a previous report.[18] Similarly, a significant CVD risk difference was elucidated between subjects with MetS, and without MetS which is also supported by another research, including prospective studies.[19]

In our study, the MetS severity score showed a significant positive linear correlation with the future risk of CVD. A previous study also reported significant dose–response relationships between the severity score and the risk of CVD/mortality[20] that supported the current finding. Again, a previous nation-wide Korean study confirmed that continuous MetS score could be used as a significant predictor of CVD and support the hypothesis that a higher degree of MetS severity serves as an estimate of the underlying metabolic dysfunction may contribute to future risk of CVD.[21]

The current study has a number of strengths. For the first time MetS severity score was applied among the rural PMW in Bangladesh. Again, several CVD risk factors and risk difference were compared for the first time between subjects with and without MetS. Finally, the correlation between CVD risk and MetS severity score was assessed. These three findings are crucial due to huge clinical relevance. This MetS severity score will help to predict the future CVD event and the clinicians may provide lifestyle changing advices to those who will be at high-risk. This continuous score will also serve as a tool to monitor the subjects who will receive any intervention.

The weak points of this study are the cross-sectional design and the convenient selection of study subjects. Moreover, as the study subjects were very selective group of population, we conveniently recruited them to save time and money. In general, these limitations may elevate the risk of recalled bias, selection bias, and lack of generalizability.

In conclusion, the PMW of Bangladesh are at high risk of CVD event due to higher burden of MetS among them. Subjects with MetS will get more preference for prevention effort as their risk is significantly differed from those without MetS. The correlation between CVD risk and MetS score indicated that the developed tool can be used to monitor the subjects with MetS following

intervention to prevent CVD. To justify its reliability, large-scale studies in various group of populations and settings are warranted.

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