Original article:

Gender Differentials of Metabolic Syndrome in Bangladesh taking Menopause into Consideration

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Abstract:

Objective:To assess the gender differences of metabolic syndrome (MetS) in Bangladesh and factors associated with it. ***Materials and methods:*** Cross sectional study was performed on 227 premenopausal women, 48 menopausal women and 217 men. The gender differentials were studied with measurement of waist circumference, blood pressure and fasting blood for triglyceride (TG), high density lipoprotein (HDL), blood sugar (FBS).***Results:***Premenopausal women had 22.9% (95% CI: 17.9-28.8%), menopausal women had 43.8% (95% CI: 30.7-57.7%), and the men had 53.9% (95% CI: 47.3-60.4%) prevalence of MetS giving a 1:1.7:2.1 ratio of premenopausal, menopausal women and men prevalence respectively. More than 95% of study population had low HDL irrespective of gender and menopause status. Obesity was 5.3% in premenopausal women, 14.6% in menopausal women and 54.4% in men. HTN was 10.6% in premenopausal women, 35.4% in menopausal women, and 19.4% in men. High TG was 42.5% in premenopausal women, 41.7%, in menopausal women and 62.0% in men. High FBS was 22.0% in premenopausal women, 37.5% in menopausal women and 30.4% in men. ***Conclusion:*** Compared to premenopausal women, MetS in men was two times higher and nearly two times higher in menopausal women, pulling menopausal women prevalence almost equal to men. Menopausal women had high prevalence of HTN while obesity was more prevalent in men. Dyslipidemia should be a concern for the policy makers in search of a prevention program.

Keywords : Metabolic syndrome, epidemiology, gender, men, women, Bangladesh.

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Introduction

Metabolic syndrome (MetS) or syndrome X or the deadly quintet had been given several definitions for establishing the diagnosis. The most updated criteria were agreed upon by different organizations worldwide has dyslipidaemia, hypertension, increased fasting glucose and abdominal obesity[1]. MetS had become a global concern because its prevalence has increased worldwide. In US, MetS had increased by 35% between 1988 and 2012, with more than a third of US adults having MetS[2]. In Bangladesh, a systematic review found that the prevalence was 30% and it was higher in females[3]. People with MetS were more likely to suffer from a heart attack and stroke[4]. There were different factors that affect the prevalence of MetS such as age, race socioeconomic status, physical activity, diet, geography and gender[5]. Different studies revealed disparity in the prevalence and components of MetS in respect to gender. For example, central obesity was more in women. Also, high triglycerides and impaired glucose tolerance were more predominant in men[6]. Some studies found gender differences in the treatment and response to treatment like less weight loss in females suffering from MetS[5]. There were some studies in Bangladesh on MetS but the knowledge about gender differences was scarce.Some studies focused on rural women[7], some only on urban[8] areas and some only on hospital outpatients[9] or

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only rural pre- and post-menopausal women[10]. But no study so far investigated the prevalence on men, premenopausal and post-menopausal women hence leaving a knowledge gap in this field. In this paper we aimed to provide important gender specific information about MetS in Bangladesh to reject the null hypothesis that there is no difference in the prevalence of MetS among men, premenopausal and post-menopausal women.

Materials and Methods

Design and setting

The re-analysis was done using the dataset from cross-sectional study[11] to assess the difference of MetS in men, premenopausal women and post-menopausal women. With proper ethical approval and planning, we collected samples from 492 willing participants from one urban and one rural area, comprising around 46% premenopausal and 10% menopausal women, while the rest 44% were males. To avoid redundancy, we only put the analysis plan which was unique for this study.

Data analysis

The entered data was assessed for the baseline differences along three categories of respondents. We then plotted the components of MetS in similar fashion, first using the continuous variable followed by dichotomous categorization of the components. The analysis further followed the ratio of the prevalence in men, pre- and post-menopausal women. Keeping premenopausal status as reference as its prevalence was the lowest (in result section), we ran the logistic regression (LR) for MetS with odds ratio (OR), initially unadjusted and then adjusted for the factors which were significantly associated in preliminary analysis. In addition, we constructed the Box and Whisker's plot to assess the components accumulation of metabolic syndrome in these three groups of respondents by age. The numeric variables were expressed as mean and standard deviation (±SD) and the categorical variables as frequency and percentage. We used Confidence Interval Analysis (CIA) software to calculate confidence interval (CI) of the prevalence. A p-value of ≤0.05 was considered significant and above the cut-off value was taken not significant (ns).

Results

The baseline features of the respondents (Table 1) showed that age was not homogeneously distributed along the three groups of respondents as assumed because postmenopausal women were older than men and premenopausal women. There was no difference of monthly income, daily water intake or daily sleeping hours among these groups. Males were more educated compared to the other two groups ($p<0.001$). On the other hand, premenopausal and menopausal women were more involved with heavy occupation compared to significantly more menwith sedentary occupation ($p<0.001$). Postmenopausal women were more from rural areas, contrary to premenopausal women and men, who were significantly more from urban areas ($p<0.001$).

Table 1. Baseline characteristics of the respondents (n=492).

Variables	Pre-menopause	Menopause	Male	Total	*p*
Age	33.9±6.6	51.7±8.6	43.6±11.2	45.5±11.1	<0.001
Monthly Income	49.9±103.4	113.1±425.7	232.1±273.4	136.4±250.4	0.50
Water intake/day	3.2±1.4	3.2±1.6	3.71±1.20	3.4±1.4	0.61
Sleep	6.7±1.7	6.3±2.0	6.6±1.4	6.6±1.6	0.17
Education					
Illiterate	34 (15.0)	16 (33.3)	13 (6.0)	63 (12.8)	<0.001
Some education	142 (62.6)	23 (47.9)	109 (50.2)	274 (55.7)	
Good education	51 (22.5)	9 (18.8)	95 (43.8)	155 (31.5)	
Occupation					
Sedentary	43 (18.9)	14 (29.2)	188 (86.6)	245 (49.8)	<0.001
Heavy	184 (81.1)	34 (70.8)	29 (13.4)	247 (50.2)	
Area					
Urban	178 (78.4)	29 (60.4)	135 (62.2)	342 (69.5)	<0.001
Rural	49 (21.6)	19 (39.6)	82 (37.8)	150 (30.5)	
Smoking					
No	227 (100.0)	48 (100.0)	162 (74.7)	437 (74.7)	<0.001
Yes	0 (0)	0 (0)	55 (25.3)	55 (25.3)	

While looking at the components of MetS from Table 2 and 3, it was revealed that postmenopausal women had higher mean values of waist circumference (p=0.02), SBP (p<0.001), DBP (p<0.001), and FBS (p=0.62) compared to the other two groups. Men had more dyslipidaemia (higher TG p<0.001, lower HDLp<0.001) compared to others. While looking at the categorical values, men were more obese (p<0.001) and with high TG (p<0.001). Postmenopausal women were more hypertensive (p<0.001) and diabetic (p=0.03). Though low HDL values were more in pre-menopausal women compared to others, the association was not significant (p=0.25).

Table 2. Components of MetS (quantitative) among the respondents.

Components	Premenopause	Menopause	Men	*p*
Waist	85.8±10.0	90.6±17.69.9	87.4±11.8	0.02
SBP	123.0±15.5	134.7±20.0	127.1±17.6	<0.001
DBP	75.4±11.6	81.8±12.4	80.3±11.2	<0.001
FBS	109.2±58.2	116.6±47.7	111.4±37.2	0.62
TG	158.9±96.6	160.9±75.0	218.0±144.4	<0.001
HDL	34.6±6.3	36.6±6.9	31.2±5.7	<0.001

Table 3. MetS and its components (categorical) among the respondents.

Components	Pre-menopause	Menopause	Men	Total	*p*
Obese	12 (5.3)	7 (14.6)	118 (54.4)	137 (27.8)	<0.001
HTN	24 (10.6)	17 (35.4)	42 (19.4)	83 (16.9)	<0.001
DM	50 (22.0)	18 (37.5)	66 (30.4)	134 (27.2)	0.03
High TG	96 (42.5)	20 (41.7)	134 (62.0)	250 (51.0)	<0.001
Low HDL	220 (97.3)	45 (93.8)	204 (94.4)	469 (95.7)	0.25
MetS	52 (22.9)	21 (43.8)	117 (53.9)	190 (38.6)	<0.001

When we looked at the final category of MetS, it was observed that the prevalence of MetS was 22.9% in premenopausal women (95% CI: 17.9-28.8%), followed by 43.8% in postmenopausal women (95% CI: 30.7-57.7%), followed by 53.9% in men as highest prevalence (53.9%, 95% CI: 47.3-60.4%) among these three.We calculated the ratio of the prevalence to get a 1:1.7:2.1 ratio of premenopausal, postmenopausal women and men prevalence respectively. Both the prevalence of men (p<0.001) and postmenopausal women (p=0.003) were significantly higher that the pre-menopausal women but men and menopausal women were homogeneous in this regard (p=0.20, data not shown).

When we checked for unadjusted LR (Table 4), the menopausal status, rural area and smoking were significantly associated with MetS and heavy working occupation had significantly reverse association. In adjusted LR, men (<0.001) and menopausal status (0.01) appeared as independent risk factors of being associated with MetS, adjusted for other variables which were not significant.

Table 4. Logistic regression of the factors related with MetS.

Variables	Unadjusted OR (95% CI)	p	Adjusted OR (95% CI)	*p*
Gender				
Pre-menopause	1	.	1	.
Menopause	2.62 (1.37-5.01)	0.004	2.28 (1.18-4.43)	0.01
Men	3.94 (2.62-5.93)	<.001	3.11 (1.78-4.43)	<0.001
Education	1.10 (0.83-1.46)	0.52	0.85 (0.61-1.18)	0.32
Area				
Urban	1			
Rural	1.82 (1.23-2.69)	0.003	1.48 (0.98-2.25)	0.06
Occupation				
Sedentary	1			
Heavy	0.38 (0.26-0.56)	<0.001	0.66 (0.40-1.12)	0.13
Smoking				
No	1			
Yes	1.76 (1.002-3.09)	0.049	0.87 (0.47-1.63)	0.66

We looked at the Box and Whisker's plot of the components of MetS by age classified by these three groups of respondents. It shows the difference of age in acquiring the components of MetS in these three groups. The prevalence of at least one component in premenopausal women (Figure 1) was found at the median age of 32-33 years, gradually adding up components with higher age, while they become a candidate of MetS by 38 years and by the median age of 40 years they acquire 4 components of MetS.The components for postmenopausal women (Figure 2) were variable with age. Some got one component around age 57-58 years and became candidate of MetS around a median age of 55 years, but some acquired 4 components before the age of 55 years. On the other hand, men acquired any one component of MetS (Figure 3) around age 35, and there was a gradual uptake of another component with higher age. Just after the age of 40 years, men became candidates of MetS and by the median age of 50, they acquired all the components of MetS.

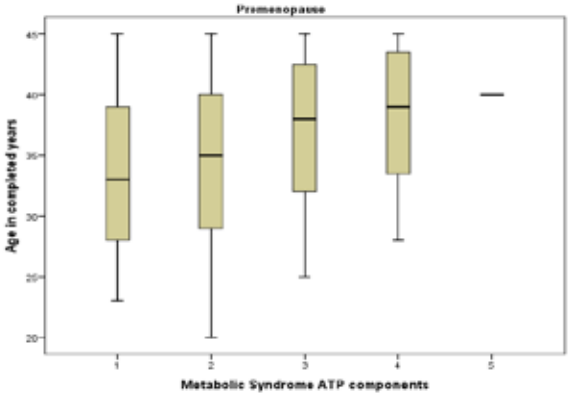

Figure 1: Box and Whisker's plot showing components of MetS by age (pre-menopause)

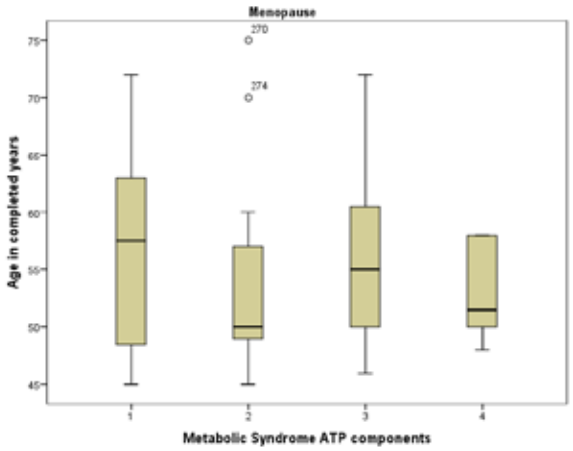

Figure 2: Box and Whisker's plot showing components of MetS by age (post-menopause)

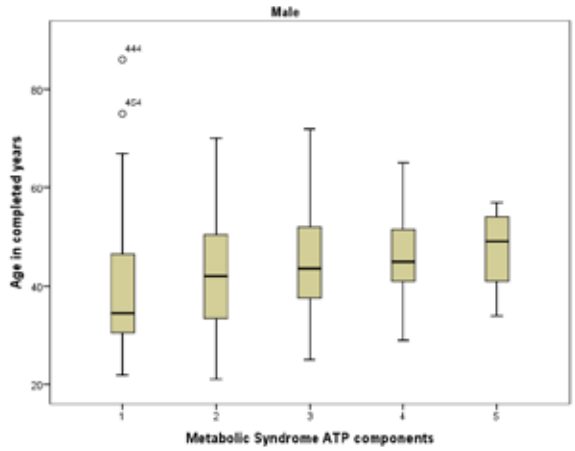

Figure 3: Box and Whisker's plot showing components of MetS by age (Men)

Discussion

Our study was the first to explore gender differences of MetS and its correlates in a rural and urban sample from Bangladesh. Our findings emphasized that gender had a fundamental role in the prevalence of MetS; (a) overall, males had the highest prevalence of MetS (54%) followed by postmenopausal (44%) and premenopausal (23%) females, (b) being a male or a postmenopausal female were independent risk factors of MetS, (c) the distribution of MetS components varied by gender; males were found to be more obese, had higher TG and lower HDL, while postmenopausal females had higher waist circumference, were more hypertensive and diabetic.

We reported males to have the highest prevalence of MetS, overall. Most of the studies conducted in East Asia support our finding. For example, studies from Korea, Thailand, China, Philippines, Taiwan and Bangladesh[11-16] reported MetS prevalence in the males to be the highest ranging from 16 to 54% compared to females whose figures ranged from 9 to 26%. The referred cross-sectional study in methodology reported the overall MetS prevalence to be 38.8% with male being the majority (54.2%) compared to all females (26.6%) irrespective of their menopausal status[11]. Male gender (OR=2.5, 95%CI:1.4-4.2) significantly increased the odds of having MetS[11]. From East Asian countries, India was an exception; two studies[17,18] found females to have higher prevalence of MetS (19 and 40%) as compared to males (17 and 33%). Contradicting our findings and similar to India, several studies from the USA reported higher prevalence of MetS among the females (ranged between 34 and 37%) as compared to males (ranged between 30 and 34%)[2,19-21]. Likewise, a European study from Italy[22] showed that females had the highest prevalence of MetS (55%) with a huge gap difference as compared to males (26%). Surprisingly, our findings do not go in line with other studies from Bangladesh. Multiple studies reported a higher prevalence of MetS among females. To add, a recent systematic review[3] evaluated MetS prevalence in Bangladesh and showed the MetS weighted-pooled prevalence to be higher among females (32% [95% CI: 27-38%]) compared to males (25% [95% CI: 16% - 35%]). Nevertheless, the meta-regression could not conclude the observed gender difference to be statistically significant ($p=0.43$). Though gender variations of MetS exist in literature, the discrepancies in prevalence figures can be attributed to the differences in ages, ethnicities, geography (rural vs urban), socioeconomic, cultural and lifestyle aspects, disparate sex psychosocial stressors and criteria applied to diagnose MetS. Moreover, the higher prevalence of MetS among females reported from other countries could be due to the inclusion of premenopausal women with menopausal women which might pull up the prevalence higher than the men. In our study, the higher prevalence of MetS among the males might be attributed to the different lifestyle patterns followed by males and females; we found significantly more men involved in sedentary occupation compared to females who were more engaged in occupation involving heavy work.

The current study highlighted menopause, in addition to male gender, to be an independent risk factor to develop MetS. This finding ties well with previous studies to established menopause as an independent predictor of MetS regardless of age or other comorbidities[23-27]. McNeill AM et. al reported that postmenopausal status increased the risk of MetS by 60%, despite adjusting for potential confounders (e.g. age, BMI, socioeconomic status, physical inactivity)[25]. Our results are also in accordance with findings from rural Bangladesh by Jasmin S. et. al.[28] who studied 1802 rural women and showed MetS to be more prevalent among postmenopausal (39.3%) than in premenopausal (16.8%) females. Additionally, MetS was significantly higher in postmenopausal than premenopausal females (OR: 1.78, CI: 1.26-2.51, p=0.001)[28].

The proposed explanations go beyond statistics alone to the physiological and biological changes associated with menopause which delineates the transitional phase into sex hormone-depleted state characterized by estrogen deficiency[29]. Menopause is accompanied with a redistribution of body fat resulting in central obesity and insulin resistance which were found to largely increase the prevalence of MetS in postmenopausal females[30]. Additionally, several biological changes take place during menopause and might aid indeveloping insulin resistance and MetS including oxidative stress, inflammatory changes, and postmenopausal alterations in adipocytokine production and lipid utilization[31,32]. These facts broadly elucidate the obvious acceleration in cardiovascular diseases (CVD) in females post menopause[33].

Males and females had different patterns in the components of MetS. In our study, postmenopausal females had higher waist circumference, were more hypertensive and diabetic. A similar pattern of results was obtained in different studies over the globe. For example, a study utilized the database of the American National Health and Nutrition Examination Survey (NHANES) between 1999 and 2004, showed that women had higher mean SBP than men with around 80% of those women being postmenopausal [34]. Also, women had higher waist circumference and central obesity, elevated total cholesterol, lower HDL and more insulin resistance[31,34]. Moreover, multiple other studies showed that females had a significant higher prevalence of abdominal obesity compared to males while males had a higher prevalence of high TG levels[33,35]. Several factors might explain such trends including the fact that postmenopausal women lack estrogen which is known to cause vasodilation and lower the risk of HTN and CVD in premenopausal women[34,36]. It also explains our findings of how males acquired almost all of the components of MetS earlier compared to females with similar age category highlighting Estrogen protective roles in premenopausal females. Though, aging alone is a risk factor for developing HTN and diabetes, blood pressure changes related to aging are more profound among females compared to males[37].

Our study is unique as it explored a wider community picture of gender variations in MetS by enrolling participants from both rural and urban areas from Bangladesh. However, we appreciate some limitations. Being based on a secondary re-analysis from a cross sectional data, our study could only establish association and not causality inferences. To add, though the components of MetS were objectively evaluated, some of the covariates were subjective in nature (e.g. lifestyle, education) and might be subject to recall bias. Finally, it was difficult to evaluate some of the important comorbidities and consequences which might affect the development of MetS such as cardiovascular diseases, hypertensive status, medications, polycystic ovarian syndrome (PCOS) etc.

Conclusion

We conclude, based on our study findings that MetS varies by gender; male sex and menopause are independent risk factors to develop MetS among urban and rural Bangladeshi participants. The gender disparity in MetS should be properly addressed and looked at especially that it might suggest different approaches of early detection and gender-specific management. Authorities should start planning for effective screening programs to tailor treatment strategies to elderly males and postmenopausal females in order to reduce MetS burden and consequences (e.g. CVD, DM and mortality). A larger-scaled population-based

surveillance is highly recommended to track MetS development and to help in planning and executing preventive strategies at younger ages including wide national awareness campaigns explaining MetS, its consequences and the importance of healthy lifestyle and regular health check-ups in its prevention.

Ethical Approval: We conducted the study after obtaining the ethical approval from Bangladesh Medical Research Council (BMRC) and ethical committee of Tokai University Graduate School of Medicine.

Conflict of Interest: We declare no conflict of interest among authors.

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Individual Authors Contribution: SB designed the study, SB and MJ collected data, entered and analyzed, wrote the abstract, methodology and result part, SJ wrote the introduction, AR wrote the discussion and conclusion. All the authors read the manuscript, reviewed and finalized the draft.

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