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Adiposity Indices as Predictors for Metabolic Syndrome Among Bangladeshi Women: A Cross Sectional Study

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Abstract

Background: The metabolic syndrome (MS) is described by the clustering of several risk factors for cardiovascular disease (CVD) such as hypertension, dyslipidemia, obesity, insulin resistance, and high fasting plasma glucose. The prevalence of MS is increasing worldwide and previous studies have shown that MS and CVD are more common in women above 55 years of age in the post menopausal phase. The aim of this study was to determine the prevalence of metabolic syndrome and adiposity indices as predictors and the related risk factors among Bangladeshi women. **Material & Methods:** This was a cross-sectional study and was conducted in the Outpatient departments of Bangladesh Medical College Hospital, Dhaka, Bangladesh during the period from May, 2022 to October, 2022. There was total 300 women (150 Premenopausal & 150 Postmenopausal) in our study. Fasting blood glucose, lipid profile, blood pressure and relevant adiposity indices (BMI, WC, WHR, WHtR &VAI) were determined using standard protocols. To analyze the correlation of WC,WHR, WHtR, BMI and VAI with MS Spearmann test was used. **Results:** Metabolic syndrome was presented in 61.58% respondents and it was more prevalent among postmenopausal (69.09 %) as compared to premenopausal (51.25 %) women. Prevalence of high blood pressure, elevated fasting blood glucose, and high triglyceride were significantly higher in postmenopausal women than premenopausal women. However, prevalence of low high-density lipoprotein cholesterol was significantly lower in postmenopausal women than premenopausal women. **Conclusion:** In our study we found a high prevalence of MS in post-menopausal women which was significantly higher than pre-menopausal women. Low HDL cholesterol, elevated fasting blood glucose, and high blood pressures were the most frequent features in comparison to the others.

Keywords:- Menopause, Metabolic syndrome, Adiposity indices

INTRODUCTION

The metabolic syndrome (MS) is described by the clustering of several risk factors for cardiovascular disease (CVD) such as hypertension, dyslipidemia, obesity (particularly central obesity), insulin resistance, and high fasting plasma glucose.[1] In 2001, The third Report of National Cholesterol Education

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Program Expert Panel on Detection, Evaluation, and Treatment of High Blood Cholesterol in Adults (Adult Treatment Panel III) (ATP III) emphasized the importance of the metabolic syndrome and provided a working definition of this syndrome for the first time.[2] The prevalence of MS is increasing worldwide and previous studies have shown that MS and CVD are more common in women above 55 years of age in the post menopausal phase.[3,4] The annual incidence of cardiovascular diseases rises by almost 50% for postmenopausal women due to the hormonal and metabolic changes that occur during this period.[5,6] Changes in lifestyle for example, poor diet quality, reduced physical activity can negatively affect and compromise physical well being and predispose to the development of several chronic pathological conditions.[7,8] Thus, menopause and obesity have become important risk factors for MS diagnosis. However, the emergence of metabolic risk factors in post-menopausal phase may be a direct result of ovarian failure with estrogen deficiency.[9] Changing hormonal milieu with decreasing estrogen and alteration of its ratio to testosterone has been implicated as a causal factor for the emergence of MS at menopausal transition.[10,11] Besides menopausal hormonal changes, aging also play roles to clustering of cardiometabolic risk factors.[12] In fact, menopausal status is accompanied by unfavorable levels of cardiovascular risk factors, like changes in body fat distribution, from gynoid to android pattern, abnormal plasma lipids, increased sympathetic tone, endothelial dysfunction, vascular inflammation and increased blood pressure.[13] Enlarged visceral adiposity regarded as a key factor to the development of MS.[14] Menopause associated with an increase in intra-abdominal fat.[15] Obesity was defined classically through employing many anthropometric indices that based on fat distribution, each one has their own advantages and disadvantages in predicting serious chronic non communicable diseases.[16] Obesity is the most common disorder associated with women in their menopausal stage and occurs in approximately 65% of all women.[17] Body mass index (BMI) is commonly used in public health studies as indicator of weight status but it does not consider the accumulation of abdominal visceral fats.[18] Visceral adiposity index (VAI) considered as a simple marker of visceral adiposity, it showed a strong independent association with both cardiovascular and cerebrovascular events and showed better predictive power for the incidence of diabetes than its individual components.[19] Waist circumference (WC), waist- hip ratio (WHR), Waist – height ratio (WHtR) are anthropometric measures used to diagnose abdominal obesity, while high triglyceride (TG) and low high density lipoprotein- cholesterol (HDL-C) are used to define dyslipidemia.[20] Prevalence of MS among pre- and post-menopausal women varied according to different population.[21] To date, several previous studies found a significance difference in prevalence of MS among pre and postmenopausal women.[22,23,24,25,26] However, studies related to MS and menopausal status is limited in South Asia. South Asian women, in general are prone to MS at a younger age and have severe morbidity and mortality consequences as compared to Caucasians and other Asians.[25] Moreover, the association between anthropometric measurements and atherogenic indices such as TG, HDL-C as well as their

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Page No- 51-61 | Section- Research Article (Biochemistry)

ability to predict metabolic syndrome among Bangladeshi women has also not been reported. In this study we aimed to determine the adiposity indices as predictors and to examine how obesity indicators and related determinants influence metabolic syndrome, and how the factors can be used to predict the syndrome among Bangladeshi women.

Objective of the Study

The main objective of this study was to determine the prevalence of metabolic syndrome and adiposity indices as predictors and the related risk factors among Bangladeshi women.

MATERIAL AND METHODS

This was a cross-sectional study and was conducted in the Outpatient departments of Bangladesh Medical College Hospital, Dhaka, Bangladesh during the period from May, 2022 to October, 2022. There was total 300 women in our study. In this study we studied on 150 premenopausal and 150 postmenopausal women. These are the following criteria to be eligible for the enrollment as our study participants: a) Women who visited at the outpatient departments of Bangladesh medical college hospital; b)Women who were aged between 21 to 80 aged years old; c) Women who were still menstruating irrespective of the regularities of their menses considered as premenopausal women; d) Women who had ceased menstruation for at least one year to several years considered as postmenopausal And a) Women that used hormone replacement therapy, antidepressant drugs, b) Women with previous surgical history; Women with pregnancy; c) Women with polycystic ovarian disease, thyroid gland diseases, hysterectomy & oophorectomy; d) Women with any history acute illness (e.g., renal or pancreatic diseases, ischemic heart disease etc.) were excluded from our study.

Diagnosis of MS

The women were diagnosed by MS according to the National Cholesterol Education Program (NCEP) & Adult Treatment Panel III (ATP III) criteria which is confirmed by the presence of three or more from the following risk factors:

1) Abdominal Obesity: WC ≥ 88cm
2) Hypertriglyceridemia: Serum triglycerides (TG) level ≥ 150 mg/dl
3) Serum high density lipoprotein (HDL): < 50mg/dl
4) High blood pressure: Systolic blood pressure (SBP) ≥ 130 mm of Hg and /or diastolic blood pressure (DBP) ≥ 85 mm of Hg.
5) High fasting blood glucose (FBG): Plasma glucose level > 110 mg/dl or on treatment for DM

Adiposity indices calculations and measurement:

BMI was computed as weight (kg) divided by height in squared meters (m2). Waist circumference (WC) was taken using a non-stretchable standard tape measurement taken mid way between the lowest rib and iliac crest with the subject standing at the end of gentle expiration. Hip circumference (HC) was measured at the widest level over the greater trochanters. Waist-hip ratio (WHR) was calculated as waist circumference (cm) divided by hip (cm) circumferences. Waist-height ratio

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(WHtR) calculated by the WC (cm) divided by the height (cm).

VAI for female was calculated in our study as: (Amato et al) 19

VAI =(WC(cm)/36.58)+(BMI *1.89) *(TG/0.81) *(1.52/HDL) for women.

Blood pressure of the participants was measured twice with a standard barometer in a sitting position, and the average blood pressure had been documented in the sheets.

Blood tests:

After taking their consent, venous blood samples were collected after 12-hours overnight fast. The samples were centrifuged for 10 minutes at 3000 rpm. Fasting levels of blood glucose, serum total cholesterol, triglycerides and high density lipoprotein cholesterol were measured by enzymatic methods analyzed in the clinical pathology lab in the Hitachi Cobas Model:C-311 biochemistry Autoanalyzer machine.

Laboratory measurements:

- Blood glucose was estimated by enzymatic method.
- Total Cholesterol was estimated by enzymatic end point (CHOD-PAP) method.[27]
- Triglyceride was estimated by enzymatic (GPO-PAP) method.[28]
- HDL Cholesterol was estimated by enzymatic end point (CHOD-PAP) method.[29]

Statistical analysis

The results obtained were statistically analyzed and compared between the two groups of the study. Baseline characteristics of the study participants were expressed in mean ± standard deviation. Comparison of mean was done by unpaired t test. The statistical analysis was performed using SPSS version 25 computer software for windows 10. Statistical significance was considered at P< 0.05. All clinical and biochemical data of study subjects were expressed as means ± standard deviations. Independent sample t- tests were conducted to assess the relationship between the MS and the studied variables.

RESULTS

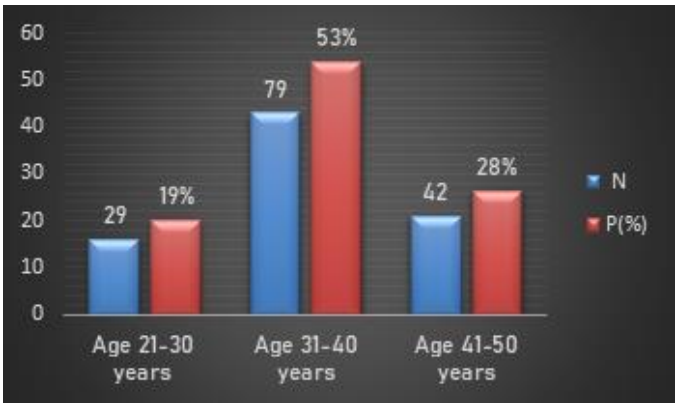

Figure 1: Age Distribution in Premenopausal Women

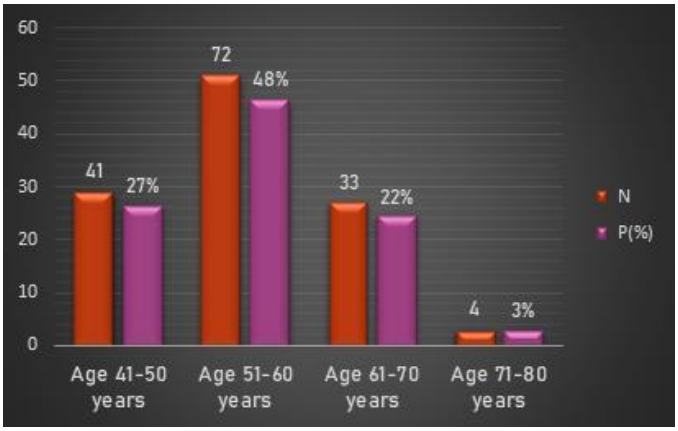

Figure 2: Age Distribution in Postmenopausal women

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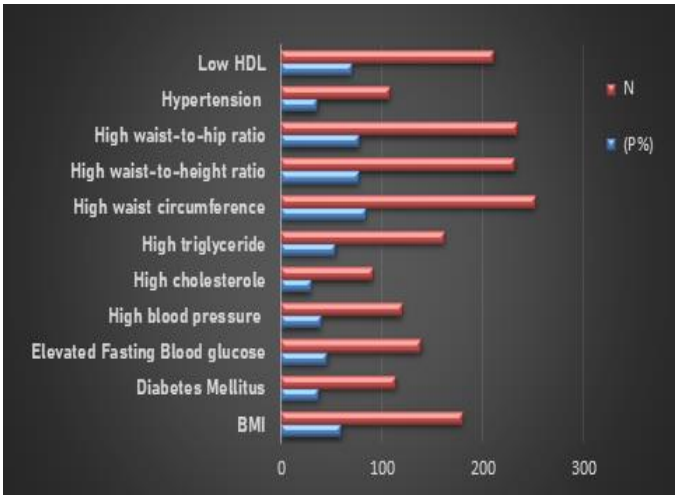

Figure 3: Risk Factors among study people

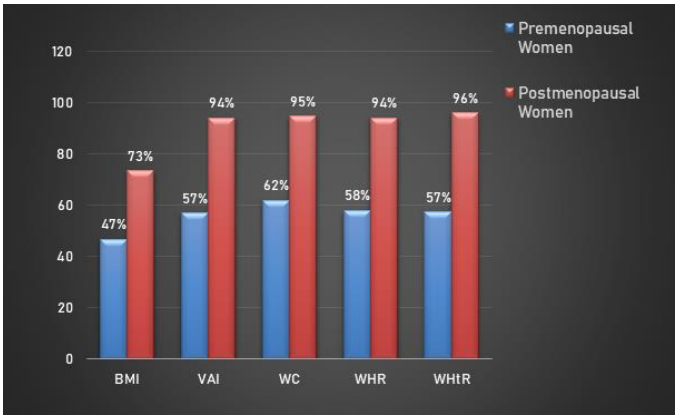

Figure 4: The prevalence of increased cut-off points of adiposity indices in predicting metabolic syndromes among Premenopausal and Postmenopausal women

Table 1: Anthropometric and biochemical characteristic of the study subjects

Parameters	Overall (n=300)	Premenopausal (n=150)	Postmenopausal (n=150)	P- Value
Age	49.87 ± 9.21	41.50 ± 3.64	56.06 ± 6.90	0.001
Height(cm)	156.32 ± 4.42	156.11 ± 4.66	156.46 ± 4.34	0.000
Weight(kg)	67.06± 8.92	66.21±8.89	67.86±8. 96	0.000
BMI(kg/m^2)	28.14 ± 4.87	27.47 ± 4.40	28.34 ± 5.67	0.001
WC(cm)	89.23 ± 14.60	88.67 ± 13.03	89.79 ± 16.18	0.000
WHR	0.85 ± 0.10	0.83 ± 0.08	0.86 ± 0.11	0.001
WHtR	0.58±0.12	0.54 ±0.07	0.62±0.13	0.001
VAI	3.04±1.27	2.40 ±0.73	3.69±1.81	0.001
SBP(mm Hg)	137.87±21.63	125.70±20.9	147.97±22.56	0.000
DBP(mm Hg)	85.57 ± 16.57	83.33 ± 16.55	87.23 ± 16.42	0.000
FBG(mg/dl)	161.16±75.45	111.63±50.66	162.16±76.47	0.000
TC (mg/dl)	181.09 ± 72.32	176.15 ± 70.00	188.75 ± 75.18	0.000
HDL (mg/dl)	40.93±10.33	41.87±10.52	39.98±10.10	0.011
Tg (mg/dl)	213.88 ± 142.63	209.50 ± 160.21	218.26 ± 122.95	0.000
MS	205(68.33%)	89(59.33%)	116(77.33%)	0.001

Abbreviations: MS (Metabolic syndrome);VAI(Visceral adiposity index);WC(Waist circumference); BMI (Body mass index); TC (Total cholesterol); Tg (Triglyceride); WhtR(Waist-to-height ratio); WHR (Waist-to-hip ratio);SBP(Systolic blood pressure); DBP (Diastolic blood pressure); FBG (Fasting blood glucose)

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Page No- 51-61 | Section- Research Article (Biochemistry)

Table 2: Prevalence of Risk Factors of Metabolic Syndromes among Premenopausal and Postmenopausal women

Risk Factors	Overall		Premenopausal women		Postmenopausal women		P-value
	n	(%)	n	(%)	n	(%)	
BMI ≥ 30 kg/m^2	180	60.00	70	46.67	110	73.33	0.062
High waist circumference (WC ≥ 88 cm)	235	78.33	93	62.00	142	94.67	0.098
High waist-to-hip ratio (WHR ≥ 0.80)	228	76.00	87	58.00	141	94.00	0.016
High waist-to-height ratio (WHtR ≥ 0.5)	230	76.67	86	57.33	144	96.00	0.095
Elevated Fasting Blood glucose (≥ 6.1 mmol/L)	139	46.33	53	35.33	86	57.33	0.001
Diabetes Mellitus (FBG >7.1 mmol/L)	114	38.00	39	26.00	75	50.00	0.006
High cholesterole (TC ≥ 200 mg/dL)	91	30.33	32	21.33	59	39.33	0.002
High triglyceride (TG ≥ 150 mg/dL)	162	54.00	79	52.67	83	55.33	0.027
Low High density Lipoprotein(HDL<50 mg/dL)	211	70.33	89	59.33	122	81.33	0.002
High blood pressure (SBP ≥ 130 mmHg and/or DBP ≥ 85 mmHg)	120	40.00	36	24.00	84	56.00	0.007
Hypertension (SBP ≥ 140 mmHg and/or DBP ≥ 90 mmHg)	108	36.00	29	19.33	79	52.67	0.013

Table 3: Correlation of Adiposity indices and determinants for the diagnosis of Metabolic Syndrome values expressed by Pearson correlation test

Variable	BMI	WC	WHR	WhtR	VAI
Fasting glucose	0.285	0.314	-0.107	0.329	0.084
Triglycerides	0.252	0.360	0.142	0.270	0.585
High density lipoprotein	-0.232	−0.127	-0.053	-0.170	-0.598
Systolic blood pressure	0.022	0.376	0.049	0.290	0.061
Diastolic blood pressure	0.089	0.326	0.117	0.267	0.066

In this study figure 1 shows that the age distribution among premenopausal women where we can see that the highest prevalence was 79(53%) aged between 31-40 years old, 29(19%) were 21-30 years old and 42(28%) were 41-50 years old respectively. Here figure 2

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Page No- 51-61 | Section- Research Article (Biochemistry)

shows the age distribution among postmenopausal women, where we found the highest prevalence in 72(48%) women aged between 51-60 years old, followed by 41 (27%) & 33(22%) were aged 41-50 & 61-70 years old respectively and the lowest prevalence was 4(3%) found in 71-80 years old.In this study [Table 1] showed the anthropometric and biochemical characteristic of the study people where we can see the mean age±SD of the study subject was (49.87 ± 9.21); (41.50 ± 3.64) & (56.06 ± 6.90) was for premenopausal and postmenopausal women respectively. The mean ± SD of BMI was (27.47 4.40) & (28.34 ± 5.67); WC was (89.76 ± 13.03) & (89.79 ± 16.18); WHR was (0.83 ± 0.08) & (0.86 ± 0.11); WHtR was (0.54 ±0.07) & (0.62±0.13); VAI was (2.40 ±0.73) & (3.69±1.81) among premenopausal & postmenopausal women respectively. We found MS 89(59.33%) & 116(77.33%) in premenopausal & postmenopausal women respectively. In our study figure 3 showed the prevalence of risk factors among study people. In which the highest prevalence was of high waist circumference 235 (78.33%), followed by high waist-to-hip ratio 288(76.67%), high waist-to-height ratio 230(76.67%); low HDL 211(70.33%) & elevated fasting blood glucose 139(46.33%), high triglyceride 162(54%); the lowest prevalence of high cholesterol 91(30.33%), hypertension 108(36%), & followed by diabetes Mellitus 114(38%), high blood pressure 120(40%) & BMI 180(60%).In this study [Table 2] showed the prevalence of risk factors of metabolic syndromes among premenopausal and postmenopausal women. The prevalence of BMI was 46.67% & 73.33%; High WC was 62% & 94.67%; High WHR was 58% & 94% and High WhtR was 57.33% & 96% in premenopausal and postmenopausal women respectively.In [Table 3], our study showed the correlation between adiposity indices and determinants of metabolic syndrome which revealed that BMI & WC was significantly positively correlated with TG, FBS, SBP, and DBP and significantly negatively correlated with HDL. WHR was significantly positively correlated with TG, SBP & DBP and significantly negatively correlated with FBS & HDL. WhtR & VAI significantly positively correlated with TG, FBS, SBP & DBP and significantly negatively correlated with HDL. In [Figure 4] our study showed the prevalence of increased cut-off points of five most common adiposity indices for predicting metabolic syndrome among premenopausal and postmenopausal women. BMI was higher (73.33%) in postmenopausal women than premenopausal (46.67%) women. Similarly, we found VAI (94% > 57%); WC (95% > 62%); WHR (94% > 58%); WHtR (96% > 57%) in postmenopausal > premenopausal women.

DISCUSSION

In our study the highest prevalence among premenopausal women was 79(53%) aged between 31-40 years old, 29(19%) were 21-30 years old and 42(28%) were 41-50 years old respectively. [Figure 1] While in other study (Jesmin et al.) the pre-menopausal women were aged between 15–51 years old.[30] Here figure 2 shows the age distribution among postmenopausal women, where we found the highest prevalence in 72(48%) women aged between 51-60 years old, followed by 41(27%) & 33(22%) were aged 41-50 & 61-70 years old respectively and the lowest prevalence was 4(3%) found in 71-80 years old. [Figure 2] In other study (Jesmin et al.) they found post-menopausal women were aged 32–85 years old.[30] We found the prevalence of MS 89

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DOI: 10.53339/aimdr.2023.9.1.9
Page No- 51-61 | Section- Research Article (Biochemistry)

(59.33%) & 116 (77.33%) in premenopausal & postmenopausal women respectively. In our study MS was seen higher in postmenopausal women than premenopausal women. [Table 1] While in the other study (Jesmin et al.) the prevalence of MS was higher in post-menopausal (39.3%) women than premenopausal (16.8%) women and this prevalence was more likely in postmenopausal women even after adjustment for age. [30] In this study we found the mean age±SD of the study people was (49.87 ± 9.21), (41.50 ± 3.64) & (56.06 ± 6.90) was for premenopausal and postmenopausal women respectively. BMI was (27.47 4.40) & (28.34 ± 5.67); WC was (89.76 ± 13.03) & (89.79 ± 16.18); WHR was (0.83 ± 0.08) & (0.86 ± 0.11); WHtR was (0.54 ±0.07) & (0.62±0.13); VAI was (2.40 ±0.73) & (3.69±1.81) among premenopausal & postmenopausal women respectively. [Table 1] In other study (Ntentie et al.)found the mean age (56.06 ± 6.90 years), SBP (139.17 ± 25.07 mmHg), DBP (87.23 ± 16.42 mmHg), WHR (0.86 ± 0.11), glucose level (106.54 ± 39.22 mg/dL) and triglycerides level (114.55 ± 66.42 mg/dL) were significantly higher among postmenopausal women meanwhile heart rate (80.07 ± 13.28 pulse/min) and hip circumference (107.89 ± 13.32 cm) were significantly higher in the pre-menopausal group.[31] While (Correa et al.) found the average age was 58.81 (±7.6) years, from 39 to 78 years old. The means of weight and WC were 70.33 kg (±14.00) and 92.14 cm (±12.54) respectively.[32] Another study (Osman et al.) found the mean age of the study people was 53.96 ± 7.5 years,[33] In our study we showed the prevalence of risk factors among study people. The highest prevalence was of high waist circumference235(78.33%), followed by high waist-to-hip ratio 288(76.67%), high waist-to-height ratio 230(76.67%); low HDL 211(70.33%) & elevated fasting blood glucose 139(46.33%), high triglyceride 162(54%); the lowest prevalence of high cholesterol 91(30.33%), hypertension 108(36%), & followed by diabetes Mellitus 114(38%), high blood pressure 120(40%) & BMI 180(60%).[Figure 3] In other study (Ntentie et al.) found an increased prevalence of impaired glucose level (glycemia ≥ 100 mg/dL) (38.7%), diabetes (14.6%), hyperlipidemia (45.0%), high triglycerides level (29.7%), elevated blood pressure (67.9%) and HTN (49.1%) among post-menopausal compared to pre-menopausal women (P < 0.05).[31] In our study the prevalence of BMI was higher in postmenopausal (73.33%) than premenopausal (46.67%) women; We found WC high in postmenopausal (94%) women which more than premenopausal (90.91%); WHR (58%) was found in premenopausal women lower than (94%) postmenopausal women and High WhtR was found 57.33% & 96% in premenopausal and postmenopausal women respectively. [Table 2] In other study (Ben Ali et al.) found that, except for hypertriglyceridemia, the frequency of central obesity, hyperglycemia, high blood pressure, and high total cholesterol level was significantly higher among post-menopausal than pre-menopausal Tunisian women.[34] Another study (Jesmin et al.) noted that prevalence of high blood pressure, elevated fasting blood glucose and high triglycerides level was significantly higher in post-menopausal women than pre-menopausal women (P < 0.05) among rural women in Bangladesh.[30] The correlation between adiposity indices and determinants of MS revealed that BMI & WC was significantly positively correlated with TG, FBS, SBP, and DBP and significantly negatively correlated

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with HDL. WHR was significantly positively correlated with TG, SBP & DBP and significantly negatively correlated with FBS & HDL. WhtR & VAI significantly positively correlated with TG, FBS, SBP & DBP and significantly negatively correlated with HDL. [Table 3] On the other hand other study (Osman et al.) illustrated the correlation between the adiposity indices and individual component of MS, which revealed that LAP, HC, and WC were significantly positively correlated with TG, FBS, SBP, and DBP while significantly negatively correlated with HDL. VAI significantly positively correlated with TG and significantly negatively correlated with HDL. BAI significantly positively correlated with TG, FBS, SBP, and DBP. WHR significantly positively correlated with TG and FBS.[33] In our study we found the prevalence of increased cut-off points of five most common parameters of adiposity indices for diagnosing metabolic syndrome like BMI, WC, WHR, WHtR & VAI was significantly higher in postmenopausal women than premenopausal women. [Figure 4]

Limitations of the study

We could only study the women who visited at the outpatient departments of Bangladesh medical college hospital within a short study period. In our study we did not investigate information about the ovarian function such as premature ovarian insufficiency (POI) as the postmenopausal status was self-reported by the patients. After evaluating once those women we did not follow-up them and have not known other possible interference that may happen in the long term with these women.

CONCLUSIONS

In our study we found a high prevalence of MS in post-menopausal women was significantly higher than pre-menopausal women. Low HDL cholesterol, elevated fasting blood glucose, and high blood pressures were the most frequent features in comparison to the others. Furthermore, the BMI, WC, WHR, WHtR and VAI indices showed a positive correlation with the outcome, and the cut-off points estimated by the graph also showed that the high prevalence in postmenopausal women can be applicable for the prediction of MS diagnosis in Bangladeshi women reaching after menopausal status and they are easily available & affordable to use for clinical purpose. So further study with a prospective and longitudinal study design needs to be done to identify the preventions of MS by health professionals.

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Page No- 51-61 | Section- Research Article (Biochemistry)

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Page No- 51-61 | Section- Research Article (Biochemistry)

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