Original Article

Metabolic Syndrome and Its Association with Menopausal Symptoms among Postmenopausal Women: A Cross-sectional Study

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Abstract

Background: With increase in postmenopausal population, screening for MetS and its relationship with menopausal symptoms needs evaluation. **Objective:** To identify the frequency of metabolic syndrome (MetS) and assess its relationship with menopausal symptoms in postmenopausal women. **Methods:** This was a cross sectional study performed at a tertiary care centre in Uttarakhand India over a period of 18 months. All postmenopausal women >40 years with natural menopause included in the study sample. We used the Consensus Definition IDF and AHA/NHLBI (2009) criteria to classify subjects as having metabolic syndrome. Menopausal symptoms were assessed using Menopause Rating Scale (MRS) questionnaire. **Results:** The frequency of metabolic syndrome in our study was 34.38% (55 out of 160 patients). We observed sleeping problems (36.88%) followed by physical & mental exhaustion (33.75%) and hot flushes (33.13%) to be the commonest menopausal symptoms. Significant association was seen for MRS along with its subscales in women with metabolic syndrome (*P* value <.05). Significant positive correlation was observed between total Menopause rating scale scores as well as all three subscales for triglycerides in patients with metabolic syndrome. **Conclusion:** Hyper triglyceridemia was associated with severe menopausal symptoms among postmenopausal women with MetS in our study.

Keywords: *Menopausal symptoms, menopause, metabolic syndrome*

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Introduction

Increasing life expectancy makes a woman spend nearly one-third of her life being menopausal.[1] In the literature search, it is noted that though 20% of menopausal women remain asymptomatic, mild and severe problems are seen in 60% and 20% of women, respectively.[2] The commonly reported menopausal symptoms include vasomotor, genitourinary, musculoskeletal, and psychological symptoms.[3-5]

Metabolic syndrome (MetS) includes a cluster of metabolic abnormalities involving central obesity, carbohydrate intolerance, dyslipidemia, hypertension, and insulin resistance.[6] Increased abdominal obesity and body fat are commonly seen in postmenopausal women owing to hormonal changes and are known risk factors for MetS.[7] In various regions of our country, the prevalence of MetS ranges from 9.3% to 47.5%.[8] Menopausal transition and postmenopausal status are known to be risk factors for developing MetS, and this increased risk is attributed to declining estrogen levels and increased risk of insulin resistance following menopause.[9,10] Literature search has shown that increased weight gain during mid-life increases the incidence of vasomotor symptoms and urinary, sleep, and joint/muscular symptoms.[7,11] Obesity constitutes one of the key components of MetS. Thurston *et al*. noted an association between increased abdominal adiposity with hot flashes.[12] Gast *et al*. observed an unfavorable cardiovascular risk profile in women with hot flushes as compared to those without vasomotor complaints.[13]

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The previous research suggests a relationship between psychological symptoms (depression and anxiety, urogenital symptoms, and sexual dysfunction) with MetS raising questions on their possible association.[14,15]

With increased life expectancy, there is an obvious increase in the postmenopausal population over these years, and hence, the metabolic abnormalities in postmenopausal women need special attention. These health issues need to be dealt with aggressively in terms of prevention, early detection, and management.

As there is a paucity of data regarding MetS and its association with menopausal symptoms from India, we designed this study to find the frequency of MetS and establish its relationship with menopausal symptoms.

Materials and Methods

This cross-sectional study was conducted in our outpatient department from October 2020 to March 2022. The study received approval from the institutional ethics committee. Women beyond 40 years with natural menopause were selected as the study population. Exclusion criteria included those receiving hormone therapy, history of chemoradiation; prior pelvic surgery involving bilateral oophorectomy and premature menopause. The participants were enrolled after taking informed consent. A history involving their age, parity, and duration of menopause was taken. General physical examinations including anthropometric measurements were recorded. Blood pressure was recorded twice at a gap of 5 min and a mean value was calculated. The blood sample was collected by venepuncture after overnight fasting for lipid profile and fasting plasma glucose.

Menopausal symptoms were assessed using the Menopause Rating Scale (MRS) questionnaire. This scale includes 11 questions and has three subscales: (1) somatic symptoms; (2) psychological symptoms; and (3) urogenital sexual problems. Each item has scores from zero (not present) to four. The sum of the results for each subscale gives the final MRS score.[16]

We used the Consensus Definition International Diabetes Federation and American Heart Association/National Heart, Lung, and Blood Institute (2009) criteria to classify participants as having MetS.[17] A diagnosis of type 2 diabetes or fasting blood sugars beyond 100 mg/dL, hypertension (systolic and/or diastolic blood pressure 130 mmHg), central obesity (waist circumference ≥80 cm), high triglyceride (TG) levels (>150 mg/dL or in treatment), and a decline in high-density lipoprotein cholesterol (50 mg/dL or in treatment) are all indicators of MetS. The presence of any three of the above defines MetS.

Statistical analysis

The data were entered Microsoft EXCEL spreadsheet. The Statistical Package for Social Sciences (SPSS) software, made by IBM, Chicago, Illinois, USA, version 21.0, was used to analyze the results. Categorical variables were taken as numbers, percentage, and quantitative data as the mean ± standard deviation the Kolmogorov–Smirnov test was used to assess data normality. Chi-square test and Spearman rank correlation coefficient were used to identify the association and correlation of parameters with the MRS. Univariate and multivariate linear regression was used to find out significant factors predicting somatic, psychological, urogenital, and total MRS in patients with and without MetS.

Results

There were 55 and 105 women, respectively, with and without MetS. In our study, the prevalence of

Table 1: Baseline characteristics of the study population

Variable	Patients with MetS (*n*=55)	Patients without MetS (*n*=105)	*P*
Age (years)	57.45±8.61	58.15±8.04	0.343‡
Time since menopause (years)	12.82±9.84	13.51±8.35	0.334‡
Parity	3.38±1.69	3.65±1.81	0.293‡
SBP (mmHg)	137.62±15.78	129.37±15.08	0.0004‡
DBP (mmHg)	84.07±10.02	77.96±7.46	<0.0001‡
WC (cm)	84.85±6.99	83.37±5.32	0.353‡
BMI (kg/m^2)	27.3±3.94	25.6±3.7	0.0007‡
FBG (mg/dL)	154.81±28.32	115.09±30.91	<0.0001‡
TG (mg/dL)	212.16±54.05	132.22±47.97	<0.0001‡
TC (mg/dL)	173.11±76.39	152.26±52.6	0.282‡
HDL cholesterol (mg/dL)	38.37±11.88	41.94±14.91	0.186‡
LDL cholesterol (mg/dL)	117.22±32.13	98.42±35.18	0.0003‡

‡Mann–Whitney test. HDL: High-density lipoprotein, LDL: Low-density lipoprotein, MetS: Metabolic syndrome, SBP: Systolic blood pressure, DBP: Diastolic blood pressure, WC: Waist circumference, BMI: Body mass index, FBG: Fasting blood glucose, TG: Triglyceride, TC: Total cholesterol

MetS was 34.38% (55 out of 160 patients). Patients having MetS had significantly higher systolic blood pressure, diastolic blood pressure, fasting blood sugars, TGs, and low-density lipoprotein (LDL)-cholesterol levels [Table 1].

As shown in Table 2, the proportion of patients with somatic complaints was comparable in both groups ($P < 0.05$). Furthermore, the distribution of physical and mental exhaustion was comparable between patients with MetS and patients without MetS (41.82% vs. 29.52%, respectively; $P = 0.118$). Depressive mood, irritability, and anxiety prevalence were significantly higher in the MetS group compared to those without MetS (depressive mood: 34.55% vs. 19.05%, respectively [$P = 0.03$], irritability: 32.73% vs. 16.19%, respectively [$P = 0.016$], and anxiety: 30.91% vs. 9.52%, respectively [$P = 0.0006$]). The distribution of sexual problems and bladder dysfunction was comparable between patients with MetS and patients without MetS. The proportion of patients with vaginal dryness was also higher

Table 2: Association of menopausal symptoms according to the Menopause Rating Scale with metabolic syndrome

Menopausal symptoms	Patients with MetS (*n*=55), *n* (%)	Patients without MetS (*n*=105), *n* (%)	Total	*P*
Somatic				
Hot flushes, sweating	23 (41.82)	30 (28.57)	53 (33.13)	0.091†
Heart discomfort	11 (20)	10 (9.52)	21 (13.13)	0.062†
Sleeping problem	25 (45.45)	34 (32.38)	59 (36.88)	0.104†
Joint and muscular discomfort	14 (25.45)	17 (16.19)	31 (19.38)	0.159†
Total scores	1.45±1.23	0.91±1.04	1.1±1.13	0.002‡
Psychological, mean±SD	1.62±1.52	0.85±1.22	1.11±1.37	0.0003‡
Depressive mood	19 (34.55)	20 (19.05)	39 (24.38)	0.03†
Irritability	18 (32.73)	17 (16.19)	35 (21.88)	0.016†
Anxiety	17 (30.91)	10 (9.52)	27 (16.88)	0.0006†
Physical and mental exhaustion	23 (41.82)	31 (29.52)	54 (33.75)	0.118†
Urogenital, mean±SD	0.87±1.56	0.48±1.21	0.61±1.35	0.001‡
Sexual problems	12 (21.82)	12 (11.43)	24 (15)	0.08†
Bladder dysfunction	11 (20)	10 (9.52)	21 (13.13)	0.062†
Dryness of vagina	15 (27.27)	15 (14.29)	30 (18.75)	0.046†
Total Menopause Rating Scale, mean±SD	3.95±3.14	2.24±2.63	2.82±2.92	<0.0001‡

†Chi-square test, ‡Mann–Whitney test. MetS: Metabolic syndrome, SD: Standard deviation

Table 3: Correlation of the Menopause Rating Scale with various parameters in patients with metabolic syndrome

Variables	Somatic	Psychological	Urogenital	Total MRS
SBP (mmHg)				
Correlation coefficient	−0.093	−0.074	0.053	−0.057
P	0.500	0.590	0.701	0.679
DBP (mmHg)				
Correlation coefficient	0.120	0.018	0.177	0.137
P	0.380	0.899	0.195	0.319
WC (cm)				
Correlation coefficient	0.199	0.171	0.176	0.170
P	0.144	0.212	0.198	0.215
FBG (mg/dL)				
Correlation coefficient	−0.006	0.129	0.128	0.112
P	0.968	0.347	0.352	0.413
TG (mg/dL)				
Correlation coefficient	0.631	0.541	0.504	0.730
P	<0.0001	<0.0001	0.0001	<0.0001
HDL (mg/dL)				
Correlation coefficient	0.013	−0.102	−0.124	−0.020
P	0.925	0.457	0.365	0.887

Spearman rank correlation coefficient. SBP: Systolic blood pressure, DBP: Diastolic blood pressure, WC: Waist circumference, FBG: Fasting blood glucose, TG: Triglyceride, HDL: High-density lipoprotein, MRS: Menopause Rating Scale

Table 4: Correlation of Menopause Rating Scale with various parameters in patients without metabolic syndrome

Variables	Somatic	Psychological	Urogenital	Total MRS
SBP (mmHg)				
Correlation coefficient	−0.142	0.026	−0.120	−0.067
P	0.147	0.790	0.221	0.496
DBP (mmHg)				
Correlation coefficient	−0.143	0.040	−0.032	−0.027
P	0.147	0.685	0.746	0.782
WC (cm)				
Correlation coefficient	0.253	0.128	0.124	0.178
P	0.010	0.195	0.209	0.069
FBG (mg/dL)				
Correlation coefficient	0.064	−0.056	0.107	−0.010
P	0.519	0.572	0.279	0.922
TG (mg/dL)				
Correlation coefficient	0.065	0.010	0.120	−0.001
P	0.512	0.918	0.222	0.995
HDL (mg/dL)				
Correlation coefficient	−0.047	0.023	0.147	0.061
P	0.632	0.813	0.134	0.538

Spearman rank correlation coefficient. SBP: Systolic blood pressure, DBP: Diastolic blood pressure, WC: Waist circumference, FBG: Fasting blood glucose, TG: Triglyceride, HDL: High density lipoprotein, MRS: Menopause Rating Scale

in patients with MetS compared to those without MetS. (Dryness of vagina: 27.27% vs. 14.29%, respectively [$P = 0.046$]). A significant association was seen in terms of the MRS as well as its subscales in women with MetS ($P < 0.05$).

A significant positive correlation was seen between total MRS scores as well as all three subscales for TGs in patients with MetS [Table 3].

A significant positive correlation was seen between somatic with waist circumference, with a correlation coefficient of 0.253 [Table 4].

We performed a univariate followed by multivariate linear regression model to identify factors related to higher MRS scores (total and subscales). Data are presented in Supplementary Tables 1 and 2. For patients with MetS, TG was a significant independent risk factor for both somatic and urogenital subscale. TG and total cholesterol (TC) both were significant independent risk factors for predicting higher psychological and total MRS scores in women with MetS. For women without MetS, fasting blood glucose and LDL were significant independent risk factors for somatic and psychological subscale variables respectively after adjusting for confounding factors. However, none of the variables were found to be independent significant risk factors for the urogenital subscale and total MRS ($P > 0.05$) in those without MetS.

Discussion

This study aimed to identify the frequency of MetS in postmenopausal women and assessed its relationship with menopausal symptoms based on the MRS. In our study, the prevalence of MetS was 34.38% (55 out of 160 women). Contrary to the present study, Srimani *et al*. in their cross-sectional study of 222 postmenopausal women from the rural area of West Bengal India reported a 46% prevalence of MetS.[18] In another study from Southern India involving 154 postmenopausal women, the prevalence of MetS was found to be 64%.[19] Just like variability in the prevalence of MetS among Indian authors, the frequency also varies in the Western population. Trompeter *et al*. in their study involving 376 postmenopausal women found that 41.5% had MetS based on NCEP ATP III criteria.[20] Unlike theirs, Lee *et al*. reported the prevalence to be 35% which was comparable to our study.[21] Hallajzadeh *et al*. conducted a review and meta-analysis on 112 cross-sectional studies. The authors concluded that there was a 37.17% pooled prevalence of MetS among postmenopausal women (95% confidence interval [CI]: 35.00%–39.31%), with variations between 13.60% (95% CI 13.55%–13.64%) and 46.00% (95% CI 1.90%–90.09%), based on usage of different diagnostic criteria.[22] We can observe that the prevalence varies, and the most likely causes of these variances include the adoption of various diagnostic criteria for MetS, the type of menopause (natural or surgical), the environment, socioeconomic distinctions, genetic susceptibility, and alterations in lifestyle.

Menopausal symptoms are a major concern of postmenopausal women. Hot flashes, night sweats, sleep issues, frequent urination, dry vagina, poor

memory, anxiety, and sadness are among the symptoms that are frequently observed. In our study, sleeping problems (36.88%) followed by physical and mental exhaustion (33.75%) and hot flushes (33.13%) were the commonly noted menopausal symptoms. Menopausal women have various issues related to sleep such as difficulty in falling asleep, night-time awakening, the inability to resume sleep, daytime sleepiness, and fractioned sleep.[23,24] Although the exact etiology of sleep disorders following menopause remains unclear but aging, nocturnal hot flashes, and sweating attributed to changing hormone patterns remain possible causes. Estrogen results in shorter sleep latency with increased number and duration of rapid eye movement (REM) sleep phase. Declining estrogen during the menopausal transition prolongs sleep latency and shortens REM sleep resulting in tiredness after waking.[25,26] The prevalence of sleep issues during menopause varies ranging from 35% to 60%.[27] In another Indian study involving 252 postmenopausal women from a rural area of New Delhi, sleep disturbances, muscle or joint pain, hot flushes, and night sweats were the most common symptoms seen in 62.7%, 59.1%, 46.4%, and 45.6%, respectively.[28] Unlike ours wherein sleeping problems were the commonest complaint, Chedraui *et al*. in their analysis of 204 postmenopausal women found that muscle and joint problems (87.2%), physical and mental exhaustion (72%), and irritability (67.1%) were the top three presenting symptoms.[29]

Unlike ours where no difference was noted in terms of vasomotor symptoms between the two groups, Lee *et al*. in their study of 183 postmenopausal women found vasomotor symptoms to be significantly higher in the MetS group compared to non-MetS group (75% vs. 60.1%, respectively; $P = 0.034$). Similarly, they also observed a lower frequency of depressive symptoms in the MetS group than in the non-MetS group (50% vs. 63.9%, respectively; $P = 0.049$) which was contradictory to our results.[21] We observed that the scores of total MRS and its subscales were significantly higher in the MetS group as compared to those without MetS but unlike ours, Cengiz *et al*. found psychological subscale and psychological subscale scores to be higher in the MetS group.[15] Similarly, Lee *et al*. noted the total MRS and somatic subscale scores to be significantly higher in the MetS group ($P = 0.021$, $P = 0.043$, respectively).[21]

In our study, the total MRS scores and its three subscales had a significant positive correlation for TGs in patients with MetS. Unlike ours, Cengiz et demonstrated a positive correlation between abdominal circumference, systolic-diastolic BP, and triglycerides with the total MRS.[15] Similarly, Lee *et al*. Noted that there was a positive correlation between high TG levels with somatic subscale ($P = 0.044$) but other components demonstrated no significant correlation ($P < 0.05$).[21]

In our study, on performing the final multivariate linear analysis to identify factors related to higher MRS (total as well as subscales), TG was seen to be an independent significant risk factor for total MRS and its subscales in women with MetS. TC was also an independent risk factor for total MRS and psychological subscale. Cengiz *et al*. also demonstrated a similar positive association of TGs with psychological subscale but they also found a significant positive correlation between AC and urogenital subscale ($P = 0.008$) which was not seen in our study.[15] Just like ours, Lee *et al*. also found TGs to be associated with total somatic subscale score.[21] We assume that this different association between MRS and components of MetS could be partly attributed to the diverse ethnicity, sociodemographic and cultural variation seen with different populations.

The main limitation of this study was being a cross-sectional study. Moreover, as it involves women from a single center; hence, it is not feasible to generalize the results to the rest of the country. Despite this potential limitation, it is important to mention that there are very few studies analyzing the association of menopausal symptoms with MetS.

Conclusion

This study showed that depressive mood, irritability, anxiety, and vaginal dryness were significantly higher in menopausal patients with MetS compared to those without MetS. Although MetS was observed in a lower frequency, hypertriglyceridemia was associated with more severe menopausal symptoms among postmenopausal women in our study. Menopausal status is itself a risk factor for developing MetS. With increased life expectancy, the population of menopausal women has increased; hence, it becomes essential to establish the relationship of menopausal symptoms with MetS and its components to prevent long-term cardiovascular events.

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Conflicts of interest

There are no conflicts of interest.

References

1. Vaze N, Joshi S. Yoga and menopausal transition. J Midlife Health 2010;1:56-8.
2. Tumbull S. Yoga as a treatment for menopausal symptoms. J Yoga Ontogenet Therap Investig 2010;2:14-5.
3. Dalal PK, Agarwal M. Postmenopausal syndrome. Indian J Psychiatry 2015;57:S222-32.

4. Santoro N, Epperson CN, Mathews SB. Menopausal symptoms and their management. Endocrinol Metab Clin North Am 2015;44:497-515.
5. Kołodyńska G, Zalewski M, Rożek-Piechura K. Urinary incontinence in postmenopausal women – Causes, symptoms, treatment. Prz Menopauzalny 2019;18:46-50.
6. National Cholesterol Education Program (NCEP) Expert Panel on Detection, Evaluation, and Treatment of High Blood Cholesterol in Adults (Adult Treatment Panel III). Third Report of the national cholesterol education program (NCEP) Expert panel on detection, evaluation, and treatment of high blood cholesterol in adults (adult treatment panel III) final report. Circulation 2002;106:3143-421.
7. Fernández-Alonso AM, Cuadros JL, Chedraui P, Mendoza M, Cuadros AM, Pérez-López FR. Obesity is related to increased menopausal symptoms among Spanish women. Menopause Int 2010;16:105-10.
8. Mangat C, Goel NK, Walia DK, Agarwal N, Sharma MK, Kaur J, *et al.* Metabolic syndrome: A challenging health issue in highly urbanized union territory of North India. Diabetol Metab Syndr 2010;2:19.
9. Rajewska J, Rybakowski JK. Depression in premenopausal women: Gonadal hormones and serotonergic system assessed by D-fenfluramine challenge test. Prog Neuropsychopharmacol Biol Psychiatry 2003;27:705-9.
10. Sullivan NR, Crane JW, Damjanoska KJ, Carrasco GA, D'Souza DN, Garcia F, *et al.* Tandospirone activates neuroendocrine and ERK (MAP kinase) signaling pathways specifically through 5-HT1A receptor mechanisms *in vivo*. Naunyn Schmiedebergs Arch Pharmacol 2005;371:18-26.
11. Pérez-Roncero GR, Martínez-Dearth R, López-Baena MT, Ornat-Clemente L. Menopause-related symptoms in middle-aged women residing in the Zaragoza province. Enferm Clin 2013;23:252-61.
12. Thurston RC, Sowers MR, Sutton-Tyrrell K, Everson-Rose SA, Lewis TT, Edmundowicz D, *et al.* Abdominal adiposity and hot flashes among midlife women. Menopause 2008;15:429-34.
13. Gast GC, Grobbee DE, Pop VJ, Keyzer JJ, Wijnands-van Gent CJ, Samsioe GN, *et al.* Menopausal complaints are associated with cardiovascular risk factors. Hypertension 2008;51:1492-8.
14. Pérez-Herrezuelo I, Aibar-Almazán A, Martínez-Amat A, Fábrega-Cuadros R, Díaz-Mohedo E, Wangensteen R, *et al.* Female sexual function and its association with the severity of menopause-related symptoms. Int J Environ Res Public Health 2020;17:7235.
15. Cengiz H, Kaya C, Suzen Caypinar S, Alay I. The relationship between menopausal symptoms and metabolic syndrome in postmenopausal women. J Obstet Gynaecol 2019;39:529-33.
16. Hauser GA, Huber IC, Keller PJ, Lauritzen C, Schneider HP. Evaluation of climacteric symptoms (Menopause Rating Scale). Zentralbl Gynakol 1994;116:16-23.
17. Alberti KG, Eckel RH, Grundy SM, Zimmet PZ, Cleeman JI, Donato KA, *et al.* Harmonizing the metabolic syndrome: A joint interim statement of the international diabetes federation task force on epidemiology and prevention; national heart, lung, and blood institute; American Heart Association; World Heart Federation; International Atherosclerosis Society; and international association for the study of obesity. Circulation 2009;120:1640-5.
18. Srimani S, Saha I, Chaudhuri D. Prevalence and association of metabolic syndrome and vitamin D deficiency among postmenopausal women in a rural block of West Bengal, India. PLoS One 2017;12:e0188331.
19. Jeyasheela K, Ebenezer ED, Londhe V, Paul TV, Yadav B, Kekre AN. Prevalence of metabolic syndrome among postmenopausal women in South India. Int J Reprod Contracept Obstet Gynecol 2018;7:2364-70.
20. Trompeter SE, Bettencourt R, Barrett-Connor E. Metabolic syndrome and sexual function in postmenopausal women. Am J Med 2016;129:1270-7.e1.
21. Lee SW, Jo HH, Kim MR, Kwon DJ, You YO, Kim JH. Association between menopausal symptoms and metabolic syndrome in postmenopausal women. Arch Gynecol Obstet 2012;285:541-8.
22. Hallajzadeh J, Khoramdad M, Izadi N, Karamzad N, Almasi-Hashiani A, Ayubi E, *et al.* Metabolic syndrome and its components in premenopausal and postmenopausal women: A comprehensive systematic review and meta-analysis on observational studies. Menopause 2018;25:1155-64.
23. Freedman RR. Hot flashes: Behavioral treatments, mechanisms, and relation to sleep. Am J Med 2005;118 Suppl 12B:124-30.
24. Xu H, Thurston RC, Matthews KA, Bryce CL, Hays RD, Kapoor WN, *et al.* Are hot flashes associated with sleep disturbance during midlife? Results from the STRIDE cohort study. Maturitas 2012;71:34-8.
25. Eichling PS, Sahni J. Menopause related sleep disorders. J Clin Sleep Med 2005;1:291-300.
26. Scharf MB, McDannold MD, Stover R, Zaretsky N, Berkowitz DV. Effects of estrogen replacement therapy on rates of cyclic alternating patterns and hot-flush events during sleep in postmenopausal women: A pilot study. Clin Ther 1997;19:304-11.
27. Kravitz HM, Joffe H. Sleep during the perimenopause: A SWAN story. Obstet Gynecol Clin North Am 2011;38:567-86.
28. Singh A, Pradhan SK. Menopausal symptoms of postmenopausal women in a rural community of Delhi, India: A cross-sectional study. J Midlife Health 2014;5:62-7.
29. Chedraui P, Hidalgo L, Chavez D, Morocho N, Alvarado M, Huc A. Menopausal symptoms and associated risk factors among postmenopausal women screened for the metabolic syndrome. Arch Gynecol Obstet 2007;275:161-8.

Supplementary Table 1: Univariate linear regression analysis showing factors predicting higher menopausal symptoms in patients with metabolic syndrome

Variable	Beta coefficient	SE	*P*	Lower bound (95%)	Upper bound (95%)
Somatic subscale					
Age	0.010	0.020	0.615	–0.029	0.049
SBP	−0.007	0.011	0.540	–0.028	0.015
DBP	0.011	0.017	0.518	–0.023	0.045
WC	0.037	0.024	0.127	–0.011	0.084
TG*	0.014	0.003	<0.0001	0.009	0.019
TC*	0.005	0.002	0.030	0.000	0.009
HDL	0.011	0.014	0.440	–0.017	0.039
FBS	0.000	0.006	0.959	−0.012	0.012
LDL	0.002	0.005	0.708	−0.009	0.013
Psychological subscale					
Age	0.029	0.024	0.230	−0.019	0.077
SBP	−0.003	0.013	0.819	−0.030	0.023
DBP	0.002	0.021	0.933	−0.040	0.044
WC	0.042	0.029	0.157	−0.017	0.101
TG*	0.013	0.003	0.0003	0.006	0.020
TC*	0.007	0.003	0.010	0.002	0.012
HDL	−0.014	0.017	0.431	–0.049	0.021
FBS	0.005	0.007	0.478	–0.009	0.020
LDL	−0.003	0.006	0.593	–0.016	0.010
Urogenital subscale					
Age	0.035	0.024	0.156	–0.014	0.084
SBP	0.006	0.014	0.678	–0.022	0.033
DBP	0.022	0.021	0.304	–0.021	0.065
WC	0.010	0.031	0.750	–0.052	0.071
TG	0.010	0.004	0.007	0.003	0.018
TC	0.004	0.003	0.108	–0.001	0.010
HDL	−0.006	0.018	0.754	–0.042	0.031
FBS	0.008	0.008	0.277	–0.007	0.023
LDL	0.000	0.007	0.947	–0.013	0.014
Total MRS score					
Age	0.074	0.049	0.135	–0.024	0.172
SBP	−0.004	0.027	0.885	–0.059	0.051
DBP	0.035	0.043	0.420	−0.051	0.120
WC	0.089	0.060	0.149	−0.033	0.210
TG*	0.037	0.006	<0.0001	0.025	0.050
TC*	0.016	0.005	0.003	0.006	0.026
HDL	−0.009	0.036	0.814	−0.081	0.064
FBS	0.014	0.015	0.364	−0.016	0.04
LDL	−0.001	0.013	0.937	−0.028	0.026

The univariate linear regression model followed by multivariate analysis (for those marked as *) for factors related to higher menopausal symptoms in patients having MetS. TG was significantly independent risk factor for both somatic and urogenital subscale. TG and TC both were significantly independent risk factors for predicting higher psychological and total MRS scores. HDL: High density lipoprotein, LDL: Low density lipoprotein, SBP: Systolic blood pressure, DBP: Diastolic blood pressure, WC: Waist circumference, FBS: Fasting blood sugar, TG: Triglyceride, SE: Standard error, MRS: Menopause Rating Scale, TC: Total cholesterol, MetS: Metabolic syndrome

Supplementary Table 2: Univariate linear regression analysis showing factors predicting higher menopausal symptoms in patients without metabolic syndrome

Variable	Beta coefficient	SE	*P*	Lower bound (95%)	Upper bound (95%)
Somatic subscale					
Age	0.005	0.013	0.695	−0.020	0.030
SBP	−0.011	0.007	0.090	−0.025	0.002
DBP	−0.019	0.014	0.164	−0.046	0.008
WC*	0.055	0.018	0.003	0.019	0.092
TG	0.004	0.002	0.058	0.000	0.008
TC*	0.007	0.002	0.0001	0.004	0.011
HDL	−0.001	0.007	0.936	−0.014	0.013
FBS*	0.009	0.003	0.004	0.003	0.016
LDL*	0.012	0.003	<0.0001	0.007	0.017
Psychological subscale					
Age	0.004	0.015	0.801	−0.026	0.033
SBP	−0.006	0.008	0.450	−0.022	0.010
DBP	0.001	0.016	0.928	−0.030	0.033
WC	0.025	0.022	0.264	−0.019	0.069
TG*	0.005	0.002	0.046	0.000	0.010
TC*	0.006	0.002	0.004	0.002	0.011
HDL	0.010	0.008	0.234	−0.006	0.025
FBS	0.005	0.004	0.167	−0.002	0.013
LDL*	0.014	0.003	<0.0001	0.007	0.020
Urogenital subscale					
Age	−0.013	0.015	0.379	−0.042	0.016
SBP	−0.011	0.008	0.181	−0.026	0.005
DBP	−0.014	0.016	0.387	−0.045	0.018
WC	0.006	0.022	0.792	−0.038	0.050
TG	0.001	0.002	0.802	−0.004	0.006
TC*	0.005	0.002	0.017	0.001	0.010
HDL*	0.016	0.008	0.041	0.001	0.032
FBS	0.002	0.004	0.544	−0.005	0.010
LDL	0.006	0.003	0.070	−0.001	0.013
Total MRS score					
Age	−0.004	0.032	0.894	−0.068	0.060
SBP	−0.028	0.017	0.102	0.062	0.006
DBP	−0.031	0.035	0.365	−0.100	0.037
WC	0.086	0.048	0.074	−0.009	0.181
TG	0.010	0.005	0.074	−0.001	0.020
TC*	0.019	0.005	<0.0001	0.010	0.028
HDL	0.025	0.017	0.146	−0.009	0.059
FBS*	0.017	0.008	0.040	0.001	0.033
LDL*	0.031	0.007	<0.0001	0.018	0.045

The univariate linear regression model followed by multivariate analysis (for those marked as *) for factors related to higher menopausal symptoms in patients without MetS. On performing multivariate regression, FBG and LDL were significant independent risk factors for somatic and psychological subscale variable respectively after adjusting for confounding factors. However, none of the variable were found to be independent significant risk factor for urogenital subscale and total MRS ($P>0.05$). HDL: High density lipoprotein, LDL: Low density lipoprotein, SBP: Systolic blood pressure, DBP: Diastolic blood pressure, WC: Waist circumference, FBS: Fasting blood sugar, TG: Triglyceride, SE: Standard error, MRS: Menopause Rating Scale, TC: Total cholesterol, FBG: Fasting blood glucose, MetS: Metabolic syndrome