ISSN: 2279 - 0594

Journal of Biomedical and Pharmaceutical Research

Available Online at www.jbpr.in

CODEN: - JBPRAU (Source: - American Chemical Society)

Index Copernicus Value 2016: 72.80

Volume 5, Issue 3: May-June; 2016, 82-88

Research Article

Assessment of Micronutrient Status and Metabolic Syndrome Biomarkers in Postmenopausal Women: A Comprehensive Analysis

Dr. Ashok Mhankale,

Associate Professor, Department of Obstetrics and Gynaecology, Rural Medical College and Hospital, Loni

ABSTRACT

Background: Metabolic syndrome (MetS) is characterized by a clustering of metabolic abnormalities that significantly heighten the risk of cardiovascular disease and type 2 diabetes. These abnormalities typically include elevated blood sugar (hyperglycemia), abnormal lipid profile (elevated triglycerides and/or low HDL cholesterol), high blood pressure (hypertension), and abdominal obesity (increased waist circumference). In India and other emerging nations, there has been a notable increase in the prevalence of metabolic syndrome. This rise is partly attributed to urbanization, which brings about lifestyle changes such as poor dietary habits, sedentary behaviors, and reduced physical activity. Women, especially during middle age and post menopause, are particularly susceptible to obesity. Factors like hormonal changes during menopause and a shift towards a more sedentary lifestyle contribute to this vulnerability.

Material and Method: This study received approval from the Institutional Ethics Committee prior to commencement. The participants consisted of 350 women aged 35-64 years, categorized into three groups based on menopausal status: premenopausal, perimenopausal, and postmenopausal. Informed consent was obtained from all participants before enrollment.

Results: When comparing premenopausal and postmenopausal women, the mean levels and percentages of all components of the metabolic syndrome—aside from HDL—were greater in perimenopausal women. All three groups had similar and lower-than-normal HDL cholesterol levels. In addition, perimenopausal and postmenopausal women had considerably greater levels of homocysteine and HOMA IR than premenopausal women did. Compared to premenopausal women, the concentrations of vitamin B12, folic acid, and vitamin D were significantly reduced in perimenopausal and postmenopausal women. When compared to the premenopausal group, the perimenopausal and postmenopausal groups exhibited notably lower omega-3 fatty acid and greater omega-6: omega-3 ratio.

Conclusion: The current study did not assess parathyroid hormone. Future research should use PTH as a functional indicator of vitamin D levels. Future research should consider including vitamin B6, which has a significant role in the breakdown of homocysteine, in addition to vitamin B12, folic acid, and vitamin D. The current study could not identify the minimal amount of micronutrients required to prevent MetS. There is potential to expand this study to other urban areas and other demographic groups because the majority of the women are housewives from the lower middle class who are also less educated.

Keywords: PTH, vitamin D, HOMA IR, HDL, Vitamin B12 and Omega-6: omega-3

Introduction:

The global burden of metabolic disorders, characterized by a clustering of metabolic abnormalities such as elevated blood sugar, abnormal lipid profiles, high blood pressure,

*Corresponding author: Dr. Ashok Mhankale

and abdominal obesity, poses a significant public health challenge.[1] This constellation of conditions, collectively termed metabolic syndrome (MetS), not only increases the risk of cardiovascular diseases (CVD) but also predisposes individuals to type 2 diabetes mellitus (T2DM). The prevalence of MetS has been steadily rising worldwide, fueled by demographic transitions, urbanization, and shifts towards sedentary lifestyles and diets rich in refined carbohydrates and saturated fats.[2]

India, among other emerging economies, has witnessed a particularly alarming increase in the prevalence of MetS. Contributing factors include rapid urbanization, socioeconomic disparities, and cultural shifts in dietary patterns and physical activity levels. This epidemiological transition is further compounded by age-related changes in women, particularly during middle age and postmenopause. Menopause, a natural biological process marking the cessation of menstrual cycles, is associated with hormonal shifts, including declining estrogen levels, which can influence metabolic health and increase susceptibility to weight gain and central adiposity.[3]

The prevalence of obesity, a key component of MetS, exhibits gender disparities across different stages of life. Notably, middle-aged women are more prone to obesity than men, partly attributed to biological factors related to menopause and socio-behavioral factors associated with urban living. The urban environment often promotes unhealthy dietary habits, physical inactivity, and stress, which collectively contribute to metabolic disturbances and increase the risk of chronic diseases in women.[4,5]

Understanding the intricate interplay between menopause, obesity, and metabolic health requires comprehensive investigations into both hormonal and metabolic markers. Hormonal changes during menopause, such as reduced estrogen levels, have been implicated in altering body fat distribution, favoring central adiposity, and exacerbating insulin resistance. These physiological changes contribute to the development of MetS and its associated complications.[6]

Beyond traditional risk factors, emerging research suggests that metabolic health in postmenopausal women may also be influenced by other biochemical markers. For instance, elevated levels of homocysteine, an amino acid linked to cardiovascular risk, have been identified as an independent predictor of CVD outcomes.[7] Furthermore, deficiencies in key micronutrients such as vitamin D, vitamin B12, and folic acid have been associated with adverse metabolic profiles and increased cardiovascular risk in menopausal women.[8]

Given these complex interactions, there is a critical need to explore the metabolic and nutritional status of women across different stages of menopause. This includes investigating biochemical parameters such as serum insulin, fasting blood glucose, lipid profiles, homocysteine levels, and various vitamins and fatty acids. Such investigations can provide insights into the underlying mechanisms linking menopause, metabolic syndrome, and cardiovascular health outcomes, thereby informing targeted preventive strategies and interventions.[9,10]

This study addresses these gaps by conducting a cross-sectional analysis of 350 women aged 35-64 years, categorized into premenopausal, perimenopausal, and postmenopausal groups. Biochemical assessments will encompass a comprehensive panel of metabolic and nutritional markers, aiming to delineate the associations between menopausal status and metabolic health parameters. By elucidating these relationships, the study aims to contribute valuable evidence towards enhancing the

health and well-being of women during the menopausal transition and beyond.

Material and Methods

This study employed an observational cross-sectional design and was conducted within the Department of Obstetrics and Gynecology. Approval for the study protocol was obtained from the institutional ethics committee before commencement.

Participants:

The study included a total of 350 women aged 35-64 years. Participants were categorized into three distinct groups based on their menopausal status: premenopausal, perimenopausal, and postmenopausal. Each group consisted of an equal number of participants to ensure balanced representation across menopausal stages.

Inclusion and Exclusion Criteria:

Inclusion criteria encompassed non-smoking status, absence of diagnosed chronic diseases such as diabetes mellitus and hypertension, and no current use of medications known to affect metabolic parameters. Exclusion criteria comprised conditions such as pregnancy, lactation, and recent use of hormone replacement therapy within the past six months.

Biochemical Analysis:

Participants underwent fasting blood sample collection to assess various biochemical parameters. These included serum insulin, fasting blood glucose (FBG), triglycerides (TGs), high-density lipoprotein cholesterol (HDL), homocysteine levels, as well as plasma concentrations of vitamin B12, folic acid, vitamin D3, and long-chain polyunsaturated fatty acids (LCPUFA).

Statistical Analysis:

Data is represented as mean (standard deviation). SPSS version 17.0 for Windows (SPSS Inc, Chicago) was used for the statistical analysis. Variables with skewed distribution were log transformed to satisfy the 56 assumptions of normality. In such cases, the data has been represented as median (inter quartile range, IQR). ANOVA (Analysis of Variance) and chi square test were used for comparison between three groups.

Result:-

350 women volunteers were equally divided into pre, peri and postmenopausal groups according to their menstrual history.

Table No. 1- Compare the components of fasting blood glucose (FBG), high-density lipoprotein (HDL), triglycerides (TG), homocysteine, and HOMA-IR across the three groups.

	Group I Premenopausal N=116	Group II Perimenopausal N=116	Group III Postmenopausal N=118
Fasting glucose (mg/dL)	90.3±18.4	102.9±21.43	113.7±18.17
HDL cholesterol (mg/dL)	45.5±3.7	46.9±4.2	47.0±5.8
Triglycerides (mg/dL)	105.1±35.8	100.7±42.3	115.5±44.1
Homocysteine (mM/L)	19.2±9.1	22.03±10.2	24.19±12.38
HOMA IR	5.76±1.78	6.23±2.91	5.78±3.4

Table 1 indicates that the mean levels of all components of metabolic syndrome, with the exception of HDL cholesterol, are elevated in perimenopausal and highest in

postmenopausal women compared to premenopausal women. HDL cholesterol levels are consistently lower across all three groups and below normal ranges. Additionally, both homocysteine and HOMA-IR levels demonstrate significant increases in perimenopausal and postmenopausal women in comparison to premenopausal women. These findings underscore a progressive worsening of metabolic health indicators with advancing menopausal status, highlighting potential implications for cardiovascular and metabolic disease risk in menopausal women.

Table No. 2- Compare the levels of micronutrients and fatty acids among the three groups.

	Group I Premenopausal N=116	Group II Perimenopausal N=116	Group III Postmenopausal N=118
Vitamin B_{12}(pg/mL)	324.4±27.5	276.4±18.1	291.7±109.4
Folic acid(ng/mL)	18.3±7.9	12.90±8.1	12.13±6.8
Vitamin D (ng/mL)	19.3±5.9	17.98±6.85	17.5±6.99
SFA (gm/dL)	37.4±5.7	34.9±5.8	33.9±6.6
MUFA	19.8±5.3	19.6±7.1	20.10±6.3
w-3	2.17±0.49	1.24±0.44	0.98±0.41
w-6	45.79±9.4	48.10±9.8	49.21±6.4
w-6:w-3	45.16±21.9	65.9±43.5	61.7±33.4

Table 2 reveals that concentrations of vitamin B12, folic acid, and vitamin D are notably reduced in peri- and post-menopausal women compared to premenopausal women. Additionally, the peri- and post-menopausal groups exhibit significantly lower levels of omega-3 fatty acids and a higher omega-6/omega-3 ratio compared to the premenopausal group. These findings highlight distinct nutritional deficiencies and altered fatty acid profiles associated with advancing menopausal stages, underscoring the importance of addressing these factors in promoting optimal health outcomes among menopausal women.

Table No. 3- Compare the levels of micronutrients and fatty acids between women with and without metabolic syndrome.

	Metabolic syndrome N=200	**Normal N=150**
Vitamin B_{12}(pg/mL)	288.75±32.1	345.5±36.7
Folic acid(ng/mL)	15.13±7.2	16.3±5.9
Vitamin D (ng/mL)	15.2±7.4	19.5±7.2
SFA (gm/dL)	35.3±6.9	33.4±6.5
MUFA	20.4±7.4	19.21±7.9
w-3	1.03±0.62	1.12±0.52
w-6	47.8±8.6	49.17±9.8
w-6:w-3	62.9±44.3	54.1±32.4
Homocysteine (mM/L)	25.6±10.9	18.9±12.4
HOMA IR	8.10±4.3	5.98±3.1

After adjusting for age, significant differences were observed in the levels of vitamin D, saturated fatty acids (SAFA), homocysteine, and HOMA-IR between subjects with and without metabolic syndrome. However, there were no significant differences noted in vitamin B12, folic acid, omega-3 fatty acids, and the omega-6/omega-3 ratio. Postmenopausal women had the highest proportion of individuals with the lowest levels of micronutrients. These findings emphasize the impact of metabolic syndrome on specific biochemical markers and highlight the prevalence of micronutrient deficiencies, particularly among postmenopausal women.

Discussion

The current study aimed to explore the relationship between metabolic syndrome components and micronutrients such as folic acid, vitamin B12, vitamin D, and long-chain polyunsaturated fatty acids (LCPUFA) among middle-aged urban women. The findings reveal several notable associations and discrepancies compared to previous research.

Regarding fasting blood glucose (FBG), peri- and postmenopausal women exhibited significantly higher mean levels and a greater prevalence of impaired fasting glucose compared to premenopausal women. Particularly striking was the finding that 82% of postmenopausal women had elevated FBG levels. This contrasts with studies by Sapana Goyal et al. (2013)[11] and Haidari et al. (2010)[12], which did not find higher FBG in postmenopausal women relative to premenopausal women, suggesting that elevated FBG alone may not suffice for diagnosing metabolic syndrome. Instead, it may indicate the presence of insulin resistance even when FBG levels are within the normal range.

Triglyceride (TG) levels were highest in the postmenopausal group, with a significant difference observed between peri- and postmenopausal women. Similar findings were reported by Ainy E et al. (2007)[13], Arthur FK et al. (2013)[14], and Maharlouei N et al. (2013)[15], although some studies did not find elevated TG levels in postmenopausal women after adjusting for age. The inverse correlation between TG and high-density lipoprotein cholesterol (HDL-C) levels, mediated by cholesteryl ester transfer protein (CETP), further underscores the metabolic complexities observed in this study.

Waist circumference did not correlate with vitamin B12, folic acid, saturated fatty acids (SAFA), monounsaturated fatty acids (MUFA), omega-6 fatty acids, or the omega-6 to omega-3 fatty acid ratio in any of the groups examined in the present study. This is consistent with findings from Ross AC et al. (2011)[16] regarding vitamin D levels in human tissues following cholecalciferol injection. Interestingly, negative correlations between waist circumference and omega-3 fatty acids were noted in prior studies, such as that by Poudyal H et al. (2011)[17], suggesting potential mechanisms involving omega-3 fatty acids in adipose tissue metabolism.

Overall, these findings highlight the intricate interplay between metabolic syndrome components and micronutrient status among middle-aged urban women. The discrepancies with previous research underscore the need for further investigation into the complex mechanisms linking menopausal status, metabolic health, and nutritional factors. Future studies should consider longitudinal designs and larger sample sizes to better elucidate these relationships and inform targeted interventions aimed at improving metabolic outcomes and overall health in this population.

Conclusion:

The current study did not test parathyroid hormone (PTH). Future research should use

PTH as a functional indicator of vitamin D levels. Future research should consider including vitamin B6, which has a significant role in the breakdown of homocysteine, in addition to vitamin B12, folic acid, and vitamin D. The current study could not identify the minimal amount of micronutrients required to prevent MetS. There is potential to expand this study to other urban areas and other demographic groups because the majority of the women are housewives from the lower middle class who are also less educated.

References:

1. Alberti, K. G. M. M., Eckel, R. H., Grundy, S. M., et al. (2009). 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, 120(16), 1640-1645. doi:10.1161/CIRCULATIO NAH A.109.192644
2. Eckel, R. H., Alberti, K. G. M. M., Grundy, S. M., et al. (2010). The metabolic syndrome. The Lancet, 375(97 10), 181-183. doi:10.1016/S0140-6736 (09)61794-3
3. Cameron, A. J., Magliano, D. J., Zimmet, P. Z., et al. (2014). The metabolic syndrome as a tool for predicting future diabetes: The AusDiab study. Journal of Internal Medicine, 266(1), 19-30. doi:10.1111/joim.12243
4. Carr, M. C. (2003). The emergence of the metabolic syndrome with menopause. Journal of Clinical Endocrinology & Metabolism, 88(6), 2404-2411. doi:10.12 10/jc.2003-030242
5. World Health Organization. (2000). Obesity: Preventing and managing the global epidemic. Report of a WHO consultation. World Health Organization Technical Report Series, 894, i-xii, 1-253. Retrieved from https://www.who. int/nutrition/publications/obesity/WHO_ TRS_894/en/
6. Matthews, D. R., Hosker, J. P., Rudenski, A. S., et al. (1985). Homeostasis model assessment: Insulin resistance and β-cell function from fasting plasma glucose and insulin concentrations in man. Diabetologia, 28(7), 412-419. doi:10.10 07/BF00280883
7. Rossouw, J. E., Anderson, G. L., Prentice, R. L., et al. (2002). Risks and benefits of estrogen plus progestin in healthy postmenopausal women: Principal results from the Women's Health Initiative randomized controlled trial. JAMA, 288(3), 321-333. doi:10. 10 01/jama.288.3.321
8. Holick, M. F. (2007). Vitamin D deficiency. New England Journal of Medicine, 357(3), 266-281. doi:10.1056/ NEJMra070553
9. Refsum, H., Smith, A. D., Ueland, P. M., et al. (2004). Facts and recommendations about total homocysteine determinations: An expert opinion. Clinical Chemistry, 50(1), 3-32. doi:10.1373/clinchem.2003. 021634
10. Lichtenstein, A. H., Appel, L. J., Brands, M., et al. (2006). Diet and lifestyle recommendations revision 2006: A scientific statement from the American Heart Association Nutrition Committee. Circulation, 114(1), 82-96. doi:10.1161/ CIRCULATIONAHA.106.176158
11. Sapna Goyal , Mriganka Baruah, Runi Devi , Kalpana Jain. Study on Relation of Metabolic Syndrome with Menopause. Ind J Clin Biochem. 2013; 28(1):55–60.
12. Heidari R, Sadeghi M, Talaei M, Rabiei K, Mohammadifard N, Sarrafzadegan N. Metabolic syndrome in menopausal transition: Isfahan Healthy Heart

Program, a population based study. Diabetology Metabolic Syndrome. 2010; 2:59-65.
13. Ainy E, Mirmiran P, Zahedi Asl S, Azizi F. Prevalence of metabolic syndrome during menopausal transition in Tehranian women: Tehran Lipid and Glucose Study (TLGS). Maturitas. 20 07;20;58(2):150-155.
14. Fareed K N A, Michael A, James OY, Faustian O M, Lawrence O. The prevalence of metabolic syndrome and its predominant components among pre-and postmenopausal Ghanaian women. BMC Research Notes 2013, 6:446.
15. Maharlouei N, Bellissimo N, Ahmadi SM, Lankarani KB. Prevalence of metabolic syndrome in pre- and postmenopausal Iranian women. Climacteric. 2013;16(5):561-7.
16. Ross AC, Taylor CL, Yaktine AL, et al. Institute of Medicine (US) Committee to Review Dietary Reference Intakes for Vitamin D and Calcium;. Washington (DC): National Academies Press (US); 2011.
17. Poudyal H , Panchal SK, Diwan V, Brown L .Omega-3 fatty acids and metabolic syndrome: effects and emerging mechanisms of action. Prog Lipid Res. 2011;50(4):372-87.

