Original Article

DOI: 10.7860/JCDR/2018/31937.11337

Public Health Section

Prevalence of Anaemia and Metabolic Syndrome and their Relationship among Postmenopausal Women in Rural West Bengal, India

SOUMI SRIMANI[1], PIUPITA DAS[2], DEBNATH CHAUDHURI[3]

ABSTRACT

Introduction: Metabolic Syndrome (MS) is becoming pandemic very fast. Anaemia continues to be one of the most significant public health issues. Anaemia is often found with the presence of MS, though the pathophysiological theory is mostly unclear.

Aim: To determine the prevalence of anaemia and MS and also to find out the relation between anaemia and MS and its components among rural postmenopausal women of West Bengal, India.

Materials and Methods: This study was conducted among 509 postmenopausal women, selected randomly from 30 villages of Singur block, West Bengal, India. Ethical clearance was obtained and informed written consent was obtained prior to the study. Haemoglobin (Hb), Fasting Blood Glucose (FBG), serum Triglycerides (TG), High Density Lipoprotein-Cholesterol (HDL-C), Blood Pressure (BP) and Waist Circumference (WC) were measured. MS was defined as per International Diabetes Federation (IDF), 2005 (for Asian-Indians) criteria. Spearman's correlation coefficient (rho) was calculated using SPSS software, version 20.0. A p-value <0.05 was considered as statistically significant.

Results: Prevalence of mild, moderate and severe anaemia among the postmenopausal women was 20.8%, 35.8% and 2.2%, respectively. Prevalence of MS among the studied population was 38.1%. Among the postmenopausal women suffering from anaemia (n=299), 35.1% were having MS. About 60.2%, 30.1%, 36.1%, 38.8% and 61.9% of them had WC ≥80 cm, FBG ≥100 mg/dL, TG ≥150 mg/dL, HDL-C <50 mg/dL and BP ≥130/85 mmHg. Statistically significant positive correlation was found between Hb level and MS (rho=0.09, p<0.05), WC (rho=0.11, p<0.05) and systolic blood pressure (rho=0.10, p>0.05). Significant negative correlation was observed between Hb level with FBG (rho=-0.11, p<0.05) and HDL-C (rho=-0.12, p<0.05).

Conclusion: High prevalence of anaemia and MS was observed among the postmenopausal women of Singur, West Bengal, India. Significant correlation existed between anaemia and MS as well as most of the components of MS among studied population indicating a possible coexistence of anaemia and MS.

Keywords: Blood glucose, Haemoglobin, Hypertension, Menopause, Waist circumference

INTRODUCTION

Anaemia is a condition in which the number of red blood cells (and consequently their oxygen carrying capacity) is insufficient to meet the body's physiologic needs. Specific physiologic needs vary with a person's age, gender, residential elevation above sea level (altitude), smoking behaviour, and different stages of pregnancy [1]. Anaemia holds global health concern, mainly precipitating in an underdeveloped and developing countries [2,3]. MS, a cluster of cardiometabolic disorders like central obesity, impaired glucose tolerance, dyslipidaemia and hypertension, one of the major public health problems has increasingly been reported from urban to rural areas in India [4-7]. Risk of MS increases with menopause and may partially explain the apparent acceleration in CVD after menopause [8]. The transition from pre-menopause to post-menopause is associated with the emergence of many features of the MS, including: 1) increased central (intra-abdominal) body fat; 2) a shift toward a more atherogenic lipid profile with increased low density lipoprotein and triglycerides levels, reduced high density lipoprotein, and small, dense low density lipoprotein particles; and 3) increased glucose and insulin levels [8]. Anaemia is often found with the presence of MS, though the pathophysiological theory is mostly unclear. Very few reports are available on the relation and occurrence of anaemia with MS [9-11].

Objective of this study was to determine the prevalence of anaemia and MS and to find out the relation between anaemia and MS including its component disorders among rural postmenopausal women of rural West Bengal, India.

MATERIALS AND METHODS

This cross-sectional study was conducted on the postmenopausal women, aged 45-70 years, selected randomly from 30 villages of Singur block, the field practice area of All India Institute of Hygiene and Public Health (AIIH&PH), Hugli district, West Bengal, India, from 27th March, 2014 to 1st November, 2016. As there is no reported data available on the prevalence of anaemia among postmenopausal women residing either rural or urban community in India, we have considered the district fact sheet of National Family Health Survey 4 (2015-16), which have reported the prevalence of anaemia among nonpregnant women between 15-49 years, for the Hugli district which includes our study area, Singur, for calculation of the sample size of this study [12]. The prevalence of anaemia (<12.0 gm/dL of Hb) among 15-49 years of nonpregnant women was 65.7% in the district of Hugli, West Bengal, India [12]. So, taking anticipated population proportion (p) as 65.7%, proportion of women without MS (q) will be 34.3%.

Considering 95% Confidence level, the sample size was calculated by the following formula:

$$n = \frac{(1.96)^2 \times p \times q}{L^2}$$

Where, L=10% proportional allowable error (i.e., 10% of p)

$$\text{So, } n = \frac{3.84 \times 65.7 \times 34.3}{(6.57)^2} = 200.47 \sim 200.5$$

Considering the Design Effect the Sample Size will be: 200.5×2=401.

All these women were studied for determining the prevalence of MS and anaemia. Women having history of thyroid dysfunction, on hormonal replacement therapy, amenorrhea due to any pathological cause or surgery, on iron-folifer supplementation, physically or mentally challenged and non-cooperative in nature were excluded from the study. Ethical clearance was obtained from the Ethics Committee of AIIH&PH, Kolkata, India. Informed written consent was obtained prior to the study. Hb level was measured by cyanomethaemoglobin method [13]. Non anaemia, mild anaemia, moderate anaemia and severe anaemia was defined as ≥12 gm/dL, 11-11.9 gm/dL, 8-10.9 gm/dL and <8 gm/dL of Hb concentration of blood [3]. BP, WC, FBG, serum TG and HDL-C were measured using standard procedure [14-18]. Overnight fasting (10-12 hours) blood specimens were collected early in the morning from the field practice area for all biochemical estimations. MS was defined as per IDF, 2005 (for Asian-Indians) criteria [19].

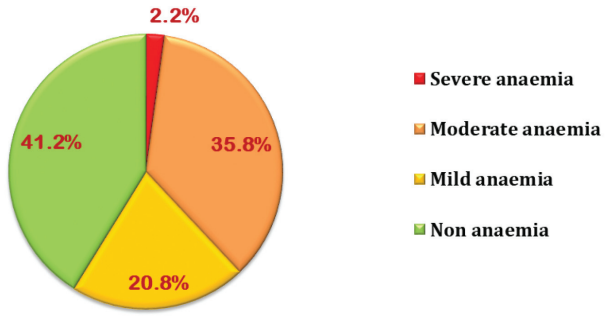
STATISTICAL ANALYSIS

Data were put in Microsoft Excel worksheet (Microsoft, Redwoods, WA, USA) and checked for accuracy. Spearman's correlation coefficient (rho) was calculated using SPSS software, version 20.0 (Statistical Package for the Social Sciences Inc, Chicago, IL, USA). A p-value of <0.05 was considered as statistically significant.

RESULTS

Prevalence of anaemia (Hb <12 gm/dL) among the postmenopausal women (n=509) was 58.8%. Further, mild, moderate and severe anaemia among them was observed to be 20.8%, 35.8% and 2.2%, respectively [Table/Fig-1]. Median Hb concentration was 11.5 gm/dL and Inter-Quartile Range (IQR) was 2.36 (10.5-12.85).

Prevalence of MS among the studied population (n=509) was 38.1%. Among the women having MS 54.1% was found to be anaemic. Further, among the women having WC ≥80 cm, FBG≥100 mg/dL, TG ≥150 mg/dL, HDL-C <50 mg/dL and BP ≥130/85 mmHg, 55.9%, 63.0%, 58.7%, 53.0% and 57.3% respectively, were anaemic [Table/Fig-2].



[Table/Fig-1]: Distribution of the postmenopausal women according to haemoglobin status (n=509).

Among the postmenopausal women suffering from anaemia (n=299) 35.1% were having MS. About 60.2%, 30.1%, 36.1%, 38.8% and 61.9% of anaemic women observed to have WC ≥80 cm, FBG ≥100 mg/dL, TG≥150 mg/dL, HDL-C <50 mg/dL and BP ≥130/85 mmHg. Further, 39.6%, 31.9% and 45.5% of the women suffering from mild, moderate and severe anaemia respectively were having MS. About 62.3%, 58.2% and 72.7% women with mild, moderate and severe anaemia respectively, had WC≥80 cm. Distribution of these three types of anaemia was 31.1%, 28.0% and 54.5% among the women having FBG ≥100 mg/dL. Likewise, 38.7%, 35.7% and 18.2% mild, moderate and severe anaemia was found among the women having TG≥150 mg/dL. About 45.3%, 33.5% and 63.6% mild, moderate and severe anaemia was seen in women having HDL-C <50 mg/dL. About 69.8%, 57.7% and 54.5% mild, moderate and severe anaemia was observed among the women having BP ≥130/85 mmHg [Table/Fig-3].

Statistically significant positive correlation was found between Hb level and MS (rho=0.09, p<0.05), WC (rho=0.11, p<0.05) and the systolic blood pressure (rho=0.10, p>0.05) using Spearman's correlation test. Significant negative correlation was observed between Hb level and FBG (rho=-0.11, p<0.05) and HDL-C level (rho=-0.12, p<0.05) [Table/Fig-2].

Parameter	Haemoglobin Status (gm/dL)				Total Number (%)	Spearman's correlation coefficient-rho (p-value)
	Hb < 8 Number (%)	Hb 8-10.9 Number (%)	Hb 11-11.9 Number (%)	Hb ≥12 Number (%)		
Metabolic Syndrome Present*						
Yes	5 (2.6)	58 (29.9)	42 (21.6)	89 (45.9)	194 (100)	Rho=0.09 p=0.03
No	6 (1.9)	124 (39.4)	64 (20.3)	121 (38.4)	315 (100)	
Waist circumference*						
≥80 cm	8 (2.5)	106 (32.9)	66 (20.5)	142 (44.1)	322 (100)	Rho=0.11 p=0.01
<80 cm	3 (1.6)	76 (40.6)	40 (21.4)	68 (36.4)	187 (100)	
Fasting glucose*						
≥100 mg/dL	6 (4.2)	51 (35.7)	33 (23.1)	53 (37.0)	143 (100)	Rho=-0.11 p=0.01
<100 mg/dL	5 (1.4)	131 (35.8)	73 (19.9)	157 (42.9)	366 (100)	
Triglyceride						
≥150 mg/dL	2 (1.1)	65 (35.3)	41 (22.3)	76 (41.3)	184 (100)	Rho=0.02 p=0.73
<150 mg/dL	9 (2.8)	117 (36.0)	65 (20.0)	134 (41.2)	325 (100)	
HDL cholesterol*						
<50 mg/dL	7 (3.2)	61 (27.9)	48 (21.9)	103 (47.0)	219 (100)	Rho=-0.12 p=0.01
≥50 mg/dL	4 (1.4)	121 (41.7)	58 (20.0)	107 (36.9)	290 (100)	
Blood Pressure**						
≥130/85 mmHg	6 (1.9)	105 (32.5)	74 (22.9)	138 (42.7)	323 (100)	SBP: Rho=0.10 p=0.02
<130/85 mmHg	5 (2.7)	77 (41.4)	32 (17.2)	72 (38.7)	186 (100)	DBP: Rho=-0.00 p=0.95

[Table/Fig-2]: Distribution of the postmenopausal women according to haemoglobin status in relation to metabolic syndrome, waist circumference, fasting blood glucose, triglyceride, HDL cholesterol and blood pressure (N=509).
*Significant (p<0.05), **Systolic BP significant (p<0.05)

Anaemia Status No. (%)		MS present No. (%)	WC (≥80 cm) No. (%)	FBG (≥100 mg/dL) No. (%)	TG (≥150 mg/dL) No. (%)	HDL-C (<50 mg/dL) No. (%)	BP (≥130/85 mmHg) No. (%)
Mild	106 (35.5)	42 (39.6)	66 (62.3)	33 (31.1)	41 (38.7)	48 (45.3)	74 (69.8)
Moderate	182 (60.8)	58 (31.9)	106 (58.2)	51 (28.0)	65 (35.7)	61 (33.5)	105 (57.7)
Severe	11(3.7)	5 (45.5)	8 (72.7)	6 (54.5)	2 (18.2)	7 (63.6)	6 (54.5)
Total	299 (100)	105 (35.1)	180 (60.2)	90 (30.1)	108 (36.1)	116 (38.8)	185 (61.9)

[Table/Fig-3]: Distribution of anaemic postmenopausal women according to the prevalence of MS and its abnormal components (n=299).

DISCUSSION

High prevalence of anaemia (approximately 60%), among the postmenopausal women of Singur block, West Bengal, India was observed. According to National Family Health Survey-4 (NFHS-4), more than half of the adult Indian women were anaemic and amongst them 64.8% were from rural West Bengal, which is very similar to our findings [20,21].

Our study revealed that around 40% postmenopausal women under investigation had MS. Prevalence of MS varies in India and different countries; 55% in urban Western India, 26.6% in rural north India, 64.3%in Iran, 49.8% in Brazil, 16.9% in Thailand and 29.0% in Puerto Rico [22-27].

We have found that 35.1% of the anaemic post-menopausal women were having MS and significant positive correlation was observed between these two disorders. In a study conducted in Chinese population reported among the women of 50-59 years of age the prevalence of combined anaemia and MS was highest [28].

About 60.2% of the anaemic postmenopausal women had central obesity and with increase in central obesity, prevalence of anaemia increases significantly. Other reported data corroborate our result that in all age groups anaemia was common in obesity [29].

In our study, 30.1% anaemic postmenopausal women had hyperglycaemia and decreasing Hb level was significantly correlated with increasing fasting blood glucose level (≥100 mg/dL). Other studies also documented that anaemia is commonly observed in diabetic patients and it contributes to the progression of diabetes-related complications and these are negatively associated with each other [30-34].

Around 38.8% of the studied population, suffering from anaemia, were observed to have low HDL-C. With increasing prevalence of anaemia, HDL-C level significantly decreased below 50 mg/dL. Few studies postulated that low HDL-C level is associated with occurrence of anaemia by increasing hepcidine level [35].

Besides, we have also found that around 61.9% postmenopausal women with anaemia had BP ≥130/85 mmHg. Significant positive correlation between anaemia and increased systolic blood pressure exists which indicates the co-existence of anaemia and hypertension. Previous study also reported the association of hypertension with anaemia [28].

However, no significant relationship was observed between Hb level and either diastolic blood pressure or serum TG level.

LIMITATION

This study observed the prevalence of total hypochromic anaemia on the basis of the Hb concentration among postmenopausal women. No attempt was taken to identify the type of anaemia, nutritional or non-nutritional, more specifically.

CONCLUSION

Prevalence of anaemia and MS among postmenopausal women studied in the Singur block, West Bengal, India revealed coexistence of both the health disorders. Significant correlation was observed between anaemia and MS as well as most of the components of MS in this population. Therefore, our study indicates that, in the study population, anaemia may increase the risk of developing MS among postmenopausal women or viceversa.

ACKNOWLEDGEMENTS

Our sincerest acknowledgement to all the participants of this study, Officer in Charge, other supportive staffs and health workers of the villages of Rural Health Unit and Training Centre, Singur of AIIH&PH, Kolkata, laboratory staffs of the department of Biochemistry and Nutrition, AIIH&PH, Kolkata, India. We also acknowledge the West Bengal University of Health Sciences, as this research work is part of the PhD thesis of the first author, registered under this university. Special thanks to the Indian Council of Medical Research (ICMR) for funding this study.

REFERENCES

[1] WHO. Haemoglobin concentrations for the diagnosis of anaemia and assessment of severity: WHO/NMH/NHD/MNM/11.1
[2] ACC/SCN. Fourth report on the world nutrition situation. Geneva: ACC/SCN in collaboration with IFPRI; 2000.
[3] WHO. Iron deficiency anaemia. assessment, prevention and control: a guide for programme managers: WHO/ NHD/01.3; 2001
[4] Rassouw JE, Anderson GL, Prentice RL, LaCroix AZ, Kooperberg C, Stefanick ML, et al. Risks and benefits of estrogen plus progestin in healthy postmenopausal women: principal results from the women's health Initiative randomized controlled trial. JAMA. 2002;288:321-33.
[5] Kaur J. A comprehensive review on metabolic syndrome. Cardiology Research Practice. 2014;2014:943162,21 pages.
[6] Deepa M, Farooq S, Datta M, Deepa R, Mohan V. Prevalence of metabolic syndrome using WHO, ATPIII and IDF definitions in Asian Indians: the Chennai Urban Rural Epidemiology Study (CURES-34). Diabetes Metab Res Rev. 2007;23:127-34.
[7] Ravikiran M, Bhansali A, Ravikumar P, Bhansali S, Dutta P, Thakur JS et al. Prevalence and risk factors of metabolic syndrome among Asian Indians: a community survey. Diabetes Res Clin Pract. 2010;89:181-88.
[8] Carr MC. The Emergence of the metabolic syndrome with menopause. J Clin Endocrinol & Metabolism. 2003;88(6):2404-11.
[9] New JP, Aung T, Baker PG, Yongsheng G, Pylypczuk R, Houghton J et al. The high prevalence of unrecognized anaemia in patients with diabetes and chronic kidney disease: a population-based study. Diabet Med. 2008;25:564-69.
[10] Singh AK. Diabetes, anemia and CKD: why treat? Current Diabetes Reports. 2010;10:291-96.
[11] Mehdi U, Toto RD. Anemia, diabetes, and chronic kidney disease. Diabetes Care. 2009;32:1320-26.
[12] International Institute by Population Sciences, Mumbai, Government of India, Ministry of Health and Family Welfare. National Family Health Survey-4: District Fact Sheet, Hugli, West Bengal. 2015-16(4).
[13] Dallman PR. Diagnosis of anemia and iron deficiency: analytic and biological variations of laboratory tests. Am J Clin Nutr. 1984;39(6):937-41.
[14] Pickering TG, Hall JE, Appel LJ, Falkner BE, Graves J, Hill MN, et al. Recommendations for blood pressure measurement in humans and experimental animals: part 1: blood pressure measurement in humans: a statement for professionals from the Subcommittee of Professional and Public Education of the American Heart Association Council on High Blood Pressure Research. Circulation. 2005;111(5):697-716.
[15] World Health Organization. Waist circumference and waist-hip ratio: report of a WHO expert consultation, Geneva, 8-11 December 2008.
[16] Jakobsen LK. Quantitative determination of blood glucose using glucose oxidase and peroxidase. Scandinav J Clin & Lab Investigation. 1960;12(1):76-79.
[17] Mayne PD. Clinical Chemistry in Diagnosis and treatment. 1994;11:224.
[18] Herrmann W, Schütz C Reuter W. Determination of HDL cholesterol. Z Gesamte Inn Med. 1983;38(1):17-22.
[19] Alberti G, Zimmet P, Shaw J, Grundy SM. The IDF consensus worldwide definition of the metabolic syndrome. Brussels: International Diabetes Federation. 2006;8:01-23. Available from https://www.idf.org/webdata/docs/MetS_def_update2006.pdf. [Access date: 31.03.2017].
[20] Rathod G, Parmar P, Rathod S. Prevalence of anemia in patients with Type 2 Diabetes Mellitus at Gandhinagar, Gujarat, India. IAIM. 2016;3(3):12-16.
[21] Government of India. Ministry of health and family welfare. National family health survey-4: 2015-16. State Fact Sheet. West Bengal.

[22] Pandey S, Srinivas M, Agashe S, Joshi J, Galvankar P, Prakasam CP, et al. Menopause and metabolic syndrome: A study of 498 urban women from western India. J Midlife Health. 2010;1(2):63-69.
[23] Singh J, Rajput M, Rajput R, Bairwa M. Prevalence and predictors of metabolic syndrome in a north Indian rural population: a community based study. Journal of Global Diabetes and Clinical Metabolism. 2016;1:01-04.
[24] 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. Diabetol Metab Syndr. 2010;2:59.
[25] Figueiredo-Neto AA, Figuerêdo ED, Barbosa JB, Barbosa FF, Costa GRC, Nina VJS, et al. Metabolic syndrome and menopause: cross-sectional study in gynecology clinic. Arq Bras Cardiol. 2010;91:01-23.
[26] Indhavivadhana S, Rattanachaiyanont M, Wongvananurak T, Kanboon M, Techatraisak K, Leerasiri P, et al. Predictors for metabolic syndrome in perimenopausal and postmenopausal Thai women. Climacteric. 2011;14:58-65.
[27] Romaguera J, Ortiz AP, Roca FJ, Cólon G, Suárez E. Factors associated with metabolic syndrome in a sample of women in Puerto Rico. Menopause. 2010;17:388-92.
[28] Shi Z, Hu X, Yuan B, Hu G, Pan X, Holmboe-Ottesen G. Coexistence of anaemia and the metabolic syndrome in adults in Jiangsu, China. Asia Pac J Clin Nutr. 2008;17(3):505-13.
[29] Stein J, Stier C, Raab H, Weiner R. Review article: The nutritional and pharmacological consequences of obesity surgery. Alimentary Pharmacol and Ther. 2014;40:582-609.
[30] Thomas MC, Cooper ME, Rossing K, Parving HH. Anaemia in diabetes: Is there a rationale to Treat? Diabetologia. 2006;49:1151-57.
[31] Thomas MC, MacIsaac RJ, Tsalamandris C, Power D, Jerums G. Unrecognized anemia in patients with diabetes: a cross-sectional survey. Diabetes Care. 2003;26:1164-69.
[32] Thomas MC, Tsalamandris C, MacIsaac RJ, Jerums G. The epidemiology of hemoglobin levels in patients with type 2 diabetes. Am J Kidney Dis. 2006;48:537-45.
[33] Ezenwaka CE, Jones-Lecointe A, Nwagbara E, Seales D, Okali F. Anaemia and kidney dysfunction in Caribbean type 2 diabetic patients. Cardiovascular Diabetology. 2008;7:25.
[34] Shi Z, Hu X, Yuan B, Pan X, Meyer HE, Ottesen GH. Association between serum ferritin, hemoglobin, iron intake, and diabetes in adults in Jiangsu, China. Diabetes Care. 2006;29(8):1878-83.
[35] Martinelli N, Traglia M, Campostrini N, Biino G, Corbella M, Sala C, et al. Increased serum hepcidin levels in subjects with the metabolic syndrome: a population study. PLoS One. 2012;7(10):e48250.

PARTICULARS OF CONTRIBUTORS:
1. Research Scholar (ICMR SRF), Department of Biochemistry and Nutrition, All India Institute of Hygiene and Public Health, Kolkata, West Bengal, India.
2. Student, Department of Biological Science, Burdwan University, Radha Gobinda B.Ed. Teacher Training College, Tarakeswar, West Bengal, India.
3. Ex Professor and Head, Department of Biochemistry and Nutrition, All India Institute of Hygiene and Public Health, Kolkata, West Bengal, India.

NAME, ADDRESS, E-MAIL ID OF THE CORRESPONDING AUTHOR:
Dr. Debnath Chaudhuri,
Flat A3, H11-B.G. Patuli, Kolkata-700094, West Bengal, India.
E-mail: dchaudhuri_bn@rediffmail.com

FINANCIAL OR OTHER COMPETING INTERESTS: As declared above.

Date of Submission: **Jul 26, 2017**
Date of Peer Review: **Aug 27, 2017**
Date of Acceptance: **Oct 26, 2017**
Date of Publishing: **Mar 01, 2018**