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Prevalence and Predictors of Metabolic Syndrome among Rural Women in West Bengal, India

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Abstract--*Metabolic syndrome (MS) is a combination of risk factors for the cardiovascular and type 2 diabetes. Our objective here is to identify the prevalence of MS among rural adult women in West Bengal, India and the known determinants identified therein. A cross-sectional community-based study was conducted in four West Bengal villagers in Nadia district where 161 women (20 yrs) recruited systematic multi-stage sampling of random samples. Demographic data were collected via a questionnaire which was pre-tested. We measured blood pressure and anthropometric scales. Biochemical studies were performed on the blood samples collected after overnight fasting. Part III (NCEP / ATP-III) National Cholesterol policy framework / Adult Treatment Recommendations for Indians and the International Diabetes Federation (IDF) proposed revised waist circumference metabolic syndrome criteria. The prevalence of metabolic syndrome was 27.33 per cent among women over the age of 20. Substantially elevated levels (P-value < 0.01) have been observed in cardio-vascular disease parameters viz. Cholesterol (total, mg / dl), HDL cholesterol , triglycerides, blood pressure (systolic and diastolic) among women with MS. Females with MS were significantly correlated with body mass index (BMI), waist circumference (WC), fasting blood sugar and blood pressure (P-value < 0.01) which have been independent predictors of MS. However, studies with a larger sam should be conducted to confirm these findings.*

Keywords-- *Metabolic syndrome, Predictors, Prevalence, Rural, Women*

I. INTRODUCTION

Metabolic Syndrome (MS) is a combination of risk factors for cardiovascular disease, and type 2 diabetes, the rising multi-communicable pandemic disease in the world today[1-5]. The syndrome is also known as Syndrome X, Dangerous Quartet and Insulin Resistance Syndrome. The behavioral syndrome's essential components include elevated blood pressure, reduced fasting glucose, dyslipidemia (elevated triglycerides and lowered lipoprotein cholesterol), and central / abdominal obesity (waist circum ferencing). According to revised NCEP-ATP III protocols (National Cholesterol Education Program-Adult Treatment Panel III), the presence of at least three of these components is called metabolic syndrome[6]. A number of researchers , particularly women, have been reported to be at higher risk of developing metabolic syndrome in Asian Indian. Our objective here is to estimate the prevalence of MS among adolescent rural women in West Bengal, India and their selected known determinants.

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II. MATERIALS & METHODS

Study setting and study subjects:

This population based Cross-Sectional study was conducted among 161 rural adult women who satisfied all the inclusion criteria. The study population was selected randomly from five villages of Haringhata Block, Nadia Distrct, West Bengal India.

Inclusion criteria

- Age >18 years and <60 years
- Individuals giving written, informed consent
- Those who are free from critical illnesses

Exclusion criteria

- All pregnant and lactating mothers
- All critically ill patients
- All type 1 diabetes mellitus patients
- Patients who are on hormonal replacement therapy
- Persons with any condition which may render them unable to complete the study or which may pose a significant risk to the physical or mental health of the subject.

III. ETHICAL CLEARANCE

Ethical clearance was obtained from Institutional Bio Ethics Committee for Human & Animal Reasearch Studies, University of Calcutta. Written informed consent was taken from all the participants at the time of recruitment.

IV. DATA COLLECTION

Standard printed questionnaires were distributed to collect information on personal and medical history.

Anthropometric Measurements

Anthropometric measures included waist circumference measured in kilometers at the narrowest measurement, halfway between both the upper border of the iliac crest and thus the lower rib margin, while the circumference measurements was calculated as both the widest indicator at the level of the larger trochanters. Height measured in centimetres, weight measured in kilograms. Body mass index (BMI) was measured as weight in kilograms divided by a square of height in meters (kg / m2). Preobese was classified with BMI around 25.0 and 29.99 and obese as 30.0 or above according to classification of the World Health Organization.

Defining metabolic syndrome (MS)

Metabolic syndrome has been evaluated on the basis of the National Cholesterol Education Program (NCEP), Adult Treatment Panel III (ATP III) criteria (for South Asians)[7], because it is presumably more suitable for the research population than the World Health Organization definition and others[8].Components and considerable values for assessing metabolic syndrome have been presented in Table 1.

Table 1: Components and considerable values for assessing metabolic syndrome in adult women (modified NCEP-ATP III).

Component	**Value**	**Metabolic Syndrome**
Waist circumference (Central obesity)	≥ 80cm	
Triglycerides	≥150 mg/dl Or on treatment for Dyslipidaemia	
HDL-Cholesterol	<50 mg/dl Or under treatment for Dyslipidaemia	
Blood Pressure:		Any 3 criteria should be present
Systolic BP	>130 mm Hg	
diastolic BP	>85 mm Hg Or treatment of previously diagnosed hypertension	
Fasting blood glucose	≥100 mg/dl Or previously diagnosed diabetic on treatment	

V. LABORATORY METHODS:

Blood samples were collected by venepuncture after an overnight fast for 8-12hours. Venous blood was collected for measurement of serum lipids (triglycerides and HDL-C) and fasting blood glucose, respectively. FBG, serum TG and HDL-C were measured using standard procedure. [9-13]

VI. STATISTICAL ANALYSIS:

Statistical analyses were performed using MINITAB 17 and R 3.3 software. Continuous variables were described using mean ± SD whereas categorical variables were presented with their frequencies. Independent two samples t test was used for comparisons of fasting blood sugar, blood pressure, different measures of lipid under different socio-economic, health related factors. The chi-squared test was used for comparisons of categorical variables. Multiple logistic regression analysis for MS was conducted to find odd ratios (adjusted and unadjusted). Tests for trend were performed on χ^2 distribution. All statistical tests were two-sided. A P-value <0.01 was considered statistically significant.

VII. RESULTS AND DISCUSSION

The overall prevalence of metabolic syndrome in our study was found to be 27.33% (n=161)(Fig 1), based on the criteria explained in Table 1.Baseline characteristics of predictors of MS of the study population was presented inTable 2. The mean age of the exposed group was 42.430 years (SD: 9.100) whereas the participants of non-exposed groups had a mean age of 34.137 years (SD: 8.551) which was significantly lower.

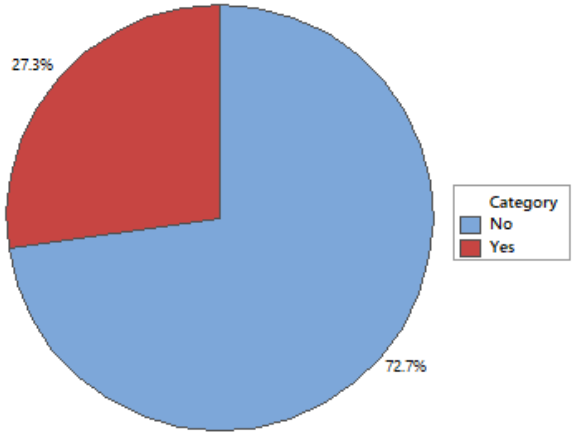

Figure 1: Distribution of adult rural women according to presence of metabolic syndrome

Table 2: Baseline Characteristics of predictors of metabolic syndrome

Characteristics		**Metabolic syndrome Mean ± SD**		**P value**
		Yes	**No**	
Age (year)		42.430 ± 9.100	34.137 ± 8.551	<0.01
Body Mass Index (kg/m^2).	Underweight(<18.50)	0	10	<0.01
	Normal (18.50 - 24.99)	9	51	
	Preobese (25.00- 29.99)	19	38	
	Obese(≥30)	16	18	
Waist circumference (cm)	Normal(<80cm)	5	57	<0.01
	High(≥80cm)	39	60	
Blood Pressure (mmHg)	Systolic	128.590 ± 5.540	118.520 ± 8.000	<0.01
	Diastolic	83.591 ± 1.808	78.188 ± 3.096	<0.01
Fasting Blood Sugar (mg/dl)		76.800 ± 8.310	73.983 ± 10.501	>0.01
Triglycerides (mg/dl)		127.320 ± 24.130	109.800 ± 13.030	<0.01
HDL Cholesterol (mg/dl)		58.590 ± 8.800	48.880 ± 7.305	<0.01

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Cholesterol (total, mg/dl)		170.140 ± 35.820	154.150 ± 29.290	>0.01
Menopausal Status	Premenopause	24	101	<0.01
	Postmenopause	20	16	
Anaemia	Non-anaemic (≥120 g/l)	37	20	>0.01
	Mild (110-119g/l)	54	15	
	Moderate (80-109 g/l)	26	9	
Income (Rs)		18021 ±17953	17891 ± 12166	>0.01

In this study, majorparticipants (37.27%)were having normal BMI (18.50 - 24.99kg/m2). Proportion of preobese (25.00- 29.99kg/m^2) and obese (≥30kg/m2) individuals were 35.41% and 21.11% respectively. Least participants (6.21%) were underweight (<18.50 kg/m^2).This is represented in Fig 2.The prevalence of MS in women with preobese and obese were found to be 33.33% and 47.05% respectively which were significantly higher than prevalence of MS in women with normal BMI(15%)(Fig 2).

An increased prevalence of MS was also observed with waist circumference (WC) among the study cases (P-value<0.05). MS was present in39.39% of cases with increased waist circumference (≥80cm) in comparison to 8.06% with normal waist circumference(Fig 3).

MS exposed group had significantly higher mean systolicblood pressurewith a higher variability compare to mean systolicblood pressure of MS unexposed group. The story was same for mean diastolic blood pressure which was higher for MS exposed group compare to MS unexposed group. Moreover, the MS exposed group had significantly elevated average triglycerides, HDL compare to MS unexposed group (Table 2, Fig 4). However, no significant difference was observed in fasting blood sugar (BF(S)) and total cholesterol between MS exposed and unexposed groups(Table 2, Fig 4).

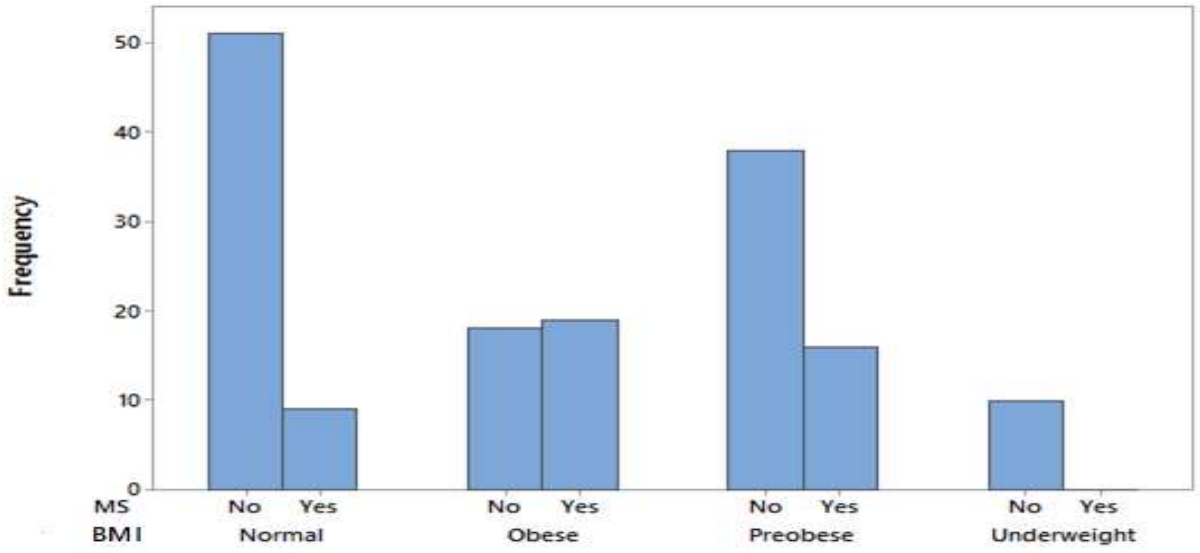

Figure 2: Prevalence of metabolic syndrome (MS) according to body mass index (BMI)

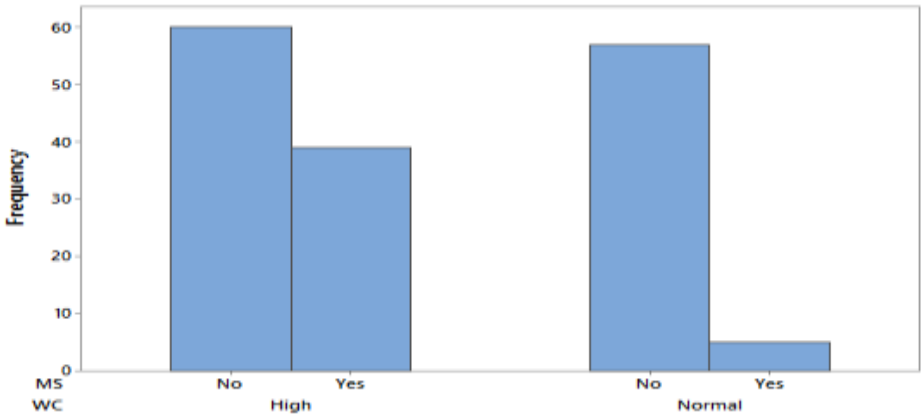

Figure 3: Prevalence of metabolic syndrome (MS) according to waist circumference (WC)

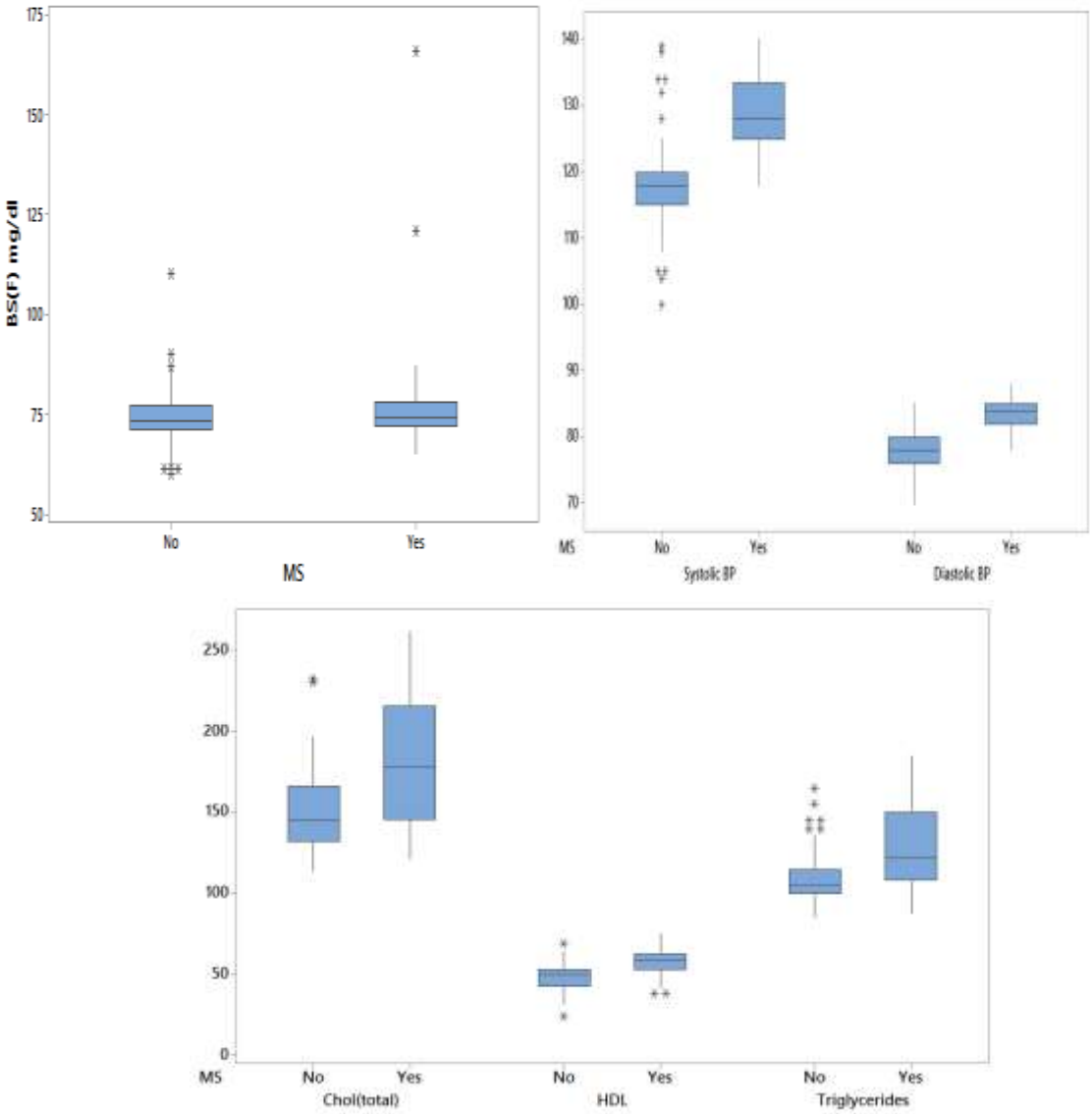

Figure 4: Box-plot of BF(S), Systolic BP, Diastolic BP, Chol(total), HDL, Triglycerides with respect to metabolic syndrome (MS)

In this studyan increased incidence of menopausal was observed as 125 participants (77.6%) had menopausal status. MS was found to be present in 19.2% of premenopausal women and 55.55% of postmenopausal women.Among all participants 35.40% were non anemic. Further, among anemic participants, 42.86% were mild and 21.74% were moderate. MS was present in 64.91% of non-anemic with an increasing trend of presence among mild anemic (78.26%) and moderate anemic(74.28%) participants.

In the logistic regression analysis it was found that BMI, WC, fasting blood sugar and diastolic blood pressurewere significantly associated with occurrence of MS (P-value<0.01). Various other factors like age,anemia, triglycerides, HDL cholesterol, Cholesterol (total), menopausal status and systolic blood pressure which was statistically significant in single variant analysis lost its significance in the logistic regression analysis(Table 3).

Table 3: Logistic regression analysis showing the predictive association of clinical variables and presence of metabolic syndrome

Term	Coefficient	S.E.	P-Value	Odds Ratio	95% CI
Constant	-177.3	48.1			
Age	-0.022	0.099	0.822	0.978	(0.805, 1.188)
Anaemia	-0.732	0.592	0.194	0.476	(0.149, 1.518)
Body Mass Index	0.468	0.243	**0.024**	1.597	(0.992, 2.570)
Waist circumference	5.82	2.33	**0.001**	7.171	(3.472, 22.847)
Blood Pressure, Systolic	0.111	0.055	0.11	1.118	(1.003, 1.246)
Blood Pressure, Diastolic	1.496	0.405	**0.000**	4.463	(2.018, 9.867)
Fasting Blood Sugar	0.201	0.144	**0.001**	1.223	(0.922, 1.622)
Triglycerides	0.029	0.056	0.596	1.029	(0.923, 1.149)
HDL Cholesterol	0.055	0.131	0.670	1.057	(0.818, 1.365)
Cholesterol(total)	0.019	0.037	0.604	1.019	(0.948, 1.095)
Menopausal status	0.38	1.82	0.835	1.465	(0.041, 51.903)

From this cross sectional study among the rural women, it was observed the high prevalence (27.33%) of metabolic syndrome. In different studies related to women, it was reported that prevalence of metabolic syndrome among urban women from eastern India is 33.5% and 48.3% among a women population from northern India[14, 15].This report is closely matches with the findings of the current study.

In this study, body mass index wasfound significantly correlated with the metabolic syndrome as increased body mass index elevated the prevalence of metabolic syndrome. Metabolic syndrome was present in 15% of rural women population who had normal BMI, and the prevalence was increased among preobese(33.33%) and obese (47.05%) participants. The relation between BMI and metabolic syndrome was statistically significant (P-

value<0.05). The result of this study is similar to the result of Canton Diabetes and Metabolic Disorders Study; apopulation based cross-sectional study by Liang H and also with the result of Cladius E et al. on Indian women population based study[15, 16].Other studies also showed positive correlation between BMI and metabolic syndrome in women.[17-20]

It was seen that among rural women who had high WC had higher prevalence of metabolic syndrome in comparison to those who had normal waist Circumference only (39.39% vs. 8.06%).Baneret et al. [21] found a significant correlation between waist circumference and metabolic syndrome in a study and it can also effectively predict the risk of metabolic syndrome. In another study,Cladius E etal. [15] also found the similar result in a study significant correlation exists between waist circumference and metabolic syndrome.

Significant correlation is also found between fasting blood sugar and metabolic syndrome(P-value<0.05).In a cohort study among people of central Iran, it was found that the most effective component as a predictor of metabolic syndrome in females was high fasting blood glucose[22].

Jung, J Y etal. [23] presented an elevated blood pressure was significantly associated with an increased risk of incident metabolic syndrome in a Korean population.This study showed significant association of diastolic blood pressure with the prevalence of metabolic syndrome among rural Indian women.

In conclusion, this present study shows a high prevalence of metabolic syndrome amongst rural women and it reinforces the need for a comprehensive non-communicable disease prevention and control program. The prevalence was higher in postmenopausal women than premenopausal women. BMI, WC, fasting blood sugar and diastolic blood pressure were significant predictors of metabolic syndrome among rural women population. As the higher degree of error was considered for the calculation of sample size which has led to low statistical power of the study, studies with larger sample size need to be conducted to validate the present findings.

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