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ASSOCIATION BETWEEN BMI AND LIFESTYLE HABITS WITH METABOLIC SYNDROME IN LUCKNOW AND ADJOINING AREAS: A CROSS-SECTIONAL STUDY

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ABSTRACT

Metabolic Syndrome (MetS)—a cluster of conditions including central obesity, insulin resistance, hypertension, and dyslipidemia—has emerged as a growing public health concern in developing nations like India, driven by rapid urbanization and increasingly sedentary lifestyles. This cross-sectional study aimed to assess the association between Body Mass Index (BMI) and key lifestyle factors such as physical activity, sleep quality, mental health, dietary habits, and socioeconomic variables among individuals diagnosed with MetS in Lucknow and surrounding regions. A total of 150 patients aged 25 to 75 years were recruited from King George's Medical University and assessed using a structured, pre-validated questionnaire (International Physical Activity Questionnaire; General Health Questionnaire-12). Statistical analyses, including chi-square and t-tests, revealed significant associations between BMI and education level, family structure, physical activity ($p < 0.05$), whereas no significant correlation was observed with age or gender. These findings support existing literature highlighting the role of modifiable behavioral factors in the etiology and progression of MetS. The study underscores the necessity for culturally tailored, gender-sensitive public health interventions targeting lifestyle management to mitigate the escalating burden of MetS in India.

KEYWORDS: Metabolic Syndrome, BMI, Lifestyle Factors, Sleep, Physical Activity

Metabolic Syndrome (MetS) is a multifaceted cluster of interrelated risk factors that significantly increase the probability of developing cardiovascular diseases and type 2 diabetes mellitus (T2DM). These factors include central obesity, insulin resistance, hypertension, elevated triglycerides, and reduced HDL cholesterol levels (Grundy *et al.*, 2005). In recent years, MetS has transitioned from a syndrome primarily affecting high-income countries to a growing public health concern in low- and middle-income countries, including India (Cameron *et al.*, 2009).

India, in particular, is experiencing a rapid epidemiological transition fueled by urbanization, dietary shifts, and reduced physical activity. This transition has led to a surge in non-communicable diseases, including MetS, even in younger populations (Ramachandran *et al.*, 2010; Sharma *et al.* 2024). Several Indian studies have documented a high and rising prevalence of MetS across both urban and rural populations, with urban areas like Chennai, Delhi, and now Tier-2 cities such as Lucknow showing particularly high rates (Deepa *et al.*, 2009; Deshmukh *et al.*, 2013).

One of the primary contributors to MetS is obesity, especially central obesity, commonly measured through BMI and waist circumference. Although BMI is a general indicator of obesity, it does not distinguish between fat distribution and muscle mass. Nevertheless, BMI continues to be widely used in epidemiological studies due to its simplicity and correlation with other MetS components (Ford *et al.*, 2008).

Table 1: Shows the various categories of weight based on the BMI (Murali Venkatrao *et al.*, 2020)

Classification	BMI
Underweight	<18.5
Normal	18.5–22.9
Overweight	23–24.9
Obese	≥25

Lifestyle factors such as sedentary behavior, poor dietary habits, smoking, and alcohol consumption have been shown to significantly modulate MetS risk. These factors often co-exist and compound one another, particularly in urban environments where fast food consumption and occupational sedentarism are prevalent (Patel *et al.*, 2022; Misra & Khurana, 2008).

Despite a growing body of evidence on MetS in metropolitan cities, there is a paucity of region-specific data from mid-sized cities like Lucknow. Cultural, dietary, and environmental variables in such regions can influence disease patterns and risk factors. Hence, this study aims to investigate the association of BMI and lifestyle habits with MetS among individuals in Lucknow and its surrounding districts. By doing so, it seeks to generate evidence that can inform region-specific health policies and preventive strategies.

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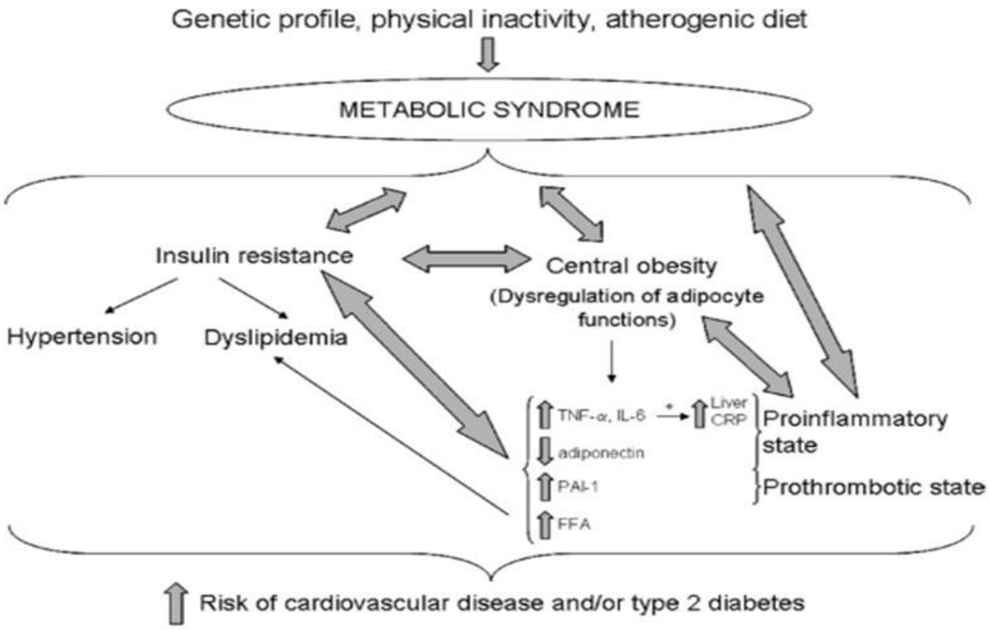


Figure 1: Depicts abnormalities clustered within the metabolic syndrome- a pathophysiological primary causative factors like free fatty acids (Galisteo *et al*, 2008)

The presence of metabolic syndrome is related with an increased long-term risk for both atherosclerotic cardiovascular disease (CVD) and type 2 diabetes mellitus. The National Cholesterol Education Program (NCEP) Adult Treatment Panel III (ATP III) report defined metabolic syndrome as the following risk factors: dyslipidemia, hypertension, and insulin resistance, abdominal obesity, as well as an inflammatory and prothrombotic state, with each metabolic syndrome component associated with increased cardiovascular risk (Figure 1).

METHODOLOGY

This study aims to assess the prevalence of elevated Body Mass Index (BMI) among individuals diagnosed with Metabolic Syndrome (MetS), and to explore how BMI is associated with key lifestyle factors, including physical activity, sleep patterns, dietary habits, and mental health. Additionally, the study seeks to examine the influence of socioeconomic and demographic factors on BMI within this patient population.

Study Design and Setting

A cross-sectional observational study was conducted at King George's Medical University, Lucknow. The study comprised 150 participants diagnosed with Metabolic Syndrome (MetS), all between the ages of 25 and 75 years. To be eligible, individuals must not have received any form of weight management treatment or intervention in the past 12 months. Exclusion criteria included being over 80 years of age, having a diagnosed mental illness or eating disorder, being pregnant or breastfeeding, current use of weight loss medications or supplements, or having tested positive for any type of hepatitis (A, B, C, D, or E).

Data Collection Tools

- Socio-demographic data: Custom questionnaire
- Physical activity: International Physical Activity Questionnaire (IPAQ)
- Mental health: General Health Questionnaire-12 (GHQ-12)
- Sleep quality and dietary habits: Self-reported measures

Statistical Analysis

Data were analyzed using SPSS version 21. Chi-square tests and t-tests were employed to evaluate associations between BMI and lifestyle/demographic variables, with significance set at $p < 0.05$.

RESULTS

A total of 150 (70 Males and 80 Females) participants diagnosed with Metabolic Syndrome (MetS) were included in the study. The age range was 25 to 75 years, with a mean age of 51.5 ± 12.2 years. The sample comprised both male and female patients from urban and semi-urban areas in and around Lucknow.

Table 2: Distribution of BMI Categories Across Anthropometric, Demographic, Socioeconomic Variables

		BMI							
		Obese		Overweight		Normal		Underweight	
		Count	Column N %	Count	Column N %	Count	Column N %	Count	Column N %
Gender	Male	33	42.9	17	53.1	17	50.0	3	42.9
	Female	44	57.1	15	46.9	17	50.0	4	57.1
Age	25-35	16	20.8	4	12.5	7	20.6	3	42.9
	36-45	19	24.7	7	21.9	9	26.5	2	28.6
	46-55	23	29.9	9	28.1	11	32.4	1	14.3
	56-65	12	15.6	7	21.9	5	14.7	0	0.0
	66-75	7	9.1	5	15.6	2	5.9	1	14.3
Resendial Area	Urban	52	67.5	26	81.3	22	64.7	4	57.1
	Rural	25	32.5	6	18.8	12	35.3	3	42.9
Marital Status	Married	73	94.8	29	90.6	29	85.3	5	71.4
	Unmarried	3	3.9	3	9.4	5	14.7	2	28.6
	3.00	1	1.3	0	0.0	0	0.0	0	0.0
Educational Status	Illiterate	13	16.9	1	3.1	6	17.6	0	0.0
	Primary	8	10.4	4	12.5	3	8.8	4	57.1
	10th	8	10.4	5	12.6	5	14.7	1	14.3
	12th	22	28.6	5	15.6	11	32.4	0	0.0
	UG	16	20.8	9	28.1	8	23.5	1	14.3
	PG	9	11.7	8	25.0	1	2.9	1	14.3
	Professional study	1	1.3	0	0.0	0	0.0	0	0.0
Family status	Nuclear	9	11.7	10	31.3	2	5.9	1	14.3
	Joint	68	88.3	22	68.8	32	94.1	6	85.7
Occupation	Government	7	9.1	9	28.1	4	11.8	0	0.0
	Homemaker	46	59.7	13	40.6	18	52.9	3	42.9
	Private	21	27.3	9	28.1	10	29.4	2	28.6
	Student	3	3.9	1	3.1	2	5.9	2	28.6
Socioeconomic status	Lower Middle	9	11.7	10	31.3	6	17.6	1	14.3
	Upper Middle	68	88.3	22	68.8	28	82.4	6	85.7
Family Medical	Yes	19	24.7	8	25.0	4	11.8	3	42.9
	No	58	75.3	24	75.0	30	88.2	4	57.1

Body Mass Index Distribution

The BMI distribution showed that 64% of participants were categorized as overweight or obese based on WHO criteria (Table 1). Only 5.3% fell in the underweight category, while 30.7% had a normal BMI. The prevalence of overweight and obesity in MetS patients aligns with existing literature highlighting central obesity as a core component of MetS (Alberti *et al.*, 2005).

Association with Socio-Demographic Variables

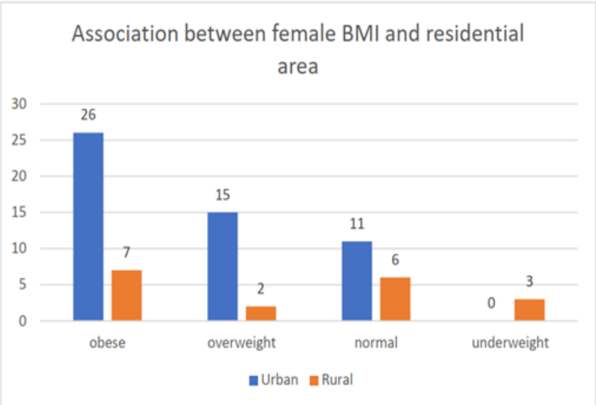
Statistical analysis indicated a significant association between education level and BMI ($\chi^2 = 12.43$, $p = 0.014$). Participants with lower educational attainment (primary or illiterate) had higher BMI values, suggesting a potential inverse relationship between awareness/health literacy and obesity, as supported by Deepa *et al.* (2006).

Similarly, family structure showed a significant relationship with BMI ($\chi^2 = 11.56$, $p = 0.021$). Patients from joint families tended to have higher BMI, possibly due to shared dietary patterns and cultural influences, a trend that is also documented in urban Indian settings (Gupta *et al.*, 2007).

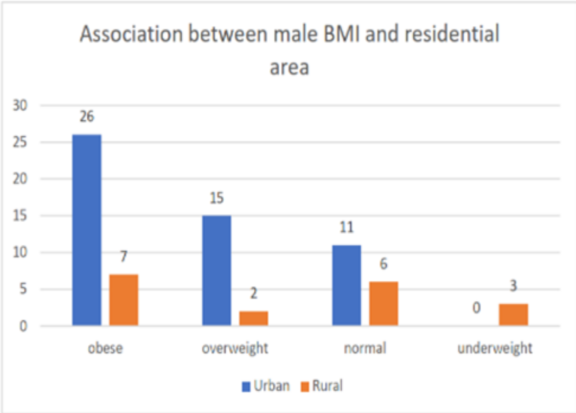
No statistically significant association was found between gender ($\chi^2 = 2.39$, $p = 0.303$) and BMI or age group ($\chi^2 = 5.67$, $p = 0.129$) and BMI, indicating that within this cohort, lifestyle and socioeconomic conditions had a stronger influence on BMI than demographic variables.

Table 3: Association between BMI and variables

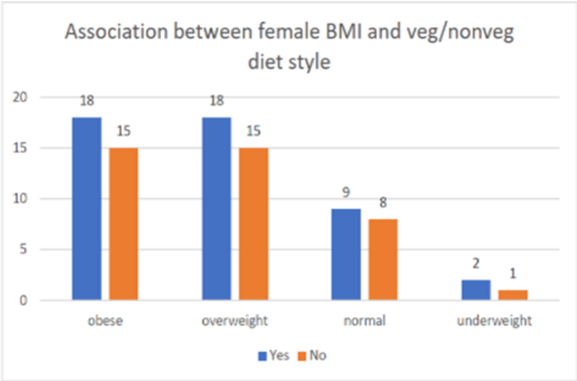
Variables		BMI
Gender	Chi-square	1.178
	Degree of freedom	3
	Sig.	0.758
Age	Chi-square	7.252
	Degree of freedom	12
	Sig.	0.841
Residential area	Chi-square	3.086
	Degree of freedom	3
	Sig.	0.379
Marital status	Chi-square	8.159
	Degree of freedom	6
	Sig.	0.227
Educational status	Chi-square	29.059
	Degree of freedom	18
	Sig.	0.048*
Family status	Chi-square	9.674
	Degree of freedom	3
	Sig.	0.022*
Occupation	Chi-square	16.731
	Degree of freedom	9
	Sig.	0.053
Socio-economic status	Chi-square	6.085
	Degree of freedom	3
	Sig.	0.108
Family Medical History	Chi-square	4.21
	Degree of freedom	3
	Sig.	0.24



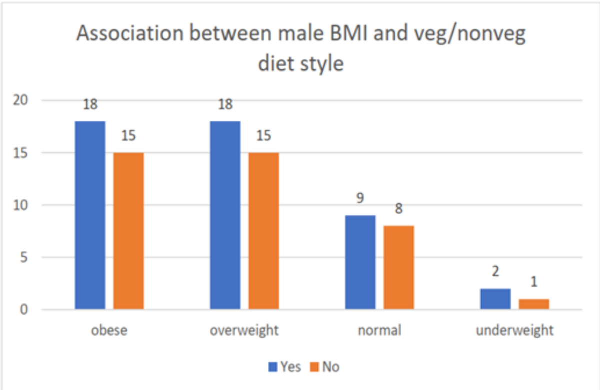
Graph 1: Residential area -wise distribution of females Mets patients based on their BMI



Graph 2: Residential area -wise distribution of males Mets patients based on their BMI



Graph 3: Illustrates diet-style of female MetS patients and their BMI



Graph 4: Illustrates diet-style of male MetS patients and their BMI

DISCUSSION

This cross-sectional study examined the association between Body Mass Index (BMI) and various lifestyle and socio-demographic factors among patients diagnosed with Metabolic Syndrome (MetS) in Lucknow and surrounding regions. The findings underscore the multifactorial etiology of obesity within MetS, highlighting the role of modifiable behaviors and structural determinants over non-modifiable variables like age and gender.

BMI and Socioeconomic Factors

The study revealed a significant association between BMI and education level. Participants with lower educational attainment were more likely to be overweight or obese. This supports prior research indicating that limited health literacy may impair individuals' understanding of nutrition, physical activity, and disease prevention, contributing to poorer health outcomes (Deepa *et al.*, 2009; Mohan *et al.*, 2007). Educational level often influences one's ability to access health information, utilize healthcare services effectively, and adhere to recommended lifestyle changes (Misra and Khurana, 2008).

Family structure was also found to be significantly associated with BMI, with joint family systems showing higher prevalence of obesity compared to nuclear families. This may be attributable to traditional dietary patterns, shared sedentary behavior, and communal meal practices in joint families, which often emphasize rich, carbohydrate-heavy diets. Prior studies have also noted a higher caloric intake and reduced physical activity in similar social settings (Deedwania *et al.*, 2014).

Interestingly, age and gender were not significantly associated with BMI in this study, suggesting that obesity among MetS patients may be more heavily influenced by environmental and lifestyle factors than biological sex or age alone. This finding is somewhat divergent from global trends, which often report higher obesity prevalence among women and older adults (WHO, 2010), indicating a possible cultural or regional variation worth exploring further.

Dietary Habits

While no significant relationship was found between specific dietary habits (Vegetarian and Non-Vegetarian and BMI in this study, descriptive trends suggested that irregular eating patterns, high intake of fast food, and frequent snacking may contribute to weight gain (Graph 3 and Graph 4). These findings are consistent with studies reporting that energy-dense diets and meal skipping are associated with central obesity and impaired glucose metabolism (Popkin, 2006). The lack of statistical significance may be due to self-reported bias or limited dietary granularity in the questionnaire.

Implications for Public Health

The study emphasizes the importance of addressing modifiable lifestyle factors—such as physical inactivity, poor sleep, and psychological distress—in managing BMI among MetS patients. Health promotion strategies must be culturally sensitive, region-specific, and consider socioeconomic barriers to behavioral change. Incorporating education campaigns, community-based physical activity programs, and routine mental health screening in primary care settings could substantially mitigate the burden of MetS.

CONCLUSION

This study highlights that elevated BMI among individuals with Metabolic Syndrome is strongly associated with modifiable lifestyle and socio-demographic factors such as physical inactivity, poor sleep quality, limited education, joint family living, and mental health challenges. These factors appear to have a greater influence than non-modifiable elements like age or gender. Therefore, addressing obesity in MetS requires a comprehensive and multidimensional public health approach. Interventions should not only promote healthier eating and physical activity but also prioritize mental well-being, sleep hygiene, and culturally appropriate education. Future research should focus on tracking these factors over time and evaluating the effectiveness of targeted, community-based strategies in reducing the burden of MetS.

REFERENCES

Cameron A.J., Zimmet P.Z., Shaw J.E. and Alberti K.G.M.M., 2009. The metabolic syndrome: in need of a global mission statement. Diabetic Medicine, **26**(3): 306-309.

Deedwania P.C., Gupta R., Sharma K.K., Achari V., Gupta B., Maheshwari A. and Gupta A., 2014. High prevalence of metabolic syndrome among urban subjects in India: a multisite study. Diabetes & Metabolic Syndrome: Clinical Research & Reviews, **8**(3): 156-161.

Deepa M., Farooq S., Deepa R., Manjula D. and Mohan V., 2009. Prevalence and significance of generalized and central body obesity in an urban Asian Indian population in Chennai, India (CURES: 47). European Journal of Clinical Nutrition, **63**(2): 259-267.

Deshmukh P.R., Kamble P., Goswami K. and Garg N., 2013. Metabolic syndrome in the rural population of Wardha, Central India: An exploratory factor analysis. Indian Journal of Community Medicine, **38**(1): 33-38.

Ford E.S. and Li C., 2008. Metabolic syndrome and health-related quality of life among US adults. Annals of Epidemiology, **18**(3): 165-171.

Galisteo M., Duarte J. and Zarzuelo A., 2008. Effects of dietary fibers on disturbances clustered in the metabolic syndrome. The Journal of nutritional biochemistry, **19**(2): 7184.

Grundy S.M., Cleeman J.I., Daniels S.R., Donato K.A., Eckel R.H., Franklin B.A. and Costa F., 2005. Diagnosis and management of the metabolic syndrome: an American Heart Association/National Heart, Lung, and Blood Institute scientific statement. Circulation, **112**(17): 2735-2752.

Misra A. and Khurana L., 2008. Obesity and the metabolic syndrome in developing countries. The Journal of Clinical Endocrinology & Metabolism, **93**(11 supplement 1): s9-s30.

Mohan V., Deepa M., Farooq S., Narayan K.V., Datta M. and Deepa R., 2007. Anthropometric cut points for identification of cardiometabolic risk factors in an urban Asian Indian population. Metabolism, **56**(7): 961-968.

Patel K.V., Segar M.W., Lavie C.J., Kondamudi N., Neeland I.J., Almandoz J.P. and Pandey A., 2022. Diabetes status modifies the association between different measures of obesity and heart failure risk among older adults: a pooled analysis of community-based NHLBI cohorts. Circulation, **145**(4): 268-278.

Popkin B.M., Kim S., Rusev E.R., Du S. and Zizza C., 2006. Measuring the full economic costs of diet, physical activity and obesity-related chronic diseases. Obesity reviews, **7**(3): 271-293.

Ramachandran A. and Snehalatha C., 2010. Rising burden of obesity in Asia. Journal of obesity, **2010**(1), 868573.

Sharma V., Deissuza D. and Parveen N., 2024. Prevalence of metabolic syndrome among the urban population of Bilaspur: A cross-sectional study. European Journal of Cardiovascular Medicine, **14**(2).

Venkatrao M., Nagarathna R., Majumdar V., Patil S.S., Rathi S. and Nagendra H., 2020. Prevalence of obesity in India and its neurological implications: a multifactor analysis of a nationwide cross-sectional study. Annals of Neurosciences, **27**(3-4): 153-161.