Section: Community Medicine

Original Research Article

# PREVALENCE OF METABOLIC SYNDROME AND ITS ASSOCIATED FACTORS AMONG ADULTS AGED 30 YEARS AND ABOVE IN AN URBAN FIELD PRACTICE AREA OF A TERTIARY CARE CENTRE IN CENTRAL INDIA: A CROSS-SECTIONAL STUDY

*Sneha Nakade[1], Aishwarya Kumar[2], Shreshtha Pandey[3]*

[1]*Assistant Professor, Department of Community Medicine, MGM Medical College and Hospital, Vashi, India.*
[2]*Assistant Professor, Department of Community Medicine, Gautam Buddha Chikitsa Mahavidyalaya, Dehradun, India.*
[3]*Senior Resident, Department of Community and Family Medicine, All India Institute of Medical Sciences, Patna, India.*

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**Corresponding Author:**
**Dr. Aishwarya Kumar,**
Assistant Professor, Department of Community Medicine Gautam Buddha Chikitsa Mahavidyalaya, Dehradun India.
Email: aish18kumar@gmail.com

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ABSTRACT

**Background:** Metabolic syndrome (MetS) is a major public health concern and a key precursor to cardiovascular disease and type 2 diabetes mellitus. Rapid urbanisation and lifestyle transitions have increased the burden of MetS in India, while data from Central India remain limited. **Objectives:** To estimate the prevalence of metabolic syndrome and identify associated epidemiological and lifestyle factors among adults aged ≥30 years in an urban area of Central India. **Materials and Methods:** A community-based cross-sectional study was conducted from June 2022 to September 2024 in the urban field practice area of a tertiary care centre in Central India. A total of 341 adults aged ≥30 years were enrolled through house-to-house visits. Information on socio-demographic characteristics, lifestyle factors, physical activity (RAPA), and perceived stress (PSS-10) was collected. Anthropometric measurements, blood pressure, fasting blood glucose, and lipid profile were assessed. Metabolic syndrome was defined using modified NCEP ATP III (2005) criteria. Data were analysed using Epi Info™ version 7.2.1.0.

**Results:** The prevalence of metabolic syndrome was 62.8%. Hypertriglyceridemia (75.9%) was the most common component, followed by abdominal obesity and elevated blood pressure (63.9% each). Metabolic syndrome was significantly associated with age >45 years, tobacco use, known hypertension and diabetes, sedentary lifestyle, BMI ≥23 kg/m², mixed diet, and moderate to high perceived stress levels ($p<0.05$).

**Conclusion:** A high burden of metabolic syndrome among urban adults in Central India highlights the need for early screening and targeted lifestyle interventions to reduce future.

**Keywords:** Metabolic Syndrome; Risk Factors; Dyslipidaemias; Life Style; Urban Population.

## INTRODUCTION

"Non-communicable diseases (NCDs) are a major public health concern in developing countries and are responsible for the highest number of deaths and disease burden worldwide. It is estimated that 74% of global deaths per year are caused by NCDs, with 77% occurring in low- and middle-income countries, placing a significant burden on health systems and economies globally.".[1]

"Metabolic syndrome (MetS), characterized by central obesity, insulin resistance, hypertension, and dyslipidaemia, poses a significant risk for atherosclerotic cardiovascular diseases and type II diabetes mellitus. Global prevalence varies from 12.5% to 31.4% depending on the definition used. In South Asia, prevalence has been reported as 14.0%

(WHO), 26.1% (ATP III), 29.8% (IDF), and 32.5% (modified ATP III).".[1,2]

"Overweight/obesity, physical inactivity, and ageing are key risk factors for MetS. South Asians, particularly Indians, have higher metabolic and cardiovascular risk, with a predisposition to abdominal obesity and insulin resistance. The ongoing epidemiological transition in India may further increase the burden of diabetes and cardiovascular disease, making it important to estimate MetS prevalence in the population.".[3,4,5]

"The World Health Organization reports that the probability of dying between 30 and 70 years from major non-communicable diseases in India is approximately 26%, underscoring the need for early risk identification in adults. Metabolic syndrome, a clustering of modifiable cardiometabolic risk factors, is a key precursor to cardiovascular disease and diabetes and therefore forms an important target for screening under the NPNCD programme among adults aged ≥30 years".[6] Although several studies have assessed MetS prevalence in India, most are limited to small areas, and few have been conducted in Central India.

Considering this gap in the literature, the present study was conducted in the urban field practice area of a tertiary care centre in Central India to estimate the prevalence of metabolic syndrome and its associated factors.

**Objective**

1. To determine the prevalence of metabolic syndrome among adults aged 30 years and above in the urban field practice area of a tertiary care centre in Central India.
2. To assess epidemiological and lifestyle factors associated with metabolic syndrome in adults aged 30 years and above.

## MATERIALS AND METHODS

**Study Procedure**

This cross-sectional study was carried out in the urban field practice area attached to a tertiary care centre in Central India over a period extending from June 2022 to September 2024. The study population comprised residents aged 30 years and above living in the selected urban area. Individuals who declined to participate, pregnant women, and those who were severely ill or bedridden at the time of data collection were excluded from the study.

The sample size was calculated using a reported prevalence of metabolic syndrome (66.7%) among adults aged ≥30 years, as reported by Pranita Kamble et al. with absolute precision of 5% and confidence level was of 95%. Based on these parameters, the calculated sample size was 341, and the same number of participants were enrolled in the study.

For this study following sampling method was followed-

- A centrally located landmark within the study area was identified, and the direction of household selection was determined by randomly rotating a pen on the ground.
- The first household was selected randomly using the last digit of a currency note, following which adjacent households in the selected direction were visited sequentially.
- All eligible individuals residing in a selected household were included. The procedure was continued until the required sample size was achieved.

**Ethical considerations**

- The study was conducted in strict adherence to ethical standards, with prior approval from the Institutional Ethics Committee (No. 1617), dated 26/4/2022 and informed consent obtained from all participants.
- Informed written consent in subject's vernacular language was taken after apprising them of the nature and purpose of study.

**Data Collection**

The principal investigator conducted face-to-face interviews with the study participants in the local language (Marathi) using a predesigned proforma, after establishing rapport to obtain information on socio-demographic characteristics and dietary habits, behavioural risk factors. Physical activity and perceived stress were assessed using the Rapid Assessment of Physical Activity (RAPA) scale and the Perceived Stress Scale-10 item (PSS-10), respectively. The presence of metabolic syndrome was assessed using the modified NCEP ATP III criteria (2005).

**Anthropometric Measurements**

Anthropometric measurements were performed using standard techniques. Body weight was assessed using a bathroom weighing scale and noted to the nearest 0.5 kg. Standing height was measured to the nearest 0.5 cm with the participant in an erect posture using a portable stadiometer. Body mass index (BMI) was derived using the formula: weight in kilograms divided by height in meters squared. Waist circumference was measured in the standing position at the midpoint between the lower margin of the lowest palpable rib and the iliac crest using a non-stretchable measuring tape.

**Blood Pressure Measurement**

Blood pressure was recorded from the right arm in the seated position using a sphygmomanometer. The average of three readings taken at half-hour intervals was used for analysis.

**Biochemical Measurements**

All participants underwent biochemical investigations. Fasting blood glucose levels were measured using FDA approved Portable Glucometer. For lipid profile estimation, 5 ml of venous blood was collected after 10–12 hours of overnight fasting. The sample obtained was analysed in a biochemistry laboratory for lipid parameters using standard laboratory procedures.

**Operational Definitions**

**Metabolic Syndrome:** Metabolic syndrome was defined as the presence of three or more of the following criteria according to the modified NCEP ATP III (2005): fasting blood sugar >100 mg/dL; systolic blood pressure ≥130 mmHg or diastolic blood pressure ≥85 mmHg; serum triglyceride levels >150 mg/dL; high-density lipoprotein (HDL) cholesterol <40 mg/dL in men or <50 mg/dL in women; and waist circumference of ≥90 cm in men or ≥80 cm in women.

**Pre-diabetes and Diabetes:** Pre-diabetes was defined as fasting blood glucose levels between 100–125 mg/dL or a prior diagnosis by a physician and/or current use of anti-diabetic medication. Diabetes was defined as fasting blood glucose ≥126 mg/dL or a prior diagnosis by a physician and/or current use of anti-diabetic drugs.

**Hypertension:** Hypertension was defined as systolic blood pressure ≥130 mmHg or diastolic blood pressure ≥85 mmHg, or a prior diagnosis of hypertension with current use of anti-hypertensive medication.

**Dyslipidaemia:** Dyslipidaemia was defined as serum triglyceride levels >150 mg/dL or HDL cholesterol <40 mg/dL in men and <50 mg/dL in women.

**Body Mass Index (BMI):** Body mass index was categorized as normal (<22.9 kg/m²), overweight (23–24.9 kg/m²), and obese (≥25 kg/m²).

**Alcohol Use:** Current alcohol users were defined as individuals who consumed at least one alcoholic drink in the year preceding the survey. Lifetime abstainers were those who had never consumed alcohol.

**Tobacco Use:** Current tobacco users included individuals who smoked or used smokeless tobacco daily or occasionally at the time of the survey.

**Dietary Pattern:** Diet was classified as vegetarian or mixed. Daily consumption of salt, sugar, and cooking oil was recorded.

**Data management and analysis**

Data were entered into Microsoft Excel and checked for completeness and consistency before analysis. Statistical analysis was performed using Epi Info™ version 7.2.1.0. Continuous variables were summarized as mean and standard deviation, while categorical variables were expressed as frequencies and percentages.

The prevalence of metabolic syndrome was calculated with 95% confidence intervals. Associations between metabolic syndrome and selected socio-demographic, anthropometric, and biochemical variables were assessed using the Chi-square test. P-value of less than 0.05 was considered statistically significant.

## RESULTS

**Table 1: Distribution of Study Subjects According to Socio-Demographic Profile**

| SOCIO- DEMOGRAPHIC FACTORS | TOTAL NO.(N=341) | PERCENTAGE (%) |
|---|---|---|
| **Age group (years)** | | |
| 30–39 | 98 | 28.73 |
| 40–49 | 76 | 22.28 |
| 50–59 | 71 | 20.82 |
| 60–69 | 63 | 18.47 |
| ≥70 | 33 | 9.67 |
| **Gender** | | |
| Male | 152 | 44.57 |
| Female | 189 | 55.43 |
| **Education** | | |
| Up to middle school | 97 | 28.40 |
| High school & secondary | 124 | 36.30 |
| Graduate & above | 120 | 35.20 |
| **Occupation** | | |
| Homemaker / Unemployed | 228 | 66.85 |
| Unskilled / Semi-skilled | 53 | 15.54 |
| Skilled / Clerical / Farmer | 33 | 9.68 |
| Semi-professional / Professional | 27 | 7.93 |
| **Socio-economic status** | | |
| Class I | 52 | 15.10 |
| Class II | 84 | 24.60 |
| Class III | 132 | 38.90 |
| Class IV | 54 | 15.90 |
| Class V | 19 | 5.60 |

Table 1: A total of 341 adults aged ≥30 years participated in the study. The mean age of the study population was 50.16 ± 14.37 years, with a predominance of females. Most participants belonged to middle socioeconomic strata and were homemakers or unemployed.

**Table 2: Distribution of Study Subjects According to Clinical Characteristics**

| CLINICAL CHARACTERISTICS | TOTAL NO.(N=341) | PERCENTAGE (%) |
|---|---|---|
| **Family history*** | | |
| Hypertension | 72 | 21.11 |
| Diabetes mellitus | 42 | 12.31 |
| Ischemic heart disease | 8 | 2.30 |
| **Known co-morbidities*** | | |
| Hypertension | 117 | 34.31 |
| Diabetes mellitus | 75 | 21.99 |
| Thyroid disorders | 34 | 9.97 |
| Others | 30 | 8.80 |

***Multiple responses allowed***

Table 2: Hypertension and diabetes mellitus were the most frequently reported comorbid conditions, while a family history of hypertension was the most common familial risk factor.

**Table 3: Distribution of study subjects according to lifestyle and behavioural factors**

| LIFESTYLE AND BEHAVIOURAL FACTORS | TOTAL NO.(N=341) | PERCENTAGE (%) |
|---|---|---|
| **Personal habits*** | | |
| Alcohol use | 36 | 10.55 |
| Tobacco use (smokeless) | 73 | 21.40 |
| Smoking | 14 | 4.10 |
| No habits | 234 | 68.62 |
| **Physical activity (RAPA scale)** | | |
| Sedentary | 106 | 31.08 |
| Underactive | 90 | 26.39 |
| Underactive – regular light activity | 109 | 31.96 |
| Underactive – regular | 18 | 5.27 |
| Active | 18 | 5.27 |
| **Dietary pattern** | | |
| Vegetarian | 120 | 35.20 |
| Mixed | 221 | 64.80 |
| Excess oil consumption† (20-30ml/day for women and 25-40ml/day for men) | 251 | 73.60 |
| Excess salt consumption (≥5 g/day) | 307 | 90.00 |
| Excess sugar consumption‡ (>38gms/day/person for men, >25gms/day for women) | 177 | 51.00 |
| Excess calorie intake | 190 | 55.70 |
| **Perceived stress level (PSS-10)** | | |
| Low | 126 | 36.90 |
| Moderate | 137 | 40.20 |
| High | 78 | 22.90 |

**** Multiple responses present***
***† As per ICMR–NIN guidelines (2020)***
***‡ As per American Heart Association recommendations***

Table 3: A substantial proportion of participants reported sedentary or underactive lifestyles. Excess intake of dietary salt, oil, sugar, and calories was commonly observed, and a considerable number of participants reported moderate to high perceived stress levels.

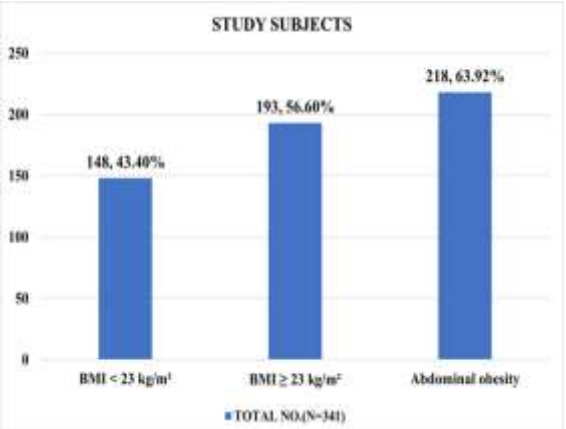


**Figure 1: Distribution of Study Subjects According to Anthropometric Characteristics**

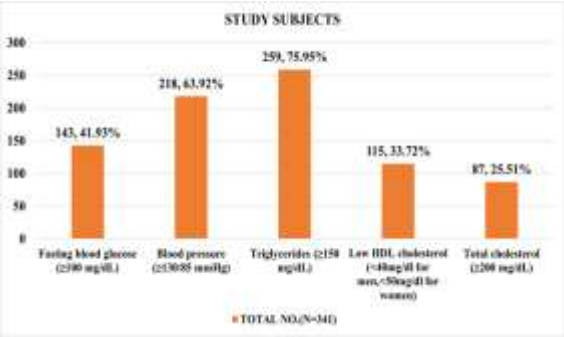


**Figure 2: Distribution of Study Subjects According to Biochemical and Clinical Parameters**

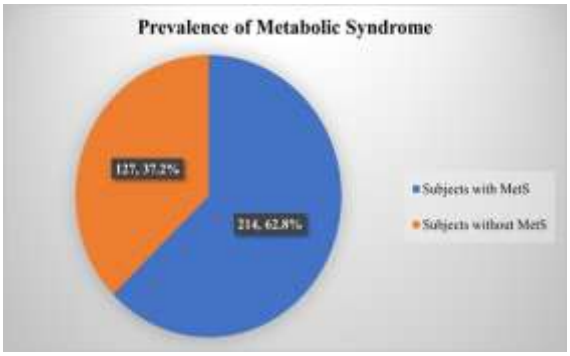


**Figure 3: Distribution of Study Subjects according to Prevalence of Metabolic Syndrome**

**Figure 1:** More than half of the participants had a body mass index ≥23 kg/m², and abdominal obesity was prevalent among a majority of study subjects.

**Figure 2:** Elevated triglyceride levels and raised blood pressure were the most frequently observed abnormalities, followed by impaired fasting glucose and low HDL cholesterol levels

**Figure 3:** Metabolic syndrome was present in nearly two-thirds of the study population. Among its components, hypertriglyceridemia was the most common, followed by abdominal obesity and elevated blood pressure.

**Table 4: Factors associated with metabolic syndrome among study subjects**

| FACTOR | SUBJECTS WITH METS (n = 214) | SUBJECTS WITHOUT METS (n = 127) | P VALUE |
|---|---|---|---|
| **Age** | | | |
| <=45 | 59(48.36%) | 63(51.64%) | <0.0001* |
| >45 | 155(70.78%) | 64(29.22%) | |
| **Gender** | | | |
| Male | 91(59.87%) | 61(40.13%) | 0.1946 |
| Female | 126(66.67%) | 63(33.33%) | |
| **Educational qualification** | | | |
| Graduation and above | 74(61.67%) | 46(38.33%) | 0.6146 |
| Below graduation | 143(64.41%) | 79(35.59%) | |
| **Socioeconomic status** | | | |
| **>=class III** | 175(65.3%) | 93(34.7%) | 0.0628 |
| **Below class III** | 39(43.42%) | 34(56.58%) | |
| **Occupation** | | | |
| No formal employment | 139(60.96%) | 89(39.04%) | 0.331 |
| Formally employed | 75(66.37%) | 38(33.63%) | |
| **Consumption of alcohol** | | | |
| Yes | 27(75%) | 9(25%) | 0.1081 |
| No | 187(61.31%) | 118(38.69%) | |
| **Use of tobacco** | | | |
| Yes | 57(78.08%) | 16(21.92%) | 0.0022* |
| No | 157(58.78%) | 111(41.22%) | |
| **Smokers** | | | |
| Yes | 12(85.71%) | 2(14.29%) | 0.069 |
| No | 202(61.77%) | 125(38.23%) | |
| **Known Morbidities** | | | |
| Hypertension | 108(92.31%) | 9(7.69%) | <0.001* |
| DM | 65(86.67) | 10(13.33%) | <0.001* |
| **Physical activity** | | | |
| Sedentary | 140(71.43%) | 56(28.57%) | 0.0001* |
| Not sedentary | 74(51.03%) | 71(48.97%) | |
| **BMI** | | | |
| < 23 kg/m$^2$ | 71(33.17%) | 77(60.63%) | <0.0001* |
| ≥23 kg/m$^2$ | 143(66.83%) | 50(39.37%) | |
| **Diet** | | | |
| Vegetarian | 65(30.37%) | 55(45.83%) | 0.0156* |
| Mixed | 149(69.63%) | 72(32.58%) | |
| **Stress levels** | | | |
| Low | 35(27.78%) | 91(72.78%) | <0.0001* |
| Moderate to high | 179(83.26%) | 36(16.74%) | |

Table 4: Metabolic syndrome was significantly more prevalent among participants aged above 45 years compared to younger adults. Tobacco use showed a significant association with metabolic syndrome, whereas no significant association was observed with gender, educational status, occupation, alcohol consumption, or smoking.

Participants with known hypertension and diabetes mellitus had a significantly higher prevalence of metabolic syndrome. Sedentary lifestyle was also significantly associated with metabolic syndrome when compared to non-sedentary individuals. A higher body mass index (≥23 kg/m²) showed a strong positive association with metabolic syndrome.

Dietary pattern demonstrated a significant association, with a higher prevalence of metabolic syndrome among individuals consuming a mixed diet compared to vegetarians. Additionally, participants

reporting moderate to high perceived stress levels were significantly more likely to have metabolic syndrome than those with low stress levels.

## DISCUSSION

The prevalence of metabolic syndrome was 62.8% in the current community-based cross-sectional study of adults over 30 in an urban field practice area in Central India. Compared to estimates from other urban Indian settings, this prevalence is significantly higher. A pooled prevalence of roughly 32% (95% CI: 29%–36%) among urban adults using similar diagnostic criteria was reported in a recent systematic review and meta-analysis of urban studies in India, indicating significant heterogeneity across urban populations. Although less than that seen in the current study, community-based studies from urban areas, such as one from urban West Bengal that reported a prevalence of 44.6% using the modified NCEP ATP III criteria, also show a high burden.

The most common factor was hypertriglyceridemia, which was followed by abdominal obesity. Studies conducted in South Asia and India have consistently shown a similar predominance of central obesity and dyslipidaemia, which is indicative of low physical activity and dietary patterns high in fats and carbohydrates (Joshi et al., 2017; Dutta et al., 2020). Similar to other urban Indian cohorts, a significant percentage of participants had elevated fasting blood glucose, while the least common abnormality was low HDL cholesterol (Choudhary et al., 2022).

Using Asian-specific cut-offs, 56.6% of participants in our study had a BMI of ≥23 kg/m² and 63.9% had abdominal obesity, indicating a high prevalence of excess body weight. According to similar urban Indian studies, the prevalence of overweight/obesity and abdominal obesity ranges from 50% to 60% and 55% to 70%, respectively, indicating that the burden found in this study is similar to that found in other Indian urban settings (Misra & Vikram, 2018; Kapoor et al., 2021).

The study participants had a high prevalence of lifestyle risk factors. 57.5% of people reported being sedentary, consuming excessive amounts of oil and salt, and experiencing moderate to high levels of stress. Similar results have been documented in recent urban studies from India, where nearly half to two-thirds of adults had sedentary lifestyles and unhealthy eating habits, supporting their role in the development of metabolic syndrome (Tandon et al., 2020; Verma et al., 2023).

Metabolic syndrome showed significant association with age >45 years, tobacco use, known hypertension and diabetes, sedentary lifestyle, BMI ≥23 kg/m², mixed diet, and higher stress levels. These associations are consistent with findings from community-based studies conducted in urban India, which have similarly identified advancing age, physical inactivity, tobacco use, higher BMI, and pre-existing cardiometabolic conditions as important correlates of metabolic syndrome (Gupta et al., 2019; Behera et al., 2022; Singh et al., 2024).

Similar findings have been documented in other urban Indian studies, indicating that metabolic risk is not restricted to particular subgroups but rather is widely distributed across sociodemographic groups in urban populations.

## CONCLUSION

According to the study, adults in Central India have a high prevalence of metabolic syndrome and a significant burden of modifiable cardiometabolic risk factors. The results emphasize the necessity of regular screening, early detection, and focused preventive measures that emphasize changing one's lifestyle. Further longitudinal studies are necessary to comprehend causal pathways and to reinforce population-based strategies for early detection and control of non-communicable diseases, given the paucity of region-specific evidence, particularly from Central India.

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