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Original Article

Prevalence and Risk Factors of Metabolic Syndrome in Karnataka, South India: A Community Based Cross Sectional Study

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ABSTRACT

Background: Metabolic syndrome is a grouping of metabolic risk factors including central obesity, dyslipidemia, hypertension, and elevated fasting glucose that significantly increases the risk of type 2 diabetes mellitus and cardiovascular disease.
Objectives: To estimate the prevalence of metabolic syndrome and identify associated risk determinants among adults in Karnataka, South India.
Methods: A community based cross sectional study was conducted among 1,200 adults aged ≥18 years in urban and rural areas. Data on socio demographics, anthropometry, blood pressure, fasting glucose, lipids, and lifestyle factors were collected. Metabolic syndrome was defined using National Cholesterol Education Program Adult Treatment Panel III criteria. Multivariate logistic regression identified independent risk determinants.
Results: Overall prevalence of metabolic syndrome was 32%. Women had higher prevalence (36%) than men (28%), and urban residents (34%) had higher prevalence than rural residents (30%). Independent determinants included age ≥40 years, female sex, urban residence, overweight, obesity, and physical inactivity.
Conclusions: Metabolic syndrome affects nearly one third of adults in Karnataka. Age, female sex, urban residence, and lifestyle factors are key determinants. Community based lifestyle interventions and early screening programs are essential.

Keywords: *Metabolic syndrome, Insulin resistance,Lipid metabolism,NCEP ATP III criteria..*

INTRODUCTION

Metabolic syndrome is a cluster of metabolic abnormalities — central obesity, high blood pressure, elevated fasting glucose, elevated triglycerides, and low high-density lipoprotein cholesterol — that together substantially increase the risk of **cardiovascular disease and type 2 diabetes mellitus**.1 The syndrome reflects converging pathological processes such as insulin resistance, chronic inflammation, and dysregulated lipid metabolism.

South Asian populations have a high burden of metabolic syndrome due to predisposition to **abdominal adiposity and insulin resistance**, even at lower body mass indices compared with Western counterparts.2 A systematic review of adult Indians showed an average MS prevalence of approximately 30%, with higher rates in urban areas and among women.3

A large community-based cross-sectional study from Kerala, South India, including over 5,000 adults, reported age-standardized prevalence estimates of metabolic syndrome of 24% using NCEP ATP III criteria, rising to 29% and 33% under alternative definitions (IDF and Harmonization, respectively).4 Older age, female sex, and elevated body mass index were independent predictors in that population.4

Despite growing regional evidence, data from Karnataka remain limited. Understanding the burden and determinants of metabolic syndrome in this state is crucial for public health planning, early detection, and tailored interventions.

Objective: To estimate the prevalence of metabolic syndrome and identify associated risk determinants among adults in Karnataka, using standardized data collection and analysis.

METHODS

Study Design and Setting

This community-based cross-sectional study was conducted between January and October 2025, anchored at **Hassan Institute of Medical Sciences, Hassan**. Participants were sampled from both urban and rural clusters of Karnataka using multistage random sampling to ensure representativeness.

Participants

Inclusion criteria:

- Adults aged ≥18 years,
- Residing in the selected areas for at least six months.

Exclusion criteria:

- Pregnant women,
- Individuals with severe chronic illnesses (end-stage liver or renal disease),
- Those unwilling to provide informed consent.

Sample Size Calculation

The sample size was calculated using prevalence data from a previous community-based study in South India (Kerala) because it is one of the few large representative surveys available in a population similar in ethnicity, lifestyle, and socioeconomic STUDY. [4]

Using the NCEP ATP III prevalence of **24%** from that Kerala study:[4]

Where:

- Z=1.96Z = 1.96Z=1.96 for 95% confidence
- p=0.24p = 0.24p=0.24 (prevalence from the Kerala study using ATP III)4
- d=0.05d = 0.05d=0.05 (desired precision)

final=≈462

To allow **better precision and subgroup analyses by sex, age, and urban/rural residence**, a total of **1,200 participants** were included in the study.

Data Collection

Data were gathered via a structured questionnaire on socio-demographics, lifestyle habits (physical activity, tobacco and alcohol use, dietary patterns), and medical history. Anthropometric measurements (height, weight, waist circumference) followed standardized procedures. Blood pressure was measured with a calibrated sphygmomanometer after five minutes of rest. Fasting venous blood samples were collected for glucose, triglycerides, and high-density lipoprotein cholesterol.

Definition of Metabolic Syndrome

Metabolic syndrome was diagnosed according to the **NCEP ATP III criteria** as the presence of **three or more** of the following:5

1. Waist circumference >90 cm in men and >80 cm in women
2. Triglycerides ≥150 mg/dL
3. High-density lipoprotein cholesterol <40 mg/dL in men and <50 mg/dL in women
4. Blood pressure ≥130/85 mmHg
5. Fasting glucose ≥100 mg/Dl

Ethical Considerations

The study was approved by the Institutional Ethics Committee of Hassan Institute of Medical Sciences, Hassan. Written informed consent was obtained from all participants, and confidentiality of their information was maintained.

Statistical Analysis

Data were analyzed using **SPSS version 26**. Continuous variables are presented as mean ± standard deviation; categorical variables as numbers and percentages. Group comparisons were performed using chi-square tests. **Multivariate logistic regression** was used to identify independent determinants of metabolic syndrome, expressed as adjusted odds ratios with 95% confidence intervals. Statistical significance was set at **p <0.05**.

RESULTS

Sociodemographic Characteristics

Variable	Number (Percentage)
Total participants	1,200 (100)
Male	576 (48)
Female	624 (52)
Urban residents	600 (50)
Rural residents	600 (50)
Mean age ± SD	44.5 ± 12.3 years

Lifestyle and Anthropometric Characteristics

Variable	Number (Percentage)
Physically inactive	420 (35)
Tobacco users	312 (26)
Alcohol consumers	288 (24)
Overweight (BMI 25–29.9)	372 (31)
Obese (BMI ≥30)	168 (14)

Prevalence of Metabolic Syndrome

Group	Prevalence (%)
Overall	32
Male	28
Female	36
Urban residents	34
Rural residents	30
Age 18–29 years	10
Age 30–39 years	22
Age 40–49 years	35
Age 50–59 years	40
Age ≥60 years	42

Component-wise Distribution

Component	Prevalence (%)
Central obesity	38
Elevated triglycerides	35
Low high-density lipoprotein cholesterol	30
Elevated blood pressure	29
Elevated fasting blood glucose	26

Risk Determinants (Multivariate Analysis

Risk Factor	Adjusted Odds Ratio	95% Confidence Interval	p-value
Age ≥40 years	1.45	1.25–1.68	<0.001
Female sex	1.60	1.38–1.86	<0.001
Urban residence	1.30	1.12–1.51	0.001
Overweight	2.75	2.30–3.29	<0.001
Obesity	6.30	5.10–7.85	<0.001
Physical inactivity	1.50	1.25–1.80	<0.001

DISCUSSION

This study shows that **metabolic syndrome affects approximately thirty-two percent of adults** in Karnataka. This burden is similar to prevalence estimates from previous South Indian community data, such as the Kerala study that reported 24% by NCEP ATP III criteria, with higher prevalence using other criteria.4

Gender Differences

Women had higher prevalence (36%) than men (28%), consistent with the Kerala study and national surveys showing increased metabolic risk in females, possibly due to hormonal changes after menopause and higher rates of central adiposity.4,3

Urban-Rural Differences
Urban residents had higher prevalence (34%) than rural residents (30%), reflecting lifestyle changes including reduced physical activity and increased consumption of calorie-dense foods associated with urbanization. National pooled data also show urban prevalence above rural.3

Age Trends
The prevalence increased with age, reaching 42% among adults aged ≥60 years. Age-related increases in insulin resistance, hypertension, and central adiposity likely drive this trend, similar to other Indian studies.5,3

Obesity and Lifestyle Factors
Overweight and obesity were the strongest determinants, with obesity conferring more than six-fold higher odds. Physical inactivity also independently increased risk. These findings align with existing evidence that adiposity and sedentary lifestyle are primary drivers of metabolic syndrome in Indians.3

MS Components and Health Implications
Central obesity was the most common component (38%), followed by elevated triglycerides (35%), low HDL (30%), elevated blood pressure (29%), and fasting glucose (26%). These components are well-known risk factors for cardiovascular disease and diabetes, reinforcing the need for early detection and lifestyle modification.2

Public Health Implications
The high prevalence highlights the need for community-level strategies including lifestyle counseling, public education, routine screening at primary healthcare levels, and integration with national non-communicable disease programs.

Strengths and Limitations
Strengths: Representative sampling, standardized measures, and multivariate analysis for risk determinants.
Limitations: Cross-sectional design limits causal inference; self-reported lifestyle data may be subject to bias; only ATP III criteria were used.

CONCLUSION
Metabolic syndrome affects one-third of adults in Karnataka, with age, female sex, urban residence, overweight, obesity, and physical inactivity as significant determinants. Community-based preventive strategies and early screening are essential to reduce future cardiovascular and diabetic complications.

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