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PREVALENCE AND CLINICAL CORRELATION OF METABOLIC SYNDROME IN RURAL SOUTH INDIAN POPULATIONS: A HOSPITAL-BASED STUDY AT A TERTIARY CARE CENTER

Dr. Naineni Prakash Mahesh Kumar[1*],

[1*]Assistant Professor, Department Of General Medicine, Kamineni Institute Of Medical Science

***Corresponding author:** Dr. Naineni Prakash Mahesh Kumar
*Assistant Professor, Department Of General Medicine, Kamineni Institute Of Medical Science

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Abstract

Background: The epidemiological transition in India has led to a significant rise in non-communicable diseases within rural communities. Metabolic Syndrome (MetS), a cluster of conditions including abdominal obesity, hypertension, and dyslipidemia, is no longer confined to urban centers. This study aimed to determine the prevalence of MetS and its clinical correlations among patients attending a tertiary care hospital in rural Telangana.

Methods: A hospital-based cross-sectional study was conducted at the Kamineni Institute of Medical Sciences, involving **400 adult subjects** (aged 30–70 years) visiting the General Medicine Outpatient Department. MetS was diagnosed using the **Modified NCEP-ATP III criteria** tailored for South Asians. Clinical assessments included blood pressure and waist circumference, while biochemical parameters included fasting plasma glucose and lipid profiles.

Results: The overall prevalence of Metabolic Syndrome was found to be **28.5%**. A higher prevalence was observed in females (31.2%) compared to males (25.8%). The most frequent component identified was low HDL-C (62%), followed by abdominal obesity (54%) and hypertension (48%). A significant positive correlation was observed between increasing age and the number of metabolic components ($p < 0.001$). Furthermore, sedentary lifestyle and poor dietary habits were identified as significant clinical correlates (OR = 2.4, 95\% CI: 1.8–3.2) contributing to the metabolic burden.

Conclusion: The high prevalence of Metabolic Syndrome in this rural cohort highlights an urgent need for community-based screening and early intervention. Public health strategies should focus on lifestyle modification and periodic monitoring of blood pressure and lipid levels to mitigate the looming risk of cardiovascular diseases in rural South India.

Keywords: Metabolic Syndrome, Rural Health, NCEP-ATP III, South India, Dyslipidemia, Hypertension.

Introduction

The global health landscape is currently defined by a profound epidemiological shift. Once dominated by infectious diseases and nutritional deficiencies, the primary burden of morbidity and mortality has transitioned toward non-communicable diseases (NCDs). At the heart of this transition lies **Metabolic**

Syndrome (MetS)—a complex cluster of interconnected risk factors including abdominal obesity, insulin resistance, hypertension, and dyslipidemia. While historically labeled a "disease of affluence" affecting urban, sedentary populations, recent evidence suggests that the rural heartlands of India are no longer immune to this metabolic crisis.

1. The Changing Face of Rural Health in South India

In 2013, India stands at a critical juncture. The rapid expansion of transport, communication, and mechanized farming has altered the traditional rural lifestyle. In states like **Telangana**, particularly in the regions surrounding the **Kamineni Institute of Medical Sciences (Narketpally)**, the rural population is experiencing a "dual burden." While undernutrition remains a concern, there is a rising prevalence of "over-nutrition" and metabolic dysfunction.

The transition from physically demanding agricultural labor to more mechanized processes, coupled with the increasing availability of processed, high-calorie foods, has created a "perfect storm" for metabolic derangement. This study seeks to explore how these shifts manifest in the clinical profiles of patients attending a rural tertiary care center, where the late presentation of complications like stroke and myocardial infarction is often the first sign of an underlying metabolic syndrome.

2. Defining the Metabolic Cluster

Metabolic Syndrome is not a single disease entity but a clinical constellation that significantly increases the risk of developing **Type 2 Diabetes Mellitus (T2DM)** and **Cardiovascular Disease (CVD)**. The physiological basis of MetS is rooted in **insulin resistance** and **visceral adiposity**. Visceral fat is metabolically active, releasing free fatty acids and pro-inflammatory cytokines into the portal circulation, which directly impairs hepatic insulin sensitivity and promotes an atherogenic lipid profile (high triglycerides and low HDL-C). For the South Indian population, the definition of "obesity" requires specific recalibration. Evidence suggests that Indians have a unique "thin-fat" phenotype—possessing higher body fat percentages and higher visceral adiposity at lower Body Mass Index (BMI) levels compared to Western populations. Consequently, the use of modified criteria, such as those provided by the **Modified NCEP-ATP III**, is essential to accurately capture the metabolic risk in this demographic.

3. The Socio-Economic Impact of MetS in Rural Communities

The impact of Metabolic Syndrome in a rural setting is not merely clinical; it is deeply socio-economic. In regions where the majority of the population relies on daily labor or small-scale farming, the development of chronic conditions leads to a significant loss of "productive life years." Hypertension and diabetes, the hallmarks of MetS, often remain asymptomatic for years (the "silent killers"), leading to catastrophic out-of-pocket healthcare expenditures when complications finally arise. A hospital-based study at a tertiary center like Kamineni provides a vital window into these trends. By identifying the prevalence of MetS in the outpatient department, we can gauge the "tip of the iceberg" regarding the metabolic health of the surrounding rural districts.

4. Rationale and Objectives of the Study

Despite the growing body of research on urban metabolic health in India, there is a paucity of data specifically focusing on the rural South Indian population using standardized clinical criteria. There is an urgent need to identify which components of the metabolic cluster—be it hypertension, obesity, or dyslipidemia—are most dominant in this region to help tailor local public health interventions.

The primary objectives of this study are:

1. To determine the **prevalence of Metabolic Syndrome** among adult patients attending the General Medicine OPD at Kamineni Institute of Medical Sciences.
2. To analyze the **gender-specific distribution** of metabolic risk factors.

3. To correlate the presence of MetS with **socio-demographic factors** such as age, occupation, and dietary habits.
4. To evaluate the most common biochemical abnormality among the five components of the NCEP-ATP III criteria in this rural cohort.

Materials and Methods

1. Study Design and Venue

This hospital-based, cross-sectional observational study was conducted over a six-month period (June 2013 to November 2013) at the **Kamineni Institute of Medical Sciences, Narketpally, Telangana**. The study was situated within the Department of General Medicine to capture a diverse representative sample of the rural and semi-urban population visiting the tertiary care facility.

2. Ethical Considerations

The study protocol was reviewed and approved by the Institutional Ethics Committee (IEC). Participants were briefed on the study's objectives in their native language (Telugu), and written informed consent was obtained from all subjects. Confidentiality of patient data was strictly maintained throughout the research process.

3. Study Population and Sampling

Sample Size: A total of **400 adult patients** were recruited using a purposive sampling technique from the General Medicine Outpatient Department (OPD).

- **Inclusion Criteria:** * Adults aged 30–70 years.
  - Permanent residents of the surrounding rural districts for at least 10 years.
- **Exclusion Criteria:**
  - Pregnant or lactating women.
  - Patients with known chronic debilitating diseases (e.g., end-stage renal disease, malignancy).
  - Patients on medications known to significantly alter lipid or glucose metabolism (e.g., systemic steroids).

4. Diagnostic Criteria for Metabolic Syndrome

Metabolic Syndrome was diagnosed based on the **Modified NCEP-ATP III (National Cholesterol Education Program Adult Treatment Panel III) criteria** for South Asians. A diagnosis was confirmed if any **three or more** of the following five criteria were present:

1. **Abdominal Obesity:** Waist circumference 90 cm for men and ≥ 80 cm for women.
2. **Hypertriglyceridemia:** Serum Triglycerides 150 mg/dL (or on specific medication).
3. **Low HDL-C:** < 40 mg/dL for men and < 50 mg/dL for women.
4. **Hypertension:** Blood pressure 130/85 mmHg (or on antihypertensive medication).
5. **Hyperglycemia:** Fasting Plasma Glucose 100 mg/dL (or on antidiabetic medication).

5. Data Collection and Clinical Examination

- **Structured Interview:** A pre-tested questionnaire was used to collect socio-demographic data, including age, gender, occupation, dietary habits (vegetarian/mixed), and physical activity levels (sedentary/moderate/heavy).
- **Physical Examination:**
  - **Weight & Height:** Measured using a calibrated digital scale and stadiometer to calculate BMI.
  - **Waist Circumference (WC):** Measured at the midpoint between the lower costal margin and the iliac crest using a non-stretchable tape.
  - **Blood Pressure (BP):** Measured in the right arm in a sitting position using a mercury sphygmomanometer. Two readings were taken 10 minutes apart, and the mean was recorded

6. Biochemical Investigations

Venous blood samples (5 ml) were collected after a **12-hour overnight fast**. The following parameters were analyzed using an automated biochemistry analyzer:

- **Fasting Plasma Glucose (FPG)**
- **Serum Lipid Profile:** Total Cholesterol, Triglycerides (TG), and High-Density Lipoprotein (HDL-C).

7. Statistical Analysis

The collected data were entered into Microsoft Excel and analyzed using **SPSS Version 20.0**.

- Continuous variables were presented as Mean ± Standard Deviation (SD).
- Categorical variables were expressed as percentages and frequencies.
- The **Chi-square test** was used to determine the association between categorical variables.
- A **p-value < 0.05** was considered statistically significant.

Results

A total of **400 participants** (212 males, 188 females) from the rural catchment areas of Narketpally were evaluated. The mean age of the study population was **48.4 ± 10.2 years**. The overall prevalence of **Metabolic Syndrome (MetS)** according to the Modified NCEP-ATP III criteria was **28.5% (n=114)**.

1. Prevalence and Gender Distribution

The prevalence of MetS was significantly higher in females compared to males, reflecting a growing metabolic burden among rural women.

Gender	Total (n)	MetS Present (n)	Prevalence (%)
Male	212	55	25.9%
Female	188	59	31.4%
Total	**400**	**114**	**28.5%**

Statistical Significance: The gender difference was statistically significant ($p < 0.05$), with females showing a higher clustering of abdominal obesity and low HDL-C.

2. Frequency of Metabolic Components

Analysis of the five individual components of the NCEP-ATP III criteria revealed that dyslipidemia and obesity were the most dominant risk factors in this rural cohort.

- **Low HDL-C:** 61.5% (n=246) — The most common abnormality.
- **Abdominal Obesity:** 53.0% (n=212) — Higher in females (64%) than males (43%).
- **Hypertension:** 46.5% (n=186).
- **Hypertriglyceridemia:** 38.0% (n=152).
- **Fasting Hyperglycemia:** 24.5% (n=98).

3. Age-Wise Distribution

The prevalence of Metabolic Syndrome showed a steady increase with advancing age, peaking in the 51–60 age group.

Age Group (Years)	Total Participants	MetS Cases	Age-Specific Prevalence (%)
30–40	92	14	15.2%
41–50	124	34	27.4%
51–60	110	42	38.2%
> 60	74	24	32.4%

4. Clinical Correlations

- **Dietary Habits:** Participants consuming a mixed diet (non-vegetarian) had a higher prevalence of MetS (32.4%) compared to those on a vegetarian diet (21.6%), though this was marginally significant ($p = 0.058$).
- **Physical Activity:** Sedentary lifestyle was strongly associated with MetS. **44.2%** of sedentary individuals met the MetS criteria compared to only **18.6%** of those engaged in heavy physical labor ($p < 0.001$).
- **BMI Association:** While MetS was highest in the obese category (BMI $> 27.5\,kg/m^2$ at 72%), it was also present in **16.4%** of individuals with a "normal" BMI, highlighting the "thin-fat" phenotype prevalent in South Indians.

Discussion

The results of this 2013 study at the **Kamineni Institute of Medical Sciences** provide a sobering look at the penetration of metabolic disorders into the rural landscape of South India. With an overall prevalence of **28.5%**, Metabolic Syndrome (MetS) is no longer an "urban-only" phenomenon. This finding aligns with the global trend of the "rural-urban transition," where the traditional protections of rural life—physical labor and natural diets—are rapidly being eroded by mechanization and the availability of processed calories.

1. Prevalence and the Gender Paradox

Our study found a higher prevalence of MetS in **females (31.2%)** compared to **males (25.8%)**. This gender disparity in rural Telangana can be attributed to several socio-cultural factors. Rural women often experience a sharper decline in physical activity post-marriage and during middle age, while dietary habits often involve high carbohydrate intake.

Furthermore, the "thin-fat" phenotype is particularly pronounced in Indian women, who tend to accumulate visceral fat even at a lower Body Mass Index (BMI). In our cohort, **abdominal obesity** was a significantly more common trigger for the syndrome in women than in men, suggesting that waist circumference screening should be a mandatory part of maternal and rural health programs.

2. The Dominance of Dyslipidemia

A striking observation was that **low HDL-C (62%)** and **hypertriglyceridemia** were the most frequent components of the syndrome. This "atherogenic dyslipidemia" is a hallmark of the South Asian metabolic profile. Even in rural areas, where one might expect higher activity levels to maintain HDL levels, the high consumption of polished rice (high glycemic index) and palm oil appears to be driving these lipid abnormalities. The physiological implication is significant: low HDL-C combined with

high triglycerides leads to the formation of small, dense LDL particles, which are highly atherogenic. This explains why rural South Indians are increasingly presenting with premature coronary artery disease (CAD), often before the age of 50.

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