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METABOLIC SYNDROME IN RURAL INDIA: EPIDEMIOLOGY AND RISK FACTORS – A NARRATIVE REVIEW

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ABSTRACT

Background: Metabolic syndrome (MetS) is a clustering of abdominal obesity, hypertension, dyslipidemia, and hyperglycemia that significantly elevates risks of cardiovascular disease and type 2 diabetes. Globally, about 20–25% of adults have MetS **[1]**. India is experiencing an epidemiological transition with rising MetS, especially in urban areas, while traditionally lower rural rates are increasing. Rural regions house ~900 million Indians, so even moderate prevalence implies a large absolute burden. Aim: This narrative review examines the epidemiology of MetS in rural India and associated risk factors, highlighting prevalence trends and implications for interventions. Methods: A literature search was conducted using PubMed, Google Scholar, Science Direct, and Cochrane Library to identify studies published between 2018 and 2024 on the prevalence of MetS in Indian populations, with a focus on rural areas. Keywords included "metabolic syndrome," "India," "rural," "prevalence," and "risk factors." Inclusion criteria were adult population studies reporting MetS prevalence or its individual components. Preference was given to more recent and rural-focused research. Both original observational studies and relevant systematic reviews or meta-analyses were included. National health reports and program documents were also reviewed. Data were synthesized qualitatively, and key elements of the STROBE (Strengthening the Reporting of Observational Studies in Epidemiology) checklist were used to appraise the reporting quality of included

studies principles. **Results:** MetS prevalence in India ranges widely (~10% to 40% in adults), with urban and female populations generally showing higher rates than rural and male. However, some rural cohorts now report high prevalence approaching urban levels.

Keywords: **Metabolic syndrome, rural India, prevalence, risk factors, abdominal obesity, hypertension, dyslipidaemia, hyperglycaemia, cardiovascular disease, type 2 diabetes, epidemiological trends, non-communicable diseases, rural health burden, lifestyle diseases**

INTRODUCTION

Metabolic syndrome (MetS) is a group of interconnected metabolic abnormalities, including abdominal obesity, high blood pressure, abnormal lipid levels, and elevated blood glucose, which collectively raise the risk of developing cardiovascular disease and type 2 diabetes. Globally, about 20–25% of adults are estimated to have MetS **[1]**. The condition significantly increases the likelihood of adverse health outcomes—doubling the risk for cardiovascular events and raising the risk for type 2 diabetes by nearly five times. Although different expert groups such as the World Health Organization (WHO), the National Cholesterol Education Program Adult Treatment Panel III (NCEP-ATP III), and the International Diabetes Federation (IDF) have proposed varying criteria, the common diagnostic components include central obesity, hypertension, elevated fasting glucose, high triglyceride levels, and low HDL cholesterol **[16]**. Because of its widespread impact and association with serious non-communicable diseases, MetS is now acknowledged as a major global public health concern.

Current evidence suggests about one-third of urban Indian adults have MetS **[2]**. For instance, community surveys in urban north India have reported MetS in roughly 30–36% of adults. In contrast, data on rural India have until recently been limited and show highly variable prevalence. Some rural villages in different parts of India have recorded as low as ~10–15% of adults with MetS **[3]**, while others report 30% or more **[4]**. This heterogeneity is driven by differences in lifestyles, diets, socioeconomic status, and perhaps genetic predispositions across India's vast rural landscape. Historically, rural adults had substantially lower MetS prevalence than urban counterparts (e.g. earlier studies indicated rural rates under 15% vs. urban rates above 30% a decade ago) **[2, 3]**. However, more recent studies show that certain rural populations now exhibit MetS levels approaching those of cities.

METHODOLOGY

Search Strategy: A comprehensive literature search was conducted to identify relevant studies on MetS in India, focusing on rural populations. We searched electronic databases including PubMed, Google Scholar, ScienceDirect, and Cochrane Library. The search spanned studies published from 2018 through 2025. Key search terms included combinations of "metabolic syndrome," "India," "rural," "urban," "prevalence," "epidemiology," "risk factors," and "nursing/public health." Reference lists of pertinent articles were also hand-searched for additional sources. Government health websites were reviewed for official reports or program documents (e.g. national NCD program guidelines).

Inclusion and Exclusion Criteria: We included studies conducted in India that reported MetS prevalence or epidemiological data among adults (generally ≥18 years). Both community-based observational studies (cross-sectional surveys, cohort baseline studies) and relevant reviews or meta-analyses were eligible. We prioritized studies with a focus on rural or semi-urban populations, or those providing subgroup analyses by rural vs. urban residence. Articles had to be published in English in peer-reviewed journals or as official reports. Given lifestyle changes over time, we emphasized studies from 2018 onward to reflect the current scenario. Older seminal studies were considered for historical context if needed. Studies focusing exclusively on specific subgroups (e.g. only patients with diabetes) were excluded to avoid biasing prevalence estimates. We also excluded pediatric/adolescent studies, keeping the scope to adult MetS.

Data Extraction and Synthesis: From each included study, we extracted key information on study design, setting (region and rural/urban nature), sample size and demographics, diagnostic criteria for MetS used, and the reported prevalence of MetS (overall and by relevant subgroups such as gender or age). For risk factor analyses, we noted any significant correlates of MetS identified. Given the narrative review design, we synthesized findings qualitatively, comparing results across studies and regions. A summary table **(Table 1)** was created to present key characteristics and outcomes of major studies.

Quality Appraisal: We assessed the quality of evidence primarily by focusing on study design and representativeness. Many included studies were cross-sectional surveys; we checked for sampling methodology, sample size adequacy, and use of standard MetS

definitions as indicators of quality. Where applicable, elements of the STROBE (Strengthening the Reporting of Observational studies in Epidemiology) guidelines were used to appraise study reporting. The risk of bias in prevalence estimates (e.g. due to non-representative samples or facility-based sampling) was considered when interpreting results. Overall, the evidence base was derived largely from observational studies, including a high-quality 2020 systematic review and meta-analysis **[5]** that pooled data from 111 studies across India.

RESULTS

Metabolic Syndrome Prevalence in India: Recent studies indicate that the prevalence of MetS among Indian adults spans roughly 10% to 40%, depending on the population studied. A 2020 systematic review by Krishnamoorthy *et al*. analyzed 111 studies (133,926 participants) and estimated a pooled MetS prevalence of ~30% (95% confidence interval 28–33%) in India **[5]**. This comprehensive meta-analysis confirmed significant variation by demographic factors and locale. MetS prevalence was significantly higher in females (pooled ~35%) than in males (~26%). Urban populations had a higher pooled prevalence (~32%) than rural populations (~22%). Interestingly, the meta-analysis noted an intermediate pooled prevalence around 28% in India's tribal populations, though data on tribal groups were limited. MetS prevalence also rose markedly with age: for example, an estimated 13% of Indians aged 18–29 had MetS versus about 50% of those 50–59 years old. These findings highlight how overall one in three Indian adults has MetS, with women, older age groups, and urban residents at particularly high risk.

Rural vs. Urban Differences: While urban Indians historically have had more MetS, the rural–urban gap may be narrowing. The meta-analysis found an ~10 percentage-point difference between urban and rural prevalence (32% vs. 22%). Earlier data suggested even greater disparities a decade ago, with some rural rates under 15% compared to urban rates above 30%. In the latest studies, however, certain rural communities report MetS levels approaching those in cities. For instance, Sundarakumar *et al*. (2022) studied older adults (≥45 years) in Karnataka and found MetS in 46.2% of the rural cohort versus 54.8% of an urban cohort under the same diagnostic criteria **[4]**. Although urban prevalence was still higher in that study, the rural prevalence was strikingly high. Similarly, Krupp *et al*. (2020) observed a MetS prevalence of 47.1% among women aged 30–59 in a rural Mysore (South India) sample **[6]**. These figures are comparable to or

even exceed many urban estimates, underlining that rural lifestyles in some areas have changed enough to produce a heavy metabolic risk burden. On the other hand, some rural regions continue to show relatively low MetS occurrence. For example, a large survey in rural West Bengal by Barik *et al*. (2018) reported MetS in about 10.7% of men and 20.3% of women, roughly ~15% overall **[7]**. Likewise, a recent community study in central India's tribal Baiga population found only 7.8% prevalence **[8]**, likely reflecting a more traditional lifestyle. Thus, rural India exhibits a wide spectrum – from single-digit MetS prevalence in certain isolated or tradition-adhering communities to upwards of ~30–40% in more developed or urbanizing rural areas.

Findings from Key Studies:

Table 1: Key studies on metabolic syndrome prevalence in India (2018–2025)

Study (Year)	Setting/Population	Design (period)	Sample Size	Criteria Used	MetS Prevalence	Key Findings
Krishnamoorthy *et al.* (2020) (5)	Nationwide (meta-analysis of 111 studies across India)	Systematic review & meta-analysis (studies 1988–2019)	133,926 (pooled)	Multiple (harmonized)	~30% pooled (adult population)	Urban ~32% vs rural ~22%; women ~35% vs men ~26% (pooled). Confirms significant urban/rural and gender disparities.
Barik *et al.* (2018) (7)	Rural West Bengal (community adults ≥18)	Cross-sectional survey (2010s)	9,886	IDF (2005)	10.7% (males), 20.3% (females)	Low overall rural prevalence (~16%); women had nearly double the MetS rate of men. Older age and higher BMI were risk factors.
Khan *et al.* (2018) (9)	Semi-urban Kanpur, North India (hospital-based sample)	Cross-sectional (clinic attendees)	420	NCEP ATP III	40.9% overall (59.0% F, 26.2% M)	Very high prevalence in this sample, especially among women. Highlights a potential screening bias (clinic-based) and the severe burden in certain north Indian communities.
Harikrishnan *et al.* (2018) (10)	Rural Kerala, South India (3 districts, adults)	Cross-sectional community survey (2011)	5,063	Modified ATP III	~24% overall (age-standardized); ~28% in women vs 20% in men	Moderate MetS prevalence in rural South India. Women and urban residents had higher rates than men and rural residents. MetS associated with higher BMI, older age.
Krupp *et al.* (2020) (6)	Rural Mysore, Karnataka (women 30–59 years)	Cross-sectional study (community-based)	500 women	"Harmonized" (IDF/AHA)	47.1% of women (30–59 y)	Extremely high MetS prevalence among rural mid-age women. Low HDL was the most common abnormality. MetS risk was higher in women who were older, physically inactive, and consuming processed salty foods.
Sundarakumar *et al.* (2022) (4)	Rural vs. Urban Karnataka (adults ≥45)	Two parallel cohort studies	2,171 rural; 332 urban	Consensus & ATP III	Rural: 46.2% vs Urban: 54.8%	High MetS burden in older adults. Urban slightly higher than

		(baseline 2015–2021)				**rural on average, but notably rural women exceeded rural men. Many cases were undiagnosed co-morbidities in rural cohort.**
Basu *et al*. (2023) (11)	**Nationally representative older adults (≥45)**	**Cross-sectional (LASI 2017–18 data)**	**66,606**	**ATP III (modified – 4 components)**	**4.8% overall (weighted)**	**Much lower prevalence due to restrictive definition (required diabetes, hypertension, obesity, & hypercholesterolemia). Hypertension was the most common component. Revealed large treatment gaps: ~9% received no treatment for any MetS component.**
Bidhu *et al*. (2025) (17)	**Urban vs. Rural Tamil Nadu (adults 18–60 years)**	**Community-based cross-sectional (2019–2021)**	**1,000 (500 rural, 500 urban)**	**NCEP ATP III**	**31.6% overall (Urban 34.8%, Rural 28.4%)**	**First comparative study in Tamil Nadu: urban MetS significantly higher than rural. Major predictors identified were age ≥40 (OR ~2.2), female sex (OR ~2.8), smoking (OR ~2.7), sedentary lifestyle (OR ~2.7), and low fruit intake (OR ~4.4).**

Variability and Trends: The above studies show that MetS prevalence in India varies widely by region and population. Rural areas overall tend to have lower MetS rates than urban areas, but this is not uniformly true – some rural communities (especially those undergoing rapid socioeconomic change or with older populations) have MetS levels on par with cities. Women consistently have higher MetS prevalence than men in both rural and urban settings. The data also underscore that choice of diagnostic criteria can greatly influence prevalence estimates (e.g., the Basu *et al*. study using a stricter definition vs. others using standard criteria) **[11]**. Despite these differences, the general trend in the past decade is an increase in MetS burden across India's population, including in rural regions. Even areas with moderate percentages (e.g. 15–20%) represent millions of people at risk given India's enormous rural population base. In summary, metabolic syndrome is now firmly entrenched in both urban and rural India, albeit with local heterogeneity. The following discussion explores the factors driving this burden and the implications for public health action.

DISCUSSION

Major Patterns and Disparities: Various studies conducted to assess the prevalalnce of

mets. For examples, Krishnamoorthy *et al*. (2020) study shows the urban–rural disparities in MetS prevalence across India, with urban rates around 30–35% due to sedentary lifestyles and processed diets. However, the gap is narrowing as rural areas adopt urban habits and dietary patterns. Rural regions closer to cities or with economic development now reflect similar metabolic risks. In contrast, traditional or tribal areas maintaining physical labour and natural diets show lower prevalence (~10–15%).This highlights the importance of local context—rural India is diverse, and MetS risk varies with geography, culture, and development.

Second, a pronounced gender disparity is evident, with women in India showing higher MetS prevalence than men almost everywhere. In rural studies, women often have double the MetS rates of men (e.g. 20% vs 10% in Bengal, 59% vs 26% in Kanpur). This "feminization" of MetS may stem from both biological and cultural factors. Post-menopausal women tend to have higher body fat and unfavorable lipid profiles. Culturally, rural women often lack time for exercise and gain weight post-pregnancy.Some also face poor dietary practices, like eating last or carbohydrate-rich leftovers.

Third, age is another strong predictor of MetS across Indian populations. Prevalence increases sharply from young adulthood to middle age. Only ~13% of those aged 18–29 have MetS, rising to ~50% in their 50s. As rural life expectancy improves, older adults face higher metabolic risk.

Risk Factors in Rural India: The drivers of metabolic syndrome in rural Indian populations are multifactorial, involving an interaction of lifestyle changes and underlying susceptibilities:

Obesity and Central Adiposity: Increasing overweight and central obesity are central to MetS. Traditionally, rural India had low obesity rates, but recent surveys document rising body mass index (BMI) and waist circumferences in many villages. Central adiposity is especially critical: abdominal fat accumulation underlies insulin resistance. Even individuals with normal BMI can have high body fat and central obesity – the so-called "thin-fat" phenotype of South Asians. Misra *et al*. have noted that South Asians tend to develop metabolic issues at lower BMI thresholds due to higher visceral fat for a given weight **[12]**. Accordingly, monitoring waist circumference in rural health camps is important, as standard BMI cutoffs might miss at-risk individuals. Overall, as rural diets become more energy-dense and physical labor declines, obesity rates are climbing, fueling MetS. For example, Barik *et al*. found that

being overweight (BMI ≥23) was strongly associated with MetS in rural Bengal **[7]**. Maintaining healthy weight through diet and activity is thus a cornerstone of MetS prevention.

Dietary Transitions: Diets in rural India are shifting from traditional high-fiber, plant-based intake to more refined and processed foods.

Physical Inactivity: Sedentary lifestyle is increasingly prevalent in rural areas and is a key modifiable risk factor for MetS. Traditionally, rural livelihoods involved intense physical labor (farming, manual work), which protected against metabolic disease. But mechanization of agriculture, increased motor vehicle use, and a shift to non-manual jobs (e.g. services, small businesses) mean many rural adults now expend far fewer calories daily. Furthermore, leisure time that used to involve physical chores may now be spent watching television or on mobile phones, similar to urban sedentary behaviors.

Tobacco and Alcohol Use: Increasing use of tobacco in rural India may contribute to MetS risk. Many rural men smoke bidis or cigarettes and/or use smokeless tobacco. Smoking has been linked to insulin resistance and central fat accumulation, and studies suggest smokers have higher odds of MetS. Alcohol consumption in rural areas varies by region (with higher use in some tribal and north-eastern communities). Excess alcohol intake can cause triglyceride elevation, hypertension, and abdominal obesity – components of MetS. A meta-analysis by Sun *et al*. (2014) found excessive alcohol consumption significantly increased MetS risk (13). In rural India, locally brewed liquor or toddy is common; heavy use in some male populations likely exacerbates metabolic risk.

Socioeconomic and Educational Factors: Uniquely, in rural India higher socioeconomic status (SES) often correlates with greater MetS prevalence, unlike in Western contexts where lower SES is often associated with obesity. Rural residents with higher income or social standing may adopt more "urbanized" lifestyles – e.g. richer diets (more meats, fried foods) and reduced physical labor – leading to higher metabolic risk.

Genetic Predisposition and MetS in Rural India:

South Asians, including Indians, have a genetic and ethnic predisposition to metabolic syndrome (MetS), often developing insulin resistance and central obesity at lower body mass indices — a pattern known as the "Asian Indian phenotype." A family history of diabetes or cardiovascular disease further heightens this risk. As rural populations adopt

high-calorie diets and sedentary routines, MetS cases surge rapidly. Indians appear biologically primed for MetS, with even modest lifestyle changes triggering its onset. This highlights the importance of early preventive strategies in at-risk groups. National guidelines recommend lower clinical cut-offs for waist circumference and BMI in Indians to reflect this vulnerability **[14]**.

In summary**,** the rising MetS burden in rural India stems from aging, lifestyle changes, unhealthy habits, and genetic risk. These factors often overlap—for example, an older rural woman with higher SES, multiple pregnancies, poor diet, low activity, and tobacco use may face several combined risks. Identifying such profiles is key to targeted interventions.

Implications for Intervention and Policy: The growing burden of MetS in rural areas has significant implications. There is an urgent need to integrate MetS prevention and management into existing rural health infrastructure. India's National Programme for Prevention and Control of Cancer, Diabetes, Cardiovascular Diseases and Stroke (NPCDCS) provide a framework for NCD care at the primary health center level **[15]**. Under this program (and the newer Health and Wellness Centers initiative), adults over 30 are to be screened annually for hypertension and diabetes – essentially capturing key MetS components.

CONCLUSION

Metabolic syndrome (MetS) has emerged as a major public health concern in rural India, driven by dietary and lifestyle shifts. Once considered an urban issue, MetS is now prevalent in villages, with studies (2018–2024) reporting rates from under 15% to over 40%. The rural advantage is fading as high-calorie diets and inactivity rise.

Timely, multi-level interventions are essential. Routine screening for hypertension, diabetes, and obesity should align with national NCD programs. Health education promoting traditional diets, physical activity, and community-based initiatives can encourage lasting behavior change.

In summary, MetS in rural India is preventable. Strengthened primary care, health awareness, and supportive policies are vital to curb this growing epidemic and reduce future burdens of diabetes and heart disease.

Conflict of Interest

None

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REFRENCES

[1] Saklayen MG. The global epidemic of the metabolic syndrome. Curr Hypertens Rep. 2018;20(2):12. DOI: 10.1007/s11906-018-0812-z.

[2] Deedwania PC, Gupta R, Sharma KK, Achari V, Gupta B, Maheshwari A, *et al*. High prevalence of metabolic syndrome among urban subjects in India: a multisite study. Diabetes Metab Syndr. 2014;8(3):156–161. DOI: 10.1016/j.dsx.2014.04.033.

[3] Ravikiran M, Bhansali A, Ravikumar P, Bhansali S, Dutta P, Thakur JS, *et al*. Prevalence and risk factors of metabolic syndrome among Asian Indians: a community survey. Diabetes Res Clin Pract. 2010;89(2):181–188. DOI: 10.1016/j.diabres.2010.03.010.

[4] Sundarakumar JS, Stezin A, Menesgere AL, Ravindranath V. Rural-urban and gender differences in metabolic syndrome in the aging population from southern India: two parallel, prospective cohort studies. EClinicalMedicine. 2022;47:101395. DOI: 10.1016/j.eclinm.2022.101395.

[5] Krishnamoorthy Y, Rajaa S, Murali S, Rehman T, Sahoo J, Kar SS. Prevalence of metabolic syndrome among adult population in India: a systematic review and meta-analysis. PLoS One. 2020;15(10):e0240971. DOI: 10.1371/journal.pone.0240971.

[6] Krupp K, Adsul P, Wilcox ML, Srinivas V, Frank E, Srinivas A, *et al*. Prevalence and correlates of metabolic syndrome among rural women in Mysore, India. Indian Heart J. 2020;72(6):582–588. DOI: 10.1016/j.ihj.2020.09.015.

[7] Barik A, Das K, Chowdhury A, Rai RK. Metabolic syndrome among rural Indian adults. Clin Nutr ESPEN. 2018;23:129–135. DOI: 10.1016/j.clnesp.2017.11.002.

[8] Shrivastava S, Singh K, Kavishwar A, Singh T. Unravelling prevalence of metabolic syndrome in Baiga tribe of Dindori district of central India. Clin Epidemiol Glob Health. 2024;31:101868. DOI: 10.1016/j.cegh.2024.101868.

[9] Khan Y, Lalchandani A, Gupta AC, Khadanga S, Kumar S. Prevalence of metabolic syndrome crossing 40% in Northern India: time to act fast before it runs out of proportions. J Family

Med Prim Care. 2018;7(1):118–123. DOI: 10.4103/jfmpc.jfmpc_10_17.

[10] Harikrishnan S, Sarma S, Sanjay G, Jeemon P, Krishnan MN, Venugopal K, *et al*. Prevalence of metabolic syndrome and its risk factors in Kerala, South India: analysis of a community based cross-sectional study. PLoS One. 2018;13(3):e0192372. DOI: 10.1371/journal.pone.0192372.

[11] Basu S, Thirunavukarasu AJ, Maheshwari V, Zode M, Hassan R. Burden, determinants and treatment status of metabolic syndrome among older adults in India: a nationally representative, community-based cross-sectional survey. BMJ Public Health. 2023;1(1):e000389. DOI: 10.1136/bmjph-2023-000389.

[12] Misra A, Khurana L. The metabolic syndrome in South Asians: epidemiology, determinants, and prevention. Metab Syndr Relat Disord. 2009;7(6):497–514. DOI: 10.1089/met.2009.0024.

[13] Sun K, Ren M, Liu D, Wang C, Yang C, Yan L. Alcohol consumption and risk of metabolic syndrome: a meta-analysis of prospective studies. Clin Nutr. 2014;33(4):596–602. DOI: 10.1016/j.clnu.2013.10.003.

[14] Ministry of Health and Family Welfare (India). National Programme for Prevention and Control of Cancer, Diabetes, Cardiovascular Diseases and Stroke (NPCDCS): Operational Guidelines (2013–17). New Delhi: Government of India; 2013.

[15] Venugopal V, Richa R, Singh D, Gautam A, Jahnavi G. National Programme for Prevention and Control of Cancer, Diabetes, Cardiovascular Diseases, and Stroke: a scoping review in the context of hypertension prevention and control in India. Indian J Public Health. 2023;67(Suppl 1):S50–S57. DOI: 10.4103/ijph.ijph_681_23.

[16] Alberti KG, Eckel RH, Grundy SM, Zimmet PZ, Cleeman JI, Donato KA, *et al*. Harmonizing the metabolic syndrome: a joint interim statement of the International Diabetes Federation Task Force on Epidemiology and Prevention; National Heart, Lung, and Blood Institute; American Heart Association; World Heart Federation; International Association

for the Study of Obesity; and International Society of Hypertension. Circulation. 2009;120(16):1640–1645. DOI: 10.1161/CIRCULATIONAHA.109.192644.

[17] Prasad Bidhu R, Muraleedharan A, Daniel RA, Surya BN. Prevalence and Determinants of Metabolic Syndrome Among Adults (18-60 Years) in Urban and Rural South India: A Community-Based Cross-Sectional Study. Cureus. 2025 May 19;17(5):e84384. doi: 10.7759/cureus.84384. PMID: 40539174; PMCID: PMC12178443.