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Original Research Article

CLINICAL AND BIOCHEMICAL PROFILE OF METABOLIC SYNDROME IN ADULTS: A HOSPITAL-BASED CROSS-SECTIONAL STUDY FROM CENTRAL INDIA

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ABSTRACT

Background: Metabolic syndrome (MetS) is a multifactorial cardiometabolic entity conferring high risk of type 2 diabetes mellitus (T2DM), atherosclerotic cardiovascular disease (ASCVD), and premature death. South Asians, including Indians, are particularly susceptible due to greater visceral adiposity and insulin resistance at lower body mass index levels. Hospital-based clinical profiling of MetS in central India remains sparse. The objective is to evaluate the clinical and biochemical profile of metabolic syndrome in adults and to assess the clustering pattern of individual components using both standard NCEP ATP III and Asian-modified criteria. **Materials and Methods:** A hospital-based cross-sectional observational study was conducted over 18 months at L.N. Medical College & J.K. Hospital, Bhopal. A total of 288 adults meeting NCEP ATP III criteria for MetS were enrolled by consecutive sampling. Detailed anthropometric, hemodynamic, and biochemical assessments were performed. Metabolic syndrome prevalence was compared using standard (waist circumference ≥90/80 cm; FBG ≥110 mg/dL) and Asian-modified (WC ≥90/80 cm; FBG ≥100 mg/dL) cutoffs. Data were analysed using descriptive statistics, Chi-square, independent t-test, Mann-Whitney U test, and one-way ANOVA. **Results:** The mean age was 47.6 ± 10.2 years, with male predominance (53.82%). Urban residence was noted in 60.42%. Mean BMI was 26.3 ± 4.1 kg/m² and mean waist circumference 94.8 ± 11.6 cm. Elevated blood pressure was the most common MetS component (61.81%), followed by abnormal waist circumference (57.29%), low HDL (50.69%), impaired fasting glucose (49.31%), and hypertriglyceridaemia (43.75%). Overall MetS prevalence was 32.29% by NCEP ATP III and 34.03% by Asian-modified criteria. Age ($p = 0.002$), waist circumference ($p < 0.001$), and systolic blood pressure ($p = 0.011$) were significantly associated with MetS. Total cholesterol, LDL, and TC:HDL ratio increased progressively across HbA1c categories ($p < 0.001$). **Conclusion:** MetS in this Indian tertiary-care cohort is characterised by predominant central obesity, hypertension, atherogenic dyslipidaemia, and dysglycaemia. Asian-modified criteria captured a greater burden of at-risk individuals, reinforcing the need for ethnicity-specific thresholds. Early opportunistic screening and integrated lifestyle-based management are essential for preventing diabetes and cardiovascular disease in this population.

INTRODUCTION

Metabolic syndrome (MetS) is a multifactorial cardiometabolic entity defined by the concurrent presence of central adiposity, insulin resistance, atherogenic dyslipidaemia, hypertension, and dysglycaemia.

Rather than an independent disease, MetS represents an intersection of these interconnected abnormalities that—working in concert with low-grade chronic inflammation, endothelial dysfunction, and a prothrombotic state—significantly amplify the risk of atherosclerotic cardiovascular disease (ASCVD), type 2 diabetes mellitus (T2DM), and premature mortality.[1,2]

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Multiple operational definitions have been proposed, reflecting conceptual differences among expert bodies. The National Cholesterol Education Program Adult Treatment Panel III (NCEP ATP III) defines MetS as the presence of three or more of five criteria: abdominal obesity, elevated triglycerides, reduced HDL cholesterol, elevated blood pressure, and elevated fasting glucose.[5]

The International Diabetes Federation (IDF) emphasises central obesity as a mandatory criterion with ethnicity-specific waist cutoffs, acknowledging that South Asians accrue cardiometabolic risk at lower anthropometric thresholds than Caucasian populations.[4]

This ethnic specificity is particularly relevant for the Indian population. South Asians demonstrate greater visceral adiposity and insulin resistance at any given body mass index (BMI) level, predisposing them to early metabolic derangements.[6,7]

Consequently, Asian-specific waist circumference thresholds (≥90 cm in men; ≥80 cm in women) are recommended over the original NCEP ATP III cutoffs (≥102 cm and ≥88 cm, respectively).[1,2]

India is currently experiencing an epidemic of MetS driven by rapid urbanisation, dietary transition to energy-dense foods, sedentary lifestyles, and genetic predisposition to visceral adiposity.[3]

Hospital-based studies from tertiary centres are particularly valuable as they capture individuals with clinically significant metabolic burden, provide insight into disease clustering, and help guide resource allocation for preventive programmes.[8,9]

Despite growing national evidence, comprehensive hospital-based data characterising the clinical and biochemical phenotype of MetS in adults from central India—using both standard and Asian-modified criteria—remain sparse. The present study was undertaken to fill this gap by profiling adults diagnosed with MetS at a tertiary referral centre in Bhopal, Madhya Pradesh.

MATERIALS AND METHODS

Study Design and Setting: This was a hospital-based, cross-sectional, observational study conducted at the Department of General Medicine, L.N. Medical College & Research Centre and J.K. Hospital, Bhopal, Madhya Pradesh, India—a tertiary care facility serving urban, peri-urban, and rural populations. The study spanned 18 months (Planning: 3 months; Recruitment & Data Collection: 12 months; Analysis & Writing: 3 months).

Ethics Ethical clearance was obtained from the Institutional Ethics Committee prior to data collection. The study was conducted in accordance with the Declaration of Helsinki. Written informed consent was obtained from all participants before enrolment.

Participants: Adults (≥18 years, both sexes) fulfilling NCEP ATP III criteria for MetS who attended the General Medicine outpatient and inpatient departments were eligible. Patients below 18 years, pregnant women, and those unwilling to participate were excluded.

Sample Size: Using the formula $n = Z^2\alpha/^2 \times p \times q / e^2$, with estimated MetS prevalence p = 25% (Indian literature), q = 0.75, Z = 1.96, and margin of error e = 5%, the calculated sample size was 288. Consecutive sampling was employed.

Diagnostic Criteria

MetS was diagnosed per NCEP ATP III criteria—presence of ≥3 of the following:

(a) Waist circumference ≥90 cm (men) / ≥80 cm (women) [South Asian cutoffs].

(b) Triglycerides ≥150 mg/dL.

(c) HDL cholesterol <40 mg/dL (men) / <50 mg/dL (women).

(d) Blood pressure ≥130/85 mmHg or antihypertensive treatment.

(e) Fasting blood glucose (FBG) ≥110 mg/dL or diabetes on treatment. Asian-modified criteria used identical components except FBG threshold ≥100 mg/dL.

Data Collection

A structured, pretested proforma captured: sociodemographic data (age, sex, marital status, education, residence, socioeconomic status); clinical history; anthropometric measurements (weight, height, BMI, waist and hip circumferences, waist-hip ratio); vital signs (blood pressure averaged over two readings 5 minutes apart, pulse, respiratory rate); and systemic examination findings.

Laboratory Investigations

After an overnight fast of 8–12 hours, 5 mL of venous blood was collected under aseptic conditions. Biochemical analyses included: fasting lipid profile (total cholesterol, triglycerides, HDL-C, LDL-C by Friedewald equation, VLDL-C, TC:HDL ratio); glucose metabolism (FBG, postprandial blood glucose, HbA1c); complete haemogram; liver function tests; renal function tests; serum electrolytes; serum uric acid; and urine albumin-creatinine ratio (when indicated). Abdominal ultrasonography was performed to assess fatty liver. All analyses were performed in the Central Laboratory of J.K. Hospital following standard internal and external quality control protocols.

Statistical Analysis

Data were entered into Microsoft Excel and analysed using R software v4.5.2. Continuous variables were tested for normality by the Shapiro-Wilk test; normally distributed variables are reported as mean ± SD, non-normal variables as median (IQR). Categorical variables are presented as frequencies and percentages. Associations between categorical variables were assessed by Chi-square test; between continuous variables and MetS status by independent samples t-test or Mann-Whitney U test as appropriate. Lipid profile differences across HbA1c categories were compared by one-way ANOVA. A p-value <0.05 was considered statistically significant.

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RESULTS

Sociodemographic Profile

Two hundred and eighty-eight adults with MetS were studied. Mean age was 47.6 ± 10.2 years. The 41–50-year age group was most represented (29.51%), followed by 51–60 years (26.39%). Males constituted 53.82% of the cohort. Most participants were married (84.38%), resided in urban areas (60.42%), and had middle socioeconomic status (Table 1). Mean BMI was 26.3 ± 4.1 kg/m²; 52.78% were overweight and 13.19% obese. Mean waist circumference was 94.8 ± 11.6 cm and waist-hip ratio 0.92 ± 0.08. Mean systolic and diastolic blood pressures were 135.2 ± 14.8 mmHg and 84.6 ± 10.2 mmHg, respectively.

Prevalence of Metabolic Syndrome

By NCEP ATP III criteria, 93/288 participants (32.29%) fulfilled MetS criteria; Asian-modified criteria identified 98/288 (34.03%). Of MetS patients under standard criteria, 13.19% fulfilled exactly three components, 13.19% fulfilled four, and 5.90% fulfilled all five criteria. Under Asian criteria, severe clustering (4–5 components) increased to 27.08%.

MetS prevalence was higher in males (34.84%) than females (29.32%) by standard criteria (p = 0.383, NS). By Asian criteria, prevalence was 36.77% in males vs. 30.83% in females (p = 0.349, NS). Age showed a significant association with MetS under standard criteria (p = 0.001), with peak prevalence in the 51–60-year group (42.11%). The youngest group (18–30 years) had the lowest prevalence (14.29%). Among the 93 MetS patients (NCEP standard), abdominal obesity was present in all (100%, being mandatory), followed by low HDL-C (93.55%), elevated blood pressure (87.10%), elevated fasting glucose (77.42%), and elevated triglycerides (73.12%). Among the 98 MetS patients by Asian criteria, the order was: abdominal obesity (100%), low HDL-C (88.78%), elevated fasting glucose (84.69%), elevated blood pressure (82.65%), and elevated triglycerides (69.39%).

Associated Conditions

Hypertension was the most common co-morbidity (61.81%), followed by overweight status (52.78%), dyslipidaemia (43.75%), prediabetes (25.69%), type 2 diabetes mellitus (23.61%), fatty liver on ultrasound (14.58%), and cardiovascular symptoms (10.76%). Physical inactivity (<150 min/week) and poor dietary habits were the most prevalent modifiable risk factors (63.89% and 63.19%, respectively). Age (mean 49.1 ± 10.0 vs. 44.7 ± 12.0 years; p = 0.002), waist circumference (109.3 ± 10.6 vs. 87.9 ± 16.1 cm; p < 0.001), and systolic blood pressure (146.4 ± 19.9 vs. 129.9 ± 22.5 mmHg; p = 0.011) were significantly higher in MetS-positive participants. Gender, education level, and socioeconomic status were not significantly associated with MetS (p > 0.05 for all).

Biochemical Profile

Mean total cholesterol was 198.6 ± 38.2 mg/dL, triglycerides 168.4 ± 92.8 mg/dL, HDL-C 42.3 ± 8.6 mg/dL, LDL-C 125.8 ± 34.5 mg/dL, and TC:HDL ratio 4.8 ± 1.2. Mean FBG was 118.6 ± 28.4 mg/dL and HbA1c 6.8 ± 1.2%; 59.03% of participants had HbA1c ≥6.5%.Total cholesterol (p < 0.001), LDL-C (p < 0.001), and TC:HDL ratio (p < 0.001) increased progressively across HbA1c categories. Total cholesterol rose from 145.1 mg/dL in non-diabetics to 223.8 mg/dL in diabetics; TC:HDL ratio increased from 3.2 to 5.6. Triglycerides, HDL-C, and VLDL-C did not differ significantly across glycaemic strata.Liver enzymes were largely within normal limits; mean ALT was mildly elevated at 38.6 ± 18.4 U/L. Renal function was preserved in most participants (mean creatinine 0.96 ± 0.28 mg/dL). Fatty liver on ultrasound was present in 42 participants (14.58%); no significant difference in MetS prevalence or lipid abnormalities was observed between those with and without fatty liver (all p > 0.05).

Table 1: Sociodemographic Characteristics of the Study Population (N = 288)

Parameter	Category	n	%
Age (years)	18–30	28	9.72
	31–40	62	21.53
	41–50	85	29.51
	51–60	76	26.39
	61–65	37	12.85
Sex	Male	155	53.82
	Female	133	46.18
Residence	Urban	174	60.42
	Rural	114	39.58
SES	Lower	102	35.42
	Middle	138	47.92
	Upper	48	16.67

Table 2: Prevalence of Individual Mets Components by Standard vs. Asian-Modified Criteria (N = 288)

Component	Standard Criterion	n (%)	Asian Criterion	n (%)
Waist Circumference	≥90/88 cm	165 (57.29%)	≥90/80 cm	173 (60.07%)
Triglycerides	≥150 mg/dL	126 (43.75%)	≥150 mg/dL	126 (43.75%)
HDL-C	<40/<50 mg/dL	146 (50.69%)	<40/<50 mg/dL	146 (50.69%)
Blood Pressure	≥130/85 mmHg	178 (61.81%)	≥130/85 mmHg	178 (61.81%)

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Fasting Blood Glucose	≥110 mg/dL	142 (49.31%)	≥100 mg/dL	151 (52.43%)
MetS Prevalence (≥3 criteria)		93 (32.29%)		98 (34.03%)

Table 3: Age-Wise Distribution of Mets by Standard NCEP ATP Iii Criteria

Age Group (years)	Total (n)	MS Present n (%)	MS Absent n (%)
18–30	28	4 (14.29)	24 (85.71)
31–40	62	12 (19.35)	50 (80.65)
41–50	85	31 (36.47)	54 (63.53)
51–60	76	32 (42.11)	44 (57.89)
61–65	37	14 (37.84)	23 (62.16)
Chi-square p-value		0.001*	

Table 4: Lipid Profile Comparison across Hba1c Categories

Lipid Parameter	Non-Diabetic (HbA1c <5.7%) n=51	Pre-Diabetic (5.7–6.4%) n=67	Diabetic (≥6.5%) n=170	p-value
Total Cholesterol (mg/dL)	145.1 ± 10.7	175.6 ± 7.1	223.8 ± 25.1	<0.001***
Triglycerides (mg/dL)	185.1 ± 116.6	209.0 ± 116.2	197.8 ± 118.5	0.079 (NS)
HDL-C (mg/dL)	43.1 ± 12.3	45.7 ± 12.9	44.8 ± 11.1	0.509 (NS)
LDL-C (mg/dL)	76.7 ± 11.7	105.3 ± 6.4	148.6 ± 22.5	<0.001***
TC: HDL Ratio	3.2 ± 0.3	4.1 ± 0.2	5.6 ± 0.8	<0.001***

DISCUSSION

This hospital-based cross-sectional study provides a comprehensive clinical and biochemical characterisation of MetS in adults attending a tertiary care centre in central India. The overall prevalence of 32.29% by NCEP ATP III criteria and 34.03% by Asian-modified criteria is consistent with the growing epidemic of MetS in urban India.Metabolic syndrome remains a major cardiometabolic concern because it clusters central obesity, dysglycaemia, hypertension, and atherogenic dyslipidaemia, thereby increasing the risk of type 2 diabetes and cardiovascular disease. In the present hospital-based study from central India, the burden of MetS was substantial, with overall prevalence of 32.29% by NCEP ATP III criteria and 34.03% by Asian-modified criteria, indicating that ethnicity-specific thresholds identify a slightly larger at-risk group than conventional cut-offs. This pattern is consistent with current reviews that emphasize MetS as a composite syndrome rather than a single disorder, and that underscore the need for early recognition in high-risk populations. Compared with the broader conceptual framing in StatPearls and the 2024 review by Samson and Garber, the present study reinforces the practical relevance of syndrome-based screening in routine clinical settings.[10]

The demographic profile in our study showed a predominance of middle-aged adults, with the largest proportion in the 41–60-year age range and a slight male preponderance. This aligns with the age-dependent increase in MetS observed in many Indian and South Asian populations, where metabolic risk becomes more evident after the fourth decade of life. Ravikiran et al,[11] and Prasad et al. similarly reported that MetS is common among Asian Indians and becomes more frequent with increasing age, especially in the presence of urbanization and sedentary lifestyle patterns. The age gradient observed in the present cohort therefore supports the notion that MetS is not simply a disease of obesity, but also a disease of cumulative exposure to adverse metabolic and lifestyle factors.[12]

Urban residence was more common in the present cohort, and this finding is important because urban living in India is associated with reduced physical activity, dietary transition, and greater psychosocial stress. This is in keeping with the epidemiological observations described by Misra and Khurana, who highlighted the growing burden of obesity and MetS in developing countries undergoing rapid socioeconomic change. Community-based work in Asian Indians has repeatedly shown higher MetS prevalence in urban compared with rural settings, a pattern that mirrors the current hospital-based profile. The present study therefore adds tertiary-care evidence to the broader public health message that urbanization is a major driver of cardiometabolic risk in India.[13]

Central obesity emerged as one of the dominant abnormalities in this cohort, with abdominal obesity present in 57.29% by standard criteria and 60.07% by Asian-modified criteria. This is highly consistent with the South Asian metabolic phenotype, in which visceral adiposity occurs at lower BMI levels than in Western populations. The observation also supports the rationale for Asian-specific waist circumference thresholds, as proposed by the IDF consensus and later reinforced by newer threshold studies. Compared with standard NCEP ATP III cut-offs, the Asian-modified criteria captured more individuals with abdominal obesity, which suggests that using non-ethnic thresholds may underestimate disease burden in Indian populations.[14]

The present study found elevated blood pressure to be the most frequent individual MetS component, affecting 61.81% of participants. This finding is particularly relevant because hypertension is one of the strongest contributors to cardiovascular outcomes in metabolic syndrome, and it often coexists with insulin resistance and central obesity. Gupta and Guptha emphasized early management of hypertension as a key preventive strategy in Indian adults, and the current data support that approach by

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showing how commonly raised blood pressure clusters with other metabolic abnormalities. Compared with community surveys that report variable component ranking, the dominance of blood pressure in this hospital cohort may reflect referral bias toward patients with established cardiometabolic disease.[15]

Atherogenic dyslipidaemia was also prominent, with low HDL cholesterol in 50.69% and hypertriglyceridaemia in 43.75% of participants. This pattern is typical of South Asian metabolic syndrome and is strongly linked to visceral adiposity, insulin resistance, and hepatic overproduction of triglyceride-rich lipoproteins. Mohamed et al. described this lipid pattern as a central pathophysiological feature of MetS, and the current study is concordant with that explanation. Compared with Indian studies that report different component order, the present findings still highlight the same core message: dyslipidaemia is common, clinically important, and should not be overlooked even when total cholesterol levels are not markedly elevated.[16]

Impaired fasting glucose was present in nearly half of the cohort, and the Asian-modified threshold identified a slightly larger proportion than the standard criterion. This supports the concept that lower glycaemic thresholds may be more appropriate for Asian populations, who often develop insulin resistance and beta-cell dysfunction earlier in life. Yajnik's work on early-life origins of insulin resistance and later diabetes in Indian populations provides an important mechanistic backdrop for this finding. In comparison with the current review literature, the present study adds clinical evidence that hyperglycaemia in MetS is already common at the time of diagnosis and should prompt stronger screening for prediabetes and diabetes progression.

The progressive rise in total cholesterol, LDL cholesterol, and total cholesterol-to-HDL ratio across HbA1c categories is another important observation from this study. This suggests that worsening glycaemic status is accompanied by a more atherogenic lipid profile, reinforcing the close metabolic interdependence between glucose and lipid abnormalities. In the context of the cardio-kidney-metabolic framework discussed in the AHA advisory, these findings are especially relevant because they illustrate how multiple organ risk domains cluster within the same patient. Compared with studies focusing on isolated metabolic components, the present work better reflects real-world cardiometabolic accumulation in Indian adults.[17]

The finding that MetS prevalence increased with age in this study is in line with the age-related trends reported in several Indian datasets and recent regional reports. Bidhu et al,[18] Deepa et al,[19] and Ashwin Raj et al.[20] all point toward a rising burden of MetS with advancing age and changing lifestyle exposure, although the exact prevalence estimates vary by region and setting. The current results fit this broader pattern and demonstrate that middle age is a particularly vulnerable period for detection and intervention. Compared with those studies, this cohort provides a tertiary-care snapshot that likely represents a clinically more metabolically burdened population.

The slightly higher prevalence obtained with Asian-modified criteria compared with standard NCEP ATP III criteria is a key strength of the study because it demonstrates the incremental value of ethnicity-adjusted thresholds. This is concordant with the IDF consensus and with later work on Asian-specific waist circumference cut-offs, which argue that standard Western thresholds are too permissive for South Asians. Misra et al,[21] also emphasized the need for revised obesity cutoffs in Asian Indians, and the present data support that position in a practical clinical sample. In that sense, the study not only describes MetS burden but also validates the operational benefit of applying population-specific diagnostic criteria.

When compared with the systematic review and meta-analysis by Krishnamoorthy et al,[22] the present prevalence is within the broad range reported across Indian adult populations, although direct comparison is limited by heterogeneity in age structure, settings, and diagnostic criteria. The meta-analysis showed that MetS prevalence in India varies substantially across studies, reflecting differences in urban-rural composition, sex distribution, and threshold definitions. The present study's hospital-based design likely contributes to a somewhat higher burden than community samples, because individuals attending tertiary care often already have multiple risk factors or overt disease. Thus, the current findings should be interpreted as reflective of clinical burden rather than population prevalence.

The present cohort also supports the broader South Asian phenotype described by Mahadevan et al,[23] in which visceral adiposity and insulin resistance develop early and are not always captured by BMI alone. The mean BMI in this study was in the overweight range, yet waist circumference and other metabolic abnormalities were clearly significant, showing why anthropometric assessment must go beyond BMI. This is important because patients with apparently modest excess weight can still carry substantial metabolic risk, particularly in Indian populations. Compared with Western-centric frameworks, the present findings argue strongly for regional adaptation in screening and counseling strategies.

The pattern of component clustering observed here suggests that MetS in this setting is not an incidental diagnosis but a marker of concentrated cardiometabolic vulnerability. Elevated blood pressure, central obesity, dyslipidaemia, and dysglycaemia coexisted in the same individuals, creating a synergistic risk environment for diabetes and atherosclerotic cardiovascular disease. This is compatible with the conceptual models presented by Samson and Garber as well as the updated management guidelines by Dobrowolski et al,[24] both of which stress integrated management rather than

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single-risk-factor treatment. The present study therefore has direct implications for practice: routine opportunistic screening should be followed by comprehensive risk-factor modification rather than isolated treatment of one abnormality.

Compared with tertiary-care profile studies such as those by Krishna et al., Latha et al,[25] Rudra Reddy et al., and others cited in the manuscript, the present work is consistent in showing that Indian MetS patients commonly present with central obesity, hypertension, and adverse lipid parameters. The similarity across these reports suggests that the syndrome's expression is relatively stable across different regions of India, even though absolute prevalence may vary. At the same time, the current study adds value by directly comparing standard and Asian-modified criteria within the same cohort, which many earlier reports did not do. This makes the results especially useful for journal discussion because they connect local findings to national and international evidence.

The clinical implications are straightforward: early detection of waist enlargement, elevated blood pressure, fasting dysglycaemia, and lipid abnormalities should become a routine part of adult care in Indian hospitals. The present data indicate that many patients with MetS already have multiple abnormalities at the time of evaluation, so delayed intervention will miss the window for prevention. The study also supports targeted counseling on diet, physical activity, weight control, and adherence to blood pressure and lipid management strategies. In comparison with the management-oriented literature, this cohort strengthens the argument that prevention must be embedded in everyday clinical workflow, especially in high-volume tertiary care settings.

Our study also has important limitations that should be acknowledged in the discussion, including its cross-sectional design, hospital-based recruitment, single-centre nature, and absence of longitudinal outcome data. These limitations mean that causal inference cannot be made and the findings may overrepresent patients with greater disease severity than the general population. Nevertheless, the strength of the work lies in the detailed phenotypic description and the direct comparison of diagnostic criteria. Taken together, the findings contribute meaningfully to the Indian MetS literature by showing that Asian-modified thresholds identify more at-risk individuals and by confirming that central obesity, hypertension, dyslipidaemia, and dysglycaemia remain the dominant clinical pattern.

Limitations

Limitations of this study include its cross-sectional design (precluding causal inference), single-centre setting (limiting generalisability), hospital-based recruitment (potential selection bias toward higher-burden cases), absence of longitudinal follow-up, and lack of advanced metabolic markers such as fasting insulin, HOMA-IR, and C-reactive protein. Imaging-based visceral fat quantification was not performed.

CONCLUSION

Metabolic syndrome is highly prevalent among middle-aged adults attending this tertiary care centre in central India, characterised predominantly by central obesity, hypertension, atherogenic dyslipidaemia, and chronic dysglycaemia. Asian-modified diagnostic thresholds identified a greater burden of metabolic risk than standard NCEP ATP III criteria, particularly through improved detection of central obesity and impaired fasting glucose, and revealed higher rates of severe component clustering. These findings reinforce the critical importance of adopting ethnicity-specific diagnostic criteria in Indian clinical practice. Early opportunistic screening—particularly of waist circumference, blood pressure, fasting glucose, and lipid profile—combined with timely lifestyle intervention and integrated cardiometabolic risk management, is essential to prevent the escalating burden of diabetes and cardiovascular disease in this population.

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