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Original Research Article

Predictors of metabolic syndrome among adults: a hospital based cross-sectional study

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ABSTRACT

Background: Metabolic syndrome (MetS) is a growing public health challenge globally, with particularly high and rising prevalence in rapidly urbanizing nations like India. Characterized by a cluster of interrelated metabolic abnormalities, MetS significantly elevates risk of type 2 diabetes mellitus and cardiovascular disease. Hospital-based prevalence data from tier-2 cities of Maharashtra remain limited.
Methods: A hospital-based cross-sectional study was conducted from July to September 2025 among 381 adults (aged ≥18) at the outpatient services of a district hospital ch. Sambhajinagar. Data were collected using a WHO STEPS-based structured questionnaire. Metabolic syndrome was diagnosed by the modified NCEP ATP III criteria with Asia-specific waist circumference thresholds. Data were analysed using SPSS v29; chi-square test and multivariable binary logistic regression were applied; $p<0.05$ was considered significant.
Results: Of 381 participants, 138 (36.22%) fulfilled diagnosis criteria for MetS. Elevated blood pressure, elevated blood glucose, central obesity, raised non-HDL cholesterol and physical inactivity were significantly associated with MetS ($p<0.05$). On multivariable logistic regression, central obesity (adjusted OR: 48.6), physical inactivity (adjusted OR: 3.21) and elevated non-HDL cholesterol ≥ 130 mg/dl (adjusted OR: 1.74) emerged as independent predictors.
Conclusions: The prevalence of MetS was substantially high among hospital outpatients. Central obesity and physical inactivity were the strongest independent predictors. Structured lifestyle modification programmes focusing on physical activity promotion and weight management should be integrated within outpatient services to curb the rising NCD burden.

Keywords: Central obesity, Hospital based study, Metabolic syndrome, Non-communicable diseases, Non-HDL cholesterol

INTRODUCTION

The global burden of non-communicable diseases (NCDs) has intensified considerably over recent decades, with metabolic syndrome (MetS) emerging as one of the most clinically significant precursors to both type 2 diabetes mellitus and cardiovascular disease (CVD). The world is in the midst of an epidemiological transition and developing nations like India now bear a disproportionately high share of this burden. MetS is not a single disease entity but a cluster of closely interrelated physiological abnormalities- central obesity, elevated blood pressure, impaired fasting glucose, reduced HDL cholesterol and elevated triglycerides- that collectively amplify cardiometabolic risk beyond the contribution of each individual component.[1,2]

Pathogenesis of MetS is complex but the interplay og visceral adiposity, insulin resistance, chronic low-grade inflammation and genetic predisposition are well recognised contributors. Lifestyle changes focusing on

increasing physical activity supposed to prevent the exploding epidemic of Metabolic syndrome.[3,4]

The prevalence of MetS is notably high among Asians including Indians and rising sharply with the adoption of westernised lifestyles. Studies conducted across Indian cities have reported prevalence rates ranging from 25% to over 40% depending on the diagnostic criteria and study population.[5-7] However data from tier-2 cities and district hospital settings remain comparatively sparse. This study was conducted to estimate the prevalence and identify epidemiological predictors of MetS among adults attending a district hospital in Chhatrapati Sambhajinagar, Maharashtra.

METHODS

The study was a hospital-based cross-sectional study carried out from July to September 2025 at the outpatient services of a district hospital, government medical college, Ch. Sambhajinagar. Sample size was calculated using Cochrane's formula [$n= Z^2\times(1-p)/d^2$], considering a MetS prevalence of 33.5% in urban India.[2] 5% absolute precision and 95% confidence interval yielding a minimum of 343; adding 10% for non-response gave a final sample size of 381.

Convenient sampling was employed. Adults aged ≥18 years attending outpatient departments during the study period were consecutively enrolled. Those with known malignancy acute febrile illness or on medications known to alter metabolic parameters were excluded.

Data were collected using a structured, pre-tested questionnaire based on the WHO STEPwise approach to surveillance (WHO STEPS).[12] The instrument captured behavioural risk factors, anthropometric measurements (height, weight, waist circumference, blood pressure) and biochemical parameters (fasting plasma glucose, total cholesterol, HDL cholesterol, triglycerides, non-HDL cholesterol).

Metabolic syndrome was diagnosed by the NCEP ATP III definition with modification for Asia-Pacific waist cut-offs: waist circumference ≥102 cm in men and ≥88 cm in women; blood pressure >130/85 mmHg; fasting triglycerides ≥150 mg/dl; non-HDL cholesterol ≥130 mg/dl and fasting blood glucose ≥100 mg/dl.[13] Presence of three or more criteria was required for diagnosis.

Data were analysed using IBM SPSS version 29.0. Associations between categorical risk-factors and MetS were examined by chi-square test. Variables with $p<0.20$ on univariate analysis were entered into a multivariable binary logistics regression model to estimate adjusted odds ratios (AOR) with 95% confidence intervals (CI). $p<0.05$ was considered statistically significant.

The study was conducted after obtaining clearance from the institutional ethics committee and written informed consent from each participant.

RESULTS

A total of 381 participants were studied. The majority (63.51%) were aged 40 years or above. Females constituted 62.20% of the study population. A sedentary lifestyle was reported by 76.37% of participants. A positive family history of MetS or related disorders was present in 38.05%. the overall prevalence of metabolic syndrome was 36.22% (138 out of 381 participants). Table 1 presents the distribution of participants according to sociodemographic characteristics and MetS prevalence.

Table 1: distribution of study participants according to prevalence and different epidemiological factors (n=381).

Variables	Category	Frequency (n=381)	Percentage
Age (years)	40	139	36.48
	≥40	242	63.51
Gender	Male	144	37.79
	Female	237	62.20
Lifestyle	Heavy worker	18	4.72
	Moderate	72	18.90
	Sedentary	291	76.37
Family history	Negative	236	61.94
	Positive	145	38.05
Addiction	Yes	159	41.73
	No	222	58.26
Metabolic syndrome	Present	138	36.22
	Absent	243	63.77

Univariate analysis (Table 2) revealed that elevated blood pressure (p,0.001), elevated blood sugar (p,0.001), central obesity (p,0.001), elevated non-HDL cholesterol (p=0.02) and physical inactivity (p=0.001) were significantly associated with MetS. Age, gender, lifestyle category, family history and addiction status did not show statistically significant associations

Binary logistic regression (Table 3) identified three independent predictors of MetS. Central obesity demonstrated the strongest association (Adjusted OR: 48.6; 95% CI: 18.3-129.0; p<0.001). Physical inactivity was the second most important predictor (adjusted OR:3.21;95% CI: 1.94-5.31; p<0.0001). Elevated non-HDL cholesterol ≥130 mg/dl was also an independent predictor (Adjusted OR:1.74; 95% CI: 1.09-2.77; P=0.02). Multivariate model fit was assessed and found to be satisfactory.

Table 2: Association between risk factors and metabolic syndrome (n=381).

Variables	Category	MetS present n=138 (%)	MetS absent n=243 (%)	P value
Age (years)	<40	12 (8.69)	22 (9.05)	>0.90
	≥40	126 (91.30)	221 (90.94)	
Gender	Male	55 (39.85)	89 (36.62)	>0.40
	Female	83 (60.14)	154 (63.37)	
Lifestyle	Heavy	7 (5.07)	11 (4.52)	>0.90
	Moderate	26 (18.84)	46 (18.93)	
	Sedentary	105 (76.08)	186 (76.54)	
Family history	Negative	86 (62.31)	150 (61.72)	>0.80
	Positive	52 (37.68)	93 (38.27)	
Addiction	Yes	57 (41.30)	102 (41.97)	>0.90
	No	81 (58.69)	141 (58.02)	
Elevated Blood pressure	Yes	138 (100)	198 (81.48)	<0.001
	No	0 (0)	45 (18.51)	
Elevated blood sugar	Yes	138 (100)	184 (75.72)	<0.001
	No	0 (0)	59 (24.27)	
Central obesity	≥88 cm (women)	83 (60.14)	10 (4.11)	<0.001
	≥102 cm (men)	52 (37.68)	5 (2.05)	
Non-HDL≥130 mg/dl	Yes	95 (68.84)	141 (58.02)	0.02
	No	43 (31.15)	102 (41.97)	
Physical activity	Active	32 (23.18)	134 (55.14)	<0.001
	Inactive	106 (76.81)	109 (44.85)	

Table 3: Binary logistic regression analysis showing predictors of metabolic syndrome.

Variables	Category	Crude OR (95% CI)	Adjusted OR (95% CI)	P value
Physical activity	Inactive versus active	4.08 (1.94-5.31)	3.21 (1.94-5.31)	<0.001
Central obesity	Present versus absent	120.4 (47.2-307.0)	48.6 (18.3-129.0)	<0.001
Non-HDL≥130 mg/dl	Yes versus no	1.60 (1.02-2.51)	1.74 (1.09-2.77)	0.02

*Statistically significant at p<0.05.

DISCUSSION

The present study revealed an overall MetS prevalence of 36.22% among hospital outpatients in Chhatrapati Sambhajinagar, diagnosed by the NCEP ATP III definition with Asia-Pacific waist cut-offs. This is consistent with reports from other Indian urban settings. Chakraborty et al. reported 32.75% in urban west Bengal, Prasad et al documented 33.5% in urban Eastern India, and Gupta et al found rates exceeding 35%in urban Rajasthan.[1-3] The marginally higher prevalence our study likely reflects patient selection bias inherent to a hospital-based design, where individual with existing cardiometabolic risk tend to be over-represented.

Central obesity as a predictor

Central obesity emerged as the dominant independent predictor of MetS (Adjusted OR: 48.6). Visceral adiposity is the pathophysiological cornerstone of insulin resistance, which drives clustering of the remaining MetS components. Abdominal fat deposits are metabolically active, releasing free fatty acids, pro-inflammatory cytokines (IL-6, TNF-α), and adipokines that collectively impair insulin signalling at lower BMI values than Western populations, justifying lower Asia-Pacific waist cut-offs.[5] the high prevalence of central obesity among women (60.14% of MetS cases) aligns with prior studies by Ramchandran et al. and Deepa et al.[7,8]

Physical inactivity as a predictor

Physical inactivity was the second strongest independent predictor (Adjusted OR: 3.21). regular physical activity improves insulin sensitivity, reduces visceral fat, lowers blood pressure and favourably alters lipid profiles through multiple mechanisms. Progressive displacement of physically demanding occupations by sedentary work, combined with motorised transportation and screen-based recreation has sharply reduced population-level physical activity and MetS in Indian urban settings. Pradeepa et al documented a strong inverse association between physical activity and MetS in a large cross-sectional survey of Asian Indians, corroborating our findings.[4] Notably the high prevalence of physical inactivity even among MetS-absent participants (44.85%) suggests this risk is pervasive across the study population.

Non-HDL cholesterol as a predictor

Elevated Non-HDL cholesterol ≥130 mg/dl was an independent predictor of MetS (Adjusted OR: 1.74). Non-HDL cholesterol encompasses all atherogenic lipid particles (VLDL, IDL, LDL) and is a more comprehensive marker of atherogenic dyslipidaemia than LDL cholesterol alone, particularly in individuals with hypertriglyceridemia- a state commonly encountered in MetS. The American Heart Association endorses non-HDL cholesterol as a secondary treatment target in such individuals.[6]

Non-significant predictors

Unlike several community-based studies, this study did not find significant associations between age, gender, family history or addiction and MetS.[1,9] This may be attributable to the hospital-based design introducing selection bias, the relatively narrow age distribution of the sample or the broad lifestyle categorisation being insufficiently sensitive to detect graded associations. Addiction as a predictor was also non-significant-consistent with reports by Chakraborty et al (OR:1.05) and Zhan et al.[1,11]

CONCLUSION

Metabolic syndrome was present in 36.22% of participants. Central obesity was the strongest predictor. Physical inactivity and raised non-HDL cholesterol were also significant predictors. Early detection and lifestyle changes can help reduce the risk of MetS. Promoting physical activity and healthy weight is therefore essential.

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Ethical approval: The study was approved by the Institutional Ethics Committee

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