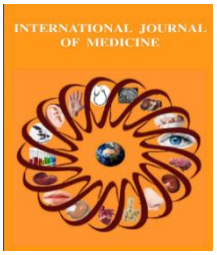

International Journal of Medicine
ISSN (P): 1468-3814; ISSN (e): 2667-7008

https://www.theinternationalmedicine.com

Volume: 7(8) 2025

Original Research

Association Between Serum Uric Acid Levels and Cardiometabolic Risk Factors Among Adults Attending a General Medicine Department: A Cross-Sectional Observational Study

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Received: 10 Jul 2025 / Accepted: 12 Aug 2025

Abstract

Background: Serum uric acid has emerged as a potential marker of cardiometabolic dysfunction, although its relationship with individual risk factors remains incompletely characterised in routine clinical populations. **Objectives:** To determine serum uric acid levels and examine their association with obesity, hypertension, glycaemic status, dyslipidaemia, and metabolic syndrome among adults attending a General Medicine Department. **Methods:** This cross-sectional observational study included 100 adults evaluated at Government Medical College, Maheshwaram, Telangana, India, from October 2024 to May 2025. Demographic, anthropometric, blood-pressure, fasting-glucose, lipid-profile, and serum uric acid data were collected. Hyperuricaemia was defined as serum uric acid ≥7.0 mg/dL in males and ≥6.0 mg/dL in females. Group comparisons, Pearson correlation, trend analysis, and multivariable logistic regression were performed. **Results:** The mean age was 52.6 ± 11.3 years, and 56.0% were males. Mean serum uric acid was 6.42 ± 1.68 mg/dL; hyperuricaemia was present in 38.0%. Participants with hyperuricaemia had higher body mass index, waist circumference, blood pressure, fasting glucose, and triglycerides, together with lower high-density lipoprotein cholesterol. Hyperuricaemia was significantly associated with hypertension, diabetes, dyslipidaemia, obesity, central obesity, and metabolic syndrome. Serum uric acid correlated positively with waist circumference (r=0.41), triglycerides (r=0.39), body mass index (r=0.36), and systolic blood pressure (r=0.31), and inversely with high-density lipoprotein cholesterol (r=-0.34). Central obesity, hypertension, elevated triglycerides, and low high-density lipoprotein cholesterol remained independently associated with hyperuricaemia. **Conclusion:** Higher serum uric acid levels were associated with clustering of cardiometabolic risk factors. Serum uric acid assessment can complement routine risk evaluation, although longitudinal studies are required to establish temporal and causal relationships.

Keywords: *Cardiometabolic risk; central obesity; dyslipidaemia; hyperuricaemia; metabolic syndrome; serum uric acid*

Introduction

Uric acid is the final oxidation product of purine metabolism in humans and is predominantly eliminated through the kidneys. At physiological concentrations, circulating urate contributes to antioxidant defence; however, persistent elevation has been linked with endothelial dysfunction, oxidative stress, inflammation, and altered renal microvascular regulation. Hyperuricaemia is the biochemical basis of gout, but its clinical relevance extends beyond crystal deposition. Epidemiological and experimental evidence increasingly places serum uric acid within the broader network of cardiovascular, metabolic, and renal disorders.1,2

Higher serum uric acid concentrations have been associated with incident hypertension, type 2 diabetes mellitus, coronary heart disease, chronic kidney disease, and cardiovascular risk. Systematic reviews have demonstrated a dose-related association between hyperuricaemia and new-onset hypertension, independent of several conventional risk factors.3,4 Prospective evidence has also linked increasing uric acid levels with the subsequent development of type 2 diabetes.5,6 A meta-analysis reported a modest association between hyperuricaemia and coronary heart disease events.7 These findings support the concept that serum uric acid is not merely an accompanying laboratory abnormality, although residual confounding and reverse causation remain important concerns.

Cardiometabolic risk commonly presents as a cluster comprising central adiposity, elevated blood pressure, impaired glucose regulation, hypertriglyceridaemia, and reduced high-density lipoprotein cholesterol. Increasing serum uric acid has shown a dose-response relationship with metabolic-syndrome risk.8 The syndrome predicts future cardiovascular disease and diabetes and is clinically defined through a harmonised set of metabolic abnormalities.9 Asian Indians develop abdominal adiposity and metabolic disturbances at lower body mass index values than many Western populations, making population-specific anthropometric thresholds essential for clinical assessment.10 In routine General Medicine practice, serum uric acid is frequently measured alongside renal and metabolic investigations, yet its relationship with the complete cardiometabolic profile is often not systematically evaluated..[6].

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DOI: 10.61336/im/25-08-17

The association between serum uric acid and cardiometabolic risk also has practical uncertainty. Uric acid can rise secondary to obesity, insulin resistance, reduced renal excretion, dietary patterns, alcohol use, and selected medications. Conversely, experimental pathways suggest that excess urate can impair nitric oxide bioavailability, activate the renin-angiotensin system, promote adipocyte inflammation, and intensify insulin resistance.1,2 Consequently, cross-sectional clinical data cannot establish directionality, but they can identify high-risk phenotypes and generate locally relevant evidence for integrated screening.

The present study was therefore undertaken to determine serum uric acid levels among adults attending the General Medicine Department of Government Medical College, Maheshwaram, Telangana, India, and to assess their association with obesity, central adiposity, hypertension, diabetes mellitus, dyslipidaemia, and metabolic syndrome. The study also evaluated correlations between serum uric acid and continuous cardiometabolic variables, examined risk-factor prevalence across serum uric acid tertiles, and identified factors independently associated with hyperuricaemia.

Materials and Methods

Study design and setting: This hospital-based cross-sectional observational study was conducted in the Department of General Medicine, Government Medical College, Maheshwaram, Telangana, India, from October 2024 to May 2025. Adults attending outpatient or inpatient services during the study period were screened consecutively.

Sample size and participants: Assuming an anticipated cardiometabolic-risk prevalence of 50%, a 95% confidence level, and 10% absolute precision, the minimum calculated sample was 96 and was rounded to 100. Adults aged 18 years or older who provided written informed consent and completed the required clinical and biochemical evaluation were eligible. Patients with acute gout, current urate-lowering therapy, acute kidney injury, stage 4 or 5 chronic kidney disease, active malignancy or chemotherapy, pregnancy, or incomplete biochemical records were excluded. Of 106 adults assessed, 100 fulfilled the criteria and were analysed.

Clinical and anthropometric assessment: Demographic characteristics, smoking status, medical history, and current treatment were recorded using a structured case-record form. Weight was measured with a calibrated digital scale and height with a stadiometer. Body mass index was calculated as weight in kilograms divided by height in metres squared. Asian Indian thresholds classified body mass index of 23.0-24.9 kg/m² as overweight and ≥25.0 kg/m² as obesity.[10] Waist circumference was measured midway between the lowest rib and iliac crest. Central obesity was defined as waist circumference ≥90 cm in males or ≥80 cm in females. Blood pressure was measured after five minutes of rest using an appropriately sized cuff, and the mean of two readings was used.

Biochemical measurements and definitions: After an overnight fast of at least eight hours, venous blood was collected for serum uric acid, fasting blood glucose, total cholesterol, triglycerides, low-density lipoprotein cholesterol, and high-density lipoprotein cholesterol. Tests were performed using standard enzymatic methods on a calibrated automated analyser. Hyperuricaemia was defined as serum uric acid ≥7.0 mg/dL in males and ≥6.0 mg/dL in females.[1] Hypertension was defined by a documented diagnosis, antihypertensive treatment, or blood pressure ≥140/90 mmHg.[11] Diabetes mellitus was defined by previous diagnosis, glucose-lowering treatment, or fasting blood glucose ≥126 mg/dL.[12] Dyslipidaemia was recorded when any lipid value was abnormal or lipid-lowering treatment was used. Metabolic syndrome required at least three harmonised components using Asian waist thresholds.[9]

Statistical analysis: Data were analysed using IBM SPSS Statistics version 26.0. Continuous variables are presented as mean ± standard deviation and categorical variables as frequency and percentage. Independent-samples t tests and chi-square tests compared uric acid groups. Pearson correlation assessed continuous associations. Linear-by-linear trend tests evaluated tertiles. Binary logistic regression generated adjusted odds ratios and 95% confidence intervals. A two-sided p-value <0.05 indicated statistical significance.

Ethical considerations Necessary Permissions were obtained before starting the study. Written informed consent was obtained from every participant, and confidentiality was maintained.

Results

Participant recruitment and study population: During the study period, 106 adults attending the General Medicine Department were assessed for eligibility. Six individuals were excluded: three did not satisfy the eligibility criteria, two declined participation, and one had incomplete biochemical data. The remaining 100 participants were included in the final analysis. Complete demographic, anthropometric, blood-pressure, glycaemic, lipid-profile, and serum uric acid data were available for all participants.

The mean age of the study population was 52.6 ± 11.3 years, with an age range of 24-76 years. Fifty-six participants (56.0%) were males and 44 (44.0%) were females. Thirty-three participants (33.0%) were aged 60 years or older. The mean body mass index was 26.1 ± 4.2 kg/m², and the mean waist circumference was 92.7 ± 12.1 cm.

Hypertension was present in 46 (46.0%) participants, diabetes mellitus in 31 (31.0%), and dyslipidaemia in 49 (49.0%). Thirty-six participants (36.0%) were overweight, whereas 32 (32.0%) were obese. Central obesity was identified in 47 (47.0%) participants, and 39 (39.0%) fulfilled the diagnostic criteria for metabolic syndrome. Twenty-four participants (24.0%) were current smokers.

The mean serum uric acid concentration was 6.42 ± 1.68 mg/dL. Males had a significantly higher mean serum uric acid concentration than females (6.77 ± 1.62 versus 5.97 ± 1.64 mg/dL; p=0.016). Hyperuricaemia was detected in 38 (38.0%) participants. The demographic and cardiometabolic characteristics are summarised in Table 1.

Table 1. Demographic and cardiometabolic characteristics of the study participants

Characteristic	Total participants (N=100)
Age, years	52.6 ± 11.3
Age ≥60 years	33 (33.0%)
Male sex	56 (56.0%)
Female sex	44 (44.0%)
Body mass index, kg/m²	26.1 ± 4.2
Waist circumference, cm	92.7 ± 12.1
Overweight	36 (36.0%)
Obesity	32 (32.0%)
Central obesity	47 (47.0%)

Characteristic	Total participants (N=100)
Current smoking	24 (24.0%)
Hypertension	46 (46.0%)
Diabetes mellitus	31 (31.0%)
Dyslipidaemia	49 (49.0%)
Metabolic syndrome	39 (39.0%)
Systolic blood pressure, mmHg	135.3 ± 18.4
Diastolic blood pressure, mmHg	83.6 ± 10.2
Fasting blood glucose, mg/dL	120.4 ± 39.8
Total cholesterol, mg/dL	191.7 ± 42.5
Triglycerides, mg/dL	165.7 ± 67.3
Low-density lipoprotein cholesterol, mg/dL	116.0 ± 35.6
High-density lipoprotein cholesterol, mg/dL	43.4 ± 9.1
Serum uric acid, mg/dL	6.42 ± 1.68
Hyperuricaemia	38 (38.0%)

Data are presented as mean ± standard deviation or number (percentage).

Comparison according to serum uric acid status: Participants with hyperuricaemia were significantly older than those with normal serum uric acid concentrations (56.1 ± 10.4 versus 50.4 ± 11.3 years; p=0.012). They also had a higher mean body mass index and waist circumference. Mean systolic and diastolic blood pressures were significantly elevated in the hyperuricaemia group.

The mean fasting blood glucose concentration was higher among participants with hyperuricaemia than among those without hyperuricaemia (134.1 ± 46.3 versus 112.0 ± 32.8 mg/dL; p=0.006). Hyperuricaemic participants also had significantly higher triglyceride concentrations and lower high-density lipoprotein cholesterol concentrations. The difference in low-density lipoprotein cholesterol between the groups did not reach statistical significance.

Hypertension was present in 24 of 38 participants with hyperuricaemia compared with 22 of 62 participants with normal serum uric acid levels (63.2% versus 35.5%; p=0.007). Diabetes mellitus, dyslipidaemia, obesity, central obesity, and metabolic syndrome were also significantly more frequent among participants with hyperuricaemia (Table 2).

Table 2. Comparison of cardiometabolic characteristics according to serum uric acid status

Characteristic	Hyperuricaemia (n=38)	Normal serum uric acid (n=62)	p-value
Age, years	56.1 ± 10.4	50.4 ± 11.3	0.012
Male sex	24 (63.2%)	32 (51.6%)	0.258
Body mass index, kg/m²	28.1 ± 4.0	24.9 ± 3.8	<0.001
Waist circumference, cm	98.5 ± 11.4	89.2 ± 11.1	<0.001
Systolic blood pressure, mmHg	142.6 ± 18.7	130.8 ± 16.8	0.001
Diastolic blood pressure, mmHg	87.2 ± 10.4	81.4 ± 9.4	0.004
Fasting blood glucose, mg/dL	134.1 ± 46.3	112.0 ± 32.8	0.006
Total cholesterol, mg/dL	202.2 ± 44.7	185.3 ± 40.1	0.052
Triglycerides, mg/dL	192.9 ± 72.1	149.0 ± 58.2	0.001
LDL cholesterol, mg/dL	121.4 ± 37.1	112.7 ± 34.5	0.234
HDL cholesterol, mg/dL	39.6 ± 8.2	45.8 ± 8.9	<0.001
Hypertension	24 (63.2%)	22 (35.5%)	0.007
Diabetes mellitus	17 (44.7%)	14 (22.6%)	0.019
Dyslipidaemia	25 (65.8%)	24 (38.7%)	0.009
Obesity	19 (50.0%)	13 (21.0%)	0.002
Central obesity	25 (65.8%)	22 (35.5%)	0.003
Metabolic syndrome	23 (60.5%)	16 (25.8%)	0.001

Data are presented as mean ± standard deviation or number (percentage). LDL: low-density lipoprotein; HDL: high-density lipoprotein. Independent-samples t tests or chi-square tests were applied as appropriate.

Correlation between serum uric acid and cardiometabolic variables: Serum uric acid demonstrated moderate positive correlations with body mass index (r=0.36; p<0.001), waist circumference (r=0.41; p<0.001), systolic blood pressure (r=0.31; p=0.002), fasting blood glucose (r=0.25; p=0.012), and triglycerides (r=0.39; p<0.001). A significant inverse correlation was observed with high-density lipoprotein cholesterol (r=-0.34; p=0.001).

The correlation with diastolic blood pressure was weaker but statistically significant (r=0.22; p=0.029). Serum uric acid was not significantly correlated with total cholesterol or low-density lipoprotein cholesterol (Table 3).

Table 3. Correlation of serum uric acid with cardiometabolic parameters

Cardiometabolic parameter	Correlation coefficient (r)	p-value
Age	0.24	0.015
Body mass index	0.36	<0.001
Waist circumference	0.41	<0.001
Systolic blood pressure	0.31	0.002
Diastolic blood pressure	0.22	0.029
Fasting blood glucose	0.25	0.012
Total cholesterol	0.18	0.071
Triglycerides	0.39	<0.001
LDL cholesterol	0.14	0.164
HDL cholesterol	-0.34	0.001

Correlation coefficients were calculated using Pearson correlation analysis. LDL: low-density lipoprotein; HDL: high-density lipoprotein.

Cardiometabolic risk according to serum uric acid tertiles: Participants were divided into three groups according to serum uric acid tertiles: lower tertile, ≤5.4 mg/dL; middle tertile, 5.5-6.8 mg/dL; and upper tertile, ≥6.9 mg/dL. The prevalence of hypertension increased progressively from 27.3% in the lower tertile to 69.7% in the upper tertile (p for trend=0.001). Similar increases were observed for obesity, central obesity, dyslipidaemia, and metabolic syndrome.

Metabolic syndrome was present in 18.2% of participants in the lower serum uric acid tertile, 32.4% in the middle tertile, and 66.7% in the upper tertile (p for trend<0.001), indicating a graded relationship between serum uric acid and the accumulation of cardiometabolic abnormalities (Table 4).

Table 4. Prevalence of cardiometabolic risk factors across serum uric acid tertiles

Risk factor	Lower tertile (n=33)	Middle tertile (n=34)	Upper tertile (n=33)	p for trend
Hypertension	9 (27.3%)	14 (41.2%)	23 (69.7%)	0.001
Diabetes mellitus	6 (18.2%)	10 (29.4%)	15 (45.5%)	0.017
Dyslipidaemia	10 (30.3%)	16 (47.1%)	23 (69.7%)	0.002
Obesity	5 (15.2%)	10 (29.4%)	17 (51.5%)	0.005
Central obesity	9 (27.3%)	15 (44.1%)	23 (69.7%)	0.001
Metabolic syndrome	6 (18.2%)	11 (32.4%)	22 (66.7%)	<0.001

Values are number (percentage). Trend was assessed using a linear-by-linear association test.

Multivariable analysis: Variables associated with hyperuricaemia in unadjusted analyses were entered into a multivariable binary logistic regression model. After adjustment for age, sex, diabetes mellitus, hypertension, central obesity, elevated triglycerides, and low high-density lipoprotein cholesterol, central obesity remained independently associated with hyperuricaemia (adjusted odds ratio [aOR]=2.74; 95% confidence interval [CI]: 1.12-6.72; p=0.028).

Hypertension (aOR=2.48; 95% CI: 1.03-5.99; p=0.043), elevated triglycerides (aOR=2.91; 95% CI: 1.17-7.21; p=0.021), and low high-density lipoprotein cholesterol (aOR=2.36; 95% CI: 1.01-5.53; p=0.048) were also independently associated with hyperuricaemia. Diabetes mellitus showed higher adjusted odds, but the association was not statistically significant (Table 5).

Table 5. Multivariable logistic regression analysis of factors associated with hyperuricaemia

Variable	Adjusted odds ratio	95% confidence interval	p-value
Age, per one-year increase	1.04	1.00-1.08	0.052
Male sex	1.39	0.57-3.39	0.468
Hypertension	2.48	1.03-5.99	0.043
Diabetes mellitus	1.82	0.72-4.60	0.205
Central obesity	2.74	1.12-6.72	0.028
Elevated triglycerides	2.91	1.17-7.21	0.021
Low HDL cholesterol	2.36	1.01-5.53	0.048

aOR: adjusted odds ratio; CI: confidence interval; HDL: high-density lipoprotein.

Discussion

This study identified hyperuricaemia in 38.0% of adults attending a General Medicine Department and demonstrated a consistent relationship between higher serum uric acid and an adverse cardiometabolic profile. Hyperuricaemic participants were older and had greater body mass index, waist circumference, systolic and diastolic blood pressure, fasting glucose, and triglycerides, together with lower high-density lipoprotein cholesterol. The graded increase in hypertension, obesity, dyslipidaemia, central obesity, and metabolic syndrome across uric acid tertiles strengthened the evidence for risk-factor clustering rather than an isolated biochemical association.

The observed association with metabolic syndrome accords with the dose-response meta-analysis by Yuan et al., which linked increasing serum uric acid with progressively higher metabolic-syndrome risk.8 Ni et al. similarly reported close associations between serum uric acid and metabolic syndrome components in a large coastal Chinese population.13 More recently, Raya-Cano et al. confirmed through systematic review and meta-analysis that individuals with metabolic syndrome have higher uric acid concentrations and that elevated urate is related to individual syndrome components.14 The present findings extend this evidence to a clinical population from Telangana and highlight central obesity as an independent correlate.

Serum uric acid correlated positively with systolic blood pressure and remained independently associated with hypertension. This pattern is consistent with meta-analyses by Grayson et al. and Wang et al., which showed increased incident-hypertension risk among individuals with hyperuricaemia.3,4 Proposed mechanisms include reduced endothelial nitric oxide, activation of the renin-angiotensin system, renal arteriolar injury, oxidative stress, and sodium-sensitive vascular responses.1,2 Because the present study was cross-sectional, the findings indicate coexistence and statistical independence rather than temporal causation.

Higher fasting glucose and a greater prevalence of diabetes were observed in the hyperuricaemia group, although diabetes lost significance after multivariable adjustment. Prospective analyses by Kodama et al. and Lv et al. documented increased type 2 diabetes risk with rising serum uric acid.5,6 In the current sample, the attenuation after adjustment suggests that abdominal adiposity, triglyceride excess, blood pressure, and low high-density lipoprotein cholesterol account for part of the crude uric acid-diabetes relationship.

The strong correlations with waist circumference and triglycerides, and the inverse correlation with high-density lipoprotein cholesterol, support an insulin-resistant, atherogenic phenotype. Hyperinsulinaemia can reduce renal urate excretion, while excess urate can contribute to adipocyte oxidative stress and inflammatory signalling.1,2 The independent associations of central obesity, elevated triglycerides, and low high-density lipoprotein cholesterol are therefore biologically coherent. Clinically, serum uric acid is inexpensive and widely available; an elevated result should prompt structured assessment of blood pressure, adiposity, glycaemic status, and lipid abnormalities. Nevertheless, treatment decisions should target established cardiometabolic risk factors rather than rely on uric acid alone, and prospective studies are required to clarify its incremental predictive value.

LIMITATIONS

The cross-sectional design prevented assessment of temporal sequence or causality. Recruitment from a single General Medicine Department and the modest sample size restricted external generalisability. Dietary purine intake, alcohol quantity, physical activity, renal filtration estimates, and detailed medication effects were not fully quantified. A single uric acid measurement also limited evaluation of biological variability, while residual confounding remained possible despite multivariable adjustment.

Conclusion

Hyperuricaemia was common among adults attending the General Medicine Department and was closely associated with an adverse cardiometabolic profile. Participants with elevated serum uric acid had greater general and central adiposity, higher blood pressure, fasting glucose, and triglyceride levels, and lower high-density lipoprotein cholesterol. Cardiometabolic abnormalities increased progressively across serum uric acid tertiles. Central obesity, hypertension, elevated triglycerides, and low high-density lipoprotein cholesterol retained independent associations after adjustment. These findings support incorporating serum uric acid into comprehensive clinical risk assessment as an adjunctive marker rather than a standalone diagnostic measure. Early identification of accompanying obesity, hypertension, dysglycaemia, and dyslipidaemia can facilitate timely preventive intervention and coordinated risk-factor management in practice.

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