



Original Article

Prevalence of Hyperuricemia and Its Association with Components of Metabolic Syndrome in Patients Attending Tertiary care hospital in North coastal Andhra Pradesh

Dr. Madhuri Swapna Yella¹, Dr. P.V.S.S. Vijaya Babu², Dr. G. Brahmeyesu³

^{1,3} Assistant Professor, Department of Biochemistry, Gayatri medical College. Visakhapatnam, AP.

² Associate Professor, Department of Biochemistry, Gayatri medical College. Visakhapatnam, AP.

OPEN ACCESS

Corresponding Author:

Dr. Madhuri Swapna Yella

Assistant Professor, Department of Biochemistry, Gayatri medical College. Visakhapatnam, AP.

Received: 17-09-2025

Accepted: 05-10-2025

Available online: 26-10-2025

Copyright © International Journal of
Medical and Pharmaceutical Research

ABSTRACT

Background: Hyperuricemia (elevated serum uric acid) has been increasingly reported to associate with components of the metabolic syndrome (MetS) — central obesity, dyslipidaemia, hypertension and insulin resistance. There is uncertainty about the strength and independence of these associations in different populations. Data from the north coastal Andhra Pradesh region are limited. Hence the present study aims to estimate the prevalence of hyperuricemia among patients with metabolic syndrome (MetS) and in age and Gender matched controls and also to study the association between serum uric acid (SUA) levels and individual MetS components.

Methodology: The study compared 50 patients with metabolic syndrome diagnosed according to IDF criteria from the Endocrinology Outpatient Department at King George Hospital, Visakhapatnam to 30 age and Gender matched healthy controls. Serum uric acid levels and metabolic parameters (waist circumference, triglycerides, HDL-C, fasting plasma glucose, and blood pressure) were evaluated.

Results: Serum uric acid levels were significantly higher in metabolic syndrome patients than in controls. Uric acid showed positive associations with waist circumference, triglycerides, and hypertension, but no significant correlation with HDL-C or fasting glucose. Levels were higher in males and rose with the number of metabolic syndrome components.

Conclusion: Serum uric acid is significantly elevated in metabolic syndrome and shows positive associations with central obesity, hypertriglyceridemia, and hypertension, suggesting its potential role as a metabolic risk marker.

Keywords: Hyperuricemia, serum uric acid (SUA), metabolic syndrome (MetS), central obesity, hypertriglyceridemia, hypertension, coronary heart disease (CHD), Type 2 Diabetes Mellitus (T2DM).

INTRODUCTION

Metabolic syndrome is wide spread among adult population in world and its prevalence increases with age. Defining the metabolic syndrome has not been an attempt to declare the existence of a new disease produced by a single pathogenesis, but rather to put together various risk factors, that as a group have a greater predictive ability for coronary heart disease. Metabolic syndrome is a cluster of risk factors which include hypertension, obesity, and dyslipidemia insulin resistance in a single patient.^[1] It can be a signal to health care physicians that patients who present with such a cluster are at much greater danger of morbidity and mortality from Type 2 Diabetes Mellitus (T2DM) and coronary heart disease (CHD). Insulin resistance is an underlying central component of the metabolic syndrome (MetS). Hyperuricaemia or elevated serum uric acid level (SUA) is a biochemical entity that is gaining increasing importance as it has been found by some researchers to be not only a cardiovascular risk factor but also play a role in the development of renal and metabolic diseases.^[2-4] Some reports on SUA and the metabolic syndrome have noted that increased SUA concentration is associated with an increased

prevalence of some of the parameters - obesity, dyslipidemia, insulin resistance and hypertension of the metabolic syndrome. [5]

Hyperuricemia is increasingly recognized as a marker and potential contributor to cardiometabolic disease. Cross-sectional and cohort studies have demonstrated associations between elevated serum uric acid and individual components of metabolic syndrome (central obesity, hypertriglyceridemia, low HDL, hypertension, and impaired fasting glucose). However, prevalence and the strength of these associations vary by population. This study was done to estimate the prevalence of hyperuricemia among patients with metabolic syndrome attending a tertiary care outpatient clinic in North Coastal Andhra Pradesh and to study its association with individual components of the syndrome.

Objectives:

1. To estimate the prevalence of hyperuricemia among adult patients with metabolic syndrome (IDF criteria) attending the outpatient Endocrinology clinic.
2. To study the association between uric acid levels and the various components of metabolic syndrome.

METHODOLOGY

Study Design

Analytical cross-sectional study with a concurrently recruited age and Gender matched control group.

Study Setting & study Duration:

Outpatient Department of Endocrinology, King George Hospital, Visakhapatnam from 2012-2013.

Study Population

Cases: Consecutive adult patients (age ≥ 18 years) diagnosed with metabolic syndrome by the IDF criteria attending the Endocrinology OPD.

Controls: Age- and sex-matched healthy volunteers (family attendants, hospital staff, or community volunteers) without metabolic syndrome and without known chronic illnesses that affect serum uric acid.

Inclusion Criteria

- Adults ≥ 18 years.
- Cases: Meet IDF definition of metabolic syndrome (central obesity plus any two of the following: raised TG, reduced HDL-C, raised blood pressure, raised fasting plasma glucose).
- Controls: No metabolic syndrome by IDF criteria; no known gout, chronic kidney disease, or active systemic inflammatory disease.
- Provide written informed consent.

Exclusion Criteria

- Known chronic kidney disease stage 3 or higher (eGFR <60 ml/min/1.73 m²).
- Current gout or on urate-lowering therapy (allopurinol, febuxostat, probenecid).
- Use of medications known to alter uric acid (e.g., high-dose aspirin, diuretics) unless unavoidable — record and consider in analysis.
- Pregnancy.
- Acute illness within previous 2 weeks.

Sample Size

50 cases with metabolic syndrome and **30** age- and sex-matched controls, consistent with preliminary data from the clinic and local feasibility.

Definitions

- **Metabolic syndrome:** According to International Diabetes Federation (IDF) criteria⁶: central obesity (waist circumference ≥ 90 cm for South Asian men, ≥ 80 cm for South Asian women) plus any two of: TG ≥ 150 mg/dL (1.7 mmol/L), HDL-C <40 mg/dL (men) or <50 mg/dL (women), BP $\geq 130/85$ mmHg or treatment for hypertension, fasting plasma glucose ≥ 100 mg/dL (5.6 mmol/L) or previously diagnosed diabetes.
- **Hyperuricemia:** Serum uric acid >7.0 mg/dL in men and >6.0 mg/dL in women.

Study Procedures

1. **Screening & recruitment:** consecutive OPD patients for eligibility were screened. Age–sex matched controls from volunteers were recruited.
2. **Consent:** written informed consent was obtained.
3. **History & examination:** Demographics, medical history, medication history (especially diuretics, low-dose aspirin, urate-lowering drugs), alcohol use, smoking, and family history were recorded. Weight, height, BMI, and waist circumference (midpoint between the lower margin of the last palpable rib and the top of the iliac crest) were measured.

Blood pressure (average of two readings taken 5 minutes apart in sitting position) was recorded.

4. **Laboratory tests:** After overnight fasting (8–12 hours), blood samples were collected for Serum uric acid, fasting plasma glucose, Serum triglycerides, Serum HDL-Serum creatinine (to calculate eGFR)
5. **Sample handling:** Samples were Analysed in the hospital laboratory using standardized enzymatic/colorimetric methods. Quality control and calibration logs were Maintained.

Statistical Analysis

Data was entered into Microsoft excel spread sheet and analysed using SPSS Software.

Descriptive statistics: Mean $\pm$ SD (or median, IQR if non-normal) for continuous variables, counts and percentages for categorical variables.

Comparison between groups: Student's t-test was used for comparison of continuous variables for various parameters of cases and controls. p value < 0.05 was considered statistically significant. 95% confidence intervals were considered.

Ethical Considerations

Institutional Ethics Committee (IEC) approval was obtained prior to study initiation. Participants were given written informed consent. Confidentiality was maintained by using unique study IDs and storing data in password-protected files. Abnormal results will be communicated to participants and referred for appropriate care.

RESULTS

The present study comprised of fifty [50] cases of metabolic syndrome and thirty [30] healthy controls. The cases comprised of 18 (36%) males and 32(64%) females of MS. In the study group females (64%) outnumbered males (36%) with a male to females' ratio of 1:1.7. Control group distribution was almost similar to that of cases.

Table:1 Comparison of various parameters of cases and controls:

Variable	CASES		CONTROLS		P value
	Mean	S.D	Mean	S.D	
WC [cm]	96.42	8.478	77.60	7.010	<0.01 Significant
TG [mg/dl]	178.78	57.58	66.60	20.004	<0.01 Significant
HDL-C [mg/dl]	46.64	7.803	51.70	8.817	<0.01 Significant
FPG [mg/dl]	115.30	15.216	84.10	9.308	<0.01 Significant
SBP[mmHg]	131.20	15.471	115.33	9.732	<0.01 Significant
DBP[mm Hg]	85.60	6.440	79.33	2.537	<0.01 Significant
Uric acid [mg/dl]	6.19	2.174	4.03	0.810	<0.01 Significant

Study of Cases:

The parameters which were taken to support the diagnosis of Metabolic Syndrome such as waist circumference, TG, HDL-C, BP, fasting plasma glucose and serum uric acid levels increased significantly in patients with Metabolic Syndrome than those in healthy age-gender matched controls as shown in table:1.

In the present study, Figure 1 depicts mean value of serum uric acid among cases is 6.19 mg/dl $\pm$ 2.174 [Mean $\pm$ S.D] & that of controls is 4.03 mg/dl $\pm$ 0.810. The increase in serum uric acid in patients of metabolic syndrome is highly significant with a p value of <0.01 than those in healthy controls.

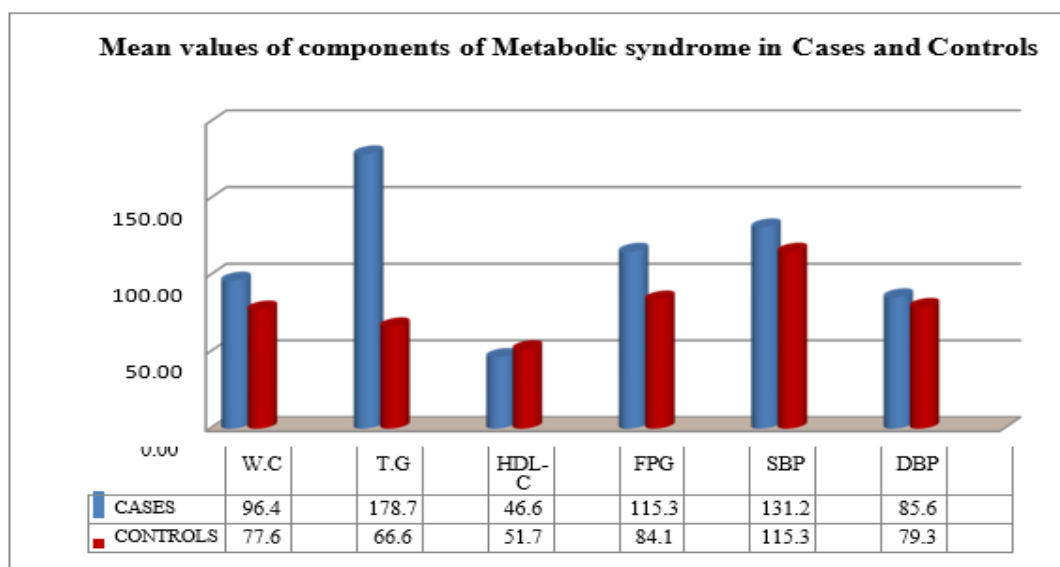


Figure: 1 Mean values of components of Metabolic syndrome in Cases and Controls

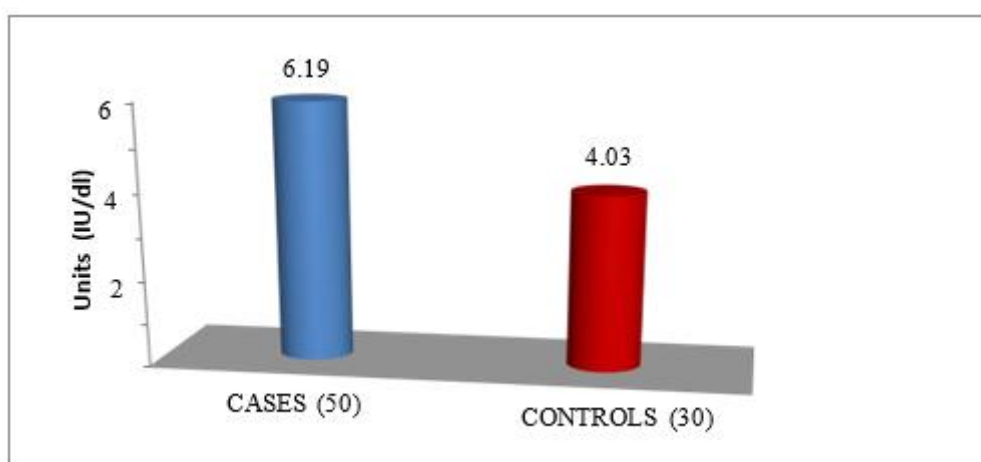


Figure: 2 Mean serum Uric acid levels in Cases and Controls

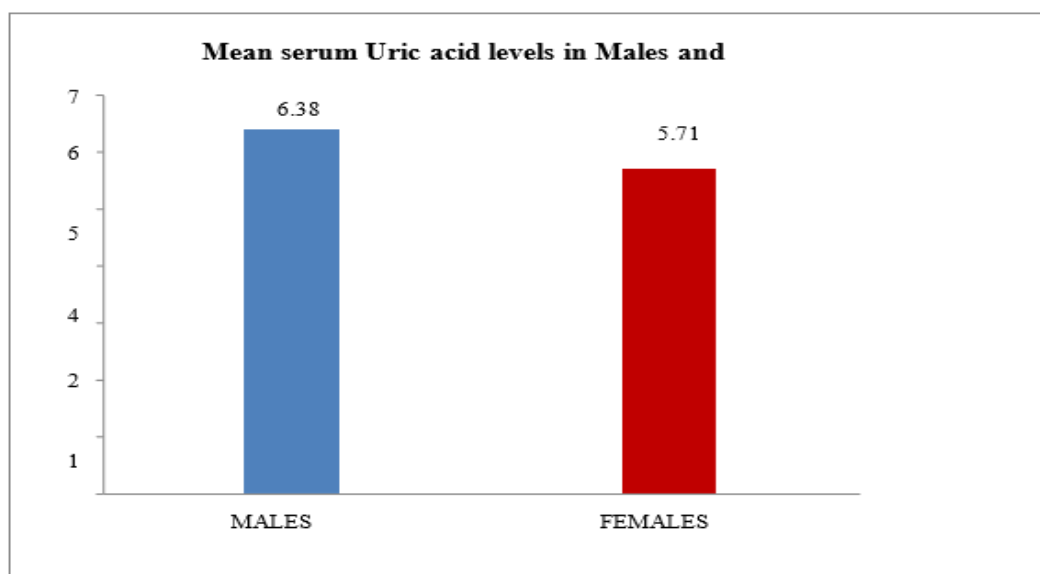


Figure:3 Mean serum Uric acid levels in Males and Females(cases)

Seven males out of 18 (38.9% of total cases) and 13 women out of 32 (40.6% of total cases) were found to have higher serum uric acid levels. In males mean serum uric acid was $6.38 \pm 2.2 \pm 0.3$ mg/dl and in females it was $5.7 \text{ mg/dl} \pm 2.1 \pm$

0.15 and On applying t test it was found that there is no difference between men and women. [p value is 0.9 which is statistically not significant)

Table:2 Mean serum uric acid levels in cases with and without elevated triglycerides:

Triglycerides	Triglycerides >150mg/dl [N= 27] Mean $\pm$ SD	Triglycerides <150mg/dl [N= 23] Mean $\pm$ SD	P value
S. uric acid (mg/dl)	6.811 $\pm$ 2.295	4.935 $\pm$ 1.521	< 0.01 Significant
Hypertension	Yes [24]	No [26]	P value
S. uric acid (mg/dl)	6.933 $\pm$ 2.548	5.038 $\pm$ 1.227	< 0.01 Significant
HDL-C	Yes [n = 27]	No [n = 23]	P value
S. uric acid (mg/dl)	6.20 $\pm$ 2.359	5.652 $\pm$ 1.943	0.4 Not significant
FPG	Yes [38]	No [12]	P value
S. uric acid (mg/dl)	5.905 $\pm$ 2.398	6.083 $\pm$ 1.298	0.13 Not significant

Out of 27 cases with increased serum triglycerides, 11 are males and 16 are females. Serum uric acid levels in male cases with elevated triglycerides were $6.373 \pm 2.576 \pm 0.286$ and in female cases with elevated triglycerides it was $7.112 \pm 2.113 \pm 0.391$ (p value < 0.01 which is statistically significant).Serum uric acid levels in cases with hypertension was $6.933 \pm 2.548 \pm 0.281$ where as it was $5.038 \pm 1.227 \pm 0.196$ in cases with normotension (p value < 0.01 which is statistically significant).Serum uric acid levels were slightly higher in subjects with normal fasting plasma glucose ($6.038 \pm 1.298 \pm 0.284$) compared to those with elevated fasting plasma glucose ($5.903 \pm 2.398 \pm 0.256$); however, the difference was not statistically significant (p = 0.13).Serum uric acid levels showed no significant difference between cases with decreased HDL-C and normal HDL-C (p = 0.4) or between elevated and normal FPG groups (p = 0.13

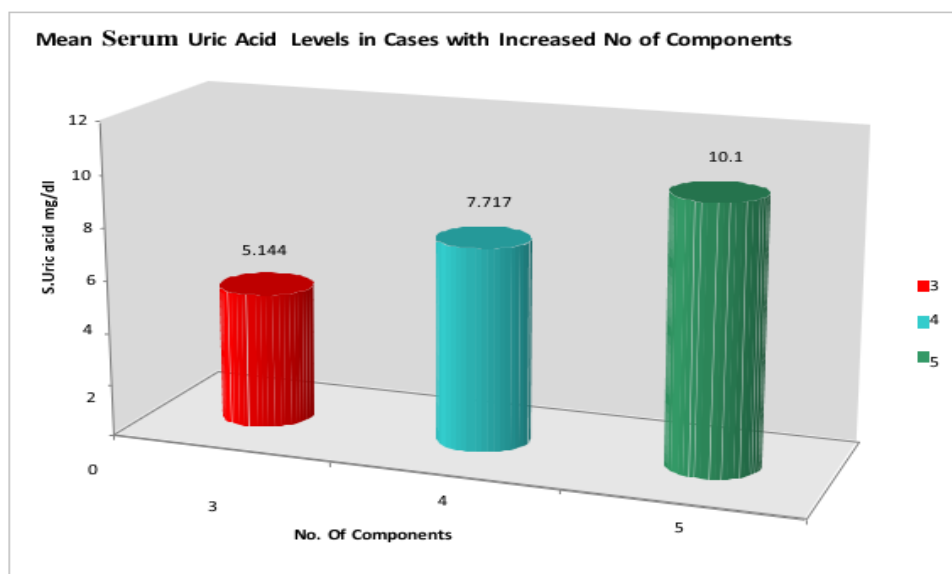


Figure:4 Mean Serum Uric Acid Levels in Cases with Increased No of Components

Serum uric acid levels rose progressively with the number of metabolic syndrome components— 5.144 ± 1.448 (three), 7.717 ± 1.315 (four), and 10.10 ± 1.804 (five)—indicating a positive association between uric acid levels and metabolic syndrome severity.

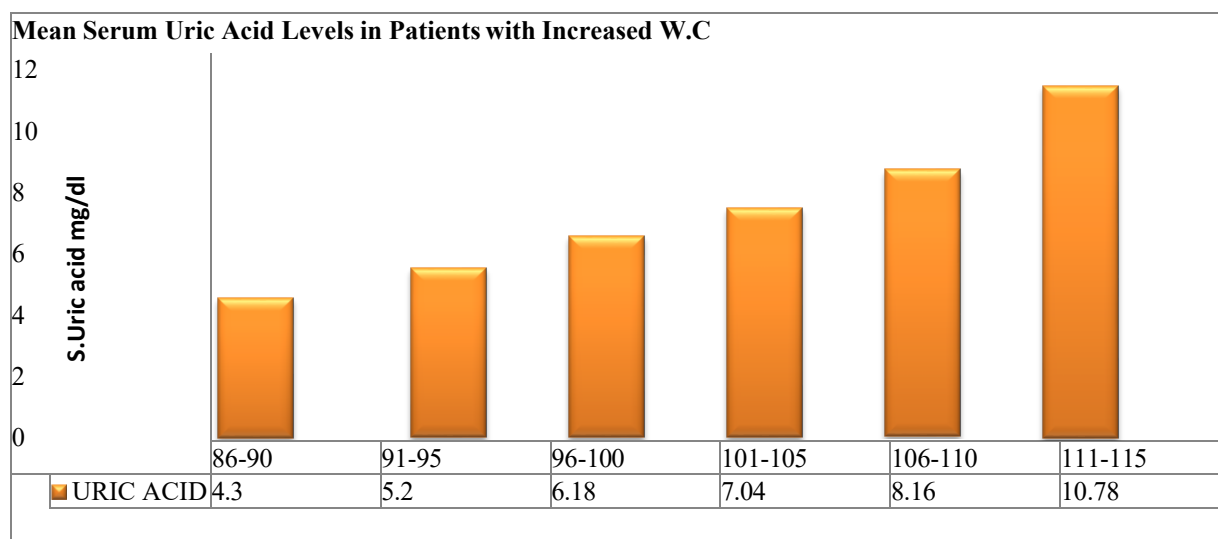


FIG:3

Number of female cases with higher serum uric acid levels were more than males. 40.62% females and 38.88% males of total cases were found to have elevated serum uric acid levels.

Out of 50 patients, all were having increased waist circumference. Serum uric acid levels were found to be increased with increase in waist circumference. There is positive association between serum uric acid levels and waist circumference.

Out of 50 patients, 27 were having elevated serum triglycerides and 23 were having normal serum triglycerides. Patients with hypertriglyceridemia (TG > 150mg/dl) had high serum uric acid compared to those without hypertriglyceridemia. Serum uric acid levels in cases with hypertriglyceridemia $6.811 \pm 2.295 \pm 0.308$ versus cases without hypertriglycerides it was 4.935 ± 1.520 has p value < 0.01 which is statistically significant.

Table:3 Mean serum uric acid levels of cases in relation to number of components:

Number of components	Number of patients (n)	Uric acid (mg/dl)
3	39	5.144 ± 1.448
4	6	7.717 ± 1.315
5	5	10.10 ± 1.804

Out of 50 patients, 39 were having 3 components, 6 were having 4 components, 5 were having 5 components. Serum uric acid levels of cases with three, four and five components of MS were 5.144 ± 1.448 , 7.717 ± 1.315 and 10.10 ± 1.804 respectively. Serum uric acid levels were increased with increase in number of components which show positive association between uric acid level and number of components of metabolic syndrome.

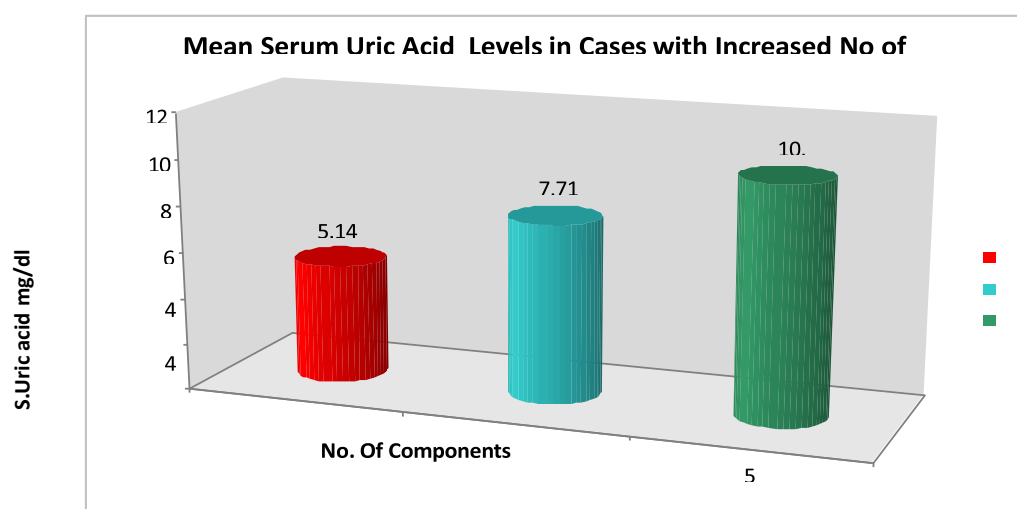


FIG:5

DISCUSSION

The study included 50 patients with metabolic syndrome from the endocrinology OPD at KGH and 30 age- and sex-matched healthy controls to assess serum uric acid levels and their association with metabolic syndrome components.

The mean age of patients was 54.58 years, with most being middle-aged (40–59 years) and predominantly female (64%). The age and sex distribution matched NCEP: ATP III data showed that increasing industrialization and aging populations are contributing to a rising global prevalence of metabolic syndrome.

Serum uric acid and metabolic syndrome:

Serum uric acid levels were significantly higher in metabolic syndrome patients (6.19 ± 2.174 mg/dl) than in healthy controls (4.03 ± 0.810 mg/dl; $p < 0.01$). Using cutoff values of >7 mg/dl for males and >6 mg/dl for females, hyperuricemia was found in 38.9% of men and 40.6% of women.⁷

Unlike other studies, no significant difference in serum uric acid levels was observed between men and women. While previous research attributes higher serum uric acid levels in men than in women, although uric acid levels in women tend to increase above the age of 50.

Studies have shown significant correlations between serum uric acid and metabolic syndrome components such as higher BMI, waist-to-hip ratio, blood pressure, and lower HDL-C. Insulin resistance plays a key role, as elevated insulin levels reduce renal uric acid clearance and promote sodium retention, contributing to hyperuricemia and hypertension. The kidney thus serves as a link between insulin resistance, hyperinsulinemia, and metabolic disturbances. Serum uric acid levels also rise with an increasing number of metabolic syndrome components.

Patients showed elevated serum uric acid levels likely due to metabolic syndrome, consistent with findings from previous studies done by Anthonia O Ogbera et al⁸, Wen-Hua Zhu et al⁹. Although more females had elevated uric acid levels than males (6.378 ± 2.233 vs. 5.706 ± 2.137 mg/dl), the difference was not statistically significant ($p = 0.9$).

The mean waist circumference of patients was 96.4 ± 8.5 cm, and serum uric acid levels increased with rising waist circumference, indicating a positive correlation between the two. All patients had central obesity, as it is a core criterion for metabolic syndrome. This finding aligns with previous studies done by SM Sadr et al¹⁰, Li-Ying Chen et al.¹¹, Anthonia O. Ogbera et al⁸, that reported associations between central obesity and hyperuricemia. No sex difference in uric acid levels was observed in this study.

Among 50 metabolic syndrome patients, 27 with elevated triglycerides had significantly higher serum uric acid levels (6.81 ± 2.29 mg/dl) than those with normal triglycerides (4.93 ± 1.52 mg/dl; $p < 0.01$). Uric acid was also higher in women with hypertriglyceridemia ($p < 0.01$), contrary to the usual estrogen-related lower levels. These findings, consistent with previous studies, Li-ying Chen¹¹, Wen-Hua Zhu⁹, serum triglyceride was markedly associated with hyperuricemia. Conen et al (2004)¹² and Schachter (2005)¹³ suggest that the link between hyperuricemia and hypertriglyceridemia is more related to lifestyle and metabolic factors than genetics.

In the present study, 24 hypertensive patients had significantly higher serum uric acid levels (6.93 ± 2.54 mg/dl) than non-hypertensive patients (5.03 ± 1.22 mg/dl; $p < 0.01$), showing a significant association between uric acid and hypertension. This aligns with previous studies D Conen¹², Remedios C, Shah M et al¹⁴, Shi-Dou Lin, Dong-Hwa Tsai et al¹⁵ indicating that hyperuricemia independently increases hypertension risk, potentially through effects on endothelial function, platelet activity, and oxidative metabolism.

In this study, 27 patients with low HDL-C showed no significant difference in serum uric acid levels compared to those with normal HDL-C (6.20 ± 2.36 vs. 5.65 ± 1.93 mg/dl; $p = 0.4$), indicating no association. While other studies Rho et al¹⁶ reported a negative correlation between uric acid and HDL-C, this is thought to be mediated by insulin resistance and may disappear when accounting for other metabolic syndrome components.

In this study, 38 patients with abnormal glucose tolerance showed no significant difference in serum uric acid levels compared to those with normal fasting plasma glucose (5.905 ± 2.398 vs. 6.083 ± 1.298 mg/dl; $p = 0.13$). Unlike some prior studies, no clear association was observed, likely because the cutoff for abnormal fasting glucose (110 mg/dL) does not necessarily reflect hyperinsulinemia. Other research H.K.Choi, et al¹⁷ has shown a bell-shaped relationship between uric acid and glucose levels, with uric acid rising at moderate FPG or HbA1c levels and decreasing at higher levels. Mechanistically, hyperuricemia may contribute to diabetes risk through oxidative stress, endothelial dysfunction, vascular inflammation, and altered renal sodium handling, which together can exacerbate insulin resistance and glucose intolerance. In this study, serum uric acid levels rose with an increasing number of metabolic syndrome components, consistent with findings from a few previous studies by Qin Li,¹⁸ Zhen Yang, Ju-Mi Lee, and Hyeon Chang Kim et al¹⁹.

CONCLUSIONS

- Serum uric acid levels are higher in patients of metabolic syndrome as compared to normal healthy individuals.
- There is significant association found between serum uric acid levels and serum triglycerides and hypertension, waist circumference and number of components of metabolic syndrome.
- Elevated serum uric acid, significantly correlated with metabolic syndrome components, is a risk factor for atherosclerosis and cardiovascular disease.

Conflict of interest: Nil

Funding sources: Nil

REFERENCES

1. Williams Endocrinology, 11TH Edition, page no.1524.
2. Klein R, Klein BE, Cornoni J, Maready J, Cassel JC, Tyroler HA: Serum uric acid, Georgia. *Arch Intern Med* 1973, 132:401-410.
3. Bengtsson C, Lapidus L, Stendahl C, Waldenstrom J: 1988. Hyperuricemia and risk of cardiovascular disease and overall death. *Acta Med Scand* 2002, 224: 549- 555.
4. Nakagawa T, Cirillo P, Sato W, Gersch M, Sautin Y, Roncal C: The conundrum of hyperuricemia, metabolic syndrome, and renal disease. *Intern Emerg Med* 2003(4):313-318.
5. Cai Z, Xu X, Wu X, Zhou C, Li D: Hyperuricemia and the metabolic syndrome. *Asia Pac J Clin Nutr* 2009, 18(1):81-87.
6. Idf.Org [home page on the internet]. The IDF consensus worldwide definition of the metabolic syndrome [accessed 2005 June 16]. Available from the website http://www.idf.org/webdata/docs/IDF-Metasyndrome_definition.
7. Taylor RN, Roberts JM: Endothelial cell dysfunction. In Lindheimer MD, Roberts JM, Cunningham FG (eds): Chesley's Hypertensive Disorders in Pregnancy, 2nd ed. Stamford, CT, Appleton & Lange, 1999, p 395.
8. Anthonia O Ogbera* and Alfred O Azenabor ; Hyperuricaemia and the metabolic syndrome in type 2 DM Ogbera and Azenabor *Diabetology & Metabolic Syndrome* 2010, 2:24.
9. Chen LY, Zhu WH, Chen ZW, Dai HL, Ren JJ, Chen JH, Chen LQ, Fang LZ. Relationship between hyperuricemia and metabolic syndrome. *J Zhejiang Univ Sci B*. 2007 Aug;8(8):593-8.
10. Sadr SM, Namayandeh SM, Moadares MM, Rafiei M. Serum uric acid levels and its association with cardiovascular risk factors. *Iranian J Publ Health*. 2009; 38(1) : 53-59.
11. Chen LY, Zhu WH, Chen ZW, Dai HL, Ren JJ, Chen JH, Chen LQ, Fang LZ. Relationship between hyperuricemia and metabolic syndrome. *J Zhejiang Univ Sci B*. 2007; 8(8): 593-8.
12. Conen D, Wietlisbach V, Bovet P, Shamlaye C, Riesen W, Paccaud F, Burnier M. Prevalence of hyperuricemia and relation of serum uric acid with cardiovascular risk factors in a developing country. *BMC Public Health*. 2004;4(1):9.
13. Schachter M. Uric acid and hypertension. *Curr Pharm Des*. 2005;11(32):4139–4143.
14. Remedios C, Shah M, Bhasker AG, Lakdawala M. Hyperuricemia: a reality in the Indian obese. *Obes Surg*. 2012 Jun;22(6):945-8.
15. Shi-Dou Lin, Dong-Hwa Tsai*, Shang-Ren Hsu. *J Chin Med Assoc* • November 2006 • Vol 69 • No 11
16. Rho YH, Choi SJ, Lee YH, Ji JD, Choi KM, Baik SH, Chung SH, Kim CG, Choe JY, Lee SW, et al. The prevalence of metabolic syndrome in patients with gout: a multicenter study. *J Korean Med Sci*. 2005;20(6):1029–1033.
17. H. K. Choi and E. S. Ford. Haemoglobin A1c, fasting glucose, serum C-peptide and insulin resistance in relation to serum uric acid levels—the Third National Health and Nutrition Examination Survey. *Rheumatology* 2008; 47: 713–717.
18. Qin Li1, Zhen Yang2*, Bin Lu1, Jie Wen1, Zi Ye1, Li Chen1, Min He1, Xiaoming Tao1, Weiwei Zhang1, Ying Huang1, Zhaoyun Zhang1, Shen Qu2 and Renming Hu1* Abstract Serum uric acid level and its association with metabolic syndrome and carotid atherosclerosis in patients with type 2 diabetes. *Cardiovascular Diabetology* 2011, 10:72.
19. Ju-Mi Lee, Hyeon Chang Kim, Hye Min Cho, Sun Min Oh, Dong Phil Choi, Il Suh; Association Between Serum Uric Acid Level and Metabolic Syndrome *Journal of Preventive Medicine and Public Health* May 2012, Vol. 45 No. 3, 181-187. Available at <http://jpmph.org>.