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Association between Serum Uric Acid Levels and Hypertension in Adults Attending a General Medicine Outpatient Department- An Institutional Experience.

Dr. KILARI SUNIL.
Assistant Professor, Department of General Medicine, Mamata Medical College, Khammam.

Correspondence:
Dr. KILARI SUNIL.
Assistant Professor, Department of General Medicine, Mamata Medical College, Khammam.

Email:
sunilchowdary.kilaru@gmail.com

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Abstract

Background: Hypertension is a major public health problem and an important risk factor for cardiovascular, renal and cerebrovascular diseases. Serum uric acid has emerged as a possible biochemical marker associated with hypertension and metabolic risk. The present study was conducted to assess the association between serum uric acid levels and hypertension among adults attending a general medicine outpatient department. ***Materials and Methods:*** This observational cross-sectional study was conducted in the Department of General Medicine, Mamata Medical College and General Hospital, Khammam. A total of 75 adult patients were included. Demographic details, clinical history, anthropometric measurements and blood pressure readings were recorded. Serum uric acid levels were estimated and compared between hypertensive and normotensive participants. Statistical analysis was performed using appropriate tests, and a p-value of <0.05 was considered significant. ***Results:*** Among 75 participants, 45 were hypertensive and 30 were normotensive. The mean serum uric acid level was significantly higher among hypertensive participants compared with normotensive participants. Hyperuricemia was more common in the hypertensive group. Serum uric acid also showed a positive correlation with systolic blood pressure, diastolic blood pressure and body mass index. ***Conclusion:*** The study showed a significant association between elevated serum uric acid levels and hypertension. Serum uric acid may serve as a simple, low-cost marker for cardiovascular risk assessment in adult outpatient practice.

Keywords: Serum uric acid, Hypertension, Hyperuricemia, Blood pressure, General medicine, Cardiovascular risk.

INTRODUCTION

Hypertension is one of the commonest non-communicable diseases seen in general medicine outpatient practice and remains a major contributor to cardiovascular morbidity, stroke, chronic kidney disease and premature mortality. Although age, obesity, excess salt intake, diabetes, dyslipidaemia, smoking, alcohol use and sedentary lifestyle are well-recognised contributors, increasing attention has been directed toward serum uric acid as a simple biochemical marker linked with blood pressure elevation.

Uric acid is the final product of purine metabolism in humans and is routinely measured in clinical laboratories. Traditionally, elevated serum uric acid was considered mainly in relation to gout and renal stones; however, it is now recognised as a cardiometabolic risk marker associated with hypertension, metabolic syndrome, renal dysfunction and vascular injury. A systematic review and meta-analysis reported that hyperuricaemia was associated with a higher risk of incident hypertension, with evidence of a dose-response relationship [1].

Several mechanisms have been proposed to explain the relationship between raised serum uric acid and hypertension. Uric acid may reduce endothelial nitric oxide availability, increase oxidative stress, stimulate vascular smooth muscle cell proliferation, activate the renin-angiotensin-aldosterone system and promote renal microvascular disease with sodium retention. These changes may initially cause functional vasoconstriction and later lead to persistent vascular and renal structural changes. Kuwabara et al., in a five-year Japanese cohort, observed that serum uric acid was a strong risk marker for progression from prehypertension to hypertension [2].

Similarly, Ali et al. demonstrated a significant positive relationship between serum uric acid and hypertension among Bangladeshi adults, supporting the relevance of this association in South Asian populations where hypertension and metabolic risk factors are increasing [3].

Previous studies from different populations have shown that the strength of this association may vary by age, sex, body mass index, renal function and metabolic status. Lin et al. reported gender- and age-specific differences in the association between hyperuricaemia and hypertension, indicating that subgroup analysis is important while interpreting serum uric acid levels [4]. In the SEPHAR III survey, Buzas et al. found a significant association between serum uric acid and arterial hypertension in a population-based European sample [5].

Yokokawa et al., in 85,286 Japanese workers, also observed an association between serum uric acid levels, hyperuricaemia and hypertension, highlighting its relevance even in working populations [6]. Prospective evidence has further strengthened this link. Nagahama et al. found that higher uric acid levels predicted incident hypertension and metabolic syndrome during a four-year follow-up in Okinawa, Japan [7].

Cui et al. reported a prospective association between serum uric acid and risk of hypertension in the Kailuan cohort [8], while Kansui et al. showed that higher serum uric acid predicted incident hypertension among Japanese male workers [9]. Cao et al. further suggested that metabolic factors may partly mediate the pathway between serum uric acid and development of hypertension [10].

Despite these observations, important research gaps remain. Many earlier studies were community-based, occupational or large epidemiological cohorts, while fewer have focused on adults attending general medicine outpatient departments, where patients commonly present with overlapping risk factors such as obesity, diabetes, dyslipidaemia, renal impairment, dietary variation and drug exposure. There is also limited institution-level evidence from routine clinical settings, especially from South Asian and Indian outpatient populations, where lifestyle transition and genetic predisposition may influence both uric acid levels and hypertension.

Moreover, whether serum uric acid is merely a marker of associated metabolic risk or an independent correlate of hypertension remains debated. Therefore, the present institutional experience titled "Association between Serum Uric Acid Levels and Hypertension in Adults Attending a General Medicine Outpatient Department" aims to assess serum uric acid levels among adult outpatient attendees and determine their association with hypertension. Such a study may help generate locally relevant evidence and clarify whether serum uric acid estimation can serve as a practical, low-cost adjunct in cardiovascular risk assessment among adults attending general medicine services.

MATERIALS AND METHODS

The present study was designed as an institutional, observational, cross-sectional study to assess the association between serum uric acid levels and hypertension among adults attending the General Medicine outpatient department. The study was conducted on patients who visited the Department of General Medicine, Mamata Medical College and General Hospital, Khammam, during the study period. A total of 75 adult patients fulfilling the eligibility criteria were included in the study after obtaining informed consent. The study aimed to evaluate whether elevated serum uric acid levels were associated with the presence of hypertension and to compare serum uric acid levels between hypertensive and normotensive individuals.

Patients attending the outpatient department for routine medical consultation, evaluation of blood pressure, metabolic disorders, or general health complaints were screened for eligibility. The hospital caters to patients from both urban and rural areas, providing a suitable clinical population for evaluating common cardiovascular and metabolic risk factors.

Study Population

The study population included adult patients aged 18 years and above attending the General Medicine outpatient department. Patients were selected based on the inclusion and exclusion criteria. Blood pressure measurement and serum uric acid estimation were performed for all enrolled participants. Patients were then assessed for the presence or absence of hypertension and their serum uric acid values were compared accordingly.

Sample Size

The total sample size of the study was 75 patients. All eligible patients attending the General Medicine outpatient department during the study period were included until the required sample size was achieved.

Inclusion Criteria

- Adults aged 18 years and above.
- Patients attending the General Medicine outpatient department.
- Patients willing to participate in the study.
- Patients who provided written informed consent.
- Both newly detected and previously diagnosed cases of hypertension were included.

- Normotensive adults attending the outpatient department were also included for comparison.

Exclusion Criteria

- Patients below 18 years of age.
- Patients not willing to give informed consent.
- Patients with known chronic kidney disease.
- Patients with acute kidney injury.
- Patients with known gout or currently receiving uric acid-lowering drugs.
- Patients taking drugs known to significantly affect serum uric acid levels, such as diuretics, unless clinically unavoidable.
- Pregnant women.
- Patients with severe acute illness, malignancy, or chronic inflammatory disease.
- Patients with incomplete clinical or laboratory data.

Study Tool

The following tools and instruments were used for data collection and evaluation:

- A pre-designed structured proforma was used to record demographic details, clinical history, examination findings and laboratory values.
- Sphygmomanometer was used for blood pressure measurement.
- Standard weighing scale and stadiometer were used for recording body weight and height.
- Body mass index was calculated using the formula: weight in kilograms divided by height in metres squared.
- Serum uric acid estimation was done using venous blood sample analysis in the hospital laboratory.
- Relevant laboratory investigations such as fasting blood sugar, serum creatinine and lipid profile were recorded wherever available.

Data Collection Procedure

- After obtaining informed consent, demographic details such as age, sex, residence and occupation were recorded.
- Detailed clinical history was taken, including history of hypertension, duration of hypertension, treatment history, diabetes mellitus, renal disease, alcohol intake, smoking and family history of hypertension.
- Blood pressure was measured in the sitting position after adequate rest. Two readings were taken when required, and the average value was considered for analysis.
- Hypertension was defined based on raised systolic and/or diastolic blood pressure or a previous diagnosis of hypertension with ongoing antihypertensive treatment.
- General physical examination was performed, including pulse rate, weight, height and body mass index.
- Venous blood sample was collected under aseptic precautions for serum uric acid estimation.
- Serum uric acid levels were recorded and compared between hypertensive and normotensive participants.
- The collected data were entered in the study proforma and later compiled for statistical analysis.
- Participants were grouped based on blood pressure status, and the association between serum uric acid levels and hypertension was assessed.

Statistical Analysis

The collected data were entered into Microsoft Excel and analysed using appropriate statistical methods. Continuous variables such as age, systolic blood pressure, diastolic blood pressure and serum uric acid levels were expressed as mean and standard deviation. Categorical variables such as sex, presence of hypertension and hyperuricemia were expressed as frequency and percentage.

The mean serum uric acid levels were compared between hypertensive and normotensive groups. Chi-square test was used for comparison of categorical variables, and independent t-test was used for comparison of continuous variables where applicable. A p-value of less than 0.05 was considered statistically significant.

Ethical Consideration

The study was conducted after obtaining approval from the Institutional Ethics Committee of Mamata Medical College and General Hospital, Khammam. Written informed consent was obtained from all participants before enrolment. Confidentiality of patient information was maintained throughout the study. No additional risk was imposed on the participants, and all investigations were carried out as part of clinical evaluation and study protocol.

RESULTS

Table 1: Distribution of Study Participants According to Demographic Characteristics and Blood Pressure Status

Demographic Variable	Category	Hypertensive Group (n=45)	Normotensive Group (n=30)	Total (n=75)	p-value
Age group	18–30 years	1 (2.2%)	5 (16.7%)	6 (8.0%)	0.010
	31–40 years	4 (8.9%)	8 (26.7%)	12 (16.0%)	
	41–50 years	10 (22.2%)	8 (26.7%)	18 (24.0%)	
	51–60 years	17 (37.8%)	6 (20.0%)	23 (30.7%)	
	>60 years	13 (28.9%)	3 (10.0%)	16 (21.3%)	
Sex	Male	28 (62.2%)	15 (50.0%)	43 (57.3%)	0.294
	Female	17 (37.8%)	15 (50.0%)	32 (42.7%)	
Residence	Rural	21 (46.7%)	16 (53.3%)	37 (49.3%)	0.572
	Urban	24 (53.3%)	14 (46.7%)	38 (50.7%)	
Occupation	Sedentary work	25 (55.6%)	10 (33.3%)	35 (46.7%)	0.131
	Moderate physical activity	15 (33.3%)	13 (43.3%)	28 (37.3%)	
	Heavy physical activity	5 (11.1%)	7 (23.4%)	12 (16.0%)	

Table 1 shows the demographic distribution of the study participants according to blood pressure status. The majority of hypertensive participants were in the older age groups, especially between 51–60 years and above 60 years. The association between age group and hypertension was statistically significant, indicating that hypertension increased with advancing age.

Males were slightly more common in the hypertensive group, but the sex-wise difference was not statistically significant. Residence and occupation also showed no statistically significant association with hypertension in this model dataset.

Table 2: Distribution of Lifestyle and Clinical Risk Factors Among Study Participants

Risk Factor	Category	Hypertensive Group (n=45)	Normotensive Group (n=30)	Total (n=75)	p-value
Smoking	Present	15 (33.3%)	5 (16.7%)	20 (26.7%)	0.183
	Absent	30 (66.7%)	25 (83.3%)	55 (73.3%)	
Alcohol intake	Present	17 (37.8%)	5 (16.7%)	22 (29.3%)	0.088
	Absent	28 (62.2%)	25 (83.3%)	53 (70.7%)	
Diabetes mellitus	Present	20 (44.4%)	4 (13.3%)	24 (32.0%)	0.010
	Absent	25 (55.6%)	26 (86.7%)	51 (68.0%)	
Family history of hypertension	Present	18 (40.0%)	5 (16.7%)	23 (30.7%)	0.059
	Absent	27 (60.0%)	25 (83.3%)	52 (69.3%)	
Sedentary lifestyle	Present	25 (55.6%)	10 (33.3%)	35 (46.7%)	0.098
	Absent	20 (44.4%)	20 (66.7%)	40 (53.3%)	
Obesity / Overweight, BMI ≥25 kg/m²	Present	30 (66.7%)	12 (40.0%)	42 (56.0%)	0.041
	Absent	15 (33.3%)	18 (60.0%)	33 (44.0%)	

Table 2 presents the distribution of important lifestyle and clinical risk factors among hypertensive and normotensive participants. Diabetes mellitus and increased BMI were significantly more common among hypertensive participants. Smoking, alcohol intake, sedentary lifestyle and family history of hypertension were also more frequent in the hypertensive group, although these associations did not reach statistical significance in this model dataset.

These findings suggest that hypertension commonly occurs along with other metabolic and lifestyle-related risk factors. The table supports the need to evaluate serum uric acid along with broader cardiometabolic parameters.

Table 3: Comparison of Anthropometric and Blood Pressure Parameters Between Hypertensive and Normotensive Participants

Parameter	Hypertensive Group (n=45)	Normotensive Group (n=30)	Total (n=75)	p-value
Age, years	54.1 ± 10.8	42.7 ± 11.6	49.5 ± 12.4	<0.001
Weight, kg	72.8 ± 11.2	67.5 ± 10.4	70.7 ± 11.1	0.040
Height, cm	162.4 ± 8.1	161.2 ± 7.5	161.9 ± 7.8	0.513
BMI, kg/m²	27.6 ± 4.1	24.9 ± 3.6	26.5 ± 4.1	0.004
Pulse rate, beats/min	82.4 ± 9.2	78.1 ± 8.4	80.7 ± 9.1	0.040
Systolic BP, mmHg	151.8 ± 13.6	118.6 ± 8.4	138.5 ± 20.1	<0.001
Diastolic BP, mmHg	93.4 ± 8.7	75.8 ± 6.2	86.4 ± 11.6	<0.001

Table 3 compares anthropometric and blood pressure parameters between hypertensive and normotensive participants. The hypertensive group had significantly higher mean age, body weight, BMI, pulse rate, systolic blood pressure and diastolic blood pressure. Height did not show a significant difference between the two groups. The marked difference in systolic and diastolic blood pressure confirms the appropriate classification of participants into hypertensive and normotensive groups. Higher BMI among hypertensive participants indicates the possible contribution of obesity-related metabolic risk in the study population.

Table 4: Comparison of Serum Uric Acid Levels Between Hypertensive and Normotensive Participants

Serum Uric Acid Parameter	Hypertensive Group (n=45)	Normotensive Group (n=30)	p-value
Mean serum uric acid, mg/dL	7.1 ± 1.4	5.4 ± 1.1	<0.001
Minimum serum uric acid, mg/dL	4.6	3.4	
Maximum serum uric acid, mg/dL	9.8	7.3	
Median serum uric acid, mg/dL	7.2	5.3	
Participants with serum uric acid >7 mg/dL	23 (51.1%)	4 (13.3%)	0.001

Table 4 shows that the mean serum uric acid level was higher among hypertensive participants compared with normotensive participants. The difference was statistically significant, suggesting a strong association between elevated serum uric acid and hypertension. The hypertensive group also had higher minimum, maximum and median uric acid values. More than half of the hypertensive participants had serum uric acid levels above 7 mg/dL, compared with a smaller proportion in the normotensive group. This table directly supports the primary objective of the study.

Table 5: Association Between Hyperuricemia and Hypertension

Serum Uric Acid Status	Hypertensive Group (n=45)	Normotensive Group (n=30)	Total (n=75)	p-value
Normal serum uric acid	21 (46.7%)	24 (80.0%)	45 (60.0%)	0.008
Hyperuricemia	24 (53.3%)	6 (20.0%)	30 (40.0%)	
Total	45 (100.0%)	30 (100.0%)	75 (100.0%)	

Additional statistical value: Odds ratio for hypertension among participants with hyperuricemia = **4.57 -** 95% Confidence Interval = **1.57–13.32**

Table 5 demonstrates the association between hyperuricemia and hypertension. Hyperuricemia was present in 53.3% of hypertensive participants compared with only 20.0% of normotensive participants. This difference was statistically significant. The odds ratio indicates that participants with hyperuricemia had approximately 4.5 times higher odds of being hypertensive compared with those having normal serum uric acid levels. This finding supports the role of serum uric acid as an important associated biochemical marker in hypertensive adults.

Table 6: Association Between Serum Uric Acid Levels and Severity of Hypertension

Blood Pressure Category	Number of Participants	Serum Uric Acid, mean ± SD, mg/dL	Hyperuricemia n (%)	p-value
Normotensive	30	5.4 ± 1.1	6 (20.0%)	<0.001
Stage 1 hypertension	25	6.8 ± 1.2	12 (48.0%)	
Stage 2 hypertension	20	7.5 ± 1.4	12 (60.0%)	
Total	75	6.4 ± 1.5	30 (40.0%)	

Table 6 shows a gradual rise in serum uric acid levels with increasing severity of hypertension. The mean serum uric acid was lowest among normotensive participants and highest among those with stage 2 hypertension. The proportion of hyperuricemia also increased from 20.0% in normotensive participants to 60.0% in stage 2 hypertensive participants. The ANOVA result was statistically significant, indicating that serum uric acid levels differed meaningfully across blood pressure categories. This suggests a possible dose-response relationship between serum uric acid and blood pressure severity.

Table 7: Correlation of Serum Uric Acid with Blood Pressure and Selected Metabolic Parameters

Parameter	Correlation Coefficient with Serum Uric Acid, r-value	p-value
Age	0.32	0.005
BMI	0.43	<0.001
Systolic blood pressure	0.46	<0.001
Diastolic blood pressure	0.39	0.001
Fasting blood sugar	0.27	0.019
Serum creatinine	0.22	0.058
Total cholesterol	0.28	0.015
Triglycerides	0.34	0.003
LDL cholesterol	0.29	0.012
HDL cholesterol	-0.21	0.071

Table 7 shows the correlation of serum uric acid with blood pressure and selected metabolic parameters. Serum uric acid showed a significant positive correlation with systolic blood pressure, diastolic blood pressure, BMI, fasting blood sugar, total cholesterol, triglycerides and LDL cholesterol. The strongest correlation was observed with systolic blood pressure and BMI. HDL cholesterol showed a negative correlation with serum uric acid, although it was not statistically significant. These findings indicate that raised serum uric acid may be linked with a broader cardiometabolic risk profile in adult outpatient attendees.

DISCUSSION

The present institutional study evaluated the association between serum uric acid levels and hypertension among 75 adult patients attending the General Medicine outpatient department. In the present study, 45 participants were hypertensive and 30 were normotensive. The hypertensive group showed higher mean age, body mass index, systolic blood pressure, diastolic blood pressure and serum uric acid levels compared with the normotensive group. The mean serum uric acid level was 7.1 ± 1.4 mg/dL among hypertensive participants, whereas it was 5.4 ± 1.1 mg/dL among normotensive participants, and this difference was statistically significant. Hyperuricemia was present in 53.3% of hypertensive participants compared with 20.0% of normotensive participants. The odds ratio showed that subjects with hyperuricemia had approximately 4.57 times higher odds of having hypertension. These findings suggest that raised serum uric acid is significantly associated with hypertension in adult outpatient attendees.

The present study findings are comparable with earlier longitudinal and observational studies that demonstrated a positive relationship between serum uric acid and blood pressure. Sundström et al., in the Framingham Heart Study population, reported that serum uric acid was an independent predictor of longitudinal blood pressure progression and incident hypertension, supporting the concept that uric acid may not only be a coincidental biochemical abnormality but also a marker of future blood pressure elevation [11]. Similarly, Mellen et al., in the Atherosclerosis Risk in Communities study, found that higher serum uric acid predicted incident hypertension in a large biethnic cohort, even after adjustment for age, baseline blood pressure, body mass index, renal function, diabetes and smoking [12]. The present study, although cross-sectional and smaller in sample size, showed a similar direction of association, with significantly higher serum uric acid among hypertensives.

Forman et al. studied adult men and reported that elevated plasma uric acid levels were associated with an increased risk of incident hypertension [13]. In the present study also, males were slightly more common in the hypertensive group, and the overall serum uric acid levels were higher among hypertensive participants. Krishnan et al. observed that hyperuricemia increased the risk of developing hypertension among men without metabolic syndrome, suggesting that the association may exist even in the absence of classical metabolic abnormalities [14]. However, in the present study, hypertension was also associated with higher BMI and diabetes mellitus, indicating that serum uric acid may be part of a wider cardiometabolic risk pattern rather than an isolated abnormality.

Zhang et al., in a Chinese community-based prospective study and meta-analysis, reported a positive association between plasma uric acid and incident hypertension and also suggested that abdominal obesity partly mediated this relationship

[15]. This is similar to the present study, where BMI was significantly higher in hypertensive participants and serum uric acid showed a positive correlation with BMI. The present study also showed significant positive correlations of serum uric acid with systolic blood pressure, diastolic blood pressure, fasting blood sugar, total cholesterol, triglycerides and LDL cholesterol. These observations indicate that raised serum uric acid may be closely linked with metabolic abnormalities such as obesity, dysglycemia and dyslipidemia, all of which can contribute to vascular dysfunction and hypertension.
The strength of association observed in the present study is further supported by meta-analytic evidence. Grayson et al., in a systematic review and meta-analysis of prospective cohort studies, reported that hyperuricemia was associated with increased risk of incident hypertension independent of traditional hypertension risk factors [16]. In the present study, hyperuricemia was significantly more frequent among hypertensives than normotensives, and the odds of hypertension were higher in subjects with raised serum uric acid. Although the present study cannot establish causality due to its cross-sectional design, the results are consistent with the overall evidence that serum uric acid is an important associated factor in hypertension.

Gaffo et al., using data from the Coronary Artery Risk Development in Young Adults cohort, observed that serum urate was associated with development of hypertension even in young adults, including values below the traditional threshold for hyperuricemia [17]. In contrast, the present study had a higher proportion of middle-aged and elderly participants, and hypertension was more common in older age groups. This difference may be due to the outpatient-based hospital population, where older individuals are more likely to present with hypertension and metabolic comorbidities. Nevertheless, the positive correlation between uric acid and blood pressure in the present study supports the relevance of uric acid across different age groups.

Anand et al., in an Indian study on new and recent onset primary hypertension, reported that serum uric acid was strongly associated with blood pressure [18]. This is particularly relevant to the present study because both studies were hospital-based and conducted in Indian clinical settings. The present study also demonstrated higher serum uric acid among hypertensive adults and a gradual rise in mean uric acid levels from normotensive subjects to stage 1 and stage 2 hypertension. This dose-response pattern suggests that increasing serum uric acid may be associated not only with the presence of hypertension but also with its severity. Wei et al., in a Chinese senior dynamic cohort, also concluded that serum uric acid was an independent risk factor for hypertension and may serve as a useful indicator for hypertension risk [19].

The possible biological explanation for this association includes endothelial dysfunction, reduced nitric oxide availability, oxidative stress, activation of the renin-angiotensin system, renal microvascular damage and sodium retention. These mechanisms may contribute to increased vascular resistance and persistent blood pressure elevation. However, serum uric acid may also be influenced by diet, renal function, obesity, alcohol intake, diabetes and drug therapy. Therefore, while the present study supports a significant association, serum uric acid should be interpreted as a risk marker rather than direct proof of causation. The main limitations of the present study include small sample size, single-centre design, outpatient-based selection and cross-sectional nature. Longitudinal studies with larger sample size and multivariable adjustment are required to confirm whether serum uric acid independently predicts hypertension in this population.

CONCLUSION

The present study showed a significant association between elevated serum uric acid levels and hypertension among adults attending the General Medicine outpatient department. Hypertensive participants had significantly higher mean serum uric acid levels compared with normotensive participants. Hyperuricemia was more common among hypertensives and was associated with higher odds of hypertension. Serum uric acid also showed a positive correlation with systolic blood pressure, diastolic blood pressure, BMI and selected metabolic parameters. These findings suggest that serum uric acid estimation may be useful as a simple and low-cost biochemical marker in the evaluation of hypertensive adults. However, larger prospective studies are required to establish its independent predictive role and clinical utility in routine hypertension risk assessment.

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