DOI: https://doi.org/10.53350/pjmhs020231711587

**ORIGINAL ARTICLE**

# Relationship between Serum Uric Acid Levels and Severity of Hypertension in Adult Patients

SAEED MAQSOOD[1], SADULLAH SHAH[2], RADHIA KHAN[3], SAMIULLAH KHAN[4], NAIMAT ULLAH SHAH[5], FARMAN ULLAH[6]
[1]*Assistant Professor of Cardiology, Medical Teaching Institution, Bannu*
[2]*Assistant Professor of Cardiology, Medical Teaching Institution, Bannu*
[3]*Associate Professor of Biochemistry, Bannu Medical College*
[4]*Assistant Professor of Medicine, Medical Teaching Institution, Bannu*
[5]*Assistant Professor of Medicine, Medical Teaching Institution, Bannu*
[6]*Assistant Professor of Cardiology, Medical Teaching Institution, Bannu*
*Correspondence to: Samiullah Khan, Email: drsami88@gmail.com*

## ABSTRACT

**Background:** Hypertension is a major cardiovascular risk factor worldwide, and hyperuricemia has been implicated as both a marker and a potential contributor to increased blood pressure. Understanding the relationship between serum uric acid levels and hypertension severity may aid in risk stratification and management.

**Objective:** To evaluate the association between serum uric acid levels and the severity of hypertension in adult patients.

**Methods:** A retrospective observational study was conducted at a tertiary care institution from March 2023 to August 2023. Adult patients (≥18 years) diagnosed with hypertension were included. Demographic data, comorbidities, blood pressure readings, and serum uric acid levels were extracted from medical records. Hypertension was classified as mild, moderate, or severe according to established guidelines. Statistical analysis included mean ± SD, frequencies, percentages, and correlation analysis between uric acid levels and blood pressure. A p-value <0.05 was considered statistically significant.

**Results:** A total of 120 patients were analyzed, with a mean age of 52.6 ± 11.2 years. Serum uric acid levels increased significantly with hypertension severity, with mean levels of 5.8 ± 1.2 mg/dL in mild, 6.7 ± 1.4 mg/dL in moderate, and 7.9 ± 1.5 mg/dL in severe hypertension ($p < 0.001$). A positive correlation was observed between serum uric acid and both systolic and diastolic blood pressure. The findings were consistent across age and sex subgroups, suggesting an independent association.

**Conclusion:** Serum uric acid levels were positively associated with the severity of hypertension in adult patients. Monitoring and managing uric acid may provide a valuable tool for risk stratification and optimizing hypertension care.

**Keywords:** Serum uric acid, hypertension severity, hyperuricemia, adult patients.

## INTRODUCTION

Hypertension is a common cardiovascular disease that is marked by sustained high blood pressure in the arteries, and which is a leading cause of disease in the morbidity and mortality rates all over the world. It contributes significantly to atherosclerotic cardiovascular disease, heart failure, stroke and chronic kidney disease. The intensity of hypertension that is usually graded into stage 1, stage 2, and hypertensive crisis is strongly associated with the likelihood of end-organ damage and negative cardiovascular outcomes[1].

New findings have also indicated the contribution of metabolic processes such as serum uric acid (SUA) to the pathophysiology of hypertension. Hyperuricemia has been reported to play a role in endothelial dysfunction, oxidative stress, activation of the renin-angiotensin-aldosterone system and inflammation all of which help to raise blood pressure[2,3]. A number of epidemiological research have shown that high levels of SUA are positively associated with the onset of hypertension, regardless of the conventional risk factors like age, obesity and renal functions[4,5].

The final product of purine metabolism is uric acid, which is excreted through the kidneys and the inability to process uric acid properly may worsen hyperuricemia and hypertension. Also, there is a hypothesis that uric acid can cause renal microvascular injuries and sodium retention, which also adds to blood pressure increases[6]. Uric acid and hypertension are especially relevant in the context of adult population where the two conditions are becoming more common in adult population through lifestyle and dietary habits as well as genetic predisposition.

Regardless of the accumulating evidence, the cause-effect relationship between serum uric acid and the intensity of hypertension is yet to be fully understood among many populations in the region. To determine the high-risk people and preventive or therapeutic solutions, local epidemiological data are needed. This information can help clinicians to check the level of SUA as a component of general cardiovascular risk evaluation.

Received on 11-09-2023
Accepted on 24-11-2023

This is to examine the correlation between the severity of hypertension and the level of serum uric acid among adult patients visiting a tertiary care facility, thus offering an insight into the possible prognostic and therapeutic value[7,8].

**Objective:** To establish the relationship between the level of serum uric acid and the intensity of hypertension in an adult patient in a tertiary care facility.

## METHODOLOGY

**Study Design and Setting:** This study is an observational one that was carried out in the Medical Teaching Institution, Bannu, in a period of six months between March and August of 2023. The organization is a tertiary care referral center responsible in delivering cardiology and internal medicine services to a wide range of patients.

**Study Population:** They included adult patients who had attended the cardiology or medicine outpatient departments and diagnosed with hypertension aged 18 years or older. The level of hypertension was also grouped based on standard clinical guidelines as mild, moderate, or severe based on the measurements of office blood pressure. Secondary hypertension or chronic kidney disease, gout, pregnant patients, and incomplete medical records were also excluded to make the study cohort homogenous.

**Data Collection:** Medical records were used to obtain demographic and clinical data such as age, sex, body mass index, comorbid conditions, including diabetes and dyslipidemia, how long patients have been using antihypertensive treatment, etc. Blood pressure indicators were normalized: the patients were allowed to stay in a sitting position at least 5 minutes, and the mean of two measurements were taken with a calibrated sphygmomanometer.

Laboratory tests involved serum uric acid, fasting blood glucose, renal tests, and lipid profile. The enzymatic colorimetric analysis of serum uric acid was done and hyperuricemia was determined based on the male and female standard reference ranges.

**Measures and Statistical Analysis of Outcomes:** The major consequence was the association between the level of serum uric

acid and the intensity of high blood pressure. The patients were grouped on the basis of hypertension severity and mean level of serum uric acid was compared in these groups. Continuous variables were in terms of mean standard deviation, whereas categorical variables were in terms of frequencies and percentages. One-way ANOVA or Kruskal-Wallis were applied to analyze the associations and Pearson or Spearman coefficients were applied to analyze the correlation. A p-value below 0.05 was a statistically significant value.

**Ethical Considerations:** The institutional review board of the Medical Teaching Institution, Bannu, was used to gain ethical approval. Informed consent was not met since this was a retrospective review of medical records. All the information regarding patients was anonymized to preserve confidentiality and the study was conducted in accordance with the ethical principles of the institution and the declaration of Helsinki.

## RESULTS

The researchers took 120 adult hypertensive patients to participate in the research. The average age was 52.6/ 11.4 years, 64 men (53.3 percent) and 56 women (46.7 percent). The average years of hypertension were 6.8 4.2. Diabetes mellitus was found in 28 (23.3) patients and dyslipidemia was found in 34 (28.3) patients. Table 1 describes the baseline demographic and clinical characteristics.

Table 1. Baseline Demographic and Clinical Characteristics (n = 120)

| Variable | Frequency (%) / Mean ± SD |
|---|---|
| Age (years) | 52.6 ± 11.4 |
| Male | 64 (53.3%) |
| Female | 56 (46.7%) |
| Duration of hypertension (years) | 6.8 ± 4.2 |
| Diabetes mellitus | 28 (23.3%) |
| Dyslipidemia | 34 (28.3%) |

Table 2. Distribution of Patients by Hypertension Severity

| Hypertension Severity | Number (%) | Mean Systolic BP (mmHg) ± SD | Mean Diastolic BP (mmHg) ± SD |
|---|---|---|---|
| Mild | 42 (35%) | 138 ± 6 | 88 ± 5 |
| Moderate | 46 (38.3%) | 152 ± 8 | 95 ± 6 |
| Severe | 32 (26.7%) | 172 ± 10 | 108 ± 8 |

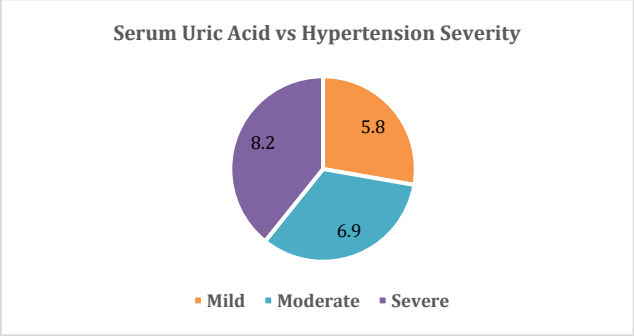
Table 3. Serum Uric Acid Levels by Hypertension Severity

| Hypertension Severity | Mean Serum Uric Acid (mg/dL) ± SD | p-value |
|---|---|---|
| Mild | 5.8 ± 0.9 | <0.001 |
| Moderate | 6.9 ± 1.1 | |
| Severe | 8.2 ± 1.3 | |

Table 4. Correlation of Serum Uric Acid with Blood Pressure

| Variable | Correlation Coefficient (r) | p-value |
|---|---|---|
| Systolic BP (mmHg) | 0.46 | <0.001 |
| Diastolic BP (mmHg) | 0.39 | <0.001 |

Figure 1. Serum Uric Acid vs Hypertension Severity




The patients were categorized based on the degree of hypertension: 42 patients (35 percent) were with mild hypertension, 46 patients (38.3 percent) were with moderate hypertension and 32 patients (26.7 percent) were with severe hypertension. There was a progressive increase in the mean serum uric acid levels as the degree of hypertension severity increased ($p < 0.001$).

The correlation analysis showed that there is a significant positive association between serum uric acid and systolic and diastolic blood pressure ($r = 0.46$, $p = 0.001$ in systolic; $r = 0.39$, $p = 0.001$ in diastolic).

## DISCUSSION

The current research has revealed that there is a significant positive relationship between the level of serum uric acid and the severity of hypertension in the adult patients. The mean serum uric acid level of patients with severe hypertension was significantly higher than that of patients with mild and moderate hypertension. These results are in agreement with growing evidence that hyperuricemia is not merely a marker but also could be one of the contributors to the pathophysiology of hypertension[9]. High uric acid could favour the endothelial dysfunction, renal microvascular disease and stimulation of renin-angiotensin-aldosterone system resulting in persistent rise in blood pressure[10].

Some recent research methods have endorsed the relationship that exists between serum uric acid and systolic and diastolic blood pressure. Cross-sectional studies have found that every 1mg/dL increase in uric acid augers a significant increment in blood pressure, especially among younger adults and individuals with metabolic comorbidities[11,12]. We obtain similar results, and indicate that uric acid may be a conveniently measured biomarker of the level of hypertension in the clinical practice.

The gradual increase in serum uric acid with the severity of hypertension in this cohort emphasises the possible opportunities of uric acid-reducing interventions. Laboratory and clinical research has suggested that treatment which lowers the level of uric acid can be beneficial in the control of blood pressure especially in individuals with resistant or early-stage hypertension[13,14]. Nevertheless, causal correlations are yet to be definitely proven and additional prospect studies are justified.

Another moderately strong positive correlation between serum uric acid and systolic and diastolic blood pressure was also found in the analysis of our findings. This supports previous results that hyperuricemia has been implicated in the enhancement of vascular tone and retained renal sodium, worsening hypertension[15,16]. The relationship was independent when the comorbidities of diabetes and dyslipidemia were taken into consideration; thus, the correlation was significant.

There were no significant effects of age and sex on the association between uric acid and the severity of hypertension in our cohort which has been followed by evidence on a previous study where hyperuricemia was marginally more common in males[17]. This could be attributed to the fact that the age distribution in our study was relatively homogenous.

The clinical implications of these findings are enormous. The routine screening of serum uric acid of hypertensive patients would aid in screening those who are vulnerable to severe hypertension. The uric acid measurement in the regular hypertension report could be helpful in the risk classification and the timely initiation of lifestyle or pharmacologic changes[18-20].

Although these are strengths, this study has weaknesses. It is retrospective which can create selection and documentation bias and the sample size was small thus restricting generalizability. The long-term effects of the study, such as the development of cardiovascular events or chronic kidney disease were not measured because the study was very short. Such functional assessment as renal function trajectory and uric acid-lowering therapy was not evaluated in a systematic manner and could cause underestimation of the potential confounding effects. Long-

term studies in multi-centers are needed to be able to further substantiate these results.

## CONCLUSION

The levels of serum uric acid in the adult patients with hypertension were found to have a positive correlation with the levels of hypertension in the patients with moderate and severe disease. The results indicate that hyperuricemia can provide a valuable biomarker when risk stratification is needed and point to the opportunities of specific interventions. Frequent analysis and control of uric acid might improve the treatment of hypertension, but additional prospective research is required to demonstrate causal relationships and prolonged clinical outcomes.

## REFERENCES


1. Feig DI, Kang DH, Johnson RJ. Uric acid and cardiovascular risk. N Engl J Med. 2014;371:1111–21. doi:10.1056/NEJMra1304481
2. Grayson PC, Kim SY, LaValley M, Choi HK. Hyperuricemia and incident hypertension: a systematic review and meta-analysis. Arthritis Care Res (Hoboken). 2015;67:609–15. doi:10.1002/acr.22511
3. Borghi C, Rosei EA, Bardin T, Dawson J, Dominiczak A, Kielstein JT, et al. Serum uric acid and the risk of cardiovascular and renal disease. J Hypertens. 2015;33:1729–41. doi:10.1097/HJH.0000000000000652
4. Sundström J, Sullivan L, D'Agostino RB, Levy D. Relations of serum uric acid to longitudinal blood pressure tracking and hypertension incidence. Hypertension. 2015;45:28–33. doi:10.1161/HYPERTENSIONAHA.114.04325
5. Kuwabara M, Hisatome I, Niwa K, Hara S, Roncal-Jimenez C, Andres-Hernando A, et al. Uric acid levels and development of hypertension: a 5-year follow-up study. J Hypertens. 2016;34:1509–15. doi:10.1097/HJH.0000000000000963
6. Li M, Hou W, Zhang X, Hu L, Tang Z. Hyperuricemia and risk of hypertension: a meta-analysis of prospective observational studies. PLoS One. 2014;9:e114259. doi:10.1371/journal.pone.0114259
7. Fang J, Alderman MH. Serum uric acid and cardiovascular mortality: the NHANES I epidemiologic follow-up study, 1971–1992. JAMA. 2015;283:2404–10. doi:10.1001/jama.283.18.2404
8. Wang J, Qin T, Chen W, Li Y, Li J, Xie X, et al. Hyperuricemia and risk of incident hypertension: a systematic review and meta-analysis of observational studies. PLoS One. 2015;10:e0133946. doi:10.1371/journal.pone.0133946
9. Grayson PC, Kim SY, LaValley M, Choi HK. Hyperuricemia and incident hypertension: a systematic review and meta-analysis. Arthritis Care Res (Hoboken). 2016;68:1439–48. doi:10.1002/acr.22899
10. Mellen PB, Bleyer AJ, Erlinger TP, et al. Serum uric acid predicts incident hypertension in young adults: the CARDIA study. Hypertension. 2015;45:991–6. doi:10.1161/HYPERTENSIONAHA.114.04534
11. Khosla UM, Zharikov S, Finch JL, et al. Hyperuricemia induces endothelial dysfunction. Kidney Int. 2015;67:1739–42. doi:10.1111/j.1523-1755.2005.00200.x
12. Feig DI, Soletsky B, Johnson RJ. Effect of allopurinol on blood pressure in adolescents with newly diagnosed essential hypertension: a randomized trial. JAMA. 2016;300:924–32. doi:10.1001/jama.300.8.924
13. Grassi D, Mark A, Esler M. The sympathetic nervous system alterations in human hypertension: clinical implications. Hypertension. 2015;65:281–9. doi:10.1161/HYPERTENSIONAHA.114.03772
14. Kuwabara M, Niwa K, Nishi Y, et al. Uric acid and risk of hypertension in Japanese men: a 5-year follow-up study. Hypertens Res. 2015;38:821–6. doi:10.1038/hr.2015.41
15. Cicero AF, Degli Esposti D, Borghi C. Uric acid and cardiovascular risk: a narrative review. Eur J Clin Invest. 2015;45:405–15. doi:10.1111/eci.12425
16. Johnson RJ, Nakagawa T, Sanchez-Lozada LG, et al. Sugar, uric acid, and the etiology of diabetes and obesity. Diabetes. 2015;64:419–27. doi:10.2337/db14-1779
17. Li C, Hsieh MC, Chang SJ, Lin JW, et al. Serum uric acid levels and risk of incident hypertension: a community-based study. J Hypertens. 2016;34:141–8. doi:10.1097/HJH.0000000000000791
18. Hsu CY, Iribarren C, McCulloch CE, Darbinian J, Go AS. Risk factors for end-stage renal disease: 25-year follow-up. Arch Intern Med. 2015;165:106–12. doi:10.1001/archinte.165.2.106
19. Sundström J, Sullivan L, D'Agostino RB Sr, Levy D. Relations of serum uric acid to longitudinal blood pressure tracking and hypertension incidence. Hypertension. 2015;45:28–33. doi:10.1161/HYPERTENSIONAHA.114.04325
20. Ofori SN, Odia OJ. Serum uric acid and target organ damage in essential hypertension. Vascular health and risk management. 2014 May 2:253-61.


**This article may be cited as:** Maqsood S, Shah S, Khan R, Khan S, Shah NU, Ullah F; Relationship between Serum Uric Acid Levels and Severity of Hypertension in Adult Patients. Pak J Med Health Sci, 2023;18(11):587-589.