



COMPARISON OF URIC ACID LEVELS AMONG NORMOTENSIVE AND HYPERTENSIVE SUBJECTS

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Abstract

Background

Hyperuricemia has been implicated in hypertension and cardiovascular disease, but comparative data remain debated.

Objective: To compare serum uric acid levels between normotensive and hypertensive subjects and evaluates associated symptom distributions and gender differences.

Methods: A cross-sectional study of 80 subjects was conducted. This study was conducted at University of Lahore, Lahore. Subjects were classified as hypertensive if systolic blood pressure measured ≥ 140 mmHg or diastolic blood pressure measured ≥ 90 mmHg. Serum uric acid levels between two groups were compared using student *t*-test. Symptom prevalence and gender differences were analyzed using chi-square and subgroup comparisons.

Results: Of 80 subjects, 41 were hypertensive and 39 normotensive subjects. Mean uric acid was significantly higher in hypertensive subjects (6.3 ± 0.23 mg/dL) compared to normotensive subjects (4.9 ± 0.18 mg/dL, $p < 0.05$). Joint pain ($p = 0.03$), polyuria ($p = 0.04$), and general weakness ($p = 0.05$) were more prevalent in hypertensive individuals. Hypertensive males showed significantly higher uric acid levels (6.6 ± 0.28 mg/dL) compared to hypertensive females (6.0 ± 0.30 mg/dL, $p = 0.04$).

Conclusion: Raised uric acid levels are significantly linked with high blood pressure and symptom burden.

Key Words: Hypertension, Uric acid, Hyperuricemia, Normotension, Polyuria

Introduction

Hypertension is a leading health problem and is affecting more than one billion people globally.¹ Hypertension is multifactorial disease. Major factors implicated in the pathogenesis include genetic predisposition, lifestyle, and metabolic factors.² Uric acid has been regarded as a promising biomarker and contributor to underlying hypertension pathology.³

Hyperuricemia is associated with endothelial dysfunction, oxidative stress, and reno-vascular damage.^{4,5} Studies have constantly demonstrated this association. Uric Acid is reported to be significantly higher among hypertensive adolescents than normotensive subjects.⁶ In animal models, elevated uric acid directly revealed increase in arterial pressure.⁷ Meta-analysis revealed that those with elevated uric acid are at higher risk of developing high blood pressure.⁸

Higher prevalence of hypertension is also a major health issue in Pakistan. An estimated prevalence of hypertension in Pakistan is between 18–33% in adults. Hypertension is contributing significantly to cardiovascular diseases.⁹ The hyperuricemia is also common in Pakistan. There is growing evidence that it is linked to hypertension and cardiovascular disease in Pakistan, though comparative evidence remains inconsistent across populations.¹⁰ The dietary patterns in Pakistan are rich in purine-containing foods and there is poor awareness of hypertension that might accelerate hyperuricemia in local population.¹¹

In view of high prevalence of hypertension and hyperuricemia in Pakistan, it is crucial to investigate this observation. Therefore, this study is planned to compare uric acid levels between normotensive and hypertensive subjects and assess symptom distribution in the study population.

Materials and Methods

This study was a cross-sectional study conducted at Institute of Molecular Biology and Biotechnology (IMBB) at University of Lahore, Lahore. It comprised of 80 subjects between the ages of 18 and 63 years. Hypertension was defined according to standard criteria, with systolic blood pressure (SBP) ≥ 140 mmHg or diastolic blood pressure (DBP) ≥ 90 mmHg. Data collected comprised of demographic variables (age and sex), blood pressure, serum uric acid, and symptom profiles including joint pain, burning feet, polyuria, and general weakness.

Blood pressure was measured by using mercury sphygmomanometer. Each subject was made to sit on a chair in a comfortable position. The mean of three readings taken at five-minute interval was used for final analysis.¹⁰ The serum uric acid was measured by using Human Diagnostics (Lot No. 25002)

Statistical Analysis: Data was analysed by using SPSS version 26.0. Data is described as mean $\pm$ SEM or frequency and percentages where applicable. Student t test was used to compare between two groups. For statistical evaluation, serum uric acid levels were compared between normotensive and hypertensive groups using the Mann–Whitney U test. Categorical variables such as symptom prevalence were analysed using chi-square. Subgroup analyses were performed to assess gender-specific differences in uric acid levels. Statistical significance was set at $p < 0.05$.

Results

A total number of eighty (80) subjects participated in the study. Of them, 41 subjects were hypertensive and 39 normotensive (Table 1). The mean age was 38.6 ± 10.2 years, with a male predominance (62%).

Serum uric acid levels were significantly higher in hypertensive subjects compared with normotensive controls. As shown in Table 2, the mean uric acid in hypertensive subjects was 6.3 ± 0.23 mg/dL, whereas normotensive subjects had a mean uric acid value of 4.9 ± 0.18 mg/dL. The difference was statistically significant ($p < 0.05$). Symptom prevalence differed between the two groups. As shown in Table 3, joint pain was reported in 22 hypertensive subjects compared to 14 normotensive subjects ($p = 0.03$). Polyuria was present in 13 hypertensive subjects compared to 9 normotensive subjects ($p = 0.04$). General weakness was more frequent in hypertensive subjects ($p = 0.05$). Burning feet did not differ significantly between the two groups ($p = 0.21$).

The relative distribution of symptoms across blood pressure categories is depicted in Figure 1, highlighting the higher burden of musculoskeletal and metabolic complaints among hypertensive individuals. Gender-specific analysis showed that hypertensive males had the highest uric acid levels (mean 6.6 ± 0.28 mg/dL), compared to hypertensive females (6.0 ± 0.30 mg/dL, $p=0.04$). In contrast, normotensive males (4.7 ± 0.17 mg/dL) and normotensive females (4.9 ± 0.30 mg/dL) showed no significant difference ($p=0.42$). These differences are summarized in Table 4 and Figure 2.

Table 1: Distribution of Subjects by Blood Pressure Status

BP Status	Count
Normotensive	39
Hypertensive	41

Table 2: Comparison of Uric Acid Levels among Normotensive and Hypertensive Subjects

Groups	Uric Acid Mean $\pm$ SEM (mg/dL)	p-value
Normotensive (39)	4.9 ± 0.18	<0.05
Hypertensive (41)	6.3 ± 0.23	

Table 3: Comparison of symptom distribution among two Group

Symptom	Normotensive (n)	Hypertensive (n)	p-value
Joint Pain	14	22	0.03
Burning Feet	6	8	0.21
Polyuria	9	13	0.04
General Weakness	15	20	0.05

Table 4: Gender-wise comparison of uric acid levels within groups

BP Group	Sex	Count	Uric Acid (Mean $\pm$ SEM)	p-value
Normotensive	Male	28	4.7 ± 0.17	0.42
Normotensive	Female	11	4.9 ± 0.30	
Hypertensive	Male	25	6.6 ± 0.28	0.04
Hypertensive	Female	16	6.0 ± 0.30	

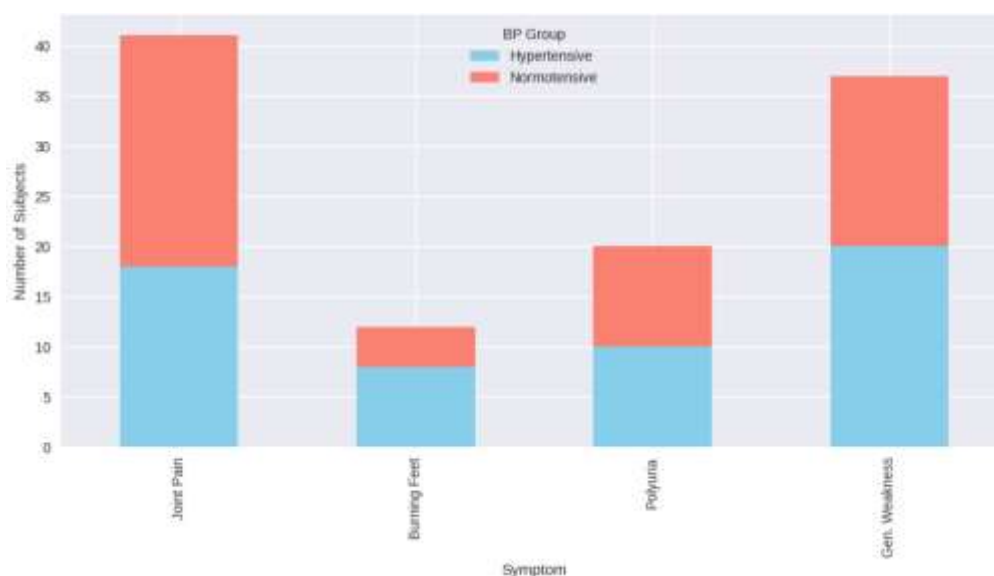


Figure 1: Distribution of symptoms (joint pain, burning feet, polyuria, and general weakness) across blood pressure groups.

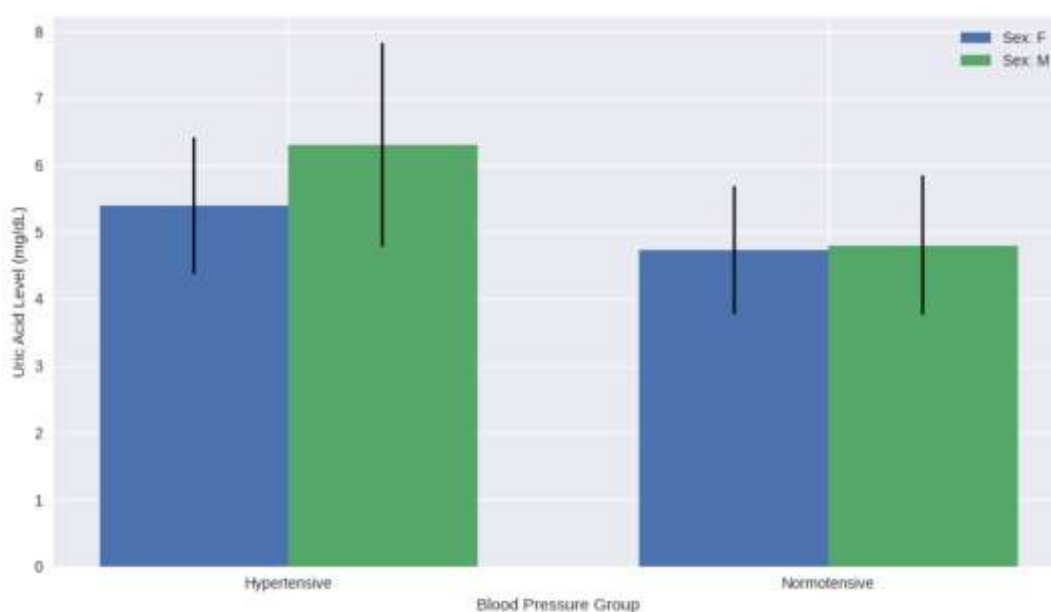


Figure 2: Gender-Stratified difference of uric acid within normotensive and hypertensive groups.

Discussion

Several mechanisms link uric acid to the pathogenesis of hypertension. Elevated serum uric reduces nitric oxide bioavailability and thus, impairs endothelial function. These changes affect vasodilation and promote arterial stiffness. Hyperuricemia also induces oxidative stress, and enhances the production of reactive oxygen species. These changes further damage the vascular function and accelerate atherosclerosis.¹² In addition, high uric levels promote inflammation, vascular remodelling and renal injury, which affect renal blood flow and sodium reabsorption. Animal studies suggested that hyperuricemia might activate the renin–angiotensin system and increases blood pressure. It is demonstrated that lowering uric acid reduced blood pressure in animal models. Some observations negated this.¹³⁻¹⁵

The current investigation demonstrated hyperuricemia in hypertensive subjects compared to normotensive subjects. Hypertensive individuals had a mean uric acid of 6.3 ± 0.23 mg/dL compared to 4.9 ± 0.18 mg/dL in normotensive subjects ($p < 0.05$). In addition, hypertensive subjects showed a greater frequency of polyuria, joint pain, and generalized weakness. Burning feet did not vary between two groups.

The findings of the present investigation are similar to the results demonstrated by Feig et al. This study documented higher uric acid levels in hypertensive subjects compared to normotensive individuals.⁶ This is further supported by Mazzali et al. in animal models that higher uric acid directly increases blood pressure.⁷ Meta-analysis also established that subjects with high uric acid levels have high risk of developing hypertension.⁸

Gender based differences are found between hypertensive males and females. Hypertensive males showed significantly higher uric acid levels than females in present study. This observation is comparable to findings of Perticone et al. that found more incidence of cardiovascular events in men with hyperuricemia and hypertension.¹⁶ Salim et al also documented Gender specific association between uric acid and hypertension risk.¹⁷ This is further supported by Redon et al. who reported gender differences in uric acid among patients receiving antihypertensive therapy.¹⁸

The present study also demonstrated that the observed symptoms like joint pain, polyuria, and generalized weakness may reflect systemic effects of hyperuricemia in hypertensive subjects. Different reviews and meta-analyses have supported these findings but other investigators have emphasized the need for longitudinal studies. Clinical trials of lowering uric acid also revealed mixed picture.¹⁹⁻²¹

Conclusion

Elevated uric acid levels are significantly associated with hypertension and symptom burden, particularly among males. The results of present study emphasize the need for routine uric acid measurement in hypertensive patients and implementation of dietary guidelines in hypertensive patients.

Study Limitations: These include small sample size and lack of inclusion of confounders like diet and renal functions.

Strength of the Study: The study provides a direct comparative analysis between normotensive and hypertensive groups using standardized measurements and appropriate statistical methods, enhancing the validity of its findings. Additionally, inclusion of symptom profiling and gender-based subgroup analysis offers a more comprehensive understanding of the clinical and demographic associations of hyperuricemia with hypertension.

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Informed Consent: It was attained from all the participants.

Data availability statement: All the data is incorporated in the manuscript.

Conflict of interest: The authors declare no conflict of interest.

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