

## Original Research Article

## Relationship between Serum Uric Acid Levels and Blood Pressure Levels in Patients Coming to Tertiary Care Teaching Hospital: A Cross Sectional Study

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**Abstract: Background:** Many studies have shown that high circulating uric acid (UA) levels lead to both hypertension and cardiovascular complications, leading to poor patient prognosis. People with metabolic syndrome (MetS), which is closely linked to hypertension, also tend to have high SUA levels. SUA levels elevate due to metS and hypertension share common pathophysiological features, so it has been difficult to confirm their involvement in the pathogenesis of hypertension. Therefore, the aim of this present study is to find out the association between the uric acid and blood pressure levels in both male and female patients of different age groups. **Methods:** It was 18 months, single-centered, cross-sectional study, conducted in the department of General Medicine, at National institute of medical sciences and research hospital. Blood samples were collected from 140 participants of both genders attending the department of Medicine with hypertensive and pre-hypertensive stages to analyze serum uric acid (SUA) level and lipid profile. The potential relationship between SUA and BP was assessed by descriptive statistics for analyzing quartiles and odd ratio. **Results:** Among 140 hypertensive patients, 66 of them were in the 61-80 age groups. Twenty percent of patients were under the age of 20 and one percent was over 87 years of age. 40 patients with pre-hypertension, 28 (70%) of patients having elevated SUA level, while 100 of patients with hypertension, 59(59%) of having elevated SUA level. It had also been found that the diagnosis duration of hypertension and hyperuricemia was causing the elevation of SUA levels in the patients. **Conclusion:** The present study indicates a direct relationship between SUA levels and hypertension. SUA levels were quite a bit higher in patients with hypertension in contrast to those with pre-hypertension, suggesting the severity of hypertension related to SUA levels.

**Keywords:** Hypertension, Hyperuricemia, Serum Uric Acid, Metabolic Syndrome.

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### INTRODUCTION

In spite of immense health improvements since 1950, cardiovascular diseases remain the third leading cause of death worldwide. Despite the epidemic of cardiovascular disease, hypertension in adults is the most common cause of morbidity and mortality in India [1]. Previous studies have shown that high circulating uric acid (UA) levels lead to both hypertension and cardiovascular complications, leading to poor patient prognosis. According to Sir Alfred Garrod, hyperuricemia (a serum uric acid level of more than 7mg/dl in boys, and more than 6mg/dl in girls) preceded gout, an inflammation of the joints. Joint inflammation and pain are caused by the deposition of monosodium urate crystals within joint spaces in the case of gout [2].

Following this, in 1874 AD, Frederick Mohamed postulated that "People with high blood pressure are born into gouty families", indicating that hyperuricemia may have an association with high blood pressure [3]. Many studies were conducted at the end of the 19th century additionally; uric acid has also been linked to cardiovascular morbidity. The lack of a mechanism is explaining the association between hypertension and elevated serum uric acid (SUA) [4]. People with metabolic syndrome (MetS), which is closely linked to hypertension, also tend to have high SUA levels. SUA levels elevate due to metS and hypertension share common pathophysiological features, so it has been difficult to confirm their involvement in the pathogenesis of hypertension [5, 6]. The efficacy of SUA-lowering agents like probenecid and allopurinol

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has been studied on a small scale have been shown to reduce the blood pressure of adolescents, suggesting SUA may be a risk factor for hypertension in adolescents [7]. Therefore, as the need of the hour, our study aimed to find out the association between the uric acid and blood pressure levels in patients coming to our tertiary care teaching hospital.

## OBJECTIVES

1. To find out the relationship between blood pressure levels and serum uric acid levels in different age groups.
2. To find out the occurrence of hyperuricemia in patients with different blood pressure levels.
3. To find out the relationship between blood pressure and serum uric acid levels in different gender.

## METHODOLOGY

### Study Design and Participants

18 months (January 2020 to June 2021), single-centered cross-sectional study was conducted in the department of Medicine at the National Institute of Medical Sciences and Research Hospital, Jaipur, Rajasthan. The study consisted of 140 participants of both genders attending the department of Medicine with hypertensive and pre-hypertensive stages during the above mentioned study period. The study protocol was approved by the Institutional Review Board in accordance with the declaration of Helsinki. All the participants met inclusion criteria were informed about the study in detail before obtaining informed consent. Patients aged  $\geq 18$  years were included in the study if they did not meet any of the exclusion criteria. Participants having co-morbid conditions like CKD, gout, immunosuppression, patients on drugs causing hyperuricemia, anti-hyperuricemic drugs intake, pregnant women, lactating mothers, individuals taking high protein diet (athletes), and most importantly unwilling patients have been excluded from the study.

### Collection of Demographic Details and Clinical Data

A well-designed paper based case report form (CRF) was designed for optimal data collection in accordance with the study protocol compliance. The CRF consisted of demographic details, physical and systemic examination, and investigations as well. We collected the demographic details of patients including age, sex, residence, and occupation/social status. The clinical data contained chief complaints with duration, concomitant disease and medication, family history. We monitored the vitals (BP, PR, RR, and Temperature) and examined the patients both physically and systemically. Physical and systemic examination included pallor, icterus, cyanosis, clubbing, pedal edema, lymphadenopathy, CVS, CNS, P/A, and RS respectively.

### Anthropometric Measurements

Participants were weighed and measured for height to calculate body mass index (BMI=body weight in kg/height in meter square). We also calculated the waist-hip ratio of the patients as a screening test. For this, we used a fiberglass tape to measure waist circumference and hip. Waist circumference measured by wrapping the tape around the belly button and the hip measurement was taken the distance around the largest part of hips.

### Laboratory Investigations

Fasting blood samples (5mL) were taken from the participants under aseptic precautions and allow them to clot and centrifuged at 3000 rpm for 15 minutes for serum separation. We did serum uric acid (SUA), renal function test, liver function test that measured separately by colorimetric methods according to the manufacturer's protocols (Human Diagnostic, Germany) with a biochemistry analyzer (Humalyzer 3000, USA).

### Diagnostic Criteria

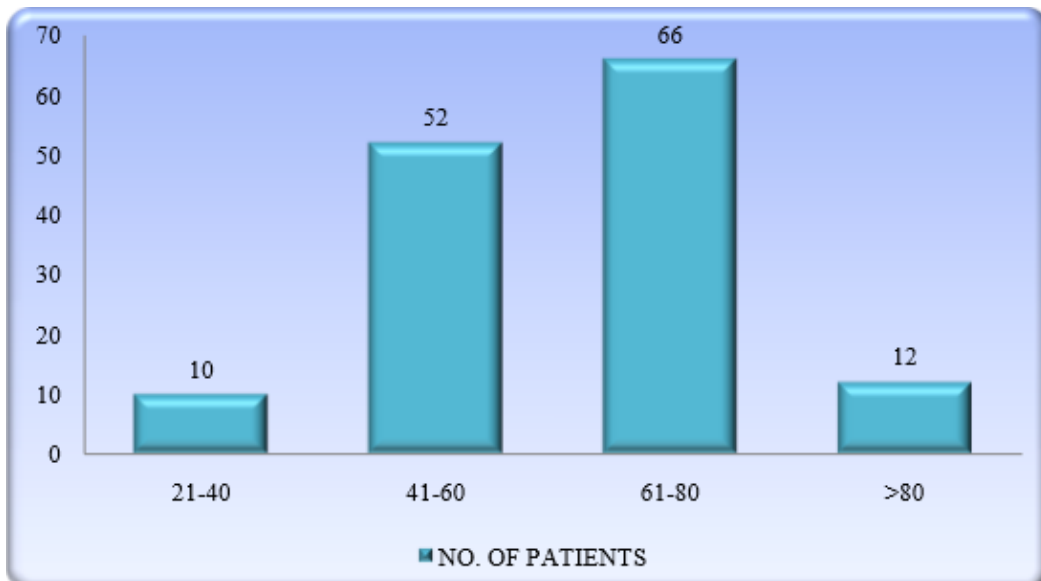
We defined the normal upper limit of serum uric acid is 6.8 mg/dL. Over 7mg/dL is considered to be saturated and the symptoms of hyperuricemia can occur [8]. Generally, hyperuricemia in adult males is defined as the blood uric acid concentration greater than 7 mg/dL and 6 mg/dL in females [9, 10]. These cut off values are generally used in the clinical laboratories and have been proposed in previous studies to find out the relation between metabolic syndrome and cardiovascular disease outcomes to define hyperuricemia.

## STATISTICAL ANALYSIS

All the collected data will be entered into a MS Excel 2007 worksheet in the form of a master chart. The data will be classified and analyzed by using SPSS V25.0 (© SPSS Inc. Chicago, USA) based on the study's objectives and aims. The potential relationship between SUA and BP was assessed by descriptive statistics and association between hypertension and hyperuricemia was tested by analyzing quartiles and odds ratio. Statistical significance will be determined using appropriate tests of significance.

## RESULTS

One hundred and forty cases of hypertension were studied, and 66 of them were in the 61-80 age group. Twenty percent of patients were under the age of 20 and one percent was over 87 years of age. Age distribution of the study participants was shown in Figure no. 1. It is evident from the bar diagram that hypertension is more prevalent in the 4th-7th decade.

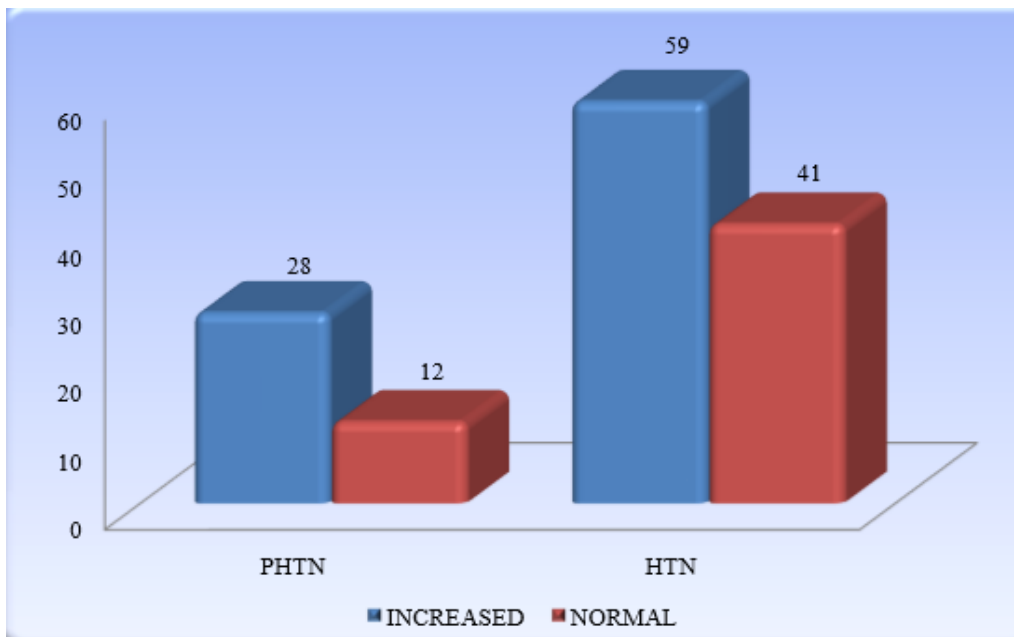


**Fig-1: Graphical representation of the age distribution of the study group**

**Association between Serum Uric Acid and Stages of HTN**

In this study 40 number of patient are in prehypertension out of which 28 number (70%) of

patients having elevated SUA level, while 100 of patients are in Hypertension out of which 59(59%) number of having elevated SUA level, which is graphically represented in Figure no. 2.

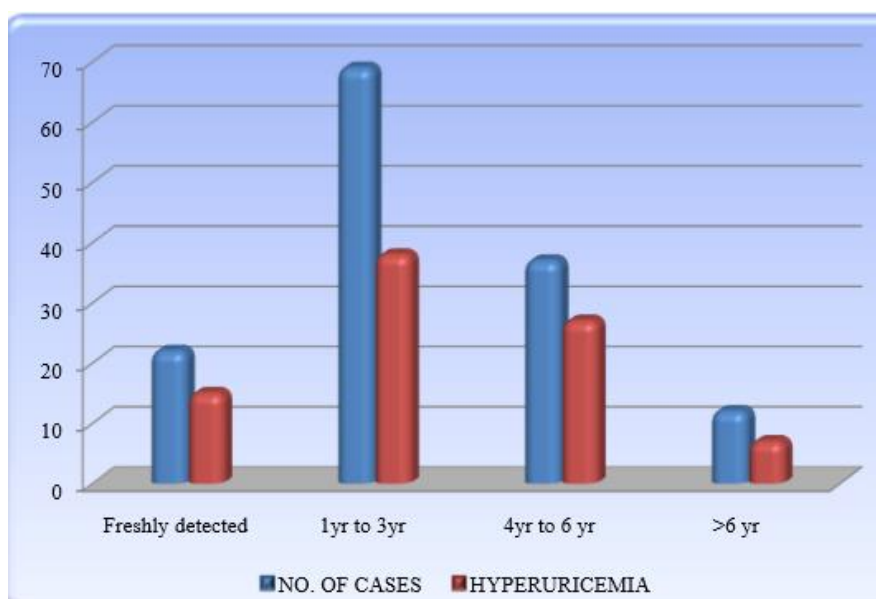


**Fig-2: Graphical representation of Serum uric acid based on type of HTN**

**Association between Serum Uric Acid Level and Duration of Hyperuricemia in Both Genders**

Among both sexes out of 22 freshly detected hypertensive patients, 15 patients had hyperuricemia, in 1 to 3years duration of hypertensive patients out of 69 patients 38 patients had hyperuricemia, in 4 to 6 years

duration of hypertensive patients out of 37 patients 27 patients had hyperuricemia and more than 6years duration of hypertension out of 12 patients 7 patients had hyperuricemia. So as the duration of hypertension in population increases, the number of patients with hyperuricemia also increases that shown in Figure no. 3.



**Fig-3: Graphical Representation of SUA Level and Duration of Hyperuricemia in Both Genders Combined**

## DISCUSSION

Result of this study suggests an apparent connection between increased SUA concentrations and hypertension among an adult group. After adjusting for age, gender, BMI, and lipid levels, the relationship remained. It was found that high rates of pre-hypertension as well as hypertension were observed in both sexes with increased SUA for both groups. Until now, no research has been done to assess the connectivity between SUA and hypertension in Bangladeshi adults [1].

There have been studies that demonstrate a link between hyperuricemia and hypertension in the adults [11-14]. Among Japanese adults, it had been found that hypertension rose by 1.20 mg/dL with every 1 mg/dL rise in SUA adjusting for multiple confounding factors, odds ratios for the top quartile were 1.58 (1.44–1.75) in men and 1.60 (1.39–1.84) in women, in comparison to the lower SUA quartile [15]. An observational study from the United States found that high levels of SUA increased the risk of pre-hypertension, with an odds ratio for the highest quartile of SUA (more than 356.9  $\mu\text{mol/L}$ ) with the lowest quartile (less than 237.9  $\mu\text{mol/L}$ ) was 1.96 (1.38–2.79) [16]. According to a large study of individuals without hypertension, the Multidimensional relative risk is 1.65 (1.41-1.93) relative to quartile 1 of SUA ( $\approx 390 \text{ mol/L}$ ), the lowest quartile ( $\approx 260 \text{ mol/L}$ ) [17]. As reported in the Framingham Heart Study, which studied participants over a four-year period, found that raising SUA by a standard deviation correlated with an odds ratio of 1.17 (1.02 to 1.33) predicting hypertension, with an odds ratio of 1.11 (1.01 to 1.23) predicting hypertension [18].

As we found, most recently, a relationship was found in serum uric acid concentration and elevated blood pressure among adults of China [19-21] and Japan [22, 23]. According to our study, we found a greater association between SUA concentration and a hypertension-related condition among women. The results of a systematic review indicate that women who have elevated levels of uric acid have a greater tendency to be hypertensive than men [24]. Although data suggested that gender differences were correlated with elevated SUA concentrations in men [25], further research on sex hormone effects could lead to a better understanding of the underlying causes of sexual differences. A comprehensive approach to prevent the side effects of elevated SUA is to address sex differences as well [20]. After overall adjusting for age, SUA exhibited a strong relationship with SBP and DBP. A link between SUA and blood pressure was found in Korean adults aged <60 years and Chinese adults among 41 to 50 years [26]. Researchers have yet to identify the exact mechanism by which SUA increases blood pressure with age. The age-relatedness of this relationship can be explained by ethnic differences, body mass index, certain single nucleotide polymorphisms, or oxidative stress should be investigated further [19]. A comprehensive mechanism by which SUA reduces hypertension has yet to be identified. Several hypotheses have been proposed to describe the relationship between SUA and hypertension. Mechanisms can be used in the accumulation of uric acid inside blood vessels. This also enhances the renin-angiotensin system, represses the release of carbon monoxide, promotes inflammation, and vasoconstriction develops later, leading to hyperplasia and hypertension [27, 28]. Furthermore, oxidative stress and endothelial dysfunction related to high SUA concentration have been associated with high blood pressure [29].

However, there were some limitations in our study. As this study used a cross-sectional design, cause-effect relationships between SUA concentrations and hypertension cannot be assumed properly. The sample size of our study was very small to get the findings in large scale. Individuals were not provided with information on hypertension in the family or on physical activity, which may influence blood pressure levels. In addition, all participants appeared to be healthy; whether this is true for other ethnicities to be investigated further. Nevertheless, the findings of this study provide valuable information for further research to determine the correlation between SUA and high blood pressure.

## CONCLUSION

We concluded that hypertension and high SUA levels have a direct relationship based on the results of the study. The study also demonstrated that SUA levels were quite a bit higher in patients with hypertension in contrast to those with pre-hypertension, suggesting the severity of hypertension related to SUA levels. According to the study, the timeframe of hypertension influenced SUA levels significantly, as individuals with longer histories of hypertension had higher levels of SUA than the individuals with shorter histories.

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