



ORIGINAL ARTICLE

## Serum uric acid level in patients with diabetes and prediabetes Experience at a tertiary care hospital.

Ume Farwa<sup>1</sup>, Syeda Sabahat Haider<sup>2</sup>, Mehvish Sana<sup>3</sup>

**Article Citation:** Farwa U, Haider SS, Sana M. Serum uric acid level in patients with diabetes and prediabetes Experience at a tertiary care hospital. Professional Med J 2023; 30(08):1026-1030. <https://doi.org/10.29309/TPMJ/2023.30.08.7600>

**ABSTRACT... Objective:** To determine the serum uric acid levels in diabetic, pre-diabetic and euglycemic study subjects. **Study Design:** Cross Sectional. **Setting:** Department of Pathology Sheikh Zayed Medical College /Hospital Rahim Yar Khan. **Period:** 1<sup>st</sup> December 2022 to 31<sup>st</sup> May 2023. **Material & Methods:** 144 patients of both genders with age 20 -70 year were included. Data was collected from the patients who came to lab for their HbA1C test. The blood samples for HbA1C and serum uric acid was collected in EDTA and gel tube respectively. HbA1C and serum uric acid was performed on Atellica CH930 fully automated chemistry analyzer based on photometry. The patients were grouped based on HbA1C as euglycemic group (HbA1C 4%-5.6%), pre-diabetic group (HbA1C 5.7%-6.4%) and diabetics group (HbA1C >6.5%) as per American Diabetes Association (ADA) criteria. Data was entered and analyzed using SPSS 22 version. ANOVA was applied to access the significance of difference of serum uric acid between euglycemic, prediabetic and diabetic groups. P-value <0.05 was taken as statistically significant. **Results:** The mean serum uric acid level in euglycemics, prediabetics and diabetics was  $5.59 \pm 1.16$ ,  $6.07 \pm 1.04$  and  $5.01 \pm 1.61$  respectively and the difference of serum uric acid between these 3 groups was statistically significant with p value 0.001. **Conclusion:** Serum uric acid was higher in prediabetics as compared to diabetics and euglycemics. Serum uric acid level should be done in prediabetic patients for prompt diagnosis of hyperuricemia and to avoid its related complications.

**Key words:** Diabetes, Hyperuricemia, Prediabetes, Serum Uric Acid.

### INTRODUCTION

Diabetes mellitus is a complex metabolic disorder characterized by chronic hyperglycemia. Poor glycemic control along with metabolic abnormalities in diabetes may leads to macro and microvascular complications effecting multiple systems like cardiovascular, renal and neurological.<sup>1</sup> Uric acid is the metabolic end product of purine bases, normally excreted through kidneys. At normal concentration Uric acid acts as a potent antioxidant and reducing agent. The normal range of serum uric acid in plasma is 1.5-6 mg /dl in females' and. 2.5-8 mg in males. Hyperuricemia is a common condition estimated to occur in about 8.9 to 24.4 % of population.<sup>2</sup> Raised serum uric acid in diabetes leads to oxidative stress which activates Renin angiotensin system causing different pathological

changes like inflammation, vascular dysfunction, high intraglomerular pressure. These pathological changes may lead to cardiovascular and renal complications.<sup>3</sup> Previous studies highlighted the close relationship of hyperuricemia with multiple health conditions such as obesity, metabolic syndrome, insulin resistance, diabetes mellitus, essential hypertension, cardiovascular disease and renal disease.<sup>4</sup> Increased level of serum uric acid has a toxic effect which causes precipitation of uric acid crystals in the tissues and joints ultimately leading to complications such as gout, nephrolithiasis and chronic nephropathy.<sup>5</sup>

The association between diabetes mellitus and serum uric acid is controversial. Previous clinical trials have found a positive relationship between diabetes and serum uric acid, while some studies

1. MBBS, MCPS (Clinical Pathology), SWMO Pathology, Sheikh Zayed Medical College, Rahimyar Khan.  
2. MBBS, FCPS (Chemical Pathology, Associate Professor Pathology, Sheikh Zayed Medical College Rahimyar Khan.  
3. MBBS, FCPS (Chemical Pathology), Assistant Professor Pathology, Victoria Hospital, Bahawalpur.

**Correspondence Address:**  
Dr. Syeda Sabahat Haider  
Department of Pathology,  
Sheikh Zayed Medical College Rahimyar  
Khan.  
sabahatariq@gmail.com

**Article received on:** 14/04/2023  
**Accepted for publication:** 17/06/2023

have reported no association of uric acid with diabetes or inverse association was present. A meta-analysis found a positive association of serum uric acid with diabetes. Hyperuricemic patients have more tendencies for development of diabetes mellitus type 2. i.<sup>6</sup> Hyperuricemia is believed to interfere with glucose homeostasis and insulin sensitivity leading to diabetes mellitus.<sup>6</sup> Elevated Serum uric acid levels in diabetes causes metabolic syndrome, hypertension and cardiovascular disease.<sup>7,8</sup> Cortese et al<sup>7</sup> have reported a powerful association between serum uric acid and cardiovascular diseases, he reported the elevated serum uric acid causes hypertension, atherosclerotic cardiovascular diseases, atrial fibrillation and heart failure through different pathologic processes. De Pergola et al<sup>9</sup> demonstrated that hyperuricemia may predict the risk of metabolic syndrome.

The objective of this study is to determine the serum uric acid level in prediabetics and diabetics so as to guide clinicians about importance of serum uric acid level in these patients in order to avoid hyperuricemia and its related complications.

## MATERIAL & METHODS

A cross sectional study was carried out in Chemical section department of pathology, Sheikh Zayed Medical college/Hospital Rahim Yar Khan from 1st December 2022 to 31st may 2023 after approval from Ethical Review committee (674/IRB/SZMC/SZH).

After informed consent 144 study subjects of both genders aged 20 to-70 years were included using consecutive sampling technique. Patients with renal, liver and cardiovascular disease were excluded on the basis of history. Pregnant and lactating females and patients taking

antihyperuricemic drugs were also excluded. Data was collected from patients who came to lab for their HbA1C test. Samples for serum uric acid and HbA1C were collected in gel tube and EDTA tube respectively. Serum uric acid and HbA1C were performed on Atellica CH 930 fully automated clinical chemistry analyzer. Based on the HbA1C results patients were categorized as euglycemic (HbA1C 4%-5.6%) prediabetic (HbA1C 5.7%-6.4%) and diabetic (HbA1C > 6.5%) according to criteria of American Diabetic Association. Demographic characteristics and test results were documented on a predesigned performa. Data was entered and analyzed on SPSS 22 version. Qualitative data was given in frequency and percentage while mean and SD was calculated for quantitative data. ANOVA was applied to assess significance of difference of serum uric acid between euglycemic, prediabetic and diabetic groups. A significant p value was taken as < 0.05.

## RESULTS

Among 144 patients 68(47.2%) were females while 76(52.7%) were males. Mean age of the participants was  $50.69 \pm 12.5\%$  years. Mean HbA1c and serum uric acid were  $7.65 \pm 2.41\%$  and  $5.72 \pm 1.35$  mg/dl respectively. The mean uric acid of the male and female patients was 5.193mg/dl and 4.98mg/dl respectively. The age and gender distribution of mean uric acid level and HbA1c is shown in Table-I. Glycemic status of participants showed that Serum uric acid was higher in prediabetics as compared to diabetics and euglycemics and difference of serum uric acid between these 3 groups was statistically significant with p value 0.001 as shown in Table (II).

Variable	Subgroups	Frequency (%)	Serum Uric Acid (mg/dl)	HbA1c (%)
Age (Years)	20-50	79(54.86%)	4.959±1.357	7.600±2.576
	>50	65(45.13%)	5.262±1.509	7.702±2.223
Gender	Male	76(52.77%)	5.193±1.583	7.529±2.400
	Female	68(47.22%)	4.987±1.241	7.776±2.443

Table-I. Distribution of mean serum uric acid level and HbA1C in study subjects with respect to age and gender

Glycemic Status	Frequency	%	Serum Uric acid (mg/dl)	P-Value
Euglycemic	35	24.3%	5.59±1.16	0.001
Prediabetic	35	24.3%	6.07±1.04	
Diabetic	74	51.4%	5.01±1.61	

**Table-II. Significance of difference of mean serum uric acid level in study subjects with respect to glycemic status**  
One way ANOVA: P<0.05 is set as significant.

## DISCUSSION

We have conducted this study to determine the level of serum uric acid in diabetes, prediabetes patients and compare them with euglycemic control. We found a higher serum uric acid level in prediabetes patients as compared to diabetics and euglycemic control with a statistically significant difference of serum uric acid between these three groups ( $p=0.001$ ). Our study comprised of a total 144 patients among which 68 (47.2%) were females while 76 (52.7%) were males. The mean age of the study participants was  $50.69\pm 12.5$  years. Among 144 study subjects 79(54.8%) were between 20-50 years and had serum uric acid  $4.95 \pm 1.357$ mg/dl while 65(45.13%) were more than 50 years and had serum uric acid  $5.262\pm 1.509$  mg/dl. A study conducted on 3200 residents of North Italy by Bombelli et al.<sup>10</sup> concluded that raised serum uric acid may lead to increased chances of impaired fasting glucose (IFG), metabolic syndrome and diabetes. Shani et al. reported an increased risk of diabetes in women with serum uric acid in normal range as compared to women with low normal values of serum uric acid.<sup>11</sup> Study conducted by Chang et al. showed that older adults between 75-84 years have increased chance to develop metabolic syndrome and type 2 diabetes mellitus.<sup>12</sup>

Our study included 74(51.4%) diabetics, 35(24.3%) prediabetics and 35(24.3%) euglycemics. Mean age of diabetics, prediabetics and euglycemics was  $51.08\pm 12$  years,  $55.03\pm 9.81$  years and  $44.54\pm 14.70$  years respectively while mean Serum Uric Acid level among diabetics, prediabetics and euglycemics was  $5.01\pm 1.61$ mg/dl,  $6.07\pm 1.04$ mg/dl and  $5.59\pm 1.16$ mg/dl respectively. Study conducted by Seraj et al. reported statistically significant difference of serum uric acid among diabetics, prediabetics and euglycemics ( $p=0.010$ ) with mean serum uric acid level of  $7.50\pm 2.24$  among diabetics,  $7.25\pm 2.15$  among prediabetics and

$6.44\pm 2.06$ mg/dl in euglycemics.<sup>13</sup> In this study a higher level of serum uric acid in diabetics was observed, while in our study higher level of uric acid was observed in prediabetics. Study conducted by Alqahtani et al. showed 53.5% incidence of hyperuricemia in whole study population ( $p=0.033$ ) while in diabetic and prediabetic patients it was 12.7% and 12.65% respectively.<sup>14</sup> Previous studies have shown a positive correlation of hyperuricemia and Diabetes, whereas others have demonstrated neutral or negative association.<sup>15</sup>

Zhang et al. demonstrated a strong and positive correlation between mean serum uric acid value and prediabetes risk, with mean serum uric acid value having a better predictive ability for prediabetes while baseline serum uric acid had a positive relation with prediabetes when HbA1c was used for diagnosis of prediabetes. They also concluded that serum uric acid may serve as a novel predictor and potential therapeutic target for prediabetes.<sup>16</sup> Vučak *et al.* also reported the positive association of raised uric acid levels and prediabetes.<sup>17</sup> Similarly, Xue *et al.*<sup>18</sup> reported that patients with prediabetes had a higher serum uric acid levels than those with euglycemic states. Haque and colleagues have reported high mean uric acid level (338.2mmol/L) in prediabetics as compared to diabetics (290.9mmol/L) in their study.<sup>6</sup> Shrestha J et al. conducted a comparative study in Nepal and documented serum uric acid levels did not vary significantly among non-diabetics, pre-diabetics and diabetics.<sup>19</sup> In 2019, another study investigated the positive association of serum uric acid with cardiovascular diseases in diabetes patients.<sup>20</sup> Similarly, Sui *et al.*<sup>21</sup> reported that the elevated uric acid level are associated with a risk of metabolic syndrome in diabetic patients. Our study reported a significant difference in serum uric acid level in diabetics, prediabetics, and euglycemic study subjects.

## CONCLUSION

It is concluded that prediabetics are more prone to have higher serum uric acid levels and its related complications as compared to euglycemic and diabetic patients. Regular assessment of serum uric acid should be done in these patients to avoid hyperuricemia related complications.



Copyright© 17 June, 2023.

## REFERENCES

1. Rahimi R, Nikfar S, Larijani B, Abdollahi M. **A review on the role of antioxidants in the management of diabetes and its complications.** *Biomed Pharmacother.* 2005; 59(7):365-73.
2. Kumari K, Kumari A, Sweta G, Kumari U, Singh GP. **Comparison of serum uric acid in normal, prediabetic and diabetic subject.** *Int J Pharm Clin Res.* 2022; 14(9):1054-1060.
3. Xiong Q, Liu J, Xu Y. **Effects of uric acid on diabetes mellitus and its chronic complications.** *Int J Endocrinol.* 2019; 13:2019.
4. Rao S, Sahayo BJ. **A study of serum uric acid in diabetes mellitus and prediabetes in a south Indian tertiary care hospital.** *J Health Allied Sci NU.* 2012; 2(02):18-23.
5. Dhungana A, Pandeya A, Pant S, Pokharel BR. **Evaluation of serum uric acid, glucose and other glycemetic parameter in type II diabetic individuals.** *J Chitwan Med Coll.* 2022; 12(2):68-73.
6. Haque T, Rahman S, Islam S, Molla NH, Ali N. **Assessment of the relationship between serum uric acid and glucose levels in healthy, prediabetic and diabetic individuals.** *Diabetol Metab Syndr.* 2019; 11(1):1-8.
7. Cortese F, Giordano P, Scicchitano P, Faienza MF, De Pergola G, Calculli G, et al. **Uric acid: from a biological advantage to a potential danger. A focus on cardiovascular effects.** *Vascul Pharmacol.* 2019; 120:106565.
8. Zupo R, Castellana F, Boninfante B, Lampignano L, Lattanzio A, Sardone R, et al. **Uric acid and potassium serum levels are independent predictors of blood pressure non-dipping in overweight or obese subjects.** *Nutrients.* 2019; 11(12):2970.
9. De Pergola G, Cortese F, Termine G, Meliotta G, Carbonara R, Masiello M, et al. **Uric acid, metabolic syndrome and atherosclerosis: The chicken or the egg, which comes first?** *Endocr, Metab Immune Disord-Drug Targets.* 2018; 18(3):251-9.
10. Bombelli M, Quarti-Trevano F, Tadic M, Facchetti R, Cuspidi C, Mancia G, et al. **Uric acid and risk of new-onset metabolic syndrome, impaired fasting glucose and diabetes mellitus in a general Italian population: Data from the Pressioni Arteriose Monitorate E Loro Associazioni study.** *J Hypertens.* 2018; 36(7):1492-8.
11. Shani M, Vinker S, Dinour D, Leiba M, Twig G, Holtzman EJ, et al. **High normal uric acid levels are associated with an increased risk of diabetes in lean, normoglycemic healthy women.** *J Clin Endocrinol Metab.* 2016; 101(10):3772-8.
12. Chang J-B, Chen Y-L, Hung Y-J, Hsieh C-H, Lee C-H, Pei D, et al. **The role of uric acid for predicting future metabolic syndrome and type 2 diabetes in older people.** *J Nutr Health Aging.* 2017; 21:329-35.
13. Khan SA, Mandal S. **Significance of serum uric acid level in prediabetic and diabetic patients.** *Prog Med Sci.* 2018; 2(2):21-6.
14. Alqahtani SAM, Awan ZA, Alasmay MY, Al Amoudi SM. **Association between serum uric acid with diabetes and other biochemical markers.** *J Family Med Prim Care.* 2022; 11(4):1401.
15. Martínez-Sánchez FD, Vargas-Abonce VP, Guerrero-Castillo AP, De los Santos-Villavicencio M, Eseiza-Acevedo J, Meza-Arana CE, et al. **Serum Uric Acid concentration is associated with insulin resistance and impaired insulin secretion in adults at risk for Type 2 Diabetes.** *Prim Care Diabetes.* 2021; 15(2):293-9.
16. Zhang Q, Bao X, Meng G, Liu L, Wu H, Du H, Shi H, Xia Y, Guo X, Liu X, Li C. **The predictive value of mean serum uric acid levels for developing prediabetes.** *Diabetes Res Clin Pract.* 2016; 118:79-89.
17. Vučak J, Katić M, Bielen I, Vrdoljak D, Lalić DI, Kranjčević K, et al. **Association between hyperuricemia, prediabetes, and prehypertension in the Croatian adult population—a cross-sectional study.** *BMC cardiovasc disord.* 2012; 12:1-6.
18. Bai X, Tan JB, Feng N, Sun JP, Zhang KY, Li L, et al. **Association between serum uric acid and prevalence of type 2 diabetes diagnosed using HbA1c criteria among Chinese adults in Qingdao, China.** *Biomed Environ Sci.* 2015; 28(12):884-93.
19. Shrestha J, Pokhrel BR, Karki M, Gautam N, Tamang B, Mandal GK, Palikhey A, Rayamajhi B. **Comparative study of serum uric acid level in diabetic, pre-diabetic and non-diabetic individuals in a tertiary care center of Nepal.** *J Chitwan Med Coll.* 2022; 12(3):44-8.

20. Rafiullah M, Siddiqui K, Al-Rubeaan K. **Association between serum uric acid levels and metabolic markers in patients with type 2 diabetes from a community with high diabetes prevalence.** Int J Clin Pract. 2020; 74(4):e13466.
21. Sui X, Church TS, Meriwether RA, Lobelo F, Blair SN. **Uric acid and the development of metabolic syndrome in women and men.** Metab. 2008; 57(6):845-52.

### AUTHORSHIP AND CONTRIBUTION DECLARATION

No.	Author(s) Full Name	Contribution to the paper	Author(s) Signature
1	Ume Farwa	Manuscript writing, Data collection, Data analysis and methodology.	
2	Syeda Sabahat Haider	Proof reading and results.	
3	Mehvish Sana	Manuscript writign, data collection, Data analysis and methodology.	