BioScientific Review (BSR)
Volume 5 Issue 3, 2023
ISSN$_{(P)}$: 2663-4198 ISSN$_{(E)}$: 2663-4201
Homepage: https://journals.umt.edu.pk/index.php/bsr

Article QR

Title:	**Assessment of Serum Urea and Creatinine Levels in Diabetic Patients**
Author (s):	Wahid Ullah, Azhar Nazir, Hasnain Israr, Shahid Hussain, Muhammad Farooq
Affiliation (s):	The University of Haripur, Pakistan
DOI:	https://doi.org/10.32350/bsr.53.03
History:	Received: June 5, 2022, Revised: March 2, 2023, Accepted: March 20, 2023, Published: September 15, 2023
Citation:	Ullah W, Nazir A, Israr H, Hussain S, Farooq M. Assessment of serum urea and creatinine levels in diabetic patients. *BioSci Rev.* 2023;5(3):26–32. https://doi.org/10.32350/bsr.53.03
Copyright:	© The Authors
Licensing:	This article is open access and is distributed under the terms of Creative Commons Attribution 4.0 International License
Conflict of Interest:	Author(s) declared no conflict of interest

A publication of
The Department of Life Sciences, School of Science
University of Management and Technology, Lahore, Pakistan

Assessment of Serum Urea and Creatinine Levels in Diabetic Patients

Wahid Ullah*, Azhar Nazir, Hasnain Israr, Shahid Hussain and Muhammad Farooq

Department of Medical Laboratory Technology, The University of Haripur, Pakistan

ABSTRACT

Diabetic nephropathy is the leading cause of renal morbidity which occurs when chronic diabetes destroys the filtering system of the kidneys. Serum urea and creatinine are widely used as renal function test parameters. This study aims to assess the level of serum urea and creatinine in diabetic patients and their relationship with each other. The study was conducted in Ayub Teaching Hospital from September 15 to December 20, 2019. A total of 176 samples from confirmed diabetic patients were analyzed including 85 female and 91 male patients. Also, 83 control samples were taken for this study. Serum urea and creatinine levels were assessed to evaluate diabetic nephropathy in diabetic patients. SPSS (version 23) was used for statistical analysis. Pearson correlation analysis was used to check the relationship of blood sugar level, creatinine, and urea. Descriptive statistics (mean ± SD) were measured for the continuous variable. Scatter plot diagrams were added for the easy visualization and interpretation of the data. The significant level was set at $p < 0.05$. Out of the 176 diabetic samples, 32 had abnormally high serum creatinine and 66 had abnormal serum urea. In controls, one individual had high creatinine and three individuals had high serum urea. A significant increase in both urea and creatinine levels was observed in diabetic samples. Both serum urea and creatinine showed a strong positive correlation with the level of glucose and remained statistically significant ($p < 0.01$). Similarly, blood glucose level showed a strong correlation with the renal function test parameters. Hence, it was concluded that serum urea and creatinine are important parameters to assess kidney function in diabetes mellitus.

Keywords: creatinine, diabetic, diabetes, glucose, serum urea

1. INTRODUCTION

Diabetes mellitus (DM) is a collective term used for a group of metabolic disorders characterized by hyperglycemia that occurs due to an insufficient metabolism of glucose because of a defect in insulin secretion, functional defect in insulin, or both at the same time [1, 2]. Diabetes, which was considered earlier as a minor threat, is now regarded as one of the major threats to human health [3]. It is the common cause of kidney failure and diabetic nephropathy leads to chronic renal failure [4].

Diabetic nephropathy is associated with proteinuria, nephrotic syndrome, and the chronic kidney disease (CKD) [5]. In the early stages of diabetic nephropathy, glomerular filtration rate (GFR) is significantly higher than normal. Although, it worsens later on. Urinary proteinuria can be detected through the urine dipstick test known as overt nephropathy [6]. Diabetic nephropathy is one of the common causes

* Corresponding Author: wu86734@gmail.com

of chronic renal failure [7]. It develops in 40% of patients with insulin dependent diabetes mellitus (IDDM) [8] .

In 2017, approximately 8.8% of the total world population was diagnosed with DM, making 424.9 million individuals [9]. This number is expected to increase up to 693 million individuals by 2045 [10]. In 2022, Pakistan was ranked at number 03 for diabetes cases among 195 countries of the world with 7.5 million cases [11]. In 2020, Pakistan had 33 million cases of diabetes [12]. Moreover, about 32.3% of cases in Pakistan lead to diabetic nephropathy [13].

Serum creatinine is the metabolic product of muscle protein creatine. The normal range of creatinine in blood is 0.8-1.4 mg/dl. Men usually have higher serum creatinine than women because of greater muscle mass [14]. Urea is the metabolic product of protein metabolism with its normal value ranging from 7-20 mg/dl in blood. Both these parameters are used to assess the renal function [15]. This study aims to measure serum urea and creatinine levels in diabetic patients and also strives to determine the relationship between the blood glucose level and serum creatinine and urea levels.

2. MATERIALS AND METHODS

This study was conducted at Ayub Medical Complex (AMC), Medical Teaching Institution (MTI), Abbottabad, KPK from September 15, 2019 to December 20, 2019. The permission to conduct this research and the relevant information was obtained from the ethical committee of the above institution. Samples from 176 confirmed diabetic patients were analyzed. Among these, 85 were female patients and 91 were male patients. A set of 83 normal controls were also included in the study. The main parameters analyzed were serum glucose and renal function test parameters (blood urea and creatinine). The diagnosis of all parameters was conducted according to the criteria of the World Health Organization (WHO). Patients with chronic kidney disease (CKD), congestive heart failure (CHF), urinary tract infections (UTIs), and muscles disorders were excluded from the study.

Venous blood samples (5 mm volume) were taken from the patients' arms and serum glucose, urea, and creatinine were estimated from these samples. The method used to estimate glucose was glucose oxidase and peroxidase [16], while the method used to estimate creatinine was Jaffe's picrate method [17]. Finally, serum urea levels were estimated by using Berthelot method [18]. The age of diabetic patients was coupled with the age of normal controls. The normal values for these three parameters are 70-140 mg/dl for random glucose, 0.7-1.4 mg/dl for creatinine, and 18-45 mg/dl for urea.

2.1. Statistical Analysis

SPSS (version 23) was used for statistical analysis. Pearson correlation analysis was used to check the relationship of BSL (blood sugar level), creatinine, and urea. Descriptive statistics mean ± SD were measured for the continuous variable. Scatter plot diagrams were added for easy visualization and interpretation of the data. The significant level was set at $p < 0.05$.

3. RESULTS

Out of the 83 control samples, all were found to have normal serum urea and creatinine levels, except for 1 individual who had a high creatinine level and 3 individuals who had high serum urea levels. On the other hand, 32 out of 176 patients had abnormally high serum creatinine and 66 out of 176 had abnormally high serum urea values (Table 1).

Table 1. Comparison of Serum Urea and Creatinine in Diabetic and Control Subjects

Sample type	Total Samples	High Creatinine	High Urea	Genfer wise distribtion	
				Male	Female
Diabetic	176	32	66	91	85
Control	83	1	3	43	40

Table 2. Mean of Serum Creatinine, Urea, and Glucose compared with the Mean of Healthy Individuals

Investigation	Diabetics (*n*=176) Mean ± SD	Control (*n*=83) Mean ± SD
Age of the individual	50.47 ± 17.71	51.01 ± 17.26
Blood Sugar	313.85 ± 114.35	126.36± 21.232
Serum Creatinine	1.212 ± 0.81	1.29 ± 0.24
Serum Urea	39.48 ± 36.33	20.08 ± 3.06

The mean (± S.D.) for creatinine in control results was 1.29±0.24, whereas in patients results it was 1.212±0.81. The mean (± S.D.) for serum urea level in controls was 20.08 ± 3.06 and in patients it was 39.48±36.33. For random blood sugar, the mean (± S.D.) was 126.36 ± 21.232. On the other hand, for control samples and for diabetic patients, it was 313±114.35 (Table 2).

Both serum urea and creatinine showed a strong positive correlation with the glucose level with an r value of 0.950 and 0.904, respectively (Table 3). The line in the graph below has an upward direction indicating a strong positive correlation (Figure 1A, 1B).

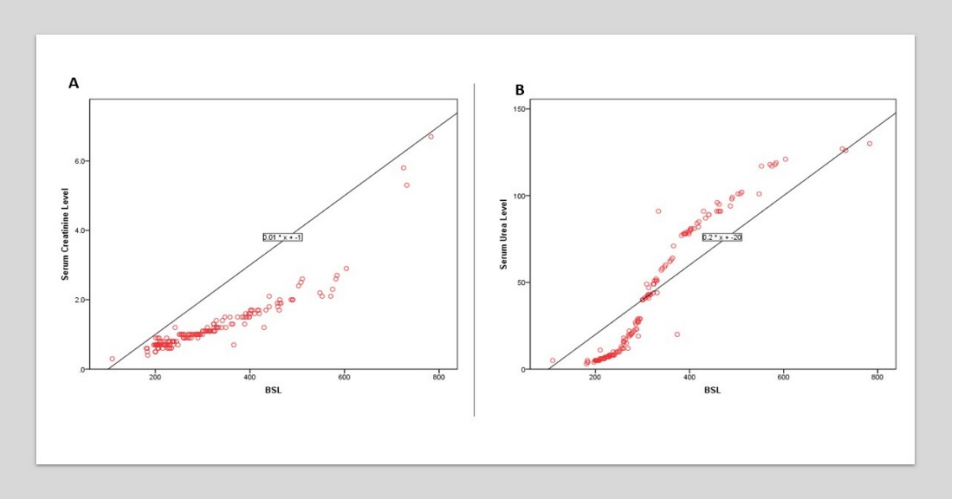

Figure 1A and 1B. Scatter Plots Showing the Relationship Between Blood Sugar Level and Serum Urea and Creatinine Levels in Diabetic Subjects (Strong Correlation).

Table 3. Gender-wise Correlation of Glucose, Urea, and Creatinine in Diabetic Subjects

Parameters	Diabetics	"r value"		Significance	
		M	F	M	F
Blood Sugar	313.85 ± 114.35	1	1	.000	.000
Serum Creatinine	1.212 ± 0.81	0.904	0.908	.000	.000
Serum Urea	39.48 ± 36.33	0.950	0.956	.000	.000

In 176 patients, 18% showed abnormal creatinine and 38% showed abnormal serum urea, as shown in Table 1. This shows that there is a significant relationship between diabetes and renal parameters. Serum urea showed greater change with glucose in diabetes than serum creatinine.

4. DISCUSSION

This study was conducted to assess serum urea and creatinine levels in diabetic patients. It was observed that renal function parameters showed significant changes in diabetic patients. These two parameters are routinely used to assess the renal function. The parameters remain abnormally high in serum when the kidneys are not functioning properly. The abnormally high serum creatinine and urea levels clearly indicate that hyperglycemia is associated with kidney dysfunction [19]. This conforms to the results of other studies which stated that hyperglycemia is one of the main causes of progressive kidney damage [20, 21]. The study conducted by Noor et al. (2020) on rats demonstrated that abnormally high serum urea and creatinine in diabetes results in progressive renal and kidney damage [1]. Hyperglycemia leads to hyperfiltration which results in micro and macrovascular changes. These changes result in increased GFR which is associated with high serum urea and creatinine levels [3].

In this study, the duration and severity of diabetes was found to be strongly associated with serum urea levels. It was observed that diabetic individuals with age more than 50 years are more likely to develop renal impairment. Patients with diabetes for more than 5 years are at a greater risk of developing abnormal renal parameters. Abnormally high values were observed in individuals of age more than 60 years. So, abnormality was likely due to high protein intake or due to increased muscle mass. An increase in urea can also be seen in high blood pressure [22]. This study reported that raised serum creatinine and urea levels in diabetic patients may be associated with pre-renal damage. Both serum urea and creatinine levels are the markers for the renal function test, although urea is more sensitive than creatinine.

Both serum urea and creatinine can be used to track the prognosis of diabetic nephropathy and the severity of damage to the kidneys in diabetes. If the level of glucose is effectively controlled in the initial stages of diabetes, then its progression to diabetic nephropathy can be stopped and renal mortality and morbidity can be reduced [23]. According to a study, most of the cases of diabetic nephropathy occur in patients with Type 2 DM. Assessing the parameters of the renal function test is a reliable and the most economic method available to diagnose nephropathy in diabetic patients [24].

4.1. Conclusion

Based on statistical analysis and findings, the current study established that uncontrolled diabetes is associated with

diabetic nephropathy. Both serum urea and creatinine levels showed deviation from normal with hyperglycemia. These two parameters can be widely used to monitor renal impairment. Serum urea and creatinine are reliable, easy to perform, and economical parameters used to monitor renal impairment in poorly controlled diabetic patients.

REFERENCES

1. Noor T, Hanif F, Kiran Z, et al. Relation of copeptin with diabetic and renal function markers among patients with diabetes mellitus progressing towards diabetic nephropathy. *Arch Med Res*. 2020;51(6):548–555. https://doi.org/10.1016/j.arcmed.2020.05.018

2. Sueud T, Hadi NR, Abdulameer R, Jamil DA, Al-Aubaidy HA. Assessing urinary levels of IL-18, NGAL and albumin creatinine ratio in patients with diabetic nephropathy. *Diabetes Metab Syndr: Clin Res Rev*. 2019;13(1):564–568. https://doi.org/10.1016/j.dsx.2018.11.022

3. Cerik I, Dindaş F, YILMAZ M. Remember Diabetes Mellitus When Assessing Renal Blood Flow in Hypertensive Patients: A Renal Frame Count Study. *Türk Kardiyoloji Derneği Arşivi*. 2023;51(1);32–39. https://doi.org/10.5543/tkda.2022.77567

4. Murtadha NA, Sarhat ER, Salih AA. Evaluation of serum adiponectin and lipid profile in regular hemodialysis patients. *Int J Special Education*. 2022;37(3);10808–10815.

5. Sagoo MK, Gnudi L. Diabetic nephropathy: an overview. In: Gnudi L, Long D, eds. *Methods in Molecular Biology*. Humana, New York: Springer; 2020:3–7.

6. Samsu N. Diabetic nephropathy: challenges in pathogenesis, diagnosis, and treatment. *BioMed Res Int.* 2021;2021: e1497449 https://doi.org/10.1155/2021/1497449

7. Selby NM, Taal MW. An updated overview of diabetic nephropathy: Diagnosis, prognosis, treatment goals and latest guidelines. *Diabetes Obes Metab.* 2020;22:3–15. https://doi.org/10.1111/dom.14007

8. Pelle MC, Provenzano M, Busutti M, et al. Up-date on diabetic nephropathy. *Life*. 2022;12(8):e1202. https://doi.org/10.3390/life12081202

9. Lovic D, Piperidou A, Zografou I, Grassos H, Pittaras A, Manolis A. The growing epidemic of diabetes mellitus. *Curr Vasc Pharmacol*. 2020;18(2):104–109. https://doi.org/10.2174/1570161117666190405165911

10. Cho NH, Shaw JE, Karuranga S, et al. IDF diabetes atlas: Global estimates of diabetes prevalence for 2017 and projections for 2045. *Diabetes Res Clin Pract*. 2018;138:271–281. https://doi.org/10.1016/j.diabres.2018.02.023

11. Adnan M, Aasim M. Prevalence of type 2 diabetes mellitus in adult population of pakistan: a meta-analysis of prospective cross-sectional surveys. *Ann Glob Health*. 2020;86(1):e7. https://doi.org/10.5334%2Faogh.2679

12. Basit A. The Diabetic Foot Worldwide: Pakistan. In: Boulton AJM, Rayman G, Wukich DK, eds. *The Foot in Diabetes.* 5th ed. Willey Online Library; 2020:47–49. https://doi.org/10.1002/9781119445821.ch4b

13. Sawaf H, Thomas G, Taliercio JJ, Nakhoul G, Vachharajani TJ, Mehdi A. Therapeutic advances in diabetic nephropathy. *J Clin Med*. 2022;11(2):e378. https://doi.org/10.3390/jcm11020378

14. Bhatia K, Misra P, Singh A, Mukherjee B, Ambade VN. Study of blood urea nitrogen (bun), serum creatinine in diabetic and non-diabetic patients in a tertiary care hospital. *Int J Med Biomed Stud*. 2019;3(4). https://doi.org/10.32553/ijmbs.v3i4.216

15. Pathan SB, Jawade P, Lalla P. Correlation of serum urea and serum creatinine in diabetics patients and normal individuals. *Int J Clin Biochem Res*. 2020;7(1):45–48. https://doi.org/10.18231/j.ijcbr.2020.009

16. Han S, Chen M, Cheng P, et al. A systematic review and meta-analysis of gut microbiota in diabetic kidney disease: Comparisons with diabetes mellitus, non-diabetic kidney disease, and healthy individuals. *Front Endocrinol.* 2022;13:e1018093. https://doi.org/10.3389/fendo.2022.1018093

17. Mali B, Nicholas PC. Jaffes' reaction for creatinine: kinetic study and spectrophotometric characteristics of the product of the reactions of creatinine, acetoacetate and creatinine and acetoacetate with alkaline picrate. Portland Press Ltd. *Biochem Soc Trans*. 1988;16(4):549–550. https://doi.org/10.1042/bst0160549

18. Richterich R, Küffer H. The determination of urea in plasma and serum by a urease/berthelot method, adapted to the greiner electronic selective analyzer GSA II (Author's Transl). *Z Klin Chcm Klin Biochem*. 1973;11(12):553–564. https://doi.org/10.1515/cclm.1973.11.12.553

19. Liu X, Du H, Sun Y, Shao L. Role of abnormal energy metabolism in the progression of chronic kidney disease and drug intervention. *Renal Failur*. 2022;44(1):790–805. https://doi.org/10.1080/0886022X.2022.2072743

20. Kamal A. Impact of diabetes on renal function parameters. *Ind J Fund Appl Life Sci*. 2014;4(3):411–416.

21. Edremitlioğlu M, Andiç MF, Sayın DB, Korkut O, Kısa Ü. Quercetin, a powerful antioxidant bioflavonoid, attenuates renal dysfunction in long-term experimental diabetes mellitus. *Marmara Med J*. 2011;24(2):88–99

22. Ekun OA, Fagbemi OF, Adejumo EN, et al. Assessment of electrolytes, markers of glycaemic control and renal dysfunction among adult Nigerians recently diagnosed with type 2 diabetes mellitus. *Afr Health Sci*. 2022;22(3):296–306. https://doi.org/10.4314/ahs.v22i3.31

23. Bamanikar S, Bamanikar A, Arora A. Study of serum urea and creatinine in diabetic and nondiabetic patients in a tertiary teaching hospital. *J Med Res*. 2016;2(1):12–15.

24. Ahmed TI, Bhola J, Shabaz M, et al. Fuzzy logic-based systems for the diagnosis of chronic kidney disease. *BioMed Res Int*. 2022;2022:e2653665. https://doi.org/10.1155/2022/2653665