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# A study on blood urea and serum creatinine in diabetes mellitus from Sangareddy District, Telangana, India

**[*1] Dr. Madhusudan Rao Sirivole MD, [2] Sadhvimani Eturi**
[1] Professor, Department of Biochemistry, Mahaveer Institute of Medical Sciences, Shivareddypet, Vikarabad. Telangana, India
[2] M.Sc., Food and Nutrition, Nutrition and Dietician Consultant, Hyderabad, Telangana, India

**Abstract**
This study was conducted in the Department of Biochemistry, M.N.R. Medical College, Sangareddy District, Telangana, India, comprising of n=50 subjects known Diabetes mellitus patients with age range 40 - 55 years and n=25 healthy controls age range 40 - 52 yrs. The study was aimed to quantitatively estimate the amount of blood sugar, urea and creatinine levels present in the blood serum, and evaluate their correlation in diabetic and non-diabetic subjects; also compare the variation in blood urea and serum creatinine levels in relation to blood sugar levels. The mean and Standard deviation of blood sugar fasting and post prandial in controls was 92.76 ± 11.18 and 126.24 ± 7.24 respectively, whereas in diabetics it was found to be 175.28 ± 32.45 and 263.04 ± 44.27 respectively. The statistical analysis data showed that the mean fasting and post prandial blood sugar levels are significantly ($p < 0.000$) higher in the diabetic subjects compared to non-diabetic controls. The mean (± S.D) values of blood urea in non-diabetic control group was observed to be 25.36 ± 3.47, whereas in diabetic patients 58.84 ± 14.39. The mean (±S.D) serum creatinine levels in healthy controls was 0.88 ± 0.14 and in diabetics 1.839 ± 0.80. Thus, the mean blood sugar, blood urea and serum creatinine levels were significantly ($p \leq 0.05$) higher in the diabetic subjects compared to controls. Sex wise blood sugar level status and renal function parameters viz., blood urea and serum creatinine in diabetic subjects was significantly higher in male over female subjects. Strong relationship of blood urea and serum creatinine levels was found with blood sugar levels. Blood urea and serum creatinine levels along with blood glucose levels would be helpful to monitor the diabetes patients to assess renal function.

**Keywords:** blood glucose, creatinine, diabetes mellitus, urea

## Introduction

Diabetic mellitus (DM) is a common group of chronic metabolic disorder of multiple aetiology; characterized by chronic hyperglycemia due to derangement in carbohydrate, fat and protein metabolism. The increase in blood glucose concentration is mainly due to insufficient or inefficient production of insulin in the body [1], which in turn damages major systems of human body particularly blood vessels and nerves [2].

Less glycemic control, sedentary lifestyle, dietary modifications, genetic mutations, smoking, high blood pressure, elevated cholesterol levels, obesity and lack of regular exercise are considered to be risk factors that have led to a dramatic increase in the incidence of diabetes [3-5\. Type II Diabetes mellitus is most common which constitute about 85-95% of all Diabetes mellitus cases.

Diabetes mellitus (DM) is one of the common and challenging health problems in the 21st century affecting about 6-7% of the world's population [3, 6]. According to WHO, diabetes affects more than 170 million people worldwide. If preventive measures are not taken, it is estimated that 438 million people will have diabetes by 2030.

Diabetes mellitus is usually associated with dyslipidemia, hypertension and visceral adiposity, which collectively increases the comorbid risk of developing chronic kidney disease and cardiovascular diseases [7].

Diabetes is also one of the major causes of kidney failure [8]. Diabetic nephropathy (DN) is the most common clinical condition of the diabetic patients with progressive deterioration of renal function and structure during their life time [9, 10]. DN affects 30% of all diabetics and it is the major leading cause of end stage renal disease (ESRD) in many countries [11-14].

DN is characterized by abnormal levels (more than 300 mg/day) of albumin in the urine, referred as macro albuminuria [15, 16] and abnormal renal function as represented by an abnormality in blood urea and serum creatinine. In DN, bio-markers viz. blood urea and serum creatinine are known to be raised with hyperglycemia in uncontrolled diabetics, usually correlating with kidney damage severity. Measurements of blood urea and serum creatinine are easily available tests which can assist in detection and prevention of diabetic kidney diseases at an early stage thereby, limit the progression to end stage renal disease [17, 18].

India leads the global top ten amongst world's population suffering from Diabetes mellitus with a figure of 50.8 million for 2010 [19], having a prevalence of 3.8% in rural and 11.8% in urban adults.

Since renal complications are very common in diabetics, we aimed to study the renal profile in diabetic patients attending outpatient department of M.N.R. Medical College Hospital, Sangareddy Dist., Telangana, India. Blood urea and serum creatinine are the simplest way to assess the kidney functional status. These substances accumulate in the body in cases of

renal dysfunction thus raising their levels in the blood.

Biochemical markers play an important role in accurate diagnosis and in assessing risk and adopting therapy to improve clinical outcome. Blood urea and serum creatinine are good indicators of a normal functioning of the kidney and increased serum levels of these parameters are indication of kidney dysfunction [20].

Therefore, the present study was aimed to quantitatively estimate the amount of blood urea and serum creatinine levels present in the blood serum, and evaluate their correlation in diabetic and non-diabetic subjects and also compare the variation in blood urea and serum creatinine levels in relation to degree of Diabetes mellitus.

## Materials and Methods

The present study was conducted in the Department of Biochemistry, M.N.R. Medical College, Sangareddy District, Telangana state, India. A total of n=75 subjects were selected in this study. Age of the subjects ranged between 40 - 55 years.

The study group comprised of n=50 subjects known Diabetes mellitus patients (25 male and 25 female) with age range from 40 to 55 years. n=25 normal healthy adult volunteers working in MNR Medical College, Sangareddy, participated in the study were treated as controls and their age ranged from 40 - 52 yrs. Controls were healthy adults who were excluded from diabetes.

Patients presenting to the Medicine OPD with past history of Diabetes mellitus for the last 3 years, were taken as cases in this study. Subjects with normal renal function tests and random blood glucose were selected as controls. The patients excluded in this study were smokers, hypertensives, hyperlipidemics, pregnant women and some other chronic disorders.

An informed consent was taken from all the subjects to participate after explaining the objective of the study. Approval for the study was obtained from the institutional research ethical committee. The variables collected were age, gender, fasting and post prandial blood glucose, blood urea and serum creatinine levels of all the subjects.

### Sample Collection

Blood samples of all these subjects were collected to study the parameters such as blood urea and serum creatinine with relation to blood sugar level (BSL).

Under aseptic conditions 2ml of the patient's intra-venous blood was collected for measuring serum creatinine, glucose and urea. For biochemical investigations serum was separated by centrifugation at 4000 rpm for 10 minutes and kept at -4°C until analysis.

Blood sugar levels were estimated by glucose oxidase and peroxidase (GOD-POD) end point assay method [21], blood urea was estimated by enzymatic urease method [22], while serum creatinine was estimated by alkaline Jaffe's Picrate method [23]. The normal ranges for blood sugar level (BSL), fasting is 70 – 110 mg/dl, post prandial (PP) is <140 mg/dl. Similarly, the normal range for blood urea is 15-40 mg/dl, and 0.6 - 1.4 mg/dl and 0.5 - 1.2 mg/dl for serum creatinine for males / females respectively.

All these laboratory parameters for fasting blood glucose (FBG), post prandial blood glucose (PPBG), blood urea and serum creatinine parameters were analyzed using Human reagent kits and with the help of semi auto analyser (Humalyser 3500, Germany). The WHO criteria for establishing Diabetes mellitus (random blood glucose ≥ 200 mg/dl) were followed to categorize the people with Diabetes mellitus. The presence of kidney disease was established solely on the basis of abnormal blood urea and serum creatinine values.

Reference ranges of various parameters according to the kits manufacturer are as follows; FBG (70-110 mg/dl), PPBG (<140 mg/dl), urea (15-40 mg/dl), creatinine (0.6-1.4 mg/dl).

### Statistical Analysis

The data collected was analyzed using Excel 2003. The statistical data was analyzed by student's t-test to compare the significance between diabetic and non-diabetic control groups. The data was expressed as mean and standard deviation (mean±SD). p value of less than 0.05 ($P \leq 0.05$) was considered as statistically significant.

## Results and Discussion

In the present study, a total of n=50 diabetic subjects were included, out of which n=25 were male and n=25 were female subjects. The male to female ratio was 1:1. The age of the subjects ranged from 40 - 55 years and the mean age was 52.92 years. The age of the healthy controls ranged from 40 – 52 years and the mean age was 48.72 years.

It has been predicted that the prevalence of diabetes mellitus (DM) in adults worldwide would increase to 5.4% by the year 2025, from the prevalence rate of 4.0% in 1995 and the prevalence rate is expected to increase more in developing countries as most of the diabetic patients are in the range of 45–64 years. While, in developed countries most of them are ≥65 years [24].

Patients with diabetes were found to have raised blood urea and serum creatinine levels compared to non-diabetic healthy controls. In our study, of the total n=50 diabetic subjects, n=16 had raised urea level and 17 subjects had raised creatinine level. On the other hand, out of n=25 controls, no subject had high urea level and 1 had increased creatinine level (Table 1). The raised creatinine in normal subjects may likely be due to high muscle mass and high protein meal intake.

**Table 1:** Comparison of blood urea and serum creatinine levels in diabetic and non-diabetic control subjects

| Parameters (mg/dl) | Diabetic (n=50) | Non-diabetic controls (n=25) |
|---|---|---|
| Raised blood urea | n=16 | 0 |
| Raised serum creatinine | n=17 | 1 |

The mean (± S.D) blood sugar fasting and post prandial in non-diabetic controls (n=25) was found to be 92.76 ± 11.18 and 126.24 ± 7.24 respectively, whereas in diabetic subjects it was found to be 175.28 ± 32.45 and 263.04 ± 44.27 respectively. The statistical analysis data showed that the mean fasting and post prandial blood sugar levels are significantly ($p < 0.000$) higher in the diabetic subjects compared to non-diabetic controls (Table 2 and Fig. 1).

The mean (± S.D) values of blood urea in non-diabetic control group were found to be 25.36 ± 3.47, whereas in diabetic patients 58.84 ± 14.39. The mean (±S.D) serum creatinine levels in healthy controls was observed to be 0.88 ± 0.14 and in diabetic subjects 1.839 ± 0.80 (Table 2). Thus, the mean blood urea and serum creatinine levels were significantly ($p \leq 0.05$) higher in the diabetic subjects over non-diabetic control group. Various studies showed that the blood urea levels increased proportionally to the increase in serum creatinine [25, 26]. The results of our study are in agreement with various studies which showed that raised serum creatinine and blood urea levels in diabetic patients may indicate a pre-renal problem [27, 28].

**Table 2:** Mean and SD values of blood urea, serum creatinine and blood sugar levels in diabetic patients and non-diabetic healthy controls

| Parameters (mg/dl) | Non-diabetic controls (n=25) | Diabetic (n=50) | p value |
|---|---|---|---|
| Blood sugar (fasting) | 92.76 ± 11.18 | 175.28 ± 32.45 | 0.000* |
| Blood sugar (post prandial) | 126.24 ± 7.24 | 263.04 ± 44.27 | 0.000* |
| Blood urea | 25.36 ± 3.47 | 58.84 ± 13.39 | 0.000* |
| Serum creatinine | 0.88 ± 0.14 | 1.839 ± 0.80 | 0.000* |

* p value less than 0.05 ($p \leq 0.05$) was considered as statistically significant.

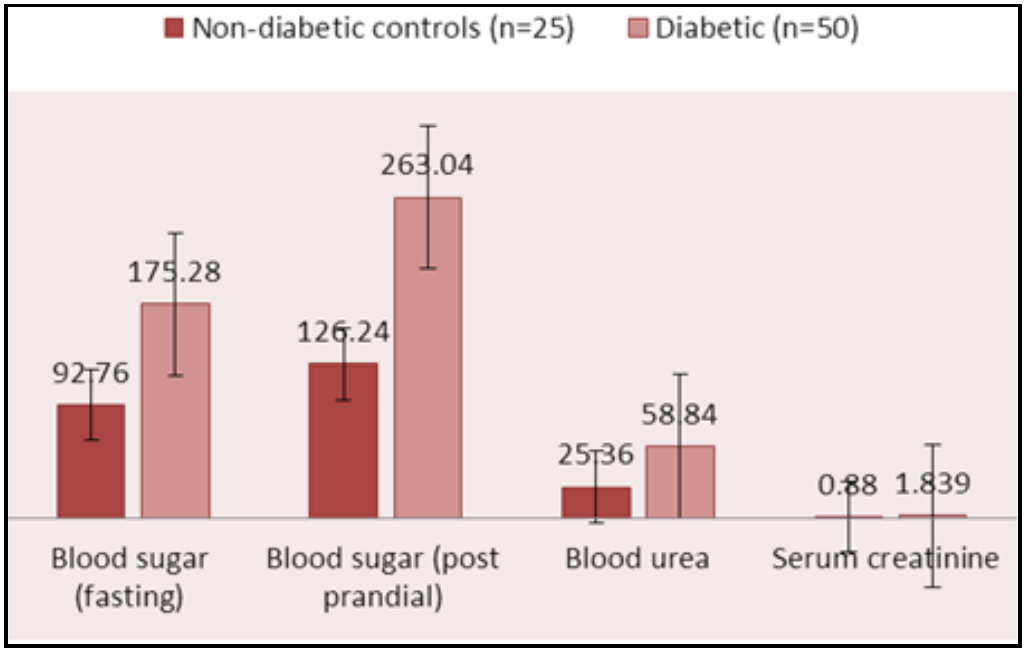


**Fig 1:** Mean of blood urea, serum creatinine and blood sugar levels in diabetic patients and non-diabetic healthy controls

Sex wise blood sugar level status in diabetic patients is summarized in Table 3 and renal function parameters viz., blood urea and serum creatinine in Table 4. The male diabetic subjects had significantly ($p \leq 0.05$) higher blood sugar (fasting and post prandial) levels compared to female diabetic subjects. Similarly, both serum creatinine and blood urea were significantly ($p \leq 0.05$) higher in males over females (Fig. 2). This could be correlated with high blood sugar levels in males. The higher values of fasting and post prandial blood sugar levels in males than the females in our study indicate poor glycemic control in males which is an indicator of diabetic nephropathy (DN). This can be explained that strict glycemic control lowers the risk of nephropathy and other diabetic complications.

In our study, high serum creatinine levels were seen in males than females, which could be because of the presence of high muscle mass in males compared to females as reported earlier [27, 29].

The mean value of blood urea and serum creatinine when compared to mean value of the blood sugar, the p value was found to be statistically significant ($p \leq 0.05$). These findings show that there is a relationship of long standing blood sugar level with blood urea level indicating that as there is persistent increase in blood sugar level and increase in blood urea levels. Our study results shows that poorly controlled blood sugar levels would cause increase in the blood urea levels and thus increase the chances of the patient suffering from diabetic nephropathy in agreement with the findings of earlier study reports that hyperglycemia is one of the major causes of progressive renal damage [30, 31].

Blood urea levels are reported to increase when there is damage to the kidney or the kidney is not functioning properly. In our study, increase of blood urea level with the increment of blood sugar level clearly indicates that long standing high blood sugar levels causes damage to the kidney. The studies conducted by Anjaneyulu and Chopra [30] had found that increase blood urea and serum creatinine in diabetic rats indicates progressive renal damage.

**Table 3:** Gender-wise correlation of blood sugar level (BSL) status in Diabetes mellitus

| Parameters (mg/dl) | Male (n=25) | Female (n=25) | Total (n=50) |
|---|---|---|---|
| Blood sugar (Fasting) | 176.64 ± 44.90 | 156.64 ± 27.32 | 175.28 ± 32.45 |
| Blood sugar (post prandial) | 279.04 ± 51.03 | 247.04 ± 29.41 | 263.04 ± 44.27 |

**Table 4:** Gender-wise correlation of renal function test (RFT) in Diabetes mellitus

| Parameters (mg/dl) | Male (n=25) | Female (n=25) | Total (n=50) |
|---|---|---|---|
| Blood urea | 41.12 ± 9.83 | 34.32 ± 6.46 | 38.84 ± 13.39 |
| Serum creatinine | 2.30 ± 0.87 | 1.34 ± 0.30 | 1.839 ± 0.80 |

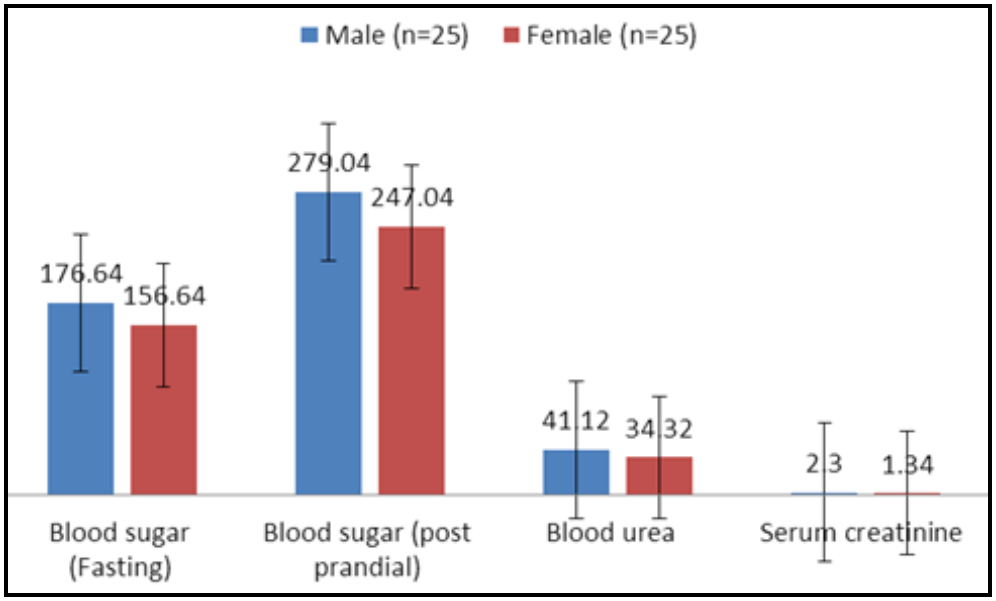


**Fig 2:** Gender-wise correlation of blood sugar level (BSL) status and renal function test (RFT) in Diabetes mellitus

Furthermore, this increase in the level of blood urea and serum creatinine indicates the progression towards diabetic nephropathy and estimation of serum creatinine has greater prognostic ability compared with that of blood urea for predicting the adverse outcomes[25]. Therefore, increased blood urea and serum creatinine levels in diabetics clearly indicate prolonged hyperglycaemia which causes irretrievable damage to nephrons of the kidney [32].

Over time, high blood sugar levels damage millions of nephrons - tiny filtering units within each kidney. As a result, kidneys are unable to maintain the fluid and electrolyte homeostasis. Serum creatinine is filtered by the Glomerulus; therefore, serum creatinine level is used as an indirect measure of glomerular filtration. As glomerular filtration rate (GFR) diminishes, there is a rise in plasma concentrations of serum creatinine and blood urea. Raised serum creatinine and reduced GFR has become fairly reliable indicators of kidney dysfunction.

Serum levels of urea and creatinine can be used as prognostic markers and predictors of renal damage in diabetic patients[27]. Effective control of blood sugar levels can stop progression to diabetic nephropathy and thus remarkably reduce the morbidity and mortality associated with this metabolic disease.

## Conclusion

We feel that, all diabetic patients should regularly monitor their glycemic status and renal profile to avert complications associated with diabetes mellitus. Strict control of blood glucose level helps to prevent progressive renal damage and diabetic nephropathy which is one of the major causes of chronic renal failure. We conclude that blood urea and serum creatinine levels are simple tests helpful in poorly controlled diabetes to assess the renal function.

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