

## ANALYSIS OF GLOMERULAR FILTRATION RATE IN NON-ALBUMINURIC AND ALBUMINURIC TYPE 2 DIABETES MELLITUS IN EARLY DETECTION OF CHRONIC KIDNEY DISEASE

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### KEYWORDS

Type 2 Diabetes Mellitus, Albuminuric DM patients, Chronic Kidney Disease, Prevalence

### ABSTRACT

**Introduction:** Chronic Kidney Disease (CKD) is a frequent complication of Type 2 Diabetes Mellitus (T2DM) and is generally tracked through albuminuria and glomerular filtration rate (GFR). Although albuminuria is a widely recognized indicator of CKD, its absence does not necessarily exclude the possibility of kidney dysfunction.

**Objectives:** To compare the GFR between non-albuminuric and albuminuric patients with T2DM and to evaluate the effectiveness of GFR measurement in the early detection of CKD in T2DM patients.

**Methods:** A prospective cross-sectional study was conducted in V.M.K.V. MEDICAL COLLEGE HOSPITAL, Department of General Medicine, between October 2023 and July 2024. The study included 100 consecutive patients with diabetes mellitus attending the OPD. Laboratory investigations were done, such as serum urea, serum creatinine, HbA1c, serum albumin, FBS, PPBS, hemoglobin, urine routine, and lipid profile.

**Results:** The mean age group of Non-albuminuric DM patients was 55.4±11.38 years and for Albuminuric DM patients was 53.64±10.82 years, in both the groups males were predominate with 74.0% and 78.0% in Non-albuminuric and albuminuric patients. The Prevalence of impaired GFR among the study subjects was found to be 39.0%. The Estimated GFR in mL/min per 1.73 m<sup>2</sup> of the study subjects was found to be > 60 in 61.0% of patients followed by 30-59 (26.0), 15-29 (11.0), and <15 in 2.0% of patients.

**Conclusion:** The Present study results found the necessity for regular monitoring of renal function and urinary albumin levels in diabetic patients, as early identification of albuminuria can facilitate timely interventions to slow the progression of kidney disease.

**Introduction:**

Chronic Kidney Disease (CKD) is a progressive condition characterized by the gradual loss of kidney function over time. It is a major public health issue worldwide, with a rising prevalence linked to various risk factors, including diabetes mellitus. Among diabetic patients, early detection of CKD is crucial as it can significantly impact management strategies and patient outcomes<sup>1</sup>. Type 2 Diabetes Mellitus (T2DM) is a leading cause of CKD, and understanding how different parameters reflect kidney function is essential for effective monitoring and intervention<sup>2</sup>.

The glomerular filtration rate (GFR) is a key indicator of kidney function, representing the rate at which the kidneys filter blood. In clinical practice, GFR is often estimated using serum creatinine levels, but more precise measurements can be obtained through methods such as inulin clearance or using formulas like the Modification of Diet in Renal Disease (MDRD)<sup>3</sup>.

Kidney disease in diabetes is typically categorized into stages based on rising protein levels in the urine and a decreasing glomerular filtration rate (GFR). Traditionally, noticeable proteinuria, or macroalbuminuria, appears before there is a more rapid decrease in GFR. However, recent studies have identified cases where GFR declines progressively without significant proteinuria, known as nonproteinuric diabetic kidney disease (DKD). In diabetic patients, particularly those with T2DM, the assessment of GFR is critical for the early identification of CKD<sup>4</sup>.

The significance of analyzing GFR in both albuminuric and non-albuminuric T2DM patients lies in its potential to uncover early kidney damage that might not be detected through albuminuria screening alone. By evaluating GFR across different patient groups, healthcare providers can better understand the progression of kidney disease and tailor interventions accordingly. This approach can lead to more accurate diagnoses, timely treatment, and improved outcomes for patients with diabetes-related CKD<sup>5,6</sup>.

The analysis of GFR in both albuminuric and non-albuminuric T2DM patients is a critical component of early CKD detection. By broadening the diagnostic criteria to include GFR, clinicians can enhance their ability to identify kidney impairment at earlier stages, leading to more effective management of CKD and better overall patient outcomes. eGFR is relatively stable and can be conveniently measured in an outpatient setting.

**Objectives:**

- To compare the GFR between non-albuminuric and albuminuric patients with T2DM.
- To evaluate the effectiveness of GFR measurement in the early detection of CKD in T2DM patients.

**Methodology:**

A prospective cross-sectional study was conducted in V.M.K.V. MEDICAL COLLEGE HOSPITAL, in the Department of General Medicine. The study was performed between October 2023 and July 2024. A total of 100 consecutive patients who had diabetes mellitus attending the OPD were included in the study. Patients with an age group of more than 40 years, diagnosed with Type 2 diabetes mellitus and hypertension were included in the study. Exclusion criteria included acute kidney injury episode, pregnancy, unspecified type of DM, Urinary tract infection, Congestive heart failure, and patient life expectancy <1 year.

A written consent form was obtained from the study participants before the start of the study. Demographic information such as age, gender, duration of diabetes, and treatment history, as well as clinical details including weight, height, body mass index (BMI), blood pressure, and results from a fundus examination for diabetic retinopathy, were collected. Laboratory investigations were done, such as serum urea, serum creatinine, HbA1c, serum albumin, FBS, PPBS, hemoglobin, urine routine, and lipid profile.

**Data variables:**

Impaired GFR<sup>7</sup>: The value of GFR <60 mL/min per 1.73 m<sup>2</sup>

Normal: Less than 30 mg of albumin excreted per day

Microalbuminuria: 30–300 mg of albumin excreted per day

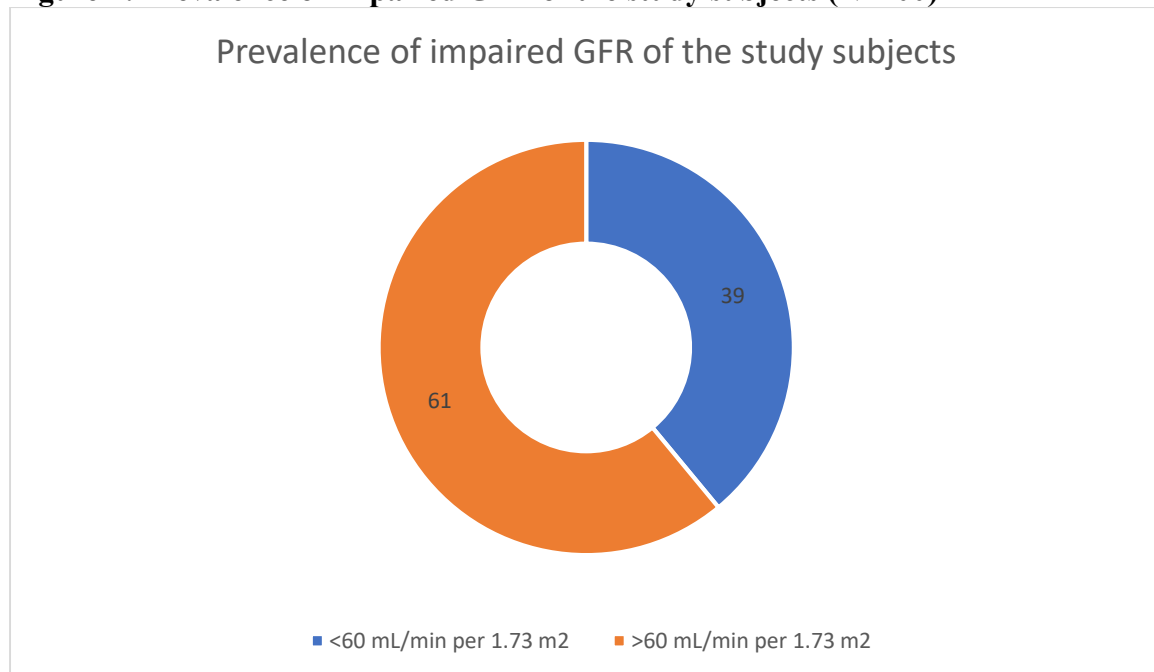
Macroalbuminuria: More than 300 mg of albumin excreted per day

**STATISTICAL ANALYSIS:**

The data was entered in MS EXCEL 2019 and analyzed using SPSS Statistics 16.0. Quantitative variables were expressed in mean standard deviation and qualitative variables were expressed in proportions. To find the significance in qualitative categorical data Chi-Square test and Fisher's Exact were used and for quantitative data, t-test were used.

**Results**

**Figure 1: Prevalence of impaired GFR of the study subjects (N=100)**



**Table 1: Baseline characteristics of the study subjects (N=100)**

Variables	Non-albuminuric DM patients (n=50)	Albuminuric DM patients (n=50)	Total (n=100)	p-value
Age (in years) (mean±SD)	55.4±11.38	53.64±10.82	54.15±10.95	0.015
<b>Gender (n,%)</b>				
Male	37 (74.0)	39 (78.0)	76 (76.0)	0.639
Female	13 (26.0)	11 (22.0)	24 (24.0)	
<b>Duration of diabetes (n,%)</b>				
<10 years	27 (54.0)	17 (34.0)	44 (44.0)	0.043
≥10 years	23 (46.0)	33 (66.0)	56 (56.0)	
BMI (kg/m <sup>2</sup> ) (mean±SD)	25.8±4.21	25.3±4.37	25.6±4.41	0.211
Smoking (n,%)	6 (12.0)	11 (22.0)	17 (17.0)	0.183
<b>Co-morbidities</b>				
Hypertension (n,%)	38 (76.0)	33 (66.0)	71 (71.0)	0.27
Dyslipidemia (n,%)	29 (58.0)	37 (74.0)	66 (66.0)	0.091
Diabetic neuropathy (n,%)	7 (14.0)	12 (24.0)	19 (19.0)	0.202

**Table 2: Laboratory investigations of the study subjects (n=100)**

Variables	Non-albuminuric DM patients (n=50)	Albuminuric DM patients (n=50)	Total (n=100)	p-value
Hb (g/dL) (mean±SD)	12.6±2.3	11.3±2.5	12.1±2.2	<0.001
HbA1C (%) (mean±SD)	7.7±2.03	7.9±2.1	7.83±2.07	<0.001
FBS (mg/dL) (mean±SD)	152.9 ± 53.2	156.5 ± 47.6	155.1 ± 49.9	<0.001
PPBS (mg/dL) (mean±SD)	213.6 ± 56.5	228.45 ± 60.18	221.02±58.2	0.042
S. Creatinine (mg/dL) (mean±SD)	0.8±0.2	1.7±1.3	1.2±0.87	<0.001
S. Uric acid (mg/dL) (mean±SD)	5.5 ± 3.6	6.7 ± 2.4	5.9 ± 3.2	<0.001
BUN (mg/dL) (mean±SD)	13.3 ± 5.8	22.9 ± 12.9	17.2 ± 10.5	<0.001

Serum potassium (mEq/L) (mean±SD)	4.1 ± 0.5	4.3 ± 0.9	4.2 ± 0.8	0.003
Median UACR (mg/gCr)	30 (12.6, 82)	50 (30, 201.4)	30.1 (17, 118)	0.002
Total cholesterol (mg/dL) (mean±SD)	197.4 ± 44.8	229.2±46.46	213.3 ± 45.5	0.036
Triglycerides (mg/dL) (mean±SD)	169.5 ± 107.1	187.8 ± 119.8	176.7 ± 113.7	<0.001
HDL-cholesterol (mg/dL) (mean±SD)	45.8 ± 16.1	47.4 ± 14.6	47.21± 15.2	<0.001
LDL-cholesterol (mg/dL) (mean±SD)	148.0 ± 46.45	129.6 ± 39.8	138.8 ± 42.6	0.315

**Table 3: Estimated GFR in mL/min per 1.73 m<sup>2</sup> of the study subjects (n=100)**

Estimated GFR in mL/min per 1.73 m <sup>2</sup>	Frequency (n)	Percentage (%)
>60	61	61.0
30-59	26	26.0
15-29	11	11.0
<15	2	2.0

**Table 4: Association between Estimated GFR and Non-albuminuric and Albuminuric DM patients (n=100)**

Variables	Impaired GFR (<60 mL/min per 1.73 m <sup>2</sup> ) (%)	Non-impaired GFR (>60 mL/min per 1.73 m <sup>2</sup> ) (%)	p-value
Non-albuminuric DM patients	11 (22.0)	39 (78.0)	<0.001
Albuminuric DM patients	28 (56.0)	22 (44.0)	

## Results:

In the present study, a total of 100 patients with type 2 diabetes mellitus patients were included of which 50 patients have albuminuria and the other 50 patients do not have Albuminuria. The mean age group of Non-albuminuric DM patients was 55.4±11.38 years and for Albuminuric DM patients was 53.64±10.82 years, in both the groups males were

predominate with 74.0% and 78.0% in Non-albuminuric and albuminuric patients. A higher proportion of non-albuminuric patients (54%) have diabetes for less than 10 years compared to albuminuric patients (34%). There was a statistical association found between them ( $p=0.043$ ). The mean BMI was found to be similar between the two groups ( $25.8 \text{ kg/m}^2$  for non-albuminuric and  $25.3 \text{ kg/m}^2$  for albuminuric), with a  $p$ -value of 0.211 indicating no significant difference. Around 76.0% of non-albuminuric patients have hypertension compared to 66.0% of albuminuric patients, with a  $p$ -value of 0.27 indicating no significant difference. The proportion was found to be higher in albuminuric patients (74.0% vs. 58.0%), with a  $p$ -value of 0.091 indicating no statistical significance.

The Laboratory investigations of the study subjects are shown in Table 2. The mean value of Hb (g/dL), HbA1C (%), FBS (mg/dL), PPBS (mg/dL), S. Creatinine (mg/dL), S. Uric acid (mg/dL), BUN (mg/dL) and Serum potassium (mEq/L) were  $12.1 \pm 2.2$ ,  $7.83 \pm 2.07$ ,  $155.1 \pm 49.9$ ,  $221.02 \pm 58.2$ ,  $1.2 \pm 0.87$ ,  $5.9 \pm 3.2$ ,  $17.2 \pm 10.5$  and  $4.2 \pm 0.8$  respectively. A statistical association was found between laboratory investigations and non-albuminuric and albuminuric patients ( $p < 0.05$ ).

The Prevalence of impaired GFR among the study subjects was found to be 39.0%. The Estimated GFR in mL/min per  $1.73 \text{ m}^2$  of the study subjects was found to be  $> 60$  in 61.0% of patients followed by 30-59 (26.0), 15-29 (11.0), and  $< 15$  in 2.0% of patients. The majority of non-albuminuric patients have preserved kidney function (78.0%) and 56.0% of the albuminuric patients show impaired GFR. The  $p$ -value of  $< 0.001$  underscores the significant association between albuminuria and impaired renal function, indicating that the presence of albuminuria is a strong predictor of renal impairment in diabetic patients.

### **Discussion:**

The present study was done to evaluate the effectiveness of GFR measurement in the early detection of CKD in T2DM patients. An increasing amount of evidence indicates a change in the progression of chronic kidney disease (CKD) among individuals with diabetes. In particular, normoalbuminuric CKD were characterized by a decrease in glomerular filtration rate without a prior or concurrent rise in albuminuria has emerged as a common form of renal impairment in diabetes<sup>8</sup>.

In the present study, the mean age of non-albuminuric diabetic patients is significantly higher (55.4 years) compared to albuminuric patients (53.64 years), with a  $p$ -value of 0.015 indicating statistical significance. The gender distribution found to be relatively similar in both groups, with 74% of non-albuminuric and 78% of albuminuric patients being male. In contrast, Thomas MC et al<sup>9</sup> study found that nonalbuminuric patients were older and more frequently females and Afghahi H et al<sup>10</sup> study observed that older age is a risk factor not only for lower eGFR, but also for higher albuminuria.

In the current study, the majority of the study participants had more than 10 years (56.0%) duration of diabetes and 44.0% had less than 10 years. Jin et al<sup>11</sup> study found that overall average duration of diabetes was  $7.6 \pm 1.5$  years. In this study, the mean value of Hb (g/dL), HbA1C (%), FBS (mg/dL) and PPBS (mg/dL) were  $12.1 \pm 2.2$ ,  $7.83 \pm 2.07$ ,  $155.1 \pm 49.9$  and  $221.02 \pm 58.2$  respectively. Similarly, Nata N et al<sup>12</sup> study reported that the mean HbA1C was  $7.98 \pm 2.07\%$ , and 31.3% of patients had an HbA1C  $< 7\%$ . In the present study, 71.0% had hypertension, 66.0% had dyslipidemia and 19.0% had diabetic neuropathy. However, there was no statistical association found between non-albuminuric and albuminuric diabetic patients ( $p > 0.05$ ). In contrast, Nata N et al<sup>12</sup> study found that 76.8% had hypertension, 69.9% had dyslipidemia, 7.1% had diabetic neuropathy and 6.6% had coronary heart disease. All comorbid

diseases except dyslipidemia were significantly higher among patients with T2DM with impaired GFR.

In the current study, non-albuminuric patients show a mean HbA1C of 7.7%, compared to 7.9% in albuminuric patients. The significant p-value (<0.001) indicates that albuminuric patients may have poorer long-term glycemic control. In advanced chronic kidney disease (CKD), glycemic control often improves naturally as glomerular filtration rate (GFR) decreases, particularly when dialysis therapy begins. This can result in low hemoglobin A1c levels (below 6%), and some patients may even need to stop using hypoglycemic medications and insulin<sup>13</sup>.

In the present study, the Prevalence of impaired GFR among the study subjects was found to be 39.0%. Nata N et al<sup>12</sup> study reported that almost 40% of 30,377 studied patients with T2DM had GFR less than 60 mL/min/1.73 m<sup>2</sup>. The majority of non-albuminuric patients have preserved kidney function (78.0%) and 56.0% of the albuminuric patients show impaired GFR. The study finding highlights significant insights into the renal health of diabetic patients, particularly in relation to estimated glomerular filtration rate (eGFR) and albuminuria.

The relationship between albuminuria and impaired kidney function has been well-documented in other studies<sup>14,15</sup>. Albuminuria is often considered a marker for kidney damage, particularly in diabetic patients. Studies have shown that even mild elevations in urinary albumin excretion can predict the progression of kidney disease and cardiovascular risk<sup>16</sup>. The study finding suggested that the potential for interventions aimed at preserving renal function in at-risk populations. However, the substantial proportion of albuminuric patients with impaired GFR indicates a need for vigilant monitoring and management strategies, including optimizing glycemic control and considering renal protective therapies.

### **Conclusion:**

The analysis of glomerular filtration rate (GFR) in non-albuminuric and albuminuric patients with type 2 diabetes mellitus highlights the critical importance of early detection in the management of chronic kidney disease (CKD). The current study results found the the necessity for regular monitoring of renal function and urinary albumin levels in diabetic patients, as early identification of albuminuria can facilitate timely interventions to slow the progression of kidney disease. Implementing preventive strategies focused on optimizing glycemic control and managing associated risk factors is essential for protecting renal health in this population.

**Conflict of interest:** No

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