

HbA1c and its Correlation with Creatinine/eGFR Among Type 2 Diabetes Mellitus Patients – A Cross-Sectional Study

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Abstract:

Background: In Type 2 Diabetes Mellitus (T2DM), chronic hyperglycemia results in nephropathy detectable as rising values of creatinine and decreased levels of eGFR. In this study, we will assess whether the association between HbA1c and renal parameters suggests poorer glycemic control predicting kidney dysfunction, thus underscoring the need for early glycemic intervention to preserve renal health. **Materials and Methods:** A facility based cross sectional study was carried out on 150 subjects from April 2025 to July 2025 who visited Diabetes Care Clinic of KLEs Dr Prabhakar Kore Hospital & MRC, Belagavi, Karnataka, India. Glycosylated Hemoglobin (HbA1c) and Creatinine levels were measured in T2DM diagnosed patients. Estimated GFR was calculated using a standard equation. Results: The mean age of the participants was 49.07±9.92 years with male prevalence. The mean HbA1c levels of the participants was 8.69±2.33%. A significant correlation was observed between creatinine with eGFR in the study ($P<0.05$). A non-significant correlation was observed between HbA1c levels and creatinine/eGFR ($P>0.05$). **Conclusion:** There was no correlation between HbA1c and either creatinine or eGFR. However, the validated inverse relationship between creatinine and eGFR implies that mechanisms other than chronic hyperglycemia are likely responsible for early renal dysfunction in these patients. Further studies should investigate other risk factors for early renal dysfunction in T2DM patients with poor glycemic control.

Keywords: Type 2 Diabetes Mellitus, Glycosylated Hemoglobin (HbA1c), Creatinine, eGFR, Correlation.

INTRODUCTION

Diabetes Mellitus is one of those chronic non-communicable diseases that do affect the lives of most people around the world. It is basically characterized by persistently high levels of blood glucose caused by failure either in the production of insulin or in how effectively the body makes use of it. Current statistical data from 2019 indicates that approximately 463 million adults aged between 20 and 79 were diagnosed with this illness, while deaths from the disease were around 4.2 million during that year.^[1] T2DM is definitely the most widespread among the different kinds of diabetes that develop from the resistance of the body to insulin. Apart from elevation in blood glucose levels, this type of diabetes has several other metabolic manifestations such as overweight, hypertension, and a disarrayed lipid profile.^[2]

Changes in HbA1c levels indicate the variation in glucose management over a longer period of time.^[3] Diabetic nephropathy, a complication of Diabetes Mellitus (DM), is responsible for the majority of cases of End Stage Renal Disease (ESRD). This metabolic disorder can actually be prevented by proper monitoring of blood glucose control and renal function using estimated GFR (eGFR) level.^[4]

It is the most important thing to identify people with type 2 diabetes as early as possible when they undergo renal impairment, linking HbA1c levels to serum creatinine and eGFR helps in enhancing care, preventing complications, and directing prompt treatment decisions.

There have been several studies on the relationship between glycemic control and either creatinine or eGFR to help clarify diabetic kidney complications and to handle chronic kidney disease, of which some report a positive correlation.^{[5][6]} some report negative correlation^[11], while some studies were unable to conclude any correlation^{[7][8][9][10]}. Hence more studies are required to learn management, taking this as our objective we correlated HbA1c with serum creatinine and eGFR levels in this current study.

MATERIALS AND METHODS

Study design and setting

This study is a facility based cross sectional study which was carried out in the diabetes care clinic of KLEs Dr Prabhakar Kore Hospital & Medical Research Center, Belagavi, Karnataka, India. The permission for the study was obtained from the Institutional ethical committee.

Patients and Methods

A study conducted at M. Yunus Hospital by Reza et al. (2023), published in *Jurnal Ilmu Kesehatan*,^[12] reported that the Pearson's correlation coefficient between HbA1c and triglycerides was 0.238. Considering this, with 95% confidence and 80% power of the test we concluded with the sample size of 136. Adding 10% attrition rate the sample size was rounded off to 150 patients for the study.

The venous blood of patients was collected. Serum creatinine was measured along with HbA1c and lipid profile using the serum in the Hi-tech laboratory.

Inclusion criteria:

- 1) Age 18-60 years
- 2) Patients diagnosed with T2DM according to WHO criteria

Exclusion criteria:

- 1) Patients with CKD, Hypothyroidism
- 2) Pregnant and lactating women
- 3) Patients with incomplete data
- 4) Type 1 diabetes mellitus patients

A total of 170 patients were enrolled for the study and 150 patients were included by excluding the patients who do not fulfill inclusion criteria or do not give the consent. The American Diabetes Association's criteria was used to define DM. The parameter HbA1c was measured by Hexokinase method with the help of Bio-Rad D10, a fully automatic analyzer. The serum creatinine was

estimated by creatinase method in Cobas c 503 automatic analyzer. The assays were performed as per the manufacturer's instructions. After the estimation of creatinine, the estimated GFR was calculated with race independent CKD-EPI equation 2009.^{[13][14]}

Statistical analysis

The data was collected, compiled and analyzed using IBM SPSS software (29.0 version). The frequency and percentage for categorical variables, mean and standard deviation for continuous variables were calculated. Pearson's correlation coefficient was used to find correlation of HbA1c with Creatinine and eGFR. The independent samples t-test was performed to determine if there is a statistically significant difference in their mean. All analysis was two-tailed, and the significance level was set at $P < 0.05$.

RESULTS

The mean age of the patients was 49.07 ± 9.92 with male predominance. The mean of HbA1c levels of patients was 8.69 ± 2.33 . Graph 1 shows the frequency distribution of gender of patients. We found a non-significant but positive correlation of HbA1c with creatinine and eGFR ($P < 0.05$). Creatinine with eGFR showed positive significant correlation ($P > 0.05$) as in Table 3. Frequency distribution tables were plotted for different parameters as in Tables 1,2,3,4. Scatter diagrams of the correlation have been plotted as shown in figure 1.

Table 1: Frequency distribution of creatinine levels in type 2 diabetes mellitus patients

Creatinine Levels in Type 2 Diabetes Mellitus Patients									
		Normal		Low		High		Total	
Creatinine		120	80.0%	14	9.3%	16	10.7%	150	100%
		Mean							
		0.80 ± 0.22							

Table 2: Frequency distribution of creatinine levels in type 2 diabetes mellitus patients based on age, gender and HbA1c levels

		Creatinine							
		Low		High		Normal		Total	
		N	%	N	%	N	%	N	%
Age	Young Adults	1	0.7	0	0	15	10	16	10.7
	Middle aged adults	13	8.6	16	10.7	105	70	134	89.3
Gender	Female	11	7.3	8	5.3	49	32.7	68	45.3
	Male	3	2	8	5.3	71	47.4	82	54.7
HbA1c	HbA1c <7%	0	0	4	2.7	34	22.7	38	25.4
	HbA1c >7%	14	9.3	12	8	86	57.3	112	74.6

Table 3: Frequency distribution of estimated glomerular filtration rate in type 2 diabetes mellitus patients

Estimated GFR											
		Normal		Mild		Moderate		Severe		Chronic	
Estimated GFR (mL/min/1.73m ²)		136	91%	11	7%	3	2%	0	0%	0	0%
		Total									
		150		100%							

Table 4: Frequency distribution of estimated glomerular filtration rate in type 2 diabetes mellitus patients based on age, gender and HbA1c level

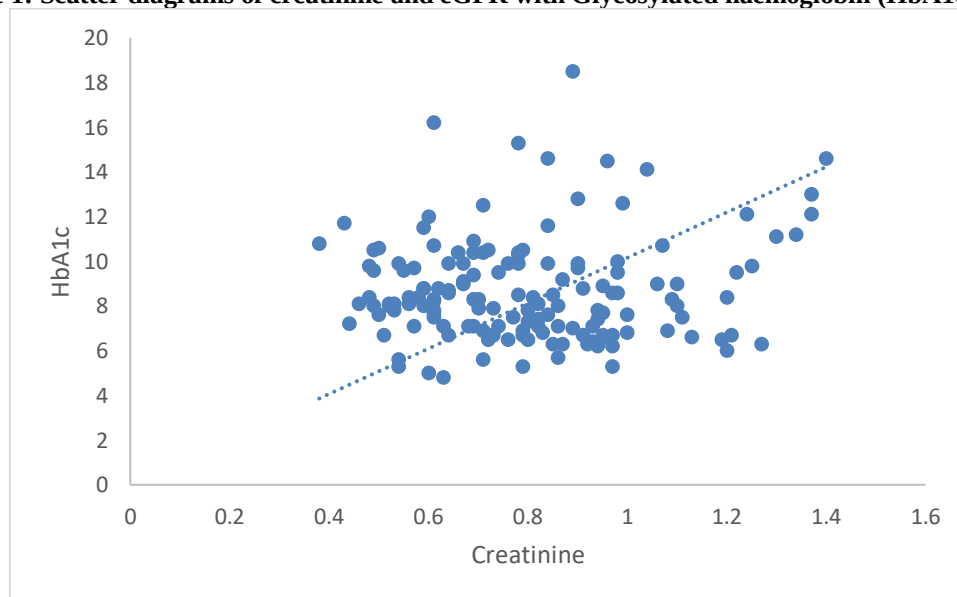
		Estimated GFR											
		Normal		Mild		Moderate		Severe		Chronic		Total	
		N	%	N	%	N	%	N	%	N	%	N	%
Age	Young Adults	16	10.7	0	0	0	0	0	0	0	0	16	10.7
	Middle aged adults	120	80	11	7.3	3	2	0	0	0	0	134	89.3
Gender	Female	59	39.3	6	4	3	2	0	0	0	0	68	45.3
	Male	77	51.4	5	3.3	0	0	0	0	0	0	82	54.7
HbA1c	HbA1c <7%	36	24	2	1.3	0	0	0	0	0	0	38	25.3
	HbA1c >7%	100	66.7	9	6	3	2	0	0	0	0	112	74.7

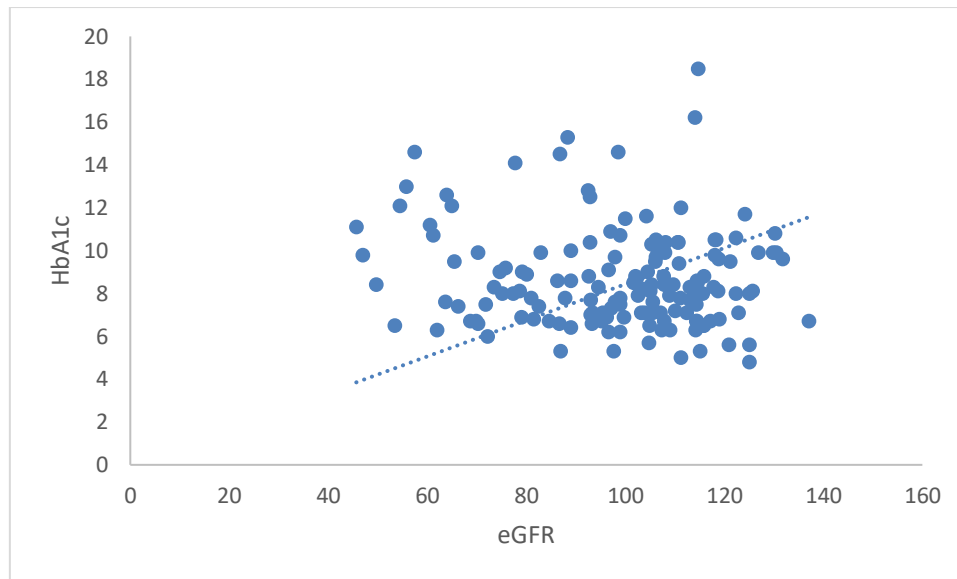
Table 5: The pearson correlation test results

Pearson correlation results				
		Creatinine	eGFR	HbA1c
Creatinine	r	1	-0.832*	0.100
	P value	-	<0.001	0.224
eGFR	r	-0.832*	1	-0.125
	P value	<0.001	-	0.128
HbA1c	r	0.100	-0.125	1
	P value	0.224	0.128	-

* Correlation is significant at the $P < 0.05$

Figure 1: Scatter diagrams of creatinine and eGFR with Glycosylated haemoglobin (HbA1c) levels.





DISCUSSION:

Currently, the overall incidence of chronic kidney disease (CKD) in India is estimated to be about 800 cases per million population (pmp), with end-stage renal disease (ESRD) occurring at 150-200 pmp. Diabetes mellitus is the principal cause of CKD, being identified in 31.2% of patients with the disease. Diabetes has become a serious health hazard around the globe, particularly in developing countries where it is the primary cause of kidney failure. Screening for early signs of diabetes-related kidney disease would be a feasible and cost-effective intervention for these regions.^[5]

This present study consisting of 82 male and 68 females with a mean age of 49.07 ± 9.92 years. Average body mass index of the subjects was 27.54 ± 3.83 .

HbA1c being indicator of diabetic control in the previous 6-8 weeks, it can be correlated with the creatinine and eGFR to find out the association and this considering the risks of abnormal kidney function in mind, we carried out a cross-sectional study to correlate HbA1c levels with serum creatinine and eGFR.

In our study Pearson's correlation coefficient was used to find correlation between HbA1c and serum creatinine and eGFR whose results indicated a non-significant positive correlation of HbA1c with serum creatinine and eGFR, but a significant positive correlation was discovered within creatinine and eGFR, which are in accordance to Nabila et al. (2022) where the correlation between HbA1C and serum creatinine levels in Javanese patients with type 2 diabetes mellitus and Mendoza López et al. (2024) after examining risk factors associated with glomerular filtration rate in Mexican adults with type 2 diabetes mellitus both of them found non-significant correlation between HbA1c and serum creatinine/eGFR.^{[7][9]}

A study by Anjankar (2021) correlated HbA1c levels with serum creatinine, and found a significant positive correlation between HbA1c and serum creatinine highlighting their relationship in assessing renal function among type 2 diabetic patients.^[5] In another study by Amandeep paul et al (2025) the correlation between HbA1c and creatinine levels, concluded a positive significant correlation between both the parameters, and stated the importance of monitoring HbA1c and renal markers to detect renal impairment.^[6]

Riyami A et al. (2024) done a study to check any indication of renal impairment in T2DM patients, they correlated the fasting blood glucose levels with the creatinine levels and estimated GFR values but were unable to find a significant correlation between the parameters.^[8] But the study by Raghavani PH et al. (2020) found out a negative significant correlation between HbA1c and eGFR in T2DM patients.^[11]

In our study relying on only one center for subjects may limit how well the results apply to the other places and people. This can create biases and makes it hard to apply the findings to different regions or populations. Additional research with a large sample sizes and different places to support or contradict the results from our region in various situations are needed. Therefore, reducing renal impairment in T2DM patients.

CONCLUSIONS

There was no correlation between HbA1c and either creatinine or eGFR. Hence HbA1c levels might not suggest that all T2DM individuals with low glycemic control will experience kidney impairment, although good glycemic control is necessary to prevent later complications in diabetes mellitus patients. However, the validated inverse relationship between creatinine and eGFR implies that mechanisms other than chronic hyperglycemia are likely responsible for early renal dysfunction in these patients. Further studies should

investigate other risk factors for early renal dysfunction in T2DM patients with poor glycemic control.

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