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SERUM LIPID PROFILE AND ITS CORRELATION WITH HBA1C AMONG ADULTS TYPE 2 DIABETES MELLITUS PATIENTS - A FACILITY BASED OBSERVATIONAL STUDY

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ABSTRACT

Introduction: In Type 2 Diabetes Mellitus(T2DM), chronic hyperglycemia results in nephropathy detectable as rising values of creatinine and decreased levels of eGFR.

Objective: To determine the correlation of HbA1c with serum creatinine and estimated glomerular filtration rate among adult patients with type 2 diabetes mellitus.

Methods: A facility-based cross-sectional study was carried out on 150 subjects from April 2025 to July 2025 who visited the Diabetes Care Clinic of KLE 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 a male prevalence. The mean HbA1c levels of the participants were 8.69±2.33%. A significant correlation was observed between creatinine and 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

Type 2 diabetes mellitus (T2DM) is a chronic metabolic disorder characterized by insulin resistance, progressive beta-cell dysfunction, and persistent hyperglycaemia. It has become a major public-health concern worldwide because of its growing prevalence and its association with cardiovascular, renal, neurological, and ocular complications. Globally, the number of people living with diabetes increased from approximately 200 million in 1990 to about 830 million in 2022, with a large proportion residing in low- and middle-income countries [1]. Cardiovascular disease remains the principal cause of morbidity and mortality among individuals with T2DM, making early assessment and control of modifiable risk factors essential [2]. Based on the latest statistics, and since T2DM has been declared a worldwide epidemic, these estimates are from the year 2019, and about 463 million people fell under the 20-79 age category with a 4.2 million mortality rate from the disease per year. T2DM is the prevalent one compared to the others [3]. It is the insulin resistance type diabetes. Besides the increased blood sugar, some other consequential metabolic scenarios and diseases are weight gain, i.e., obesity, high blood pressure, and dyslipidaemia [4]. Participants with even slightly raised HbA1c levels may not even know they have the disease. It reflects glucose exposure and control for a considerable period [5]. Glycated haemoglobin (HbA1c) is widely used to assess average glycaemic control over the preceding two to three months. It reflects chronic exposure of haemoglobin to circulating glucose and is valuable for diagnosis, monitoring of treatment response, and estimation of long-term risk of microvascular and macrovascular complications [6]. Poor glycaemic control is associated with oxidative stress, altered hepatic lipid metabolism, increased free fatty acid flux, and impaired lipoprotein clearance, all of which may worsen the lipid profile [7,8]. This biological link makes HbA1c a potentially useful indicator of dyslipidaemia and cardiovascular risk in adults with T2DM.

Several studies have explored the relationship between HbA1c and serum lipid parameters in patients with T2DM [9]. Many have reported that increasing HbA1c levels are associated with higher total cholesterol, triglycerides, and LDL-C, along with lower HDL-C levels [10]. However, the strength and direction of these associations have varied between populations. Some studies have shown stronger correlations with triglycerides

and HDL-C, whereas others have found significant relationships with total cholesterol or LDL-C [11]. These differences may reflect variation in obesity, diet, duration of diabetes, medication use, physical activity, glycaemic status, and underlying genetic factors.

Objective

To determine the correlation of HbA1c with serum creatinine and estimated glomerular filtration rate among adult patients with type 2 diabetes mellitus.

METHODOLOGY

This study is a facility-based cross-sectional study that was carried out in the diabetes care clinic of KLEs Dr Prabhakar Kore Hospital & Medical Research Center, Belagavi, Karnataka, India from April 2025 to July 2025. Permission for the study was obtained from the Institutional Ethics Committee. A study conducted at Reza et al. (2023), published in Jurnal Ilmu Kesehatan [12], reported that the Pearsons 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 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

Data collection

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.

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.

Table 1: Frequency distribution of creatinine levels among type 2 diabetes mellitus patients (n=150)

Parameter	Normal n (%)	Low n (%)	High n (%)	Total n (%)	Mean ± SD
Creatinine	120 (80.0)	14 (9.3)	16 (10.7)	150 (100.0)	0.80 ± 0.22

Most participants were middle-aged adults (134, 89.3%), among whom 105 (70.0%) had normal creatinine levels, 13 (8.6%) had low levels, and 16 (10.7%) had elevated levels. Among young adults, 15 (10.0%) had normal creatinine and only 1 (0.7%) had a low creatinine level, while none had elevated creatinine. Males constituted the majority of participants (82, 54.7%), with 71 (47.4%) exhibiting normal creatinine levels, whereas females accounted for 68 (45.3%), of whom 49 (32.7%) had normal creatinine levels.

Table 2: Distribution of creatinine levels according to age, gender, and HbA1c among type 2 diabetes mellitus patients (n=150)

Variable	Category	Low n (%)	High n (%)	Normal n (%)	Total n (%)
Age	Young adults	1 (0.7)	0 (0.0)	15 (10.0)	16 (10.7)
	Middle-aged adults	13 (8.6)	16 (10.7)	105 (70.0)	134 (89.3)
Gender	Female	11 (7.3)	8 (5.3)	49 (32.7)	68 (45.3)
	Male	3 (2.0)	8 (5.3)	71 (47.4)	82 (54.7)
HbA1c	<7%	0 (0.0)	4 (2.7)	34 (22.7)	38 (25.4)
	≥7%	14 (9.3)	12 (8.0)	86 (57.3)	112 (74.6)

Normal renal filtration function was observed in 136 (91.0%) patients. Mild reduction in eGFR was identified in 11 (7.0%) patients, while only 3 (2.0%) demonstrated moderate reduction. None of the participants had severe reduction or chronic kidney failure based on eGFR classification.

Table 3: Frequency distribution of estimated glomerular filtration rate among type 2 diabetes mellitus patients (n=150)

Parameter	Normal n (%)	Mild n (%)	Moderate n (%)	Severe n (%)	Chronic n (%)	Total n (%)
Estimated GFR (mL/min/1.73 m²)	136 (91.0)	11 (7.0)	3 (2.0)	0 (0.0)	0 (0.0)	150 (100.0)

ll young adults (16, 10.7%) had normal eGFR. Among middle-aged adults, 120 (80.0%) had normal renal function, while 11 (7.3%) and 3 (2.0%) had mild and moderate reductions in eGFR, respectively. Among females, 59 (39.3%) had normal eGFR, with 6 (4.0%) exhibiting mild impairment and 3 (2.0%) showing moderate impairment. In males, 77 (51.4%) had normal eGFR and 5 (3.3%) had mild impairment, while none had moderate or severe reductions.

Table 4: Distribution of estimated glomerular filtration rate according to age, gender, and HbA1c among type 2 diabetes mellitus patients (n=150)

Variable	Category	Normal n (%)	Mild n (%)	Moderate n (%)	Severe n (%)	Chronic n (%)	Total n (%)
Age	Young adults	16 (10.7)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	16 (10.7)
	Middle-aged adults	120 (80.0)	11 (7.3)	3 (2.0)	0 (0.0)	0 (0.0)	134 (89.3)
Gender	Female	59 (39.3)	6 (4.0)	3 (2.0)	0 (0.0)	0 (0.0)	68 (45.3)
	Male	77 (51.4)	5 (3.3)	0 (0.0)	0 (0.0)	0 (0.0)	82 (54.7)
HbA1c	<7%	36 (24.0)	2 (1.3)	0 (0.0)	0 (0.0)	0 (0.0)	38 (25.3)
	≥7%	100 (66.7)	9 (6.0)	3 (2.0)	0 (0.0)	0 (0.0)	112 (74.7)

A strong and statistically significant negative correlation was observed between serum creatinine and eGFR ($r = -0.832$, $p < 0.001$), indicating that increasing creatinine levels were associated with declining renal filtration function. HbA1c demonstrated a weak positive but non-significant correlation with serum creatinine ($r = 0.100$, $p = 0.224$) and a weak negative but non-significant correlation with eGFR ($r = -0.125$, $p = 0.128$).

Table 5: Pearson correlation between creatinine, eGFR, and HbA1c

Variable	Statistic	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	—

DISCUSSION

Diabetes mellitus is a major public health concern and remains one of the leading causes of chronic kidney disease worldwide. Persistent hyperglycemia in type 2 diabetes mellitus can contribute to microvascular damage, including diabetic nephropathy, which may initially present with subtle alterations in renal function markers. Therefore, monitoring glycemic control along with renal parameters such as serum creatinine and estimated glomerular filtration rate is important for early identification of renal impairment and timely clinical intervention. In the present study, the mean age of the participants was 49.07 ± 9.92 years, with a slight male predominance. Most patients had poor glycemic control, as reflected by a mean HbA1c level of 8.69 ± 2.33%, and 74.6% of patients had HbA1c levels greater than 7%. Despite this high proportion of poorly controlled diabetes, most participants had normal serum creatinine levels and normal eGFR. Serum creatinine was normal in 80.0% of patients, while high creatinine was observed in only 10.7%. Similarly, normal eGFR was seen in 91.0% of patients,

with only 7.0% showing mild and 2.0% showing moderate reduction in eGFR. These findings suggest that although poor glycemic control was common, overt renal dysfunction was not frequent in this study population [12,13]. Hence, about that goal, a cross-sectional study was implemented to correlate HbA1c with serum creatinine and eGFR. In our study, Pearson's correlation coefficient was used to find the correlation between HbA1c and serum creatinine and eGFR which indicated that a slight increase in HbA1c corresponded to a slight increase in serum creatinine and eGFR [14]. However, it was more notably and positively correlated that creatinine was to eGFR and that was the portion primarily in agreement with other studies. Examining the correlation between serum creatinine levels and HbA1C values in patients diagnosed with type 2 diabetes mellitus and on the glomerular filtration rate risk factors in adult Mexicans with type 2 diabetes mellitus, both have observed a lack of statistical significance between HbA1c and serum creatinine/eGFR [15,16]. The present study involved participants from a single centre, which might limit the generalisability of the findings beyond that centre. Some biases can make it difficult to generalise the findings to other areas or populations [17]. There is a need for larger-scale studies to corroborate or refute the findings obtained from our region, as well as for the translational scenarios [18]. This study had some limitations. First, it was conducted at a single healthcare facility, which may limit the generalizability of the findings to other populations. Second, the cross-sectional design prevented assessment of causal relationships between HbA1c and renal function markers. Third, the duration of diabetes, treatment history, blood pressure control, body mass index, lifestyle factors, and medication use were not fully analyzed, although these factors may influence renal function. Fourth, renal assessment was based mainly on serum creatinine and eGFR, while urine albumin-to-creatinine ratio was not included, which may have limited the detection of early diabetic kidney disease. Finally, the sample size was relatively modest, and larger multicenter studies are needed to confirm these findings.

CONCLUSIONS

It is concluded that HbA1c showed no statistically significant correlation with serum creatinine or estimated glomerular filtration rate among adult patients with type 2 diabetes mellitus. Most patients had preserved renal function despite poor glycemic control. However, serum creatinine demonstrated a strong inverse correlation with eGFR, confirming the expected relationship between these renal function markers. These findings suggest that HbA1c alone may not be sufficient to predict early renal dysfunction in type 2 diabetes mellitus, and routine renal assessment using creatinine, eGFR, and other markers such as urine albumin-to-creatinine ratio should be considered for early detection and prevention of diabetic kidney disease.

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