

CORRELATION OF GLYCATED HEMOGLOBIN AND FATING LIPID PROFILE AMONG TYPE 2 DIABETES PATIENTS

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ABSTRACT

Background and Objectives: Patients with T2DM are at an increased risk of developing dyslipidemia, which is associated with cardiovascular diseases. This study aimed to assess the relationship between HbA1c levels and the fasting lipid profile in individuals with T2DM within our community.

Methods: This cross-sectional study was performed from November 2024 to April 2025 at Farooq Hospital, Lahore. One hundred sixty T2DM patients were included, whereas people without T2DM were excluded. The sample was collected in EDTA and clotted vacutainers separately for analysis of HbA1c and fasting lipid profile. The data was evaluated using IBM SPSS version 27.0 software. The Chi-square test and Pearson correlation were applied to determine the relationship between variables.

Results: Of the 160 T2DM patients, 48.75% were male and 51.25% were female. The average age was 54.16 ± 12.978 . Out of the total, 25% T2DM patients exhibited adequate glycemic control, whereas 75% T2DM patients did not achieve adequate glycemic control. The average HbA1c, cholesterol, TG, HDL, and LDL levels were 8.159 ± 2.064 , 195.83 ± 67.32 , 195.63 ± 226.51 , 44.5 ± 15.57 , and 110.04 ± 40.72 , respectively. Cholesterol, TG, and HDL had a positive correlation with HbA1c; however LDL showed a negative correlation.

Conclusion: The elevated HbA1c is a good predictor of dyslipidemia so the patients must to be instructed to consistently monitor and regulate fasting lipid profile and HbA1c levels.

Key Words: Type 2 diabetes mellitus, fasting lipid profile, glycated hemoglobin

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Insulin resistance occurs when the body's cells become less receptive to insulin, is a defining feature of type 2 diabetes mellitus (T2DM). This causes the increased blood sugar levels. T2DM is diagnosed when a patient's glycated hemoglobin (HbA1C) is $> 6.5\%$, fasting blood glucose is ≥ 126 mg/dL, or 2-hour post-prandial glucose is ≥ 200 mg/dL.^{1,2} Chronic T2DM can harm, malfunction, and

destroy several organs, including the eyes, nerves, foot, blood vessels, kidneys, and heart. Prolonged diabetes has been associated to microvascular complications such as retinopathy, neuropathy, and nephropathy.³ T2DM morbidity and consequences can be significantly decreased by maintaining strict glycemic control, aiming for an HbA1c of less than 7%.²

In 2015, the International Diabetes Federation stated that 415 million people between the ages of 20 and 79 were diagnosed with T2DM. The prevalence of the condition is expected to increase to around 573 million adults by the year 2021. The number of people throughout the world who have T2DM is expected to rise 200 million by the year 2040.⁴ Southeast Asian nations have also experienced a rise during the previous two decades. The top three countries with the highest overall number of people with T2DM are China (88.5 million), India (65.9 million), and the United States (28.9 million), owing to their massive populations.⁵

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The T2DM patients are more likely to develop dyslipidemia, which is linked to macrovascular diseases like heart disease and stroke, as well as microvascular diseases like neuropathy and nephropathy.⁶ Dyslipidemia is distinguished by elevated triglyceride (TG) levels, low high-density lipoprotein (HDL) levels, and elevated low-density lipoprotein (LDL) levels in blood.^{7,8} Some studies revealed that HbA1c might be a good predictor of dyslipidemia and heart disease.^{9,10} Despite its usage as a measure of glycemic control and related diabetic problems, several research question the link between HbA1c and dyslipidemia.^{11,12} This study was carried out to assess the correlation between HbA1c levels and fasting lipid profiles among T2DM people within our community.

METHODS

This cross-sectional study was conducted from November 2024 to April 2025. A non-probability convenient sampling technique was followed. The one hundred and sixty T2DM patients of the said duration were included and non-diabetic patients were excluded. A performa was designed to collect the data. Following the acquisition of verbal informed consent, samples were collected from T2DM patients. About 3ml to 5 ml, the ethylenediamine tetraa-cetic acid (EDTA) blood samples were collected to perform HbA1c and clotted sample were collected to perform fasting lipid profile. The HbA1c and fasting lipid profile

were performed through automated analyzers. The collected data was entered in a excel sheet and analyzed by the Statistical Package for the Social Sciences (IBM SPSS) version 27.0 software. A descriptive statistical analysis was conducted. The qualitative variables were estimated through frequency and percentages while quantitative variables were estimated by mean (+ standard deviation). The Chi-square test and Pearson correlation were applied to determine the relationship between variables.

RESULTS

Among the 160 T2DM patients, 78 (48.75%) were male, and 82 (51.25%) were female. The range of age was 28 to 81 years old. The mean (\pm standard deviation) age was 54.16 ± 12.978 . The HbA1c levels in T2DM patients were estimated. From total, 40 (25%) T2DM patients had good glycemic control (5.5% to 6.5%) while 120 (75%) T2DM patients do not have good glycemic control ($> 6.5\%$) (Figure 1). The fasting lipid profile was accessed in T2DM patients (Table 1). The values of fasting lipid profile were also accessed with good and poor glycemic control of T2DM patients (Table 2). The cholesterol, TG, and HDL demonstrated an almost perfect correlation with HbA1c showed values of 0.096, 0.269, and 0.231 respectively. The LDL demonstrated negative correlation (-0.062) with HbA1c (Table 3).

Table 1: Fasting lipid profile values of type 2 diabetes mellitus patients

Biochemical parameters	Frequency (%)	Range	Mean \pm SD	Standard error of mean
HbA1c	160 (100%)	5.4-12.5	8.159 \pm 2.064	0.163
Cholesterol				
< 200 mg/dl	86 (53.75%)			
> 200 mg/dl	74 (46.25%)	24.6-555	195.83 \pm 67.32	5.322
TG				
< 150 mg/dl	84 (52.5%)	57-2061	195.63 \pm 226.51	17.907
> 150 mg/dl	76 (47.5%)			
HDL				
< 34 mg/dl	18 (11.25%)	11-154	44.5 \pm 15.57	1.231
34-65 mg/dl	136 (85.0%)			
> 65 mg/dl	6 (3.75%)			
LDL				
> 100 mg/dl	88 (55.0%)	24-244	110.04 \pm 40.72	3.22
< 100 mg/dl	72 (45.0%)			

Table 2: Comparison of fasting lipid profile values with good and poor glycemic control

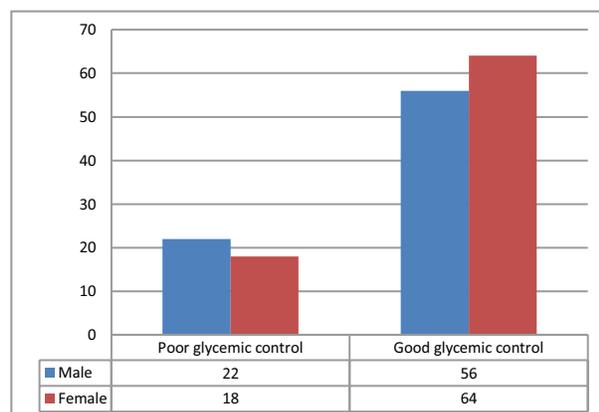
Biochemical parameters	Good glycemic control	Poor glycemic control	p-value (Chi-square)
	(HbA1c: 5.5%-6.5%)	(HbA1c: >6.5%)	
Cholesterol			
< 200 mg/dl	26 (16.25%)	15 (9.37%)	0.001*
> 200 mg/dl	60 (37.5%)	59 (36.87%)	
TG			
< 150 mg/dl	22 (13.75%)	18 (11.25%)	0.001*
> 150 mg/dl	62 (38.75%)	58 (36.25%)	
HDL			
< 34 mg/dl	6 (3.75%)	12 (7.5%)	0.004*
34-65 mg/dl	34 (21.25%)	102 (63.75%)	
> 65 mg/dl	-	6 (3.75%)	
LDL			
> 100 mg/dl	24 (15.0%)	16 (10.0%)	0.001*
< 100 mg/dl	64 (40.0%)	56 (35.0%)	

Table 3: Correlation matrix of fasting lipid profile with glycated hemoglobin

		HbA1c	Cholesterol	TG	HDL	LDL
HbA1c	Pearson Correlation	1	0.096	.269**	.231**	-0.062
	Sig. (2-tailed)		0.228	0.001	0.003	0.439
Cholesterol	Pearson Correlation	0.096	1	.682**	.751**	.475**
	Sig. (2-tailed)	0.228		0	0	0
TG	Pearson Correlation	.269**	.682**	1	.739**	-.195*
	Sig. (2-tailed)	0.001	0		0	0.013
HDL	Pearson Correlation	.231**	.751**	.739**	1	0.122
	Sig. (2-tailed)	0.003	0	0		0.126
LDL	Pearson Correlation	-0.062	.475**	-.195*	0.122	1
	Sig. (2-tailed)	0.439	0	0.013	0.126	

**Correlation is significant at the 0.01 level (2-tailed).

*Correlation is significant at the 0.05 level (2-tailed).

**Figure-1:** Glycemic control in gender

DISCUSSION

T2DM can result in problems such as cardiovascular disease. The present study evaluated the association between fasting lipid profile and HbA1c. The research by Hussain A et al. indicated that HbA1c serves as a predictor of dyslipidaemia and a reliable glycemic index, with its early detection acting as a preventive measure against the progression of cardiovascular disease in individuals with T2DM.¹³ In present study, more females (51.25%) were observed to have T2DM than males (48.75%) with the mean age of 54.16 ± 12.978 . The good glycemic control was also observed in females (40.0%) than males (35.0%). A study by Rehman et al. represented

consistent findings with present study. They showed 47% were males and 53% were females with the mean age of 47.85 ± 8.61 . They also observed good glycemic control in females (17%) than males (14%).¹⁴

In present study the mean HBA1c, cholesterol, TG, HDL and LDL were 8.159 ± 2.064 , 195.83 ± 67.32 , 195.63 ± 226.51 , 44.5 ± 15.57 , and 110.04 ± 40.72 respectively. The study of Shaik et al., represented that the mean cholesterol was 179.53 ± 16.36 , the mean TG level was 183.74 ± 17.64 , mean LDL was 105.85 ± 8.50 , mean HDL was 36.94 ± 4.28 and mean HBA1c was 7.96 ± 1.46 in T2DM patients.¹⁵

The present study evaluated that the cholesterol ($p=0.001$), TG ($p=0.001$), HDL ($p=0.004$) and LDL ($p=0.001$) were associated with HBA1c. The study by Rehman et al., found that the cholesterol and LDL were associated while TG and HDL were not statistically associated with glycemic control.¹⁴ In present study, cholesterol, TG, and HDL demonstrated an almost perfect correlation with HBA1c while LDL demonstrated negative correlation. Arshad Hussain and his colleagues obtained comparable results in Afghan patients with a mean age of 51 years. Their investigation demonstrated a positive correlation between total cholesterol, TG, and LDL. The connection between HbA1c and HDL was negative, however it was statistically insignificant.¹³ The results were comparable to the present study, possibly due to the significant genetic connection between the Afghani and Pakistani population.

A study by Yahya et al., represented that the cholesterol, and TG, were substantially elevated in individuals with uncontrolled T2DM (p -values= 0.009 , 0.001 , and 0.001 , respectively). The LDL and HDL levels were considerably lower in individuals with uncontrolled T2DM (p -values= 0.941 , 0.198). The patient's glycemic regulation significantly influences blood lipid levels.¹⁶ Various causes may account for the minor differences in comparison. The sampling of lipid profiles may provide elevated blood TG levels if not conducted in a fasted condition. However, the determination that HbA1c can serve as a predictor for dyslipidemia remained unchanged.

CONCLUSION

The present study established that the dyslipidemia in T2DM patients is correlated with HBA1c. The

cholesterol, TG and HDL were found to be positive correlated with HBA1c while LDL showed negative correlation. The elevated HBA1c is a good predictor of dyslipidemia so the patients must be instructed to consistently monitor and regulate fasting lipid profile and HBA1c levels.

Ethical Approval: The institutional review board granted the approval (Ref No: FH/CU/0106/2024-2025).

Conflict of Interest: *None*

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AUTHOR'S CONTRIBUTION

Omar Shahid: Data Collection

Rabia Sadaf: Data Analysis

Fiaz Rafiq: Interpretation of results, Statistical Analysis

Zainab Yousaf: Statistical analysis, Manuscript drafting and revision

Masooma Jaffar: Results interpretation, Supervision

Rizwan Akhtar: Manuscript writing, Critical analysis and curation of data

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