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Original Research Article

The Study of the Association between Glycated Haemoglobin and Lipid Profile in Type 2 Diabetes Mellitus at a Tertiary Care Centre: A Retrospective Cross-Sectional Study

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Conflict of interest: Nil

Abstract:

Background: Type 2 diabetes mellitus patients are prone to diabetic dyslipidemia, which puts them at risk of developing macrovascular (stroke, peripheral vascular disease, and coronary artery disease and microvascular (nephropathy, neuropathy, and retinopathy) diseases.

Aims and Objectives: In the present study, we find the association between HbA1c and the lipid profile in patients with T2DM.

Materials and Methods: The present retrospective cross-sectional study was carried out on 90 Eastern Indian diabetic patients at the Pharmacology Department in collaboration with the Medicine Department at Nalanda Medical College and Hospital, Patna, Bihar.

Result: The mean age of the female participants was 60.73±13.91 years and male participants was 56.83±12.54 years. The participants' basic characteristics were analysed and compared according to gender. The females had significantly higher values for BMI, HbA1c, TC, HDL-C, LDL-C, TG, FBS and PPBS compared to the males.

Conclusion: In the present study, a significant positive relationship was found between HbA1c and triglycerides (TGs) while no significant associations were found with age, BMI, TC, LDL-C, HDL-C, or FBS levels.

Keywords: Type 2 diabetes mellitus, Glycated hemoglobin, Glycemic control, dyslipidemia, Triglyceride.

Introduction

Type 2 diabetes mellitus patients are prone to diabetic dyslipidemia, which puts them at risk of developing macrovascular (stroke, peripheral vascular disease, and coronary artery disease [CAD] and microvascular (nephropathy, neuropathy, and retinopathy) diseases [1]. Naqvi et al. (2017) have reported that, for T2DM patients, one of the most common complications linked with uncontrolled hyperglycemia is dyslipidemia, and they show a positive relationship between HbA1c and high triglyceride levels, HbA1c may be a marker of triglyceride levels, and it may be able to predict Cardiovascular Disease risk factors in people with type 2diabetes [2]. Glycated haemoglobin (HbA1c) levels are routinely measured in diabetics to monitor their glycemic control. The goal is to achieve a level below 7%. Multiple factors, like sugar intake, exercise, and medication adherence, can have an effect on HbA1c levels. Some studies have reported that HbA1c could potentially be utilised as a possible biomarker for predicting dyslipidemia and cardiovascular disease (CVD) [3, 4]. Ozder A, study showed widespread lipid abnormalities, including hypercholesterolemia, hypertriglyceridemia, elevated LDL, and decreased HDL, in the course of diabetes-triggered dyslipidemia. This study shows that hyperlipidemia predominates over the increased prevalence of diabetic dyslipidemia [5].

There are several conflicting results in the literature, such as a Turkish study that found a significant relationship between total cholesterol (TC), LDL, triglycerides (TGs), and HbA1c5, while others reported no considerable relationship [6].

Abnormalities of lipid profiles in diabetic patients, often termed "diabetic dyslipidemia", are characterised by high total cholesterol (TC), high triglycerides (TGs), low high-density lipoprotein cholesterol (HDL-C), increased levels of low-density lipoprotein (LDL) particles, and increased levels of very low-density lipoprotein cholesterol (VLDL-C) [7]. Elevated HbA1c is an independent risk factor for dyslipidemia and coronary artery disease. It has also been seen that 18% of cardiovascular disease (CVD) risk increases with every 1% increase in HbA1c in diabetics. It has been suggested that a reduction of 0.2% in the value of HbA1c reduces mortality due to cardiovascular events by 10% [8].

Aims and Objectives: In the present study, we find the association between HbA1c and the lipid profile in patients with Type 2 diabetes mellitus.

Materials and Methods

The present retrospective cross-sectional study was carried out on 90 Eastern Indian diabetic patients. A written informed consent was obtained and documented from all participants, and they were informed about the nature of the study. The confidentiality of the study subjects was maintained. The study was conducted at the Pharmacology Department in collaboration with the Medicine Department at Nalanda Medical College and Hospital, Patna, Bihar, India. The study protocol has been revised and approved by the institute's Research Ethics Committee. The study was done from January 2022 to December 2022.

Inclusion Criteria

All patients aged >30 years with a known diagnosis or newly diagnosed with Type 2 Diabetes mellitus as per American Diabetic Association (ADA) criteria established in 2010 were included in the study.

Exclusion Criteria

Patients suffering from CVD, thyroid disorders, renal problems, and other endocrinopathies, as well as those taking lipid-lowering agents, were excluded from the study.

These criteria set the following as values that are indicative of T2DM: HbA1C 6.5%, FPG 126 mg/dl (7.0 mmol/l), 2-h plasma glucose 200 mg/dl (11.1 mmol/l) during an oral glucose tolerance test (OGTT), or random plasma glucose 200 mg/dl (11.1 mmol/l).

Necessary demographic, clinical, and laboratory parameters like age, sex, diabetes, height, weight, blood sugar fasting, postprandial, and various lipid profiles were collected in a preformed questionnaire through a guided interview.

Statistical analysis was done using SPSS version 22 and Microsoft Excel 15 to calculate Numerical data was expressed as the mean, and standard qualitative data was expressed as frequency and percentage. The Student's t-test was applied for comparison, and the mean and standard deviation were used to express quantitative data. The Pearson correlation coefficient was applied to measure the correlation between various parameters, and an independent sample t-test was utilised to measure the mean difference between different parameters. A linear regression test was computed to find out the association between HbA1c and lipid profile, FPG, BMI, and age; the results were regarded as significant when the p-value was <0.050.

Results

In our study, there were a total of 90 patients (49 females and 41 males). The mean age (mean ±S.D.) of the female participants was 60.73±13.91 years, and that of the male participants was 56.83±12.54 years. According to gender, an analysis and comparison of the participants' basic characteristics was conducted. The females had significantly higher values for BMI (p =0.001), HbA1c (p=0.008), TC (p =0.005), HDL-C (p = 0.001), LDL-C (p =0.002), TG (p = 0.58), FBS (p = 0.08), and PPBS (p = 0.213) compared to the males (Table 1 and Graph 1).

Table 1: Gender-wise comparison of Demographic and clinical parameters of type 2 DM

Parameters	Females(n=49)	Males(n=41)	p-value
	(Mean ± SD)		
Age (years)	60.73±13.91	56.83±12.54	0.531
BMI (Kg/m^2)	28.56±5.23	26.59±4.91	0.001*
HbA1C (gm%)	8.15±1.68	7.60±1.76	0.008*
Total cholesterol (mg/dl)	176.14±38.12	156.32±40.95	0.005*
HDL-C (mg/dl)	50.83±16.06	43.35±12.65	0.001*
LDL-C (mg/dl)	110.34±35.72	88.75±32.54	<0.002*
Triglyceride (mg/dl)	148.79±103.6	140.82±77.94	0.58
FBS (mg/dl)	158.26±44.71	152.92±38.17	0.08
PPBS (mg/dl)	216.59±50.95	206.52±52.41	0.213

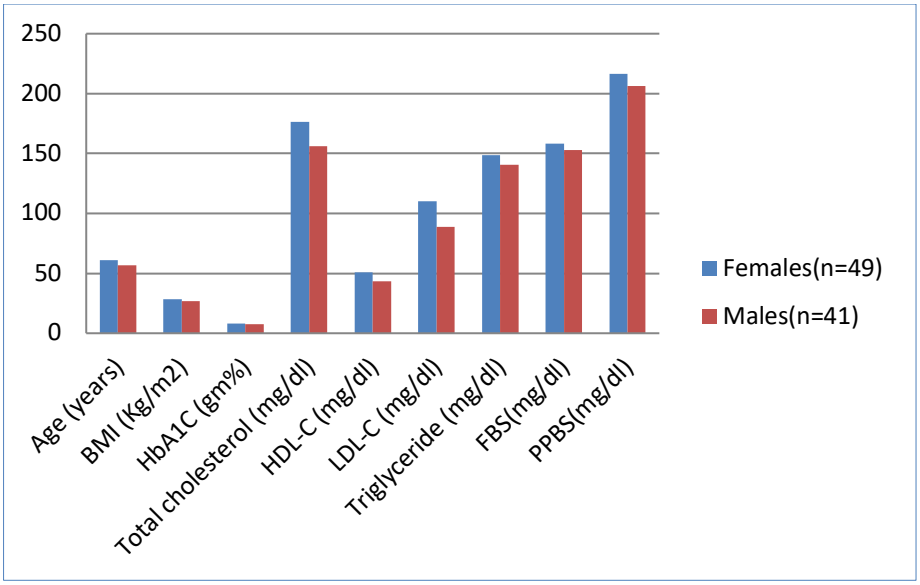

Figure 1: Gender wise comparison of demographic and clinical parameters of type 2 DM patients

Note:*Significant p-value. Abbreviations: BMI, Body mass index; LDL-C, Low-density lipoprotein cholesterol; HDL-C, High-density lipoprotein cholesterol; FBS, Fasting Blood Sugar; PPBS, Postprandial Blood Sugar

Table 2: Comparison of basic parameters of type 2 diabetes mellitus patients according to their glycaemic control

Parameter	Good glycemic control (HbA1c level <7%) (n=39)	Poor glycemic control (HbA1c≥7%) (n=51)	p-value
	Mean ± SD		
Age (years)	60.5±14.37	58.85±15.58	0.20
BMI (Kg/m^2)	28.50±7.91	30.43±6.50	0.130
HbA1c (gm%)	6.31±1.50	7.84±1.98	<0.002
Total cholesterol (mg/dl)	192.90±44.31	180.51±42.89	0.164
HDL-C (mg/dl)	52.60±14.87	48.04±13.02	0.25
LDL-C (mg/dl)	102.05±36.98	108.93±31.24	0.31
Triglyceride (mg/dl)	167.87±22.51	184.26±66.72	<0.05*
FBS (mg/dl)	142.63±58.96	148.82±56.12	0.42

Note: *Significant *p*-value.

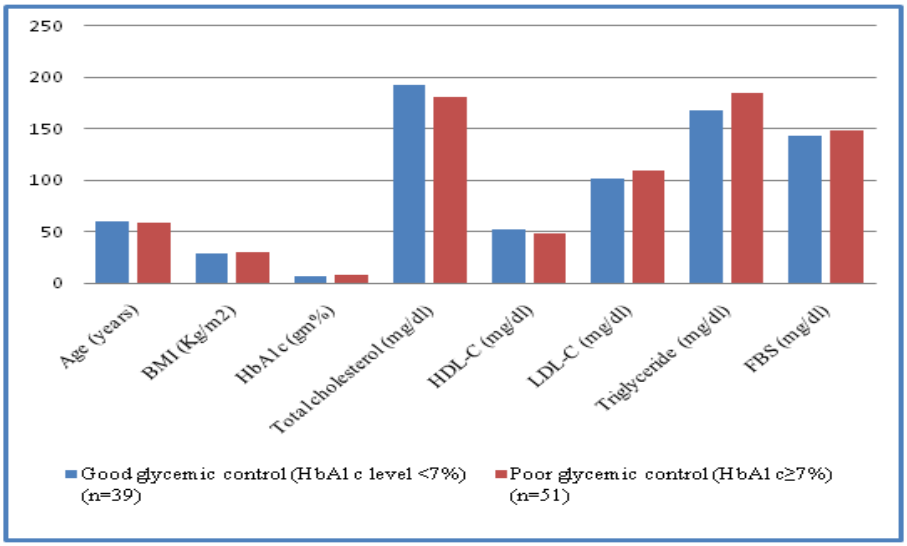

Figure 2: Comparision basic parameters of type 2 DM patients according to their glycemic control

There were 39 (43.33%) patients in the group with HbA1c levels <7%(Good glycemic control), and 51 (56.67%) subjects in the group with HbA1c levels >7%(Poor glycemic control). The TG level (p <0.05) and HbA1c (p <0.002) levels showed a change that was statistically significant, whereas no other parameters showed a significant difference because p values were >0.05 (Table 2 and Figure 2).

Table 3: Correlation analysis between HbA1C and age, BMI, FBS, and lipid parameters

Parameters	Correlation analysis	
	Coefficient	p-value
Age (years)	−0.056	0.246
BMI (Kg/m^2)	0.063	0.321
Total cholesterol (mg/dl)	0.187	0.03
HDL-C (mg/dl)	−0.680	0.230
LDL-C (mg/dl)	0.573	0.162
Triglyceride (mg/dl)	0.416	<0.05*
FPG (mg/dl)	−0.082	0.190

Note: *Significant *p*-value.

Table 3 shows the Pearson correlation of HbA1c with other variables. A significant correlation of HbA1c was observed with TG (r=0.416, p<0.05) but there were no significant correlations with the other parameters.

Table 4: Linear regression analysis of Type 2 DM patients showing dependency of HbA1c on age, BMI, FBS, and lipid parameters

Parameter	Regression analysis	
	Unstandardized Coefficients b	p-value
Age (yrs)	−0.048	0.58
BMI (Kg/m^2)	0.00	0.65
Total cholesterol (mg/dl)	0.130	0.49
HDL-C (mg/dl)	−0.143	0.14
LDL-C (mg/dl)	−0.583	0.56
Triglyceride (mg/dl)	0.391	0.04*
FBS (mg/dl)	−0.056	0.30

The results from a linear regression analysis indicated that the HbA1c values were associated with TG (p=0.04) and were independent of age, BMI, TC, LDL-C, HDL-C and FPG levels (Table 4).

Discussion

In the present study, a significant positive relationship was found between HbA1c and triglycerides (TG). A similar correlation has been reported by Hussain A et al. [8], and Ozder A; [5] that found a positive relationship between HbA1c and high TG levels. Whereas Sarkar S et al. [6], reported no correlation between HbA1c and TG. The results of the present research show that HbA1c is a direct indicator of increased TG and indirectly aids in determining the risk of both macrovascular and microvascular problems [8], Insulin resistance is considered to be the cause of dyslipidemia in people with type 2 diabetes. Inadequate insulin secretion or function that causes higher liver production of very low-density lipoprotein (VLDL) and late removal of TG-rich lipoproteins, primarily as a result of higher substrate levels for TG synthesis, are the reasons for increased TG levels in T2DM patients [15].

The present study found no relationship between HbA1c and TC or LDL-C, similar to the study done by Sarkar S et al. [6] However, Hussain A et al.[8] and Deshmukh S et al.[9] found a significant relationship between HbA1c, TC, and LDL-C.

Further, the present results show a statistically non-significant negative link between HbA1c and HDL-C, similar to Hussain A et al.[8] and Ozder A [5] studies, but inconsistent with several studies that reported a notable negative relationship between HbA1c and HDL-C.(8,9,10) Naeem M. et al.[4] and Singh G. et al.[11] found a positive relationship between HbA1c and HDL-C.

The present findings show that the female group had higher levels of HbA1c than the male group and that women normally have higher HDL-C levels than men. Therefore, no significant negative correlation was found.

The correlation between HbA1c values and TGs was determined by linear regression analysis (p = 0.020), which also showed that the correlation is unrelated to age, BMI, TC, LDL-C, HDL-C, and FPG levels.

Comparing the two genders showed that the females had considerably higher BMI, TC, LDL-C, HDL-C, and HbA1c values than the males, which is consistent with findings from other research that have shown similar findings [4, 12]. However, in this case, our results are dissimilar to those of other studies [3, 13]. One of the reasons for the gender-wise difference in lipid parameters could be the influence of sex hormones on the distribution of body fat, which causes altered lipoprotein levels [14].

The difference in our results could also be due to the differences in BMIs and ages between the two groups, as well as the length of time since diagnosis with DM.

In the present study, it was found that the TG levels of the participants with HbA1c levels above 7% (Poor glycemic control) were significantly higher than those of the group with HbA1c levels below 7% (good glycemic control); however, no significant differences were found in the other parameters. According to Naeem M. et al., people with HbA1c > 7% have significantly higher levels of TC, LDL-C, and TGs as well as lower HDL-C than those with HbA1c <7%. Compared to patients with poor glycemic control, it seems that patients who have good glycemic control have less dyslipidemia.

Hussain et al. reported that HbA1c is not only a dependable glycemic index but also a forecaster of dyslipidemia. Each 1% change in HbA1c values above the normal level shows a variation of approximately 35 mg/dl in the mean blood glucose level [15, 16].

Importantly, a 1% drop in the HbA1c level decreases the 40% risk of microvascular complications.16 However, the literature indicates the positive effects of enhanced physical activity and lifestyle modifications on improving glycemic control and dyslipidemia [17].

The study's strength is that we conducted a comparison, a correlation, and a regression analysis using the patients' complete biochemical data.

Limitations of the study

The present study has certain limitations, including being retrospective, having a small sample size, and not being able to evaluate the patients' dietary preferences, habits, duration of time since DM diagnosis, or duration of regular physical activity.

Conclusion

In the present study, a significant positive relationship was found between HbA1c and triglycerides (TGs) while no significant associations were found with age, BMI, TC, LDL-C, HDL-C, or FBS levels. Therefore, it is important to use caution when interpreting HbA1c as a biomarker of dyslipidemia in our local population. An approach for educating diabetic patients about blood sugar control and the adverse effects of dyslipidemia is necessary. To treat and prevent the condition, family physicians and T2DM patients should be aware of this risk.

Author Contributions

Nitesh Kumar gaves concept and idea, study design, and manuscript drafting data collection and analysis,; Mukeh Kumar, Asha Singh, and S. M. Inamul Haque gave manuscript revision, and data interpretation and valuable suggestions.

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