

ORIGINAL RESEARCH

Relationship between HbA1c and Lipid Profile Seen in Indian Type 2 Diabetes Mellitus Patients Attending tertiary Hospital: A Cross-Sectional Study

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**Abstract:**

**Background:** Diabetes is prone to be known as the life-long disease that affects the way human bodies handle glucose. This study was conducted to assess relationship between HbA1c and lipid profile seen in Indian Type 2 Diabetes mellitus patients attending tertiary hospital.

**Material & methods:** Necessary demographic, clinical and laboratory parameters were collected as in a preformed questionnaire. All these parameters were analyzed. Data was analyzed with Statistical Package for Social Sciences (SPSS) software version 16. A p value less than 0.05 was considered significant.

**Results:** Majority of patients have a high HbA1c level (79%) whereas the rest have the level within the target value (21%). Majority of the patients had high level of triglyceride i.e. 90%. 64% participants had a low level of HDL which is below 40 mg/dl. 91% of patients had a high level of LDL. It was found that there was a correlation between high total cholesterol level with high level of HbA1c. There was an also significant correlation between high level of triglyceride and low level of HDL with high level of HbA1c. There was very slight weak significant correlation found between high level of LDL and high level of HbA1c.

**Conclusion:** The study concluded that there was a correlation between lipid profile and HbA1c in patients with T2DM.

**Keywords:** HbA1c, lipid profile, Type 2 Diabetes mellitus.

**Introduction:**

Diabetes Mellitus (DM) is an endocrine disorder with high blood sugar level with disturbances of carbohydrate, lipid and protein metabolism resulting from variable degree of insulin resistance and deficiency or both.<sup>1</sup> Diabetes, “the disease of millennium” is recognised by raised blood sugar which causes, over a time lethal injuries to the myocardium, arterial endothelial linings, retina, nephrons and myelin sheath of neurons.<sup>2</sup> Diabetes is the leading cause of visual loss, myocardial infarction, cerebrovascular episodes and lower extremities amputation.<sup>3</sup> Abnormalities of lipid profiles in diabetic patients often termed “diabetic dyslipidemia”, is characterized by high total cholesterol (TC), high triglycerides (TG), 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).<sup>4</sup> Glycated hemoglobin (HbA1c) levels are routinely measured in diabetics to monitor their glycemic control. The goal is to achieve a level below 7%. Levels of HbA1c can be affected by multiple factors, including sugar intake, exercise and adherence to medications. Some studies have reported that HbA1c could potentially be utilized as a possible biomarker for predicting dyslipidemia and cardiovascular disease (CVD).<sup>5,6</sup> The level of circulating HbA1c is taken as the gold standard of glycemic control, and regulating it is imperative for avoiding T2DM complications. HbA1c values not only reflect glycemic control but are also the main factor in determining the risk of diabetes-related complications<sup>7</sup> and mortality.<sup>8</sup> This study was conducted to assess relationship between HbA1c and lipid profile seen in Indian Type 2 Diabetes mellitus patients attending tertiary hospital.

**Material & methods:**

The present single centre, cross sectional study was conducted in the Department, in a tertiary care centre among all OPD patients in Raichur institute of medical science, Raichur. The present study was approved by Ethics Committee of the institute as per norms from the institute. Throughout the study, ethical considerations were followed. Written informed consent was taken from all the parents/guardians in accordance with the principles of declaration of Helsinki as revised in 2013. Patients referred to the Central Clinical Laboratory who were suspected of having type 2 Diabetes Mellitus, patients 40 to 70 years old, irrespective of the gender were included in the study. Already diagnosed cases of type 2 Diabetes Mellitus who came for follow up, patients with known diagnosis of type 1 Diabetes mellitus, hypothyroidism, chronic renal failure, nephrotic syndrome, familial hypercholesteremia, cholestatic jaundice, alcohol consumption, patient on lipid lowering drugs for some other indications, beta blockers or thiazide diuretics, paraneoplastic syndrome, anemic patients and obese patients were excluded from the study. Sample Size was calculated as:

$$N = \frac{Z^2 P(1-P)}{d^2}$$

Where P = Prevalence; 0.5

Z = for 95% Confidence Interval

d = Allowable error 7%

N= 100 Subjects

**Methodology**

Necessary demographic, clinical and laboratory parameters like age, sex, diabetes, height, weight, blood sugar fasting and postprandial and various lipid profiles data were collected as in a preformed questionnaire through guided interview. Samples were collected from patients attending outpatient department and stable indoor patients from department.

**Technique of sample collection**

Venous blood was collected into two vials, three milliliter blood in plain vial and two milliliter blood in potassium-EDTA vial. Fasting blood sugar will be labeled as per fasting for eight hours and post prandial blood sugar were assessed two hours after food intake. Glucose oxidase-peroxidase (GODPOD) method were applied to measure fasting blood sugar and Nycocard Reader was used to estimate the glycated hemoglobin (HbA1c). Venous Blood sample was allowed to clot at room temperature in plain test tube and the serum was separated. Serum lipids (Triglyceride-TG, total Cholesterol-TC, and High-density lipoprotein cholesterol-HDL-C) measured directly and the value of Low-density lipoprotein cholesterol LDL-C was calculated using the Friedewald's formula.<sup>9</sup> All these parameters were analyzed using a fully automated chemistry analyzer and ready-to-use reagent kits according to the manufacturer's instructions. Interpretation of lipid profile value was done as per national cholesterol education program-Adult treatment panel III (NCEP-ATPIII). According to these guidelines' recommendation normal, desirable, borderline and high-risk level of total cholesterol (TC) is defined as up to 240mg/dl respectively. Triglyceride (TG) value up to 149 mg/dl, 150-199 mg/dl, 200-499 mg/dl and >500 mg/dl is defined as optimal normal, borderline, high and very high risk level TG respectively. Low density lipoprotein (LDL) level is defined optimal risk when 190 mg/dl respectively and low risk HDL as >60 mg/dl and high-risk level dl and PPBS ≤ 180mg/dl and uncontrolled DM when it is greater than the optimal target value. Glycemic status was divided into two groups; Good Glycemic Control (GGC) if HbA1c < 7% and Poor Glycemic Control (PGC) if HbA1c ≥ 7% as per ADA criteria.<sup>10</sup>

**Statistical analysis**

Data was analyzed with Statistical Package for Social Sciences (SPSS) software version 16. Normally distributed data was presented as mean and standard deviation. Pearson correlation test was done to identify the correlation between parametric data. Comparison of means was done by Student 't' test in parametric data with two groups. A p value less than 0.05 was considered significant.

**Results:**

The mean age of the subjects was 51.67 ± 14.8 years old. Maximum patients belong to age group 25-60 years age group (75%). In accordance to gender, there is only a slight difference in between male and female which was accounted for 48% and 52% respectively.

**Table 1: Demographic Characteristics of Samples**

Variable	N(%)
Age (Mean + SD)	51.67±14.8 years
25-60 years old	75(75%)
Above 60 years	25(25%)
Gender	
Male	48(48%)
Female	52(52%)

The mean HbA1c of the subjects was 8.45. Majority of patients have a high HbA1c level (79%) whereas the rest have the level within the target value (21%).

**Table 2: HbA1c Characteristics of Samples**

HbA1c Characteristics	N(%)
Mean HbA1c	8.45
<7%	21(21%)
>7%	79(79%)

The mean total cholesterol was 207.3mg/dL. 75% of patients had considerably high total cholesterol level. Mean Triglyceride was 360.6mg/dL. Majority of the patients had high level of triglyceride i.e.90%. Mean HDL was 41 mg/dL. 64% participants had a low level of HDL which is below 40 mg/dl. Mean LDL was 145.9 mg/dL. 91% of patients had a high level of LDL.

**Table 3: Lipid Profile Characteristics of Samples**

Lipid Profile Characteristics	N(%)
Mean total cholesterol	207.3
Normal (120-200 mg/dL)	25(25%)
High (>200 mg/dL)	75(75%)
Mean triglyceride	360.6
Normal (< 150 mg/dL)	10(10%)
High (>150 mg/dL)	90(90%)
Mean HDL	41

<b>Normal (&gt;40 mg/dL)</b>	<b>36(36%)</b>
<b>Low (&lt;40 mg/dL)</b>	<b>64(64%)</b>
<b>Mean LDL</b>	<b>145.9</b>
<b>Normal (&lt; 100 mg/dL)</b>	<b>9(9%)</b>
<b>High (&gt;100 mg/dL)</b>	<b>91(91%)</b>

It was found that there was a correlation between high total cholesterol level with high level of HbA1c, where 92% patients had a high level of cholesterol also have a high level of HbA1c (p=0.001). There was an also significant correlation between high level of triglyceride and low level of HDL with high level of HbA1c. Around 88% of patients who had high level of triglyceride also had a high level of HbA1c (p=0.014). In addition, 88% of patients who had low level of HDL also have a high level of HbA1c (p=0.037). There was very slight weak significant correlation found between high level of LDL and high level of HbA1c, in spite of high percentage of patients who had high level of LDL and high level of HbA1c at the same time.

**Table 4: Correlation between Lipid Profile and Hb1Ac**

<b>Lipid Profile</b>	<b>Hb1Ac</b>		<b>p-value</b>
	<b>&lt;7%</b>	<b>&gt;7%</b>	
<b>Total Cholesterol</b>			
<b>Normal</b>	<b>35(35%)</b>	<b>65(65%)</b>	<b>0.001</b>
<b>High</b>	<b>8(8%)</b>	<b>92(92%)</b>	
<b>Triglyceride</b>			
<b>Normal</b>	<b>45(45%)</b>	<b>55(55%)</b>	<b>0.014</b>
<b>High</b>	<b>12(12%)</b>	<b>88(88%)</b>	
<b>HDL</b>			
<b>Normal</b>	<b>25(25%)</b>	<b>75(75%)</b>	<b>0.037</b>
<b>Low</b>	<b>11(11%)</b>	<b>89(89%)</b>	
<b>LDL</b>			
<b>Normal</b>	<b>40(40%)</b>	<b>60(60%)</b>	<b>0.05</b>
<b>High</b>	<b>14(14%)</b>	<b>86(86%)</b>	

**Discussion:**

HbA1c levels could be employed as a possible biomarker for recognizing T2DM patients at risk of CVD and could be used as a guide for treating patients.<sup>11,12</sup> Majority of patients have a high HbA1c level (79%) whereas the rest have the level within the target value (21%). Majority of the patients had high level of triglyceride i.e. 90%. 64% participants had a low level of HDL which is below 40 mg/dl.. 91% of patients had a high level of LDL. It was

found that there was a correlation between high total cholesterol level with high level of HbA1c. There was an also significant correlation between high level of triglyceride and low level of HDL with high level of HbA1c. There was very slight weak significant correlation found between high level of LDL and high level of HbA1c. Begum A et al<sup>13</sup> found that there was a significant correlation between HbA1c value and serum levels of TC, TG and HDL-C ( $p < 0.05$ ) but no significant correlation of HbA1c value with LDL-C in-diabetes patient. The study concluded that HbA1c value correlate well with lipid profile in-diabetes patients. So, HbA1c can be used as a predictor of dyslipidemia in type 2 diabetes. Alzahrani SH et al<sup>14</sup> investigated the association between glycated hemoglobin (HbA1c) and the lipid profile in patients with type 2 diabetes mellitus (T2DM) at a tertiary care hospital in Jeddah, Saudi Arabia (SA). The study concluded that glycatedHb was associated with TGs, and no significant association was found with age, BMI, TC, LDL-C, HDL-C and FPG levels. Pandey T et al<sup>15</sup> did a study to assess Association between Glycated Hemoglobin and Lipid Profile in Type 2 Diabetes Mellitus in Tertiary Care Center. The study concluded that there was a significant moderate correlation between HbA1c and lipid profile. Lipid profile values were significantly higher in poor glycemic control than good glycemic control patients. Hence, HbA1c can be considered as a surrogate marker for dyslipidemia in type 2 DM patients. Priya S et al<sup>16</sup> estimated the serum lipid profile and HbA1c levels in type 2 diabetes mellitus (T2DM) and determine the associated factors including the duration of diabetes mellitus among type 2 diabetes mellitus of a tertiary care hospital in Tamil Nadu, India. The study concluded that Significant positive correlation of HbA1c with lipid profiles in our study suggests that HbA1c can also be used as a predictor of dyslipidemia in addition to a glycemic control parameter for prevention of complication. Ghimire MR, et al<sup>17</sup> found that while comparing controlled (HbA1c < 7%) with uncontrolled (HbA1c  $\geq 7\%$ ) glycated hemoglobin and level of different components of lipid profile like total cholesterol, triglyceride, LDL- cholesterol and HDL-cholesterol, there was a statistical correlation [ $\chi^2=4.67$ ;  $df=1$ ;  $p=0.031$ ] between only high triglyceride level and uncontrolled type 2 diabetes.

**Conclusion:**

The study concluded that there was a correlation between lipid profile and HbA1c in patients with T2DM.

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