

# Study on Glycated hemoglobin and Lipid Profile in Type-2 Diabetes Mellitus

Manoj Kumar Yadav<sup>1</sup>, Dr. Tapan Kumar Mohapatra<sup>2</sup>, Dr. Rabindra Kumar Mohapatra<sup>3</sup>  
Dr. Ketki Khandhadiya<sup>4</sup>, Dr. Kazi Ashique Firdoush<sup>5</sup>, Kedar Prasad Yadav<sup>6</sup>

<sup>1</sup>Tutor, Department Of Biochemistry, Hi-Tech Medical College & Hospital Rourkela, Odisha

<sup>2</sup>Associate Professor, Department Of Biochemistry, Hi-Tech Medical College & Hospital Rourkela, Odisha

<sup>3</sup>Associate Professor, Department Of Biochemistry, Hi-Tech Medical College & Hospital Rourkela, Odisha

<sup>4</sup>Assistant Professor, Department Of Biochemistry, Heritage Institute of Medical Sciences, varanasi

<sup>5</sup>Assistant Professor, Department Of Biochemistry, Iq City Medical College & NH Hospital, Durgapur West Bengal

<sup>6</sup>Tutor, Department Of Biochemistry, Sd Major Singh Medical College & Hospital, Farrukabad

**Abstract:** *The patients with type-2 diabetes have an increased prevalence of lipid abnormalities. The present study was carried out to evaluate the diagnostic value of the relationship between Glycated hemoglobin (HbA1c) and lipid profile in type-2 diabetic population. An early intervention to normalize circulating lipids has been shown to reduce cardiovascular complications and mortality. Venous blood samples were collected from all known cases of diabetes and controls to analyze Glycated hemoglobin, fasting & post prandial blood sugar, total cholesterol, triglyceride, HDL-c, LDL-c & VLDL-c. Serum concentrated of HbA1c and all the parameters of lipid profile except HDL-C were increased while HDL-C concentration decreased in cases as compared to that of controls. These findings suggest that HbA1c level can be used as good parameter for predicting the lipid profile in type-2 diabetic patients.*

**Keywords:** Type-2 Diabetes mellitus, Hyperlipidemia, Glycated hemoglobin, Lipid profile.

**Abbreviations used:** Glycated hemoglobin(HbA1c), Cardiovascular Disease(CVD), Total Cholesterol(TC), Triglyceride(TG), High Density Lipoprotein Cholesterol(HDL-c), Low Density Lipoprotein Cholesterol(LDL-c), Very LOw Density Lipoprotein Cholesterol(VLDL-c).

## 1. Introduction

In the ancient Sanskrit Literature, diabetes mellitus was described as “honey-urine disease,” associated with gross emaciation and wasting. Diabetes is a global endemic with rapidly increasing prevalence in both developing and developed countries.<sup>1</sup>In Indian population, 61.3 million people had diabetes in 2011, which is expected to reach 101.2 million by 2030 (International Diabetes Federation) now placing India at second position in world diabetic prevalence.<sup>2</sup>Prevalence of diabetes mellitus has been steadily increasing in urban as well as rural areas in India & it will be one of the major cause of death in India in 21<sup>st</sup> century. Diabetes mellitus is a group of metabolic disease characterized by hyperglycemia resulting from defects in insulin secretion, insulin action, or both.<sup>3</sup> Diabetes causes about 5% of all death globally each year.<sup>4</sup>Hyperglycemia is the apparent feature of diabetes due to diagnostic dependency of patients on blood glucose measurements.<sup>5</sup> However, most of the individuals may also carry unnoticed hyperlipidemia, characterized by increased levels of triglycerides and Low Density Lipoprotein-Cholesterol (LDL-C) and decreased High Density Lipoprotein-Cholesterol (HDL-C).<sup>6</sup> Glycated hemoglobin (HbA1c) is a routinely used marker for long-term glycemic control. In accordance with its function as an indicator for the mean blood glucose level, HbA1c predicts the risk for the development of diabetic complication in diabetes patients.<sup>7,8</sup> Apart from classical risk factors like

dyslipidemia, elevated HbA1c has now been regarded as an independent risk factor for Cardiovascular Disease in subjects with or without diabetes. Each one percent increase in absolute HbA1c shows eighteen percent increase cardiovascular disease.<sup>9</sup> Positive relationship between HbA1c and cardiovascular disease has been demonstrated in non-diabetic cases even within normal range of HbA1c.<sup>10,11</sup> Hence, the aim of this study was to observe the relationship between glycated hemoglobin (HbA1c) & serum lipid profile in type-2 Diabetes patients.

## 2. Materials and Methods

The present study was conducted in Hi-Tech Medical College & Hospital Rourkela, Odisha, India, during the period from November 2012 to July 2013. The study protocol was approved by the Ethics committee of Hi-Tech Medical College & Hospital Rourkela. Randomly selected, 100 patients with type-2 diabetic male patients with an age ranged from 30 to 70 years along with 100 healthy controls were studied for following parameters.

1. blood Glucose by GOD-POD methods.<sup>12</sup>
2. Glycated Haemoglobin (GHb) by cation exchange resin methods.<sup>13</sup>
3. Total Cholesterol (TC) by enzymatic end point CHOD-POD methods.<sup>14</sup>
4. Triglyceride (TG) by enzymatic glycerol phosphate oxidase/peroxidase methods.<sup>15</sup>

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5. HDL-Cholesterol by direct enzymatic end point method.<sup>16,17</sup>
6. LDL-Cholesterol by Friedewald's formula.<sup>18</sup>
7. VLDL-Cholesterol by Friedewald's equation.  

$$LDL-c = TC - HDL-c(TG/5)$$

All the parameters under investigation were determined in the serum of the subjects using commercially available reagent kits. The glycated hemoglobin (HbA1c) was estimated by appropriate standard kits. For serum lipid reference level National Cholesterol Education Programme (NCEP) Adult Treatment Panel III (ATPIII) guideline was referred. According to NCEP ATP III guideline hypercholesterolemia defined as TC>200mg/dl, high LDL-c when value>100mg/dl, hypertriglyceridemia>50mg/dl and low HDL-c when value <40mg/dl. Dyslipidemia defined by presence of one or more than one abnormal serum lipid concentration. Value of HbA1c were given as % of total hemoglobin and values of all other parameters were given in mg/dl. All values were expressed as mean±SD. We used student t-test and Pearson's correlation coefficient to find the statistical significance. A P-value <0.05 was to be considered statistically significant.

### 3. Results and Discussion

We studied the lipid profile with glycated hemoglobin in type-2 diabetic patients. Present study focus on the dyslipidemic pattern and its relation with glycated hemoglobin in type-2 diabetes mellitus. The mean HbA1c, TC, TG, HDL-c, LDL-c, VLDL-c were 10.50±1.14, 253.36±36.72, 202.97±55.44, 37.04±5.81, 163.11±53.25 and 40.59±11.09 respectively (Table-1).

In our study, the level of TC, TG, LDL-c, VLDL-c were significantly increased (P<0.0001) while HDL-c level was significantly decreased (P<0.0001) as compare to controls.

Further, it was found that glycated hemoglobin (HbA1c) was positively and significantly related with Total Cholesterol (r=0.409), Triglycerides (r=0.316), Low Density Lipoprotein Cholesterol (r=0.574), Very Low Density Lipoprotein Cholesterol (r=0.316). However, High Density Lipoprotein Cholesterol (r=0.193) did not show any significant relation with HbA1c (Table-2). High prevalence of hypercholesterolemia, hypertriglyceridemia and high LDL-c & low HDL-c was found in type-2 diabetes which is well known risk factors for cardiovascular disease.<sup>19</sup> The cause of dyslipidemia in type 2 diabetes mellitus may be that, insulin is not working properly and which affects the liver apo lipoprotein production.<sup>20</sup> The apo lipoprotein regulates the enzymatic activity of lipoprotein lipase and cholesterol ester transport protein.<sup>20</sup> A highly positive significant relationship of HbA1c with dyslipidemia was observed in the present study. Erciyas et al<sup>21</sup> also reported positive correlation of HbA1c level with TC and TG in diabetic patients. The diabetes complication and control trail established HbA1c as Value ≤7.0% was said to be appropriate for reducing the risk of cardiovascular complications. The diabetic patients with higher HbA1c value can exhibit a significant increase in TC, TG, LDL-c and HDL-c in comparison to patients with HbA1c value ≤7.0%<sup>22</sup> Khan et al<sup>23</sup> reported the severity of dyslipidemia increases in patients with higher HbA1c value.

As elevated HbA1c and dyslipidemia are independent risk factors of CVD, diabetic patients with elevated HbA1c and dyslipidemia can be considered as a very high risk group for CVD. Improving glycemic control can substantially reduce the risk of cardiovascular events in diabetes<sup>24</sup> and also reported that reducing the HbA1c level by 0.2% could lower the mortality by 10%.<sup>25</sup> Thus present study suggests the importance of glycemic control in prevention of cardiovascular disease in type-2 diabetics.

**Table 1**

Mean ± SD of HbA1c and lipid profile of type-2 diabetes and controls		
Parameters	Type 2 Diabetes (n=100)	Controls (n=100)
	Mean ± SD	Mean ± SD
HbA1c (%)	10.50±1.14	5.41±0.55
TC (mg/dl)	253.36±36.72	166.06±20.69
TG (mg/dl)	202.97±55.44	117.56±23.39
HDL-C (mg/dl)	37.04±5.81	43.66±6.63
LDL-C (mg/dl)	163.11±53.25	97.96±21.21
VLDL-C (mg/dl)	40.59±11.09	23.41±4.55

**Statistically Significant at p value <0.0001**

**Table 2**

Correlation among HbA1c and lipid profile of type-2 diabetes:		
Parameters	Correlation Coefficient	P- value
TC (mg/dl)	+0.409	<0.001
TG (mg/dl)	+0.316	<0.001
HDL-C (mg/dl)	-0.193	NS*
LDL-C (mg/dl)	+0.574	<0.001
VLDL-C (mg/dl)	+0.316	<0.001

\*NS: Statistically not Significant

### 4. Conclusions

HbA1c showed positive correlation with TC, TG, LDL-c, VLDL-c and negative correlations was found between HbA1c and HDL-c levels. These findings suggest that HbA1c level can be used as good parameter for predictor of dyslipidemia in type-2 diabetics in addition to as glycemic control. Thus, early diagnosis of dyslipidemia can be used as a preventive measure for the development of cardiovascular disease in type-2 diabetics. So, HbA1c may be utilized for screening diabetic patient for risk of cardiovascular events and also for timely intervention with lipid lowering drugs.

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### Author Profile



**Mr Manoj Kumar Yadav** is Tutor, Department Of Biochemistry, Hi-Tech Medical College & Hospital Rourkela, Odisha, India



**Dr Tapan Kumar Mohapatra** is Associate Professor, Department Of Biochemistry, Hi-Tech Medical College & Hospital Rourkela, Odisha



**Dr Rabindra Kumar Mohapatra** is Associate Professor in Department Of Biochemistry, Hi-Tech Medical College & Hospital Rourkela, Odisha



**Dr Ketki khandhadiya** is Assistant Professor, Department Of Biochemistry, Heritage Institute of Medical Sciences, Varanasi, India



**Dr Kazi Ashique Firdoush** is Assistant Professor in Department Of Biochemistry, IQ City Medical College & NH Hospital, Durgapur West Bengal, India



**Mr Kedar Prasad Yadav** is Tutor, Department Of Biochemistry, SD Major Singh Medical College & Hospital, Farrukabad, India