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# Glycosylated haemoglobin as a predictor of Dyslipidemia in Type2 Diabetes Patients

**Dr. Meghshyam ,Medicine Resident, Department of Medicine, SMS Hospital Jaipur**
**Email-meghubagela91@gmail.com**
**Dr. Chandan Kumar Nihala, Medicine Resident, Department of Medicine, SMS Hospital Jaipur**
**Dr. Ajeet Singh, Principal Specialist, Department of Medicine, SMS Hospital Jaipur**
**Dr. Suresh Yadav, Medical Office, RUHS Hospital, Jaipur**
**Corresponding Author- Dr. Suresh Yadav, Medical Office, RUHS Hospital, Jaipur , email- syjpr007@gmail.com**

## Abstract

**Introduction-** Type 2 Diabetic patients with coronary artery disease (CAD) have significantly higher levels of cholesterol and lipids as compared to Diabetic patients without CAD. Dyslipidemia as reflected by increase in total cholesterol, low-density lipoprotein cholesterol, triglycerides and decrease in high-density lipoprotein cholesterol is one of the major risk factors for CAD.

**Aim-**To find out association between dyslipidemia and glycosylated haemoglobin (HBA1C) in type-2 Diabetic patients and find out the prevalence of dyslipidemia in type-2 Diabetic Patients.

**Materials and Methods-** The hospital based observational cross sectional study was conducted in Medicine Department , SMS Medical College Jaipur from January 2023 to June 2024 on 60 DM-2 patients - out of which 30 patients have HBA1C- 6.5 – 8.4 (Group A ) and 30 patients have HBA1C ≥8.5 (Group B).

**Results-** In present study the mean total Cholesterol (TC) in group A (DM-2 patients having HBA1<8.5) and group B (DM-2 patients having HBA1C ≥8.5) were 200.07±22.48 and 237.83±41.28 mg/dl respectively. The mean Triglyceride (TG) in group A and group B were 149.10±22.06 and 166.40±24.71 respectively. The mean Low density lipoprotein (LDL) in group A and group B were 101.23±13.15 and 120.67±24.48 respectively. The mean High density lipoprotein (HDL) in group A and group B were 40.53±3.65 and 37.97±3.94 respectively i.e. mean TC, TG and LDL was significantly higher and mean HDL was significantly lower in group B as compared to group A.

**Conclusion**-The poor glycemic control is also linked to an abnormal lipid profile, such as elevated TC, elevated L.D.L, elevated TG and low-H.D.L as demonstrated by higher prevalence of dyslipidemia in poorly controlled Diabetic patients.
**Keywords-** CAD, Dyslipidemia, glycosylated haemoglobin.

**Introduction-** Diabetes mellitus (DM) is highly prevalent in developing and developed countries. DM is characterized by metabolic abnormalities leading to long-term micro and macro vascular complications. Patients with coexisting diabetes and metabolic syndrome have a high prevalence of coronary artery disease (CAD) [1].

Recently population surveys conducted in India had reported about 9-fold increase of coronary artery disease (CAD) in urban areas which is mainly attributed to increase in the prevalence of lipid and glucose abnormalities [2]. Research has shown that Indian population has high prevalence of dyslipidemia as reflected by raised triglycerides (TG) and low high-density lipoprotein (HDL) and higher prevalence of metabolic syndrome leading to high burden of CAD [3].

Glycosylated Haemoglobin ($HbA_1C$) is commonly used as a marker of long term glycaemic status. Poor glycaemic control as reflected by high $HbA_1C$ is an independent risk factor for CAD in patients with DM [4].

Type 2 Diabetic patients with CAD have significantly higher levels of cholesterol and lipids as compared to Diabetic patients without CAD [5]. Research has shown that high $HbA_1C$ is significantly associated with the severity of CAD in Diabetic patients [6]. According to American Diabetes Association (ADA) each 1% increase in $HbA_1C$ corresponds to a 35% increase in the risk of macrovascular complication and 18% increase in risk of myocardial infarction and 25% increase in Diabetes related mortality [7].

The Framingham study has found a linear increase in CAD risk with increment of total cholesterol (TC) level from 180 mg upward and has found that subjects with HDL cholesterol less than 35 mg/dl have 8 fold increase in CAD incidence than those with HDL cholesterol more than 65 mg/dl [8]. The Lipid Research clinics Coronary Primary Prevention Trial has found that a 1% fall in the Total Cholesterol reduced the risk of CAD by 2% [9]. Similarly

Helsinki heart study concluded that increase in HDL cholesterol and decrease in low-density lipoprotein cholesterol (LDL-C) were associated with reduced CAD risk.[10]

Relatively few studies have been conducted to demonstrate co-relation between HbA1C & dyslipidemia in Indian Diabetic patients therefore the present study aim to fill lacunae in this sphere of literature. This study aimed to evaluate the relationship between glycaemic control (HbA1C) and serum lipid profile.

**Aim and Objectives-**

To find out association between dyslipidemia and glycosylated haemoglobin in type-2 Diabetic patients and find out the prevalence of dyslipidemia in type-2 Diabetic Patients.

**Materials and Method-** The hospital based observational study was conducted at Department of medicine, S.M.S. Medical College Jaipur (Rajasthan) India from April 2023 to July 2024 on 60 patients of Type-2 DM who were divided into two groups of 30 patients in each group- 30 patients of DM-2 with HbA1C range between 6.5 – 8.4, and 30 patients of DM-2 with HbA1C ≥8.5.

**Inclusion Criteria:**

- Known patients of type -2 diabetes mellitus on treatment with either insulin or oral drugs or both.

**Exclusion Criteria:**

- Patient already on hypolipidemic drugs
- Chronic Kidney Disease
- Chronic Liver Disease
- Nephrotic syndrome
- Patient on medication such as Estrogen, Progestin, Anabolic steroids, Corticosteroids, Retinoid, Cyclosporine & Anti-retroviral medication.

- Known case of Hypothyroidism
- Gestational DM
- Excessive Alcohol intake

Methodology of data collection:

Diabetic patients presented in medicine department at SMS Medical College Jaipur Detailed history of present illness with past history, personal history, family history was taken. General and systemic examination was done. Following which written consent was taken and HbA1c estimation was done by enzymatic assay method on automated analyser. Total cholesterol was measured using liquid cholesterol reagent set for determination of total cholesterol based on enzymatic method using cholesterol esterase, cholesterol oxidase and peroxidase on automated analyser, Triglycerides were measured by glycerokinase peroxidase- peroxidase method on automated analyser, HDL cholesterol was measured by phosphotungstic acid method on automated analyser . Automated analyser used was of Shenzhen Mindray Bio-Medical Electronics.

**Results-**

Table 1: Age categorisation of cases as per HBA1C category

| **Parameter** | | **HBA1C** | | | | | | **P Value** |
|---|---|---|---|---|---|---|---|---|
| | | **6.5%-8.4%** | | **>=8.5%** | | **Total** | | |
| | | **No.** | **%** | **No.** | **%** | **No.** | **%** | |
| **Age Category** | **<60 Years** | 12 | 52.2% | 11 | 47.8% | 23 | 38.3% | 0.781 |
| | **60-69 Years** | 16 | 47.1% | 18 | 52.9% | 34 | 56.7% | |
| | **>=70 Years** | 2 | 66.7% | 1 | 33.3% | 3 | 5.0% | |
| | **Total** | 30 | 50.0% | 30 | 50.0% | 60 | 100.0 % | |
| **.Sex** | **Female** | 7 | 58.3% | 5 | 41.7% | 12 | 20.0% | 0.519 |
| | **Male** | 23 | 47.9% | 25 | 52.1% | 48 | 80.0% | |

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | **Total** | 30 | 50.0% | 30 | 50.0% | 60 | 100.0 % | |

Table 2: Smoking and Hypertension profile of cases as per HBA1C category

| **Parameter** | | **HBA1C** | | | | | | **P Value** |
|---|---|---|---|---|---|---|---|---|
| | | **6.5%-8.4%** | | **>=8.5%** | | **Total** | | |
| | | **No.** | **%** | **No.** | **%** | **No.** | **%** | |
| **Smoking** | **No** | 22 | 52.4% | 20 | 47.6% | 42 | 70.0% | 0.573 |
| | **Yes** | 8 | 44.4% | 10 | 55.6% | 18 | 30.0% | |
| | **Total** | 30 | 50.0% | 30 | 50.0% | 60 | 100.0% | |
| **Hypertension** | **No** | 18 | 52.4% | 18 | 47.6% | 42 | 70.0% | 1 |
| | **Yes** | 12 | 44.4% | 12 | 55.6% | 18 | 30.0% | |
| | **Total** | 30 | 50.0% | 30 | 50.0% | 60 | 100.0% | |

Table 3: HBA1C profile of cases

| **Parameter** | **HBA1C** | | | **P Valu e** |
|---|---|---|---|---|
| | **6.5%-8.4%** | **>=8.5%** | **Total** | |
| | **Mean (SD)** | **Mean (SD)** | **Mean (SD)** | |
| **HBA1C** | 7.29±.56 | 10.23±1.26 | 8.76±1.77 | <.001 |

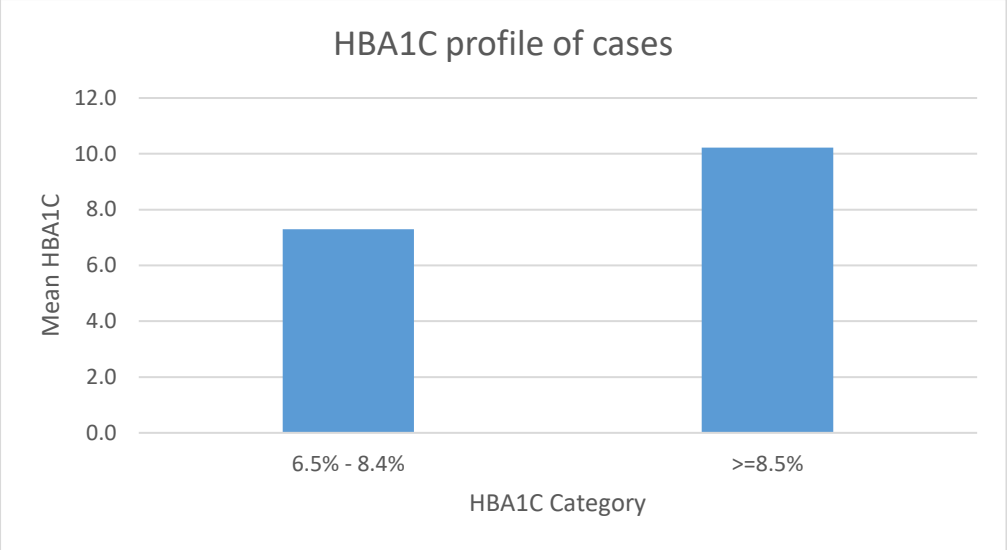



Table 4: Dyslipidaemia profile of cases as per HBA1C category

| Parameter | | HBA1C | | | | | | P Value |
|---|---|---|---|---|---|---|---|---|
| | | 6.5%-8.4% | | >=8.5% | | Total | | |
| | | No. | % | No. | % | No. | % | |
| Dyslipidaemia | No | 25 | 65.8% | 13 | 34.2% | 38 | 63.3% | .001 |
| | Yes | 5 | 22.7% | 17 | 77.3% | 22 | 36.7% | |
| | Total | 30 | 50.0% | 30 | 50.0% | 60 | 100.0% | |

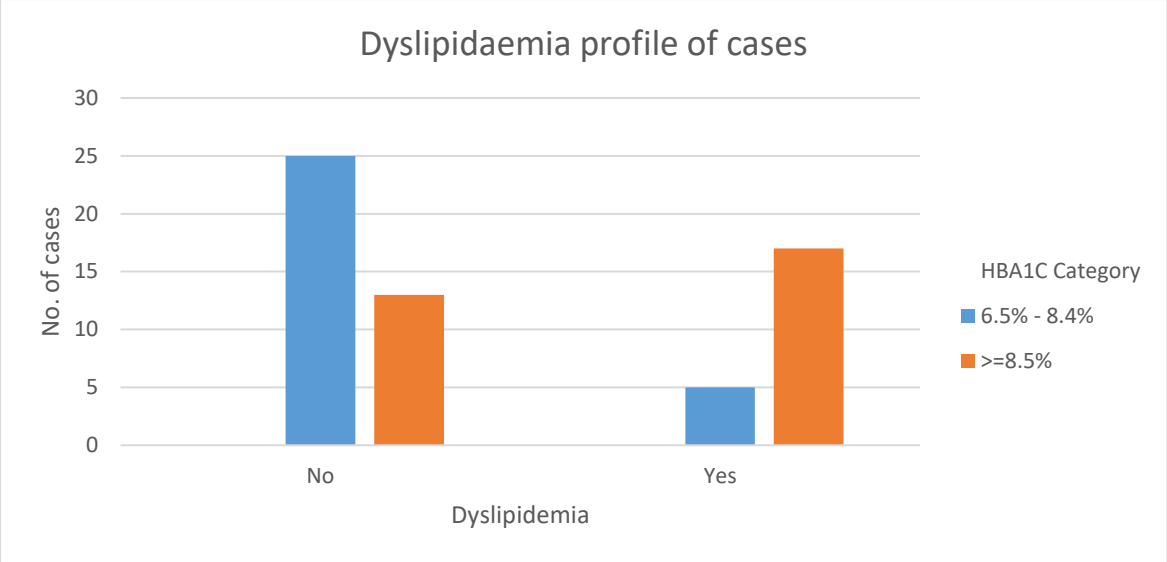
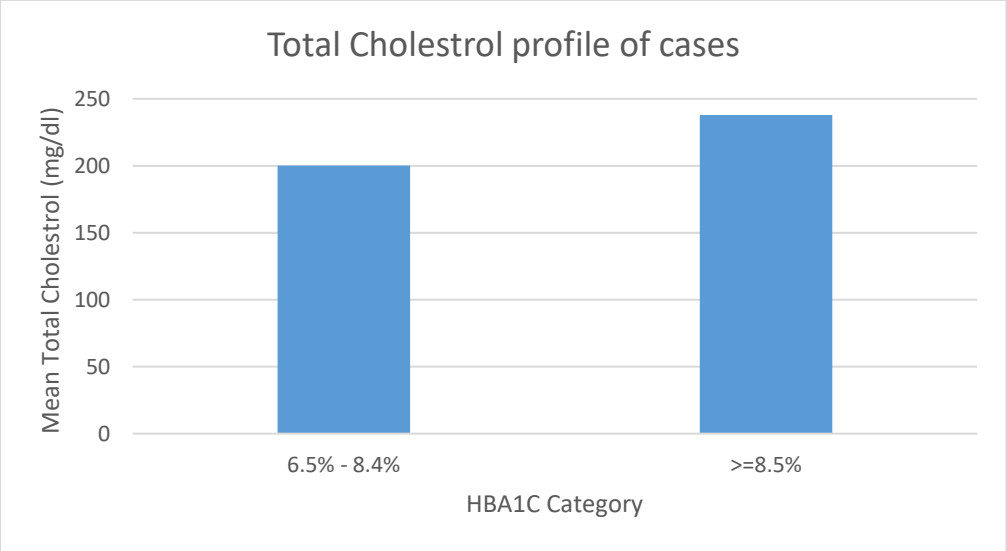
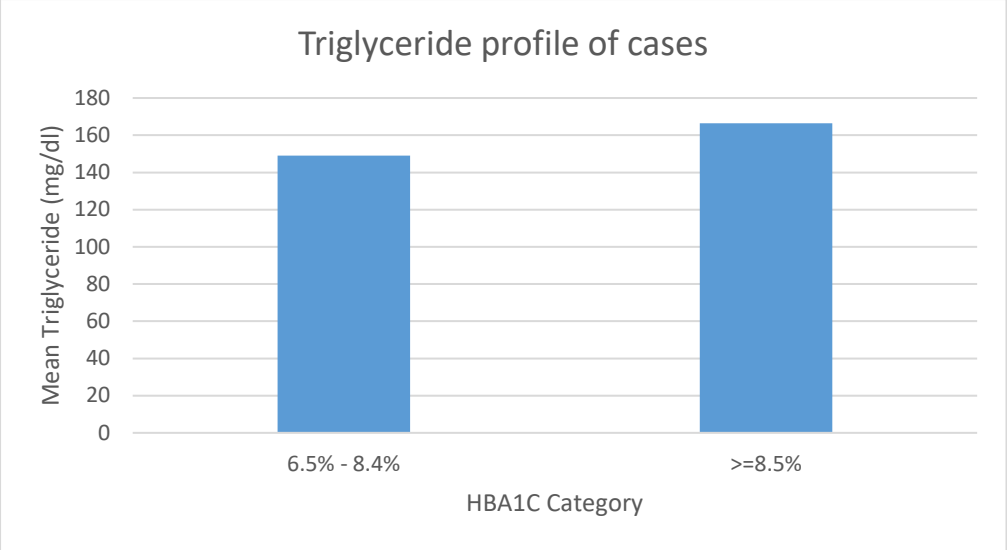
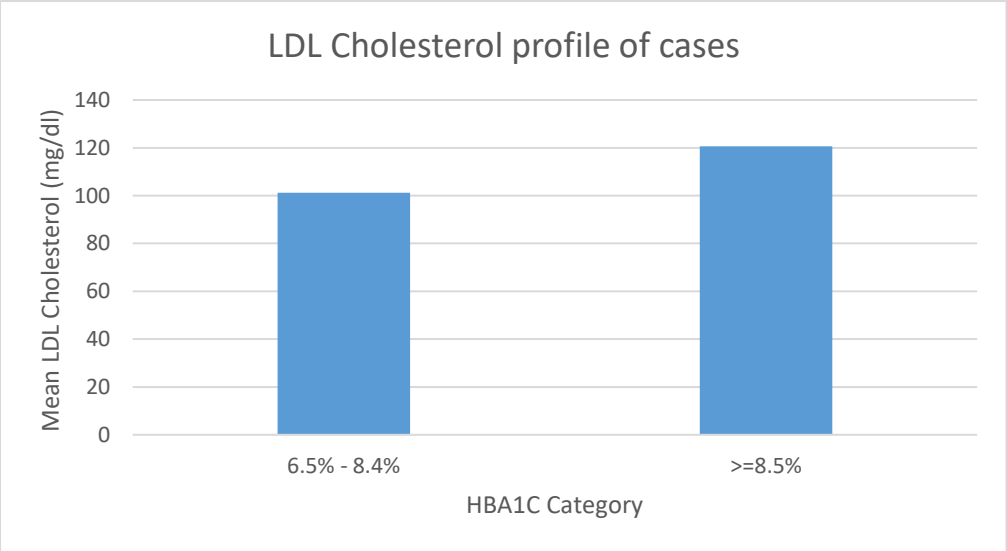


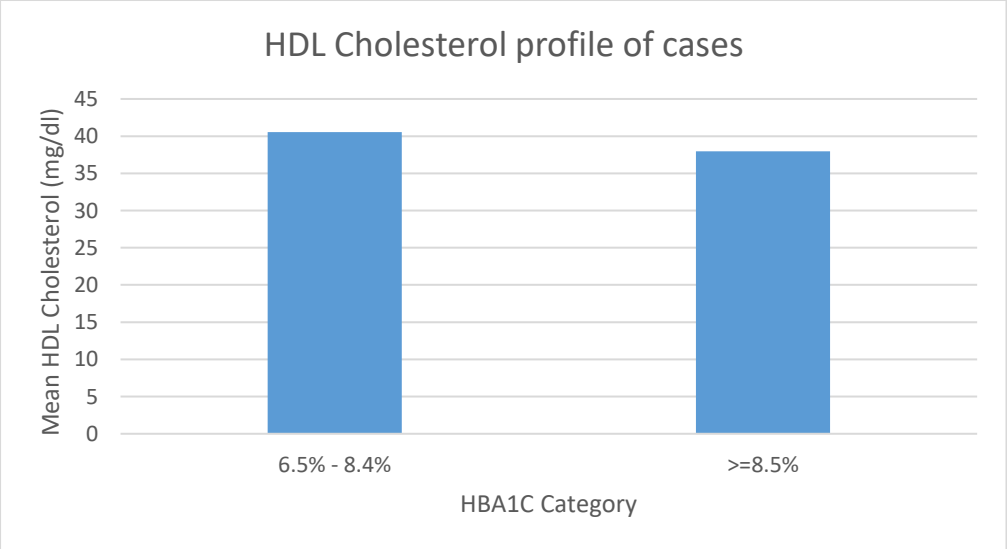

Table 5: Lipid profile of cases as per HBA1C category

| Parameter | HBA1C | | | P Value |
|---|---|---|---|---|
| | 6.5%-8.4% | >=8.5% | Total | |
| | Mean (SD) | Mean (SD) | Mean (SD) | |
| **Total Cholesterol (mg/dl)** | 200.07±22.48 | 237.83±41.28 | 218.95±38.06 | <.001 |
| **Triglyceride (mg/dl)** | 149.10±22.06 | 166.40±24.71 | 157.75±24.81 | .003 |
| **LDL Cholesterol (mg/dl)** | 101.23±13.15 | 120.67±24.48 | 110.95±21.81 | .002 |
| **HDL Cholesterol (mg/dl)** | 40.53±3.65 | 37.97±3.94 | 39.25±3.98 | .015 |




Triglyceride profile of cases
Mean Triglyceride (mg/dl)
180
160
140
120
100
80
60
40
20
0
6.5% - 8.4%
>=8.5%
HBA1C Category


LDL Cholesterol profile of cases
Mean LDL Cholesterol (mg/dl)
140
120
100
80
60
40
20
0
6.5% - 8.4%
>=8.5%
HBA1C Category


HDL Cholesterol profile of cases
Mean HDL Cholesterol (mg/dl)
45
40
35
30
25
20
15
10
5
0
6.5% - 8.4%
>=8.5%
HBA1C Category

**Discussion-**

Dyslipidemia as reflected by increase in total cholesterol, low-density lipoprotein cholesterol, triglycerides and decrease in high-density lipoprotein cholesterol is one of the major risk factors for the acute coronary syndrome and alone account for more than 50% of population attributable risk for CAD[11].

In present study the prevalence of dyslipidemia was 36.7% and prevalence of dyslipidemia was significantly higher in Group B (77.3% versus 22.7%) i.e. we found a significant positive correlation between dyslipidemia and HbA1c in the present study (p value<0.001). The prevalence of dyslipidemia in ACS cases was 48.6% in a study conducted by Sahadeb Prasad Dhungana et al.(2020) in Nepal.[12] Similarly Raut MM et al. (2024) in their study found a significant positive correlation between dyslipidemia and HbA1c which is consistent with results of present study. [13] Pant DC et al.(2018) , and **Khan F R, Ali J** et al. (2021) in their study found that prevalence of dyslipidemia significantly increases with HBA1C which is in agreement with results of present study [14, 15].

In present study the mean Total Cholesterol, mean LDL and mean TG were significantly higher in Group B as compared to Group A whereas mean HDL was significantly lower in Group B as compared to Group A i.e. we found a significant positive correlation between Total Cholesterol, LDL and TG and HBA1C and a negative correlation between HDL and HBA1C. Similarly Raut MM et al. (2024) in their study found a significant positive correlation between the HbA1c and total cholesterol levels, but non-significant correlations were discovered with other lipid profile parameters [13]. However Begum et al. showed no significant link between HbA1c value and LDL-C in diabetic patients. However, significant correlations were seen between HbA1c value and serum levels of TC, TG, and HDL-C [16]. According to Alzahrani SH et al. no significant link was found between HbA1c and the other indices, although there was a significant correlation with TG [17]. Nnakenyi ID et al. in their study found a positive, statistically significant connection between HbA1c and TC, LDL-C , and TG . On the other hand, HbA1c and HDL-C did not correlate well [18]. Naqvi et al. in their research demonstrate that high HbA1c (cut-off of 9%) raises the risk of

hypertriglyceridemia by 2.69[19]. Hussain A. et al , Kidwai SS. et al., and Prabhavathi K. et al. all reported drawing similar conclusions [20-22].

**Conclusion-** The poor glycemic control is also linked to an abnormal lipid profile, such as elevated total cholesterol, elevated L.D.L, elevated TG and low-H.D.L as demonstrated by higher prevalence of dyslipidemiq in poorly controlled Diabetic patients. Further studies are needed on a large scale, including trials and longitudinal studies adjusted for confounding variables to use HBA1c as a predictor of the severity of CAD and dyslipidemia and fulfil the current research gaps.

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