

# Status of glycemic control and lipid profile in type 2 diabetes mellitus: A descriptive cross-sectional study

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## ABSTRACT

**Introduction:** Dyslipidemia in diabetes mellitus is commonly seen in the form of high total cholesterol (TC), high low-density lipoprotein (LDL), high triglyceride (TG) and low high-density lipoprotein (HDL) levels. This study was done to study the association of glycemic control with lipid profile in Type 2 Diabetes Mellitus (T2DM) patients. **Methods:** This was a cross sectional, observational study conducted from December 2018 to June 2020 at Universal College of Medical Sciences and Teaching Hospital, Bhairahawa. It involved 125 patients of type 2 diabetes mellitus (68 males and 57 females), who visited in outpatient department of Internal Medicine. Laboratory tests [(Fasting Blood Sugar (FBS), Post Prandial Blood Sugar (PPBS), Glycosylated Hemoglobin (HbA1c), Renal Function Test (RFT) and Fasting Lipid Profile] were noted. The data was analyzed with SPSS Version 25. Descriptive statistics like frequency, percentage, mean and standard deviation (SD) were calculated. Independent t-test was used to measure the association between glycated hemoglobin with blood glucose level and glycated hemoglobin with lipid profile. **Results:** The study patients were categorized into two groups on the basis of HbA1C level [(good glycemic control  $\leq 7$  (n=33) and poor glycemic control  $>7$  (n=92)]. In good glycemic control the mean TC was 143.30, LDL 71.88, HDL 43.70, VLDL 29.55, TG 134.39 mg/dl while in poor glycemic control the mean TC was 182.47, LDL 114.85, HDL 32.03, VLDL 36.61, TG 179.33 mg/dl with p-value  $<0.05$ . **Conclusions:** There was significant positive association of HbA1c with TC, LDL, VLDL, TG and significant negative association with HDL.

**Keywords:** Dyslipidemia, HbA1c, lipid profile, Type 2 diabetes mellitus.

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## INTRODUCTION

Diabetes mellitus (DM) is a group of metabolic disease of abnormal carbohydrate metabolism which is characterized by hyperglycemia due to defect in insulin secretion, action or both.<sup>1</sup> It is mainly classified into type 1, type 2, "other specific types" and gestational diabetes mellitus.<sup>2</sup> Globally the prevalence among adults over 18 years of age rose from 4.7% in 1980 to 8.5% in 2014.<sup>3</sup> It is estimated that in 2011, 366 million people had DM and it would have increased to 522 million by 2030.<sup>4</sup> The prevalence of DM in Nepal ranges from 6.3-8.5%.<sup>5,6</sup>

Type 1 Diabetes Mellitus (T1DM) is characterized by autoimmune destruction of pancreatic beta cells which leads to absolute insulin deficiency and accounts for 5-10% of diabetes in adults. They have a longer period of symptoms like polyuria, polydipsia, fatigue than in children.<sup>7</sup> While in Type 2 Diabetes Mellitus (T2DM), which accounts for  $>90\%$  of diabetes in adults, it is characterized by hyperglycemia due to progressive loss of insulin secretion from beta cells due to relative insulin deficiency. Most of them are asymptomatic and classical symptoms of diabetes usually appear when there is an

increase in blood glucose level. It is primarily due to genetics and lifestyle factors like sedentary lifestyles, cigarette smoking and lavish alcohol consumption.<sup>8,9</sup> Diabetes with dyslipidemia leads to the development of atherosclerotic plaque, accelerating atherogenesis, resulting in an increase in cardiovascular risk and also worsens diabetes and vice versa. There is an atherogenic lipid profile, low high-density lipoprotein (HDL) and high triglyceride (TG) which have a greater risk of cardiovascular disease (CVD) in comparison with non-diabetics.<sup>10</sup>

Hence, this study was done to study the association of glycemic control with lipid profile in Type 2 Diabetes Mellitus (T2DM) patients.

## METHODS

This study was conducted in the Department of Internal Medicine. A cross-sectional, observational study was carried out on patients with known case of T2DM visiting outpatient department. The ethical clearance was obtained from Institutional Review Committee (IRC) of Universal College of Medical Sciences and Teaching Hospital (Ref. No. UCMS/IRC/213/18). Patients already diagnosed as T2DM and under treatment, aged more than 25 years and patients who gives written consent were enrolled in the study. Type 2 diabetic patients who were not undergoing treatment for the same, aged less than 25 years, those patients with familial dyslipidemia and the patients who did not give written consent were excluded from the study.

Sample Size was calculated using the following formula

$$n = \frac{Z^2 pq}{d^2}$$

where, n= Sample size, Z= 1.96 at 95% confidence interval, p(expected prevalence)=8.2 %<sup>11</sup>, q=1-p=91.9 %, d=5% (Maximum tolerable error). The calculated sample size was 116. We have taken 125 as total sample size.

Patient was counselled regarding the procedure. Under aseptic condition, about 6 ml of fasting blood samples (overnight fast between 8 to 12 hours) were drawn from the median cubital vein on the anterior forearm into clot activator/ separating gel tubes. Fasting blood sugar, post-prandial blood sugar, blood urea, serum sodium and serum potassium, blood sugar and fasting lipid profile was done by Humastar 600 machine by using spectrophotometry method. Glycated Hemoglobin was determined using GPP-100 HbA1C kit used on GPP-100 Specific Protein Analyzer. Blood glucose was determined by GOD-PAP (glucose oxidase and 4-aminoantipyrine). Cholesterol was determined after enzymatic hydrolysis and oxidation. Triglyceride was

estimated using GPO-PAP (glycerine phosphate oxidase) method. LDL was estimated by using Friedwald formula  $LDL = Total\ cholesterol - (HDL-C + TG/5)$ .

The data collected were entered and analyzed in Statistical Package for Social Sciences (SPSS) Version 25.0. Descriptive statistics like frequency, percentage, mean and standard deviation (SD) were calculated. Independent t-test was used to measure the association between glycated hemoglobin with blood glucose level and glycated hemoglobin with lipid profile. The level of statistical significance was set at p-value <0.05 at 95% CI.

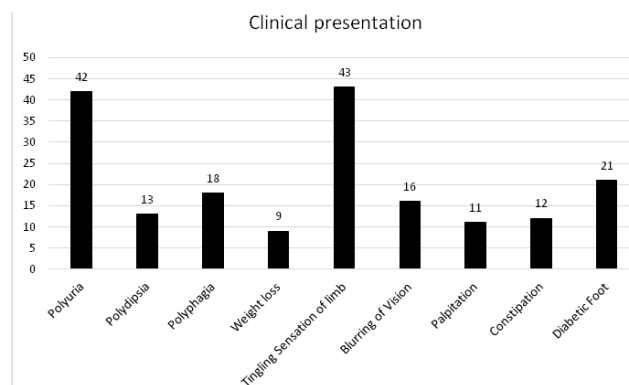
## RESULTS

A total of 125 patients presented in the OPD with the diagnosis of T2DM were included in the study and analyzed systematically. Among 125 patients, majority of the patients, 53 (42.40%) were from age group, 46 to 55 years, followed by 56 to 65 years of age group 27 (21.60%). The least common age group was, patients above 76 years 4(3.20%). The mean age of study patients was 53.31 and standard deviation was 10.83 years with a range of minimum 25 to 86 years. (Table 1)

**Table 1:** Distribution of study patients according to age group (N=125)

Age group (in years)	Frequency	Percentage (%)
26-35	7	5.60%
36-45	22	17.60%
46-55	53	42.40%
56-65	27	21.60%
66-75	12	9.60%
>76	4	3.20%

Among 125 patients enrolled in study visiting outpatient department, 43(34.40%) had tingling sensation of limb, 42(33.60%) had polyuria while 21(16.80%) had diabetic foot (wound/ulcer). Weight loss was the least common symptom associated with 9(7.20%) patients. (Figure 1)



**Figure 1:** Clinical presentation at the time of study (N=125)

Among the patients studied, diabetic neuropathy was the most common complication of T2DM seen in 33(26.4%), followed by diabetic retinopathy 16(12.8%) while glaucoma was the least common seen in 4(3.2%). (Table 2)

**Table 2:** Complications at the time of presentation in patients studied (N=125)

Complications	Frequency	Percentage (%)
Diabetic Neuropathy	33	26.4%
Diabetic Nephropathy	14	11.2%
Diabetic Retinopathy	16	12.8%
Autonomic Neuropathy	9	7.2%
Cataract	12	9.6%
Glaucoma	4	3.2%

The mean FBS with good glycemic control (i.e. HbA1C $\leq$ 7) was 131.87 and with poor glycemic control (i.e. HbA1C $>$ 7) mean was 218.97 and mean difference was 87.09 and its p-value is  $<0.001$  which is statistically significant.

The mean PPBS with good glycemic control was 179.15 and with poor glycemic control was 302.21 and mean difference was 123.06 and its p-value is  $<0.001$  which is statistically significant. (Table 3)

**Table 3:** Association of HbA1C with blood glucose in study patients (N=125)

Glycated Hemoglobin (%)	$\leq 7$ (n=33)	$> 7$ (n = 92)	Mean difference	p value*
FBS (mg/dL)	131.87 $\pm$ 29.58	218.97 $\pm$ 71.32	87.09	$<0.001^*$
PPBS (mg/dL)	179.15 $\pm$ 32.67	302.21 $\pm$ 82.81	123.06	$<0.001^*$

Independent t-test; \*p-value $<0.05$  signifies statistical significance

Similarly, in patients with good glycemic control the mean of TC was 143.30 and with poor control was 182.47 and its p value is  $<0.001$  which is statistically significant. The mean of LDL in good glycemic control was 71.88 and with poor control was 114.85 and its p value is  $<0.001$  which is statistically significant. The mean of HDL in good control was 43.70 and with poor control was 32.03 and its p-value is  $<0.001$  which is statistically significant. The mean of VLDL in good control was 29.55 and with poor control was 36.61. The mean of TG in good control was 134.39 and with poor control was 179.33 and its p-value is  $<0.001$  which is statistically significant. (Table 4)

**Table 4:** Patients lipid profile in relation with good and poor glycemic control

Parameters	HbA1C $\leq$ 7% (n=33)	HbA1C $>$ 7% (n = 92)	Mean difference	p value*
Total Cholesterol (mg/dL)	143.30 $\pm$ 23.36	182.47 $\pm$ 35.39	39.16	$<0.001^*$
LDL (mg/dL)	71.88 $\pm$ 19.02	114.85 $\pm$ 38.82	42.96	$<0.001^*$

HDL (mg/dL)	43.70 $\pm$ 8.78	32.03 $\pm$ 11.66	11.66	$<0.001^*$
VLDL (mg/dL)	29.55 $\pm$ 12.21	36.61 $\pm$ 10.72	7.06	0.05
TG (mg/dL)	134.39 $\pm$ 41.15	179.33 $\pm$ 46.96	44.93	$<0.001^*$

Independent t-test; \*p-value $<0.05$  signifies statistical significance

## DISCUSSION

In this study the mean age of patients was 53.31 years with standard deviation of 10.83 and range of 25 to 86 years. The majority of patients were of age group 46 to 55 years. Similar result was found in a study conducted in Manipal College of Medical Sciences, Nepal by Pokharel et al., where mean age was 52.7 with standard deviation 10.50.<sup>12</sup> There was slight male preponderance in this study with male 54.4% male and 45.6% female. In study done by Memon et al., 67.8% were male and 32.14% were female with male preponderance which correlates with our study.<sup>13</sup> Tingling sensation of limb 34.4% followed by polyuria 33.6%, diabetic foot 16.8%, polyphagia 14.4%, blurring of vision 12.8%, polydipsia 10.4%, constipation 9.6%, palpitation 8.8% and weight loss 7.2% which correlates with study done by Singh et al.<sup>14</sup>

The present study on T2DM patients showed that there was positive association of TC, LDL, VLDL and TG and negative association of HDL in relation with HbA1C. Prabhavathi et al. conducted a similar study where there was positive association of TC, LDL, TG and negative association with HDL which correlates with our study.<sup>15</sup> Similarly, Jain et al.<sup>16</sup> Sarkar et al.<sup>17</sup> Khan et al.<sup>18</sup> and Hussain et al.<sup>19</sup> also found similar result in their study.

The limitation of this study was that it was a single-centered study, so the findings could not be generalized. Also, the type of antidiabetic drugs and their dosages were not specified. Hence, their individual effect could not be assessed.

## CONCLUSIONS

Glycemic control with glycated hemoglobin has helped in predicting the dyslipidemia in patients. So, it can be used as a screening method for T2DM patients to prevent further cardiovascular events and timely management.

**CONFLICTS OF INTEREST:** None declared

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## AUTHORS CONTRIBUTION

SK did concept designing, definition of intellectual content, literature search, RMP, AS did review and editing SB did data acquisition and analysis, manuscript preparation;

SS and SB did concept designing, literature search, data analysis and manuscript review.

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