

CORRELATION OF GLYCATED HEMOGLOBIN WITH SERUM TRIGLYCERIDE TO HIGH DENSITY LIPOPROTEIN RATIO IN TYPE 2 DIABETES MELLITUS PATIENTS

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**ABSTRACT****Introduction:** Diabetes mellitus is an endocrine disorder characterized by hyperglycemia. It may be due to a defect in insulin secretion or action or both. Importantly, lipid metabolism is also abnormal in diabetes such as an increment of TG level and reduction in plasma HDL level which is the major cardiovascular risk. Glycated hemoglobin is measured to monitor the long-term glycemic status of the patients.**Materials and Methods:** The current study is designed retrospectively to find out the correlation between HbA1C and TG to HDL ratio. The data on the lipid profile of newly diagnosed diabetes mellitus were retrieved from the laboratory software of National Medical College, a tertiary care hospital in Madhesh province, Nepal. The categorical data were expressed in frequency and percentage and continuous data were expressed in mean and standard deviation depending on their distribution. Pearson correlation analysis was used to correlate the glycated hemoglobin and TG to HDL ratio.**Result:** The current study investigated the diabetic and lipid profile in 604 retrospectively enrolled patients. Out of which 358 (59.3%) were diabetic and 246 (40.7%) were healthy subjects. The comparison of serum lipid levels between diabetes and healthy subjects revealed a significant difference concerning Triglycerides, total cholesterol, HDL, LDL, and VLDL (P value less than 0.05). The correlation analysis revealed a significant positive correlation between TG/HDL ratio and glycated hemoglobin (0.09, 0.02).**Conclusion:** Our results revealed the correlation between HbA1C and TG/HDL ratio in the Nepalese diabetic population. Hypertriglyceridemia was common in diabetic patients. Elevation of the TG/HDL ratio aggravates the cardiovascular risks in the diabetic patients.**Keywords:** Diabetes mellitus, Glycated Hemoglobin, TG to HDL ratio**INTRODUCTION**

Diabetes mellitus (DM) is an endocrine disorder characterized by hyperglycemia and perturbation in carbohydrate, lipid, and protein metabolism.¹ DM is due to impaired insulin secretion or action or both. Type 2 Diabetes mellitus (T2DM) is rampant worldwide and is accompanied by hyperglycemia, insulin resistance, and eventually deficiency of insulin.²

Glycated hemoglobin (HbA1c) serves as an indicator of the average glucose concentration of the past three months. This is estimated to monitor blood glucose control.³ The HbA1C level of more than 6.5 % is considered diabetes

mellitus as per the American Diabetes Association (ADA).⁴

Dyslipidemia is commonly seen in diabetic patients.^{5,6,7} Hypertriglyceridemia and low levels of high-density lipoprotein (HDL) are associated with diabetes mellitus. The elevated level of TG and reduced HDL level is considered a predictor of CVD, which has more predictive power than glycated hemoglobin (HbA1C).⁸ The serum TG level increases in the diabetic population not only due to hyperglycemia but also hyperinsulinism as compensation for insulin resistance. Hypertriglyceridemia in the diabetic population depends upon the availability of circulating

free fatty acids and their contribution to endogenous TG production.⁹

HbA1C measurement is considered the gold standard for glycemic control and assessment of microvascular complications. Some studies have shown the utility of HbA1C for the prediction of cardiometabolic outcomes like dyslipidemia and cardiovascular disease.^{10,11}

The study aimed to correlate the TG /HDL ratio and HbA1C in the diabetic Nepalese population. Moreover, the status of lipid profile parameters and sugar profile parameters were also compared between diabetic and healthy controls. Diabetes as well as dyslipidemia is present in the Nepalese population. The TG/HDL ratio is assessed as a surrogate marker of insulin resistance and dyslipidemia and glycated hemoglobin to rule out the microvascular changes in the pathogenesis of diabetes mellitus.

MATERIALS AND METHODS

The current study is a retrospective and hospital-based cross-sectional study conducted in the Department of Biochemistry, National Medical College, Birgunj, Nepal. The recorded data of 358 newly diagnosed diabetic and 246 healthy control populations were retrieved from the laboratory software. The study duration was six months (September 2022 to May 2023). The convenient sampling method was used.

The WHO criteria for diabetes mellitus were followed. The patients having normal diabetic profiles and lipid profiles were considered as control populations. The diabetic profile (Fasting glucose, post-prandial glucose, Glycated hemoglobin) and lipid profile (total cholesterol, triglycerides, HDL cholesterol, and LDL) were estimated in the clinical laboratory services of National Medical College and Teaching Hospital using the standardized protocol of a fully automated random access clinical chemistry analyzer of Beckmann Coulter AU480 (California, America) clinical chemistry analyzer. The values of VLDL and TG to HDL ratio were calculated. The reference ranges in the laboratory were used as per the manufacturer.

The ethical clearance was obtained from the institutional review committee (IRC) of National Medical College, Nepal (Ref no: F-NMC/591/079-080) before starting the research.

Statistical analysis

The data were entered in the Microsoft Excel version 2013 and exported to the Statistical Package for Social Sciences (SPSS) version 25 accordingly. The categorical variables were expressed in frequency and percentages.

Continuous variables were expressed in mean and standard deviation. An Independent t-test was used to compare the mean and standard deviation between the control and diabetic population. Pearson correlation was used to find out the correlation between TG to HDL ratio with other variables. The P-value of less than 0.05 was considered statistically significant.

RESULTS

The current study investigated the diabetic and lipid profile in 604 retrospectively enrolled patients. Out of which 358 (59.3%) were diabetic and 246 (40.7%) were healthy subjects. The male patients were predominant in both groups. Eighty-seven (87) and 137 females respectively in the control and diabetic population contributes 35.4% and 38.3% respectively. Secondly, 159 (64.6%) and 221 (61.7%) males were present respectively in the control and diabetic group as shown in Table 1.

Table 1: Cross-tabulation of gender and study population (n=604)

S. N.	Gender\Groups	Control	Diabetes mellitus
1	Male	159 (64.6%)	221 (61.7%)
2	Female	87 (35.4%)	137 (38.3%)

The mean and standard deviation of the diabetic profile and lipid profile parameters were compared and significant differences were revealed between the control and diabetic population concerning FBS, PPBS, HbA1C, TC, TG, VLDL, and TG/HDL as illustrated in Table 2.

Table 2: Comparison of variables between Diabetic and control groups

S. N.	Variables	Groups		P value*
		Control (n = 246)	Diabetic (n =358)	
1	Age (years)	48.65 ± 13.15	51.18 ± 12.08	0.06
2	FBS (mg/dL)	100.87 ± 40.05	154.30 ± 55.00	0.00
3	PPBS (mg/dL)	185.42 ± 82.73	265.03 ± 83.91	0.00
4	HbA1c (%)	4.71 ± 1.22	7.75 ± 1.65	0.00
5	TC (mg/dL)	166.25 ± 41.89	174.12 ± 46.13	0.00
6	TG (mg/dL)	143.86 ± 44.26	216.32 ± 71.50	0.00
7	HDL (mg/dL)	44.26 ± 18.88	39.44 ± 16.13	0.00
8	LDL (mg/dL)	88.05 ± 37.03	92.74 ± 41.23	0.00
9	VLDL (mg/dL)	28.77 ± 9.05	43.26 ± 21.10	0.00
10	TG/HDL ratio	3.25 ± 2.34	5.48 ± 4.43	0.03

Table 3 illustrates the correlation of the TG/HDL ratio with other variables including the glycated hemoglobin. A significant positive correlation of TG/HDL ratio was found with HbA1C (0.09, 0.02). The TG/HDL ratio was significantly correlated with other lipid profile parameters and diabetic profile parameters (P value <0.05).

Table 3: Correlation of TG/HDL ratio with other variables

S. N.	Variables	r value	P value*
1	Age	-0.22	0.00*
2	FBS	0.08	0.03*
3	PPBS	0.11	0.00*
4	HbA1C	0.09	0.02*
5	TC	0.33	0.00*
6	TG	0.95	0.00*
7	HDL	-0.45	0.00*
8	VLDL	0.71	0.00*
9	LDL	0.10	0.00*

The correlation of TG/HDL ratio versus HbA1c was plotted in the scatterplot as depicted in Figure 1.

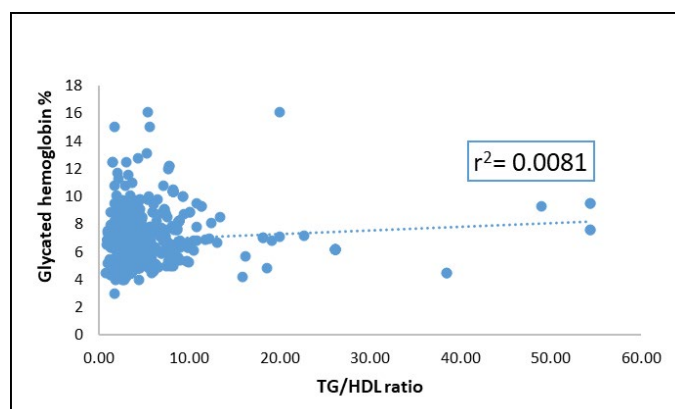


Figure 1: Scatterplot of glycated hemoglobin and TG to HDL ratio

DISCUSSION

The current study revealed a significant positive correlation between HbA1C and TG/HDL ratio. A study conducted in China by Renn X et al. has shown similar findings.¹² They also revealed the association of the TG/HDL ratio with insulin resistance. Though the Homeostatic Model Assessment for Insulin Resistance (HOMA-IR) is estimated as a marker of insulin resistance, which is not easily available and expensive, so many studies have suggested the TG/HDL ratio as a marker of insulin resistance in diabetes mellitus.^{13,14,15}

Our study also revealed the significant correlation of the TG/HDL ratio with other diabetic profile parameters such as fasting blood glucose, post-prandial blood glucose, and glycated hemoglobin. In agreement with the study by Young KA et al. who have shown the association of TG/HDL ratio with β cell function and insulin sensitivity.¹⁶

The current study revealed the increment of TG, TC, LDL, and decrement of serum HDL when compared with the healthy subjects, these findings are consistent with a study conducted at Khammam, Andhra Pradesh, India by Yadav T et al.¹⁷ However, they didn't report the correlation

of the TG/HDL ratio with glycated hemoglobin in their study population.

A study conducted in the western part of Nepal reported a significant positive correlation between HbA1C with TG, TC, and LDL and a significant negative correlation with HDL.¹⁸ These findings are consistent with our findings. Many studies have shown that poor glycemic control in diabetes mellitus leads to dyslipidemia.

CONCLUSION

Our results revealed the correlation between HbA1C and TG/HDL ratio in the Nepalese diabetic population. Hypertriglyceridemia was common in diabetic patients. Elevation of the TG/HDL ratio aggravates cardiovascular risks in diabetic patients. Elevation of HbA1C suggests the microvascular changes in the diabetic patients which is found to correlate with TG/HDL ratio. Moreover, the current study recommends further longitudinal studies should be carried out to know the metabolic outcomes of diabetes.

LIMITATIONS

The research is a retrospective audit. The history of oral hypoglycemic and hypolipidemic drugs was not taken. The study duration was short.

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