

## Original Research Article

# Blood pressure, lipid profile and glycemic control among type-2 diabetic patients in North Kerala

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## ABSTRACT

**Background:** Glycemic control, lipid control and other modifiable risk factor, is very important to prevent complications of type 2 diabetes. The objective of this study was to analyze glycemic control, lipid profile, BP and find the correlation of these parameters in the diabetic population of North Kerala.

**Methods:** This was a cross sectional study among the type 2 diabetic patients with 40-60 years of age, and those without any cardiac, renal, liver, and thyroid dysfunction. Fasting blood sugar, BP, HbA1c and lipid profile were assessed by VITROS 5600 integrated system. The study population was grouped in to two based on their glycemic control (HbA1c  $\geq 7\%$  and HbA1c  $< 7\%$ ). Statistical analysis was performed by SPSS software. The comparison of variables age, BP, FBS, HbA1c, total cholesterol, LDL, HDL, TG, and TG/HDL was tested using independent student t test. The correlations between the variables were analyzed using Pearson correlation coefficient. P values less than 0.05 were considered significant.

**Results:** There was a significant positive correlation between DBP and poor glycemic control group ( $t=2.35$ ,  $p=0.0102$ ). Fasting blood sugar ( $p\leq 0.00001$ ), total cholesterol ( $p=0.0031$ ), triglycerides ( $p\leq 0.00001$ ), LDL ( $p=0.0051$ ), HDL ( $p=0.0010$ ) and TG/HDL ( $p\leq 0.00001$ ) also were significantly higher in this group. Age or gender showed no correlation with HbA1c and BP.

**Conclusions:** This study shows highly significant positive correlation between TG/HDL and poor glycemic control. It appears the degree of hypertension is not correlated with HbA1c, but significantly correlated with lipid profile especially among those with poor glycemic control.

**Keywords:** Glycemic control, Lipid profile, Type 2 diabetes mellitus, TG-HDL ratio

## INTRODUCTION

Diabetes mellitus is recognized as one of the most common non-communicable disease and major cause for increased mortality globally. Studies give the evidence for high prevalence of hypertension in diabetics comparing to the nondiabetics. Also, development of type-2 diabetes is more common in hypertensive patients.<sup>1</sup> Good glycemic control is most important in management of diabetes mellitus. Glycated hemoglobin (HbA1c) is a routine test to monitor their glycemic control. The goal is to achieve a

level below 7%. 1% increase in HbA1c estimated an increase of diabetic complications by 18%.<sup>2</sup> The diabetic patients on glycemic control is varied from one population to another. The correlation of HbA1c with lipid profile is conflicting and further studies are needed to overcome this discrepancy. Also, the correlation between TG/HDL and insulin resistance is already explored, but with glycemic control is limited.

The aim of the study was to analyze glycemic control, lipid profile, BP and the correlation of these parameters.

## METHODS

This observational, cross sectional study was conducted at MES Medical College and Hospital, Perinthalmanna, Kerala. Study conducted during January 2021 to March 2021. 113 type 2 diabetic patients on oral hypoglycemic drugs, in the age group 40-60 years, without any other systemic diseases were selected for our study. Those taking lipid-lowering agents also were excluded. Written informed consent was obtained from the subjects.

Diabetes was confirmed based on fasting and postprandial blood glucose levels by WHO norms. BP was measured by sphygmomanometer. The blood investigations glucose, lipid profile (total cholesterol, HDL, LDL, triglycerides), HbA1c were carried out by fully automated analyzer VITROS 5600 integrated system. The ratio TG/HDL also calculated. The study subjects were grouped according to the level of HbA1c (good glycemic index <7%, and poor glycemic index >7%).

### Statistical analysis

The data is expressed as mean±SD. Statistical analysis was carried out by SYSTAT. The comparison of parameters in the study groups was done by independent 't' test, while the correlation was determined by Pearson's correlation coefficients. P<0.05 indicated statistical significance.

## RESULTS

The study population was 113 T2DM patients in the age group of 40-60 years. Among them 51.33% were males and the mean age of the total study population was

52.5±5.9 years. There were 62% of the patients with increased blood pressure. The mean systolic BP levels 130.5±18.1 mmHg and mean diastolic BP levels 82.4±8.5 mmHg). The Pearson correlation analysis results demonstrated that HbA1c was not correlated with either SBP or DBP. There was a positive correlation of BP with TC and LDL, but other variables showed no correlation (Table 1). The correlation of HbA1c with age, BP, FBS, total cholesterol (TC), triglycerides (TG), LDL, HDL, VLDL, TG/HDL also measured. TG, VLDL, TG/HDL showed a highly significant positive correlation and HDL showed significant negative correlation with HbA1c at the level of significance p<0.05. FBS and TC also positively, but weakly correlated with HbA1c (Table 2).

The T2DM patients were classified according to their values of HbA1c in two groups: DM2 HbA1c <7%, with good glycemic control (N=44) and DM2 HbA1c ≥7%, with poor glycemic control (N=69). The variables are expressed as mean SD. The comparison of variables among the two groups is done by 'independent t-test at the level of significance p<0.05. T2DM Patients in the group HbA1c ≥7% had significantly higher values of FBS, HbA1c, TG, TG/HDL levels compared to DM2 patients in DM2 HbA1c <7% group (Table 3). Total cholesterol, LDL also were increased and HDL level was lowered significantly in poor glycemic control group. There was no significant difference in age between the two groups. Comparison of BP among the two groups showed a positive correlation with poor glycemic control, but SBP showed a weak correlation which was not significant. DBP was significantly higher in the poor glycemic control group HbA1c ≥7%

**Table 1: Correlation between BP and other variables in the study population.**

Variables	SBP		DBP	
	r value	P value	r value	P value
Age	0.0826	0.3844	0.065	0.4939
FBS	-0.0119	0.9004	0.0517	0.5865
TC	0.2201	0.0191*	0.2608	0.0053**
TG	0.0845	0.3735	0.1836	0.0516
LDL	0.2398	0.0105*	0.2605	0.0053**
HDL	-0.075	0.4298	-0.0385	0.6856
TG/HDL	0.1246	0.1885	0.1961	0.0373*

Note: \*\*\* indicate moderately significant, \* less significant. Significance was measured at the level of p<0.05.

**Table 2: Correlation between HbA1c and other variables in the study population.**

Variables	r value	P value
Age (years)	0.0826	0.3844
SBP (mmHg)	0.1402	0.1386
DBP (mmHg)	0.1296	0.1713
FBS (mg/dl)	0.2078	0.0272*
TC (mg/dl)	0.2121	0.0241*
TG (mg/dl)	0.5546	<0.00001***

Continued.

Variables	r value	P value
LDL (mg/dl)	0.1752	0.0634
HDL (mg/dl)	-0.2883	0.0019**
VLDL (mg/dl)	0.5085	<0.00001***
TG/HDL	0.6716	<0.00001***

Note: \*\*\* indicate moderately significant, \* less significant. \*\*\*indicates highly significant. Significance was measured at the level of  $p < 0.05$ .

**Table 3: Comparison of variables among two groups according to HbA1c value.**

Variables	HbA1c <7% (N=44)	HbA1c ≥7% (N=69)	t value	P value
Age (years)	52.2±5.8	52.7±6.0	0.47	0.3199
SBP (mmHg)	127±14.4	132.8±20.0	1.64	0.0518
DBP (mmHg)	80±7.2	83.9±9.4	2.35	0.0102*
FBS (mg/dl)	132.8±26.7	181.8±61.3	5.01	<0.00001***
HbA1c (%)	6.2±0.5	9.0±0.9	9.23	<0.00001***
TC (mg/dl)	200.5±23.5	213.6±25	2.79	0.0031**
TG (mg/dl)	125.7±23.7	151.5±28.4	5.02	<0.00001***
LDL (mg/dl)	124.6±18.7	135.4±23.0	2.60	0.0051**
HDL (mg/dl)	50.6±5.7	47.1±6.2	- 3.15	0.0010**
TG/HDL	2.5±0.4	3.3±0.6	6.92	<0.00001***

Note: \*\*\* indicate moderately significant, \* less significant. \*\*\*indicates highly significant. Significance was measured at the level of  $p < 0.05$ .

## DISCUSSION

In this cross-sectional study among the T2DM patients of north Kerala region, we observed 62% of them with increased BP. Many studies revealed the importance of BP control in diabetic patients to minimize diabetes-related complications.<sup>3,4</sup>

This study analyzed the correlation between BP and other variables such as HbA1c, FBS, TC, TG, HDL, LDL, TG/HDL and Age. Our results demonstrated that either SBP ( $p=0.1386$ ) or DBP ( $p=0.1713$ ) not correlated with HbA1c. Khorasani S H et al (Iran) also reported same result in their study.<sup>5</sup> Bower et al (Maryland) reported a strong association between hypertension, diabetes, and insulin resistance.<sup>6</sup> Our study also compared BP among the good glycemic control and poor glycemic control group. It is showed only DBP ( $p=0.0102$ ) was significantly higher in the poor glycemic control group HbA1c  $\geq 7\%$ . In a study Britton et al (Boston) reported higher HbA1c values were associated with increased risks of hypertension.<sup>7</sup>

The authors also showed the correlation between increased risks of hypertension and poor glycemic control among those with diagnosed diabetes. Correlation of BP with lipid profile parameters showed, a positive correlation of BP with TC and LDL, but no correlation with other variables. Biadgo et al (Ethiopia) reported that there is a correlation between systolic BP only with TG among various lipid profiles and diastolic BP was not found to have statistically significant correlation with any of the lipid profiles.<sup>8</sup> Study in Jamaican population, Gorden et al (Jamaica) reported that hypertensive T2DM patients had significantly higher serum TC.<sup>9</sup>

According to the findings of our study, there was a weak correlation between FBS and HbA1c ( $p=0.0272$ ). Rao et al (Bengaluru) also reported both fasting and random blood sugar highly correlated with HbA1c, however, no significant correlation was observed between HbA1c and any of the tested lipid profiles.<sup>10</sup> In our study it is also found that HbA1c highly correlated with the lipid parameters TG ( $p \leq 0.00001$ ), VLDL ( $p \leq 0.00001$ ), TG/HDL ( $p \leq 0.00001$ ), HDL ( $p \leq 0.00019$ ), TC ( $p=0.0241$ ). A similar correlation has been reported by several other studies.<sup>11,12</sup> They reported a positive relationship between HbA1c and high TG levels in agreement with the present study. Sarkar et al (Maharashtra) in their study reported no correlation between HbA1c and TG.<sup>13</sup>

The findings indicated that HbA1c is a direct indicator of increased TG and indirectly helps to assess the risk for macro- and microvascular problems.<sup>11,14</sup> This increased TG in T2DM patients can be explained as the inadequate secretion or function of insulin causes an increase in the hepatic VLDL secretion and enhanced substrate levels for TG synthesis.<sup>13</sup> Our results showed a statistical significant negative correlation between HbA1c and HDL. Several studies that reported in agreement with our study with a notable negative relationship between HbA1c and HDL.<sup>13,15,16</sup>

However, Alzahrani et al and a few other studies reported a statistically non-significant negative link between HbA1c and HDL.<sup>11,12,17</sup> The present study found no relationship between HbA1c and LDL. Similar result reported in some studies, but there are studies inconsistent with the result which stated significant correlation between HbA1c and LDL.<sup>11,13,16-18</sup> In the present study, T2DM patients in the group HbA1c  $\geq 7\%$  had significantly higher

values of FBS, HbA1c, TG, TG/HDL levels compared to DM2 patients in DM2 HbA1c <7% group. These parameters showed a highly significant positive correlation in poor glycaemic group with  $p \leq 0.00001$ . Babic et al (Bosnia) reported a similar positive correlation between TG/HDL and poor glycaemic control.<sup>19</sup> Another study by Laverdy et al found that TG/HDL served as markers of poor glycaemic control as the patients with HbA1c more than 6.5% had higher triglyceride and lower HDL.<sup>20,21</sup>

## CONCLUSION

This study shows highly significant positive correlation between TG/HDL and poor glycaemic control. TG/HDL-C ratio might be a useful predictor of glycaemic control in T2DM patients. It appears the degree of hypertension is not correlated with glycaemic control, but significantly correlated with lipid profile especially among those with poor glycaemic control. HbA1c, lipid profile and BP should be kept under strict control so that complications associated with diabetes would be delayed.

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