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*Original Research Article.*

# Lipid Profile in Type 2 Diabetes Mellitus: A Special Focus on Triglyceride to HDL Ratio

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## ABSTRACT

**Background:** Patients with type-2 diabetes have increased risk of cardiovascular disease associated with atherogenic abnormalities and dyslipidaemia. Some identified factors associated with cardio-metabolic risk are hyperinsulinemia, insulin resistance (IR) and carotid intima-media thickness (cIMT). However, the accurate measurement of insulin or IR parameters is complicated in the clinical practice. Recently it has been observed that the Triglycerides/High Density Lipoprotein Cholesterol (TG/HDL-C) ratio can identify IR, cardio-metabolic risk and cardiovascular disease.

**Objectives:** This study was aimed to evaluate the risk of cardiac problems and insulin resistance by analyzing lipid profile along with TG/HDL-c ratio in known diabetics and normal male and female subjects.

**Materials and Methods:** Total of 183 subjects including 43 non-diabetic, 43 diabetic males and 63 non-diabetic and 25 diabetic females, who gave consent were included for study. Fasting blood samples were collected and analyzed for glucose, and lipid profile by semi-auto analyzer using commercial kits. Values were reported as mean ± standard deviation (SD). The data were analyzed by student 't' test and p value of < 0.05 was taken as statistically significant at 95% confidence interval.

**Results:** The study showed increased fasting blood glucose, total cholesterol, LDL VLDL and triglycerides and decreased HDL in diabetic male and female subjects compared to respective controls. TG/HDL-c was significantly high in diabetic male and female subjects compared to respective controls.

**Conclusion:** Dyslipidemia was observed in male and females' diabetics. The increased TG/HDL-c ratio observed in this study indicates the higher insulin resistance and an atherogenic pattern in diabetes.

**Keywords:** Lipid Profile, Diabetes, Triglyceride, TG/HDL Ratio, Insulin Resistance.

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## INTRODUCTION

The importance of lipid profile has reached far and large number of people. It is now a normal test which even a healthy human is interested in. The reason being the lipid profile gives us an idea as to how healthy is our heart and will also tell us about how far we are from cardiac problems. Initially total cholesterol, Low density lipoproteins (LDL) and High-density lipoproteins (HDL) cholesterol were taken very seriously. The LDL cholesterol was termed as bad cholesterol and HDL cholesterol as good cholesterol. Then the role of hyperglycemia in the abnormal lipid metabolism was highlighted.

Thus, both diabetes Type 1 and 2 were associated with many abnormalities in the metabolism of plasma lipids and lipoproteins. Most important changes included an increase in LDL cholesterol, triglycerides and a decrease in HDL cholesterol. The abnormalities in these patients were observed despite normal LDL cholesterol levels. A study has shown that decreased high-density lipoprotein cholesterol is not a risk factor for recurrent vascular events in patients with vascular disease on intensive lipid-lowering medication.[1]

These changes were also a feature of the insulin resistance syndrome (also known as the metabolic syndrome), which underlies many cases of type 2 diabetes. In fact, pre-diabetic individuals often exhibit an atherogenic pattern of risk factors that includes higher levels of total cholesterol, LDL cholesterol, and

triglycerides and lower levels of HDL cholesterol than individuals who do not develop diabetes.[2,3] Insulin resistance has striking effects on lipoprotein size and subclass particle concentrations for Very low-density lipoproteins (VLDL), LDL, and HDL.[4,5] Patients with type-2 diabetes have increased risk of cardiovascular disease associated with atherogenic abnormalities and dyslipidaemia. Coronary artery disease, especially myocardial infarction is the leading cause of morbidity and mortality worldwide. Hyperglycaemia and atherosclerosis were associated in type-2 diabetes.[5]

Some identified factors associated with cardio-metabolic risk are hyperinsulinemia, insulin resistance (IR) and carotid intima-media thickness (cIMT).[6] However, the accurate measurement of insulin or IR parameters is complicated in the clinical practice. Recently it has been observed that the Triglycerides/High Density Lipoprotein Cholesterol (TG/HDL-C) ratio can identify IR, cardio-metabolic risk and cardiovascular disease.[7] Thus TG/HDL ratio can be taken as surrogate marker for insulin resistance.[8] Nevertheless, there are discrepancies in the discriminatory power and the cutoff points among populations.[9-11]

As such, it is expected that a commonly available and standardized measurement of TG/HDL-C ratio could help clinicians to identify patients who are not only IR but also display the characteristic of dyslipidemia.[12] A high serum triglyceride to high-density lipoprotein cholesterol (TG/HDL-C) ratio has been reported as an independent predictor for cardiovascular events in the general population.[13] In this study we have studied dyslipidemia along with TG/HDL ratio in Type 2 diabetes and control subjects of both sexes.

## MATERIALS AND METHODS

### Study Participants

The diabetic men and women in our study were known diabetics attending the hospital for a regular health check-up and diabetic management in this hospital. Healthy subjects of both sexes with the same age were selected for control subjects. The total number of participants were 183. The age group of men in our study was 29 – 79, and for women it is 27 – 75. The first group consisted of 43 men without any hyper glycaemia and are non-diabetic, age groups between 29 - 74, the second group consisted of known diabetic men age group ranging from 32 – 79. The third group had nondiabetic women acting as control group, age group ranging from 27 – 72, and last or fourth group was made of diabetic women, age group ranging from 30 - 75.

### Inclusion and Exclusion Criterion

Diabetic and non- diabetic women and men in the study were selected depending on the exclusion criterion. Men and Women with any type of hormonal abnormality, pregnancy, hormonal therapy, heavy exercise and familial hypertriglyceridemia were excluded.

### Sample Collection

After an overnight fasting for 12 -14 hours, 5 ml of venous blood was drawn under aseptic precaution in a sterile plain vacutainer from selected subjects. For glucose estimation sample is separately taken in fluoride, oxalate bottles and remaining sample in plain vial for serum collection. Glucose is estimated in plasma and lipid profile is estimated in serum on the same day.

### Assay Methods

All the estimations were done using Erba-chem-5, plus-2 semi-automated analyzer. The quality control is checked using control sera of two levels. Total cholesterol and HDL cholesterol estimations were done by CHOD/PAP enzymatic method[14,15], triglycerides by GPO/Pap end point method.[16] Glucose was estimated by GOD/PAP method.[17,18]

LDL was calculated using the Friedewald formula[19]

LDL-C = TC − (HDL-C + TG/5)

VLDL was calculated using the formula:

VLDL-C = TG/5

Results were reported as mean + standard deviation (SD).The data were analysed by Student 't' test and p value of < 0.05 was taken as statistically significant at 95% confidence interval.

Ethics—the blood was collected after taking written/oral consent from the subjects. This project has been approved by the ethical committee of Shadan Institute of Medical Sciences.

**Table 1: Gender and age of control subjects and patients with type 2 diabetes**

| Study groups | No of Subjects | Age range (Mean ± SD) |
|---|---|---|
| **Control Male** | 43 | 29 – 74 (54 ± 16) |
| **Type 2 diabetes Male** | 26 | 32 - 79 (57 ±12) |
| **Control Female** | 63 | 27 - 72 (45 ± 14) |
| **Type 2 diabetes Female** | 51 | 30 - 75 (49 ±15) |
| **Total number of subjects** | 183 | 27– 79* |

*Minimum and Maximum years of age

**Table 2: The concentration of Fasting Blood Glucose and Lipid profile in Male control subjects and Male patients with type 2 diabetes**

| Male | FBG mg/dl | Total Cholesterol mg/dl | HDL Cholesterol mg/dl | LDL Cholesterol mg/dl | VLDL Cholesterol mg/dl | Triglycerides mg/dl | TG/HDL |
|---|---|---|---|---|---|---|---|
| **Control** | 91 ± 8.1 | 167.9 ± 32.5 | 42.3 ± 5.4 | 97.4 ± 22.7 | 27.4 ± 10.3 | 138.5 ± 51.5 | 3.7 ± 1.3 |
| **Diabetic** | 164.7 ± 52.7[c] | 211.3 ± 31.2[c] | 38.2 ± 3.7[c] | 116.2 ± 17.7[c] | 34.1 ± 11.5[b] | 182.5 ± 87.7[b] | 4.6 ± 1.7[b] |

Statistical analysis was done by Student t-test,

Values are Mean ± SD; statistically significant= p<0.05; [a]p= <0.05; [b]p=<0.01; [c]p=<0.001

**Table 3: The concentration of Fasting Blood Glucose and Lipid profile in Female control subjects and Female patients with type 2 diabetes**

| Female | FBG mg/dl | Total Cholesterol mg/dl | HDL Cholesterol mg/dl | LDL Cholesterol mg/dl | VLDL Cholesterol mg/dl | Triglycerides mg/dl | TG/HDL |
|---|---|---|---|---|---|---|---|
| **Control** | 89.9 ± 9.3 | 164.5 ± 29.9 | 40.7 ± 5.4 | 98.2 ± 23.5 | 26.6 ± 8.0 | 134.6 ± 46.3 | 3.5 ± 1.2 |
| **Diabetic** | 150.8 ± 53.5[c] | 204.7 ± 30.9[c] | 37.9 ± 3.9 [c] | 113.4 ± 22.1[c] | 36.1 ± 9.3[c] | 166.3 ± 70.3[c] | 4.2 ± 1.8[b] |

Statistical analysis was done by Student t-test,

Values are Mean ± SD; statistically significant= p<0.05; [a]p= <0.05; [b]p=<0.01; [c]p=<0.001

## RESULTS

Table 1 gives sex and age of control subjects and patients with type 2 diabetes. Male control group was with 43 subjects having 29 to 74 years (54 ± 16, Mean ± SD) and male diabetic group was with 26 subjects having 32 to 79 years (57 ± 12, Mean ± SD). Female control group was with 63 subjects having 27 to 72 years (45 ± 14, Mean ± SD) and female diabetic group was with 51 subjects having 30 to 75 years (49 ± 15, Mean ± SD). Overall, the study was with the total of 183 subjects consisting male and female diabetics along with the control subjects of both the groups. Fasting Blood Glucose, Lipid profile along with the triglycerides to HDL-cholesterol ratio of male and female diabetics along with the control subjects of both the groups were shown in Table 2 & Table 3. The analysis of results of control and diabetic subjects of both sexes were done by student t-test respectively and p<0.05 was taken as statistically significant.

Fasting blood glucose levels were clearly showed significantly an increased level in diabetic subjects of both male and females when compared to respective controls. In diabetic male and female subjects' dyslipidemia was clearly shown as all the tested lipid parameters (Total cholesterol, LDL VLDL and Triglycerides), except HDL cholesterol were significantly increased when compared to respective control subjects. HDL cholesterol was significantly decreased in diabetic male and female subjects when compared to respective controls. Triglyceride to HDL ratio in both male and female diabetic subjects were higher when compared to controls indicating an increased 'insulin resistance' in diabetic subjects.

## DISCUSSION

According to a study conducted in 2018, there are about 77 million people suffering from diabetes in India[20] and about 17.5% of the global total.[21] Projections made by international diabetes federation are the number would increase to about 134 million by 2045.

Diabetes mellitus is a group of metabolic disorders of carbohydrate metabolism in which glucose utilization is greatly affected, producing hyperglycemia. Furthermore, it has been proposed that underutilization of glucose is associated with changes in lipid profile.

Thus, women and men with type 2 diabetes mellitus (T2DM) have an increased incidence of atherosclerotic cardiovascular disease (CVD) which is attributed to multiple risk factors including dyslipidemia characterized by elevated plasma triglyceride (TG), low levels of High- Density–Lipoprotein Cholesterol (HDL-C) and increased small-dense Low-Density Lipoprotein (sd-LDL) particles.

The ratio of TG/HDL-C is calculated and named as the "atherogenic index"

The objective of our present study is to observe the changes in the lipid profile among men and women with diabetes compared to non-diabetic subjects. We studied a total of 26 men and 51 women with diabetes and 43 men and 63 women without diabetes. It was observed a clear hyperglycemia in diabetics. The total cholesterol, LDL cholesterol and triglycerides were higher in diabetics compared to controls. HDL showed significant lower values in diabetics. The basis of lipid abnormalities in T2DM is a deficient action of insulin on target tissues due to impairment of insulin secretion, defects in insulin action, or both. Insulin resistance, which represents a reduced physiological response of the peripheral tissues to the action of the normal levels of insulin, is a major finding in several metabolic disorders, including T2DM and metabolic syndrome.[22-24] Factors associated with cardio-metabolic risk are hyperinsulinemia, insulin resistance (IR) and carotid intima-media thickness (cIMT).[6] However, the accurate measurement of insulin or IR parameters is complicated in the clinical practice. Recently it has been observed that the Triglycerides/High Density Lipoprotein Cholesterol (TG/HDL-C) ratio can identify IR, cardio-metabolic risk and cardiovascular disease.[7] Thus TG/HDL ratio can be taken as surrogate marker for insulin resistance.[8]

Dyslipidemia was observed in male and females' diabetics. The increased TG/HDL-c ratio observed in this study indicates the higher insulin resistance and an atherogenic pattern in diabetes. TG/HDL-c ratio may be a beneficial parameter to assess IR in high-risk group of CVD individuals. In view of the observations of the study, along with lipid lowering drugs the strategies to reduce triglyceride and to improve HDL concentrations may prove in reducing cardiovascular events.

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