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# Dyslipidemia in Type 2 Diabetic Patients

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**Original Research Article**

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**Abstract:** Type 2 diabetes mellitus has become a leading cause of morbidity and mortality world over. Insulin resistance plays a key role in the development of diabetic dyslipidemia, plasma lipid abnormalities contributes to the risk for atherosclerosis and coronary heart diseases in majority of patients with type 2 diabetes. The aim of the study was to assess the serum lipid profile in type 2 DM patients without and with complications. The current study was undertaken in 90 subjects. 30 diabetics without complications (group I), 30 diabetics with complications (group II) and 30 non diabetics as normal control group (Group III). The serum total Cholesterol, Triglycerides, LDL-C and VLDL-C levels were significantly much higher in diabetic cases with complications compared to cases without complications and HDL-C levels were significantly lower in cases of both the 3groups when compared to controls. The elevation of serum total Cholesterol, Triglycerides, LDL-C and VLDL-C levels were significant in both the study groups when compared to controls. We found significantly lower levels of HDL-C in diabetic cases with complications when compared to cases without complications. The lowering is significant in both the study groups when compared to control. Hence it is concluded that the serum lipid profile levels appears to be useful to prevent the diabetic complications and provide valuable information for proper medical intervention.

**Keywords:** Type 2 Diabetes Mellitus, Dyslipidemia & Lipid Profile

## INTRODUCTION

Diabetes mellitus is a heterogeneous group of disorders characterized by variable degree of insulin resistance, impared insulin secretion and increased glucose production [1]. Diabetes is the major cause of heart attacks,stroke ,nerve damage,renal failure ,blindness and amputation. The long standing elevation of blood glucose is associated with chronic complications of diabetes which includes coronary heart diseases, nephropathy, neuropathy and retinopathy. DM will be a leading cause of morbidity and mortality in the foreseable future. Diabetic patients have increased risk for stroke and death from heart disease. A common pattern of lipid abnormilities known as diabetic dyslipidemia which includes hypertriglyceridemia, reduced HDL-C and a shift towards small dense LDL[2].The underlying mechanism of diabetic dyslipidemia is complex and still not well understood .Hyperglycemia alone cannot fully explain the lipid changes, insulin resistance is believed to be the main trigger for diabetis dyslipidemia. The composition of lipid particles in diabetic dyslipidemia is more atherogenic then in dyslipidemia in general. Raised serum triglycerides and low HDL-C often precede the onset of type2 diabetes for many years, LDL particles are converted to smaller more atherogenic, lipoprotiens termed as small dense LDL [3].Recent evidence suggests that low HDL-C is an independent factor not only for CVD but also for the development of diabetes itself[4].Patients with diabetes show qualitative and kinetic abnormilites for all lipoprotiens[5]. The objective of this study was to assess the serum lipid profile levels in type 2 diabetic patients with complications.

## MATERIALS AND METHODS

The present study was carried out in the Department of Biochemistry KBN Institute of Medical Sciences Gulbarga. Clearance was obtained from the institutional ethical committee.

The study was carried out on 30 age and sex matched healthy controls and 60 type 2 diabetic patients who attended the outpatient and inpatient department of KBN Institute of Medical Sciences Gulbarga. A total 60 patients of type 2 diabetes mellitus between 40 – 70 years, which were divided into following groups.

***Control group***: Included 30 healthy, age and sex matched individuals.

***Group I***: Included 30 patients of type 2 diabetes without complications.
***Group II***: Included 30 patients of type 2 diabetes with proven complications, like CAD, retinopathy and neuropathy.

The diagnosis of type 2 diabetes mellitus was established with the recommended criteria's of American diabetes Association.

**Inclusion Criteria**

Patients in the age group of 40 – 70 years with type 2 diabetes without and with proven complications, like CAD, neuropathy and retinopathy were selected.

**Exclusion criteria**

Patients with the following conditions are excluded from the study. Chronic liver diseases. Hypothyroidism and Patients taking drugs like steriods, diuretics and on oral contraceptive pills.

Informed consent was taken from patient and control subjects. A pre-structured and pre-tested proforma was used to collect the data. Baseline data including age and sex, detailed medical history including conventional risk factors, clinical examinations and relevant investigations including ECG, echocardiogram, nerve conduction test, fundoscopy etc were included as part of the methodology.

**Laboratory methods**

Fasting venous blood samples were collected from cases and controls and the samples were centrifuged, serum was separated and stored at $4^0$C. Lipid profile,FBS and PPBS was analysed using fully automated analyser by following methods:

Estimation of Serum total cholesterol by COD-POD method [6], Serum triglycerides by Tinder's GPO-POD method and serum HDL cholesterol by Phosphotungstate method. Serum LDL cholesterol and VLDL cholesterol values were calculated by applying Friedewald's formula.

Serum Creatinine estimation was carried out using Jaffe's alkaline picrate method and blood urea was measured using Specific Urease method. FBS and PPBS were measured by GOD/POD method [7].

**STATISTICAL METHODS**

Student t test/Chi-square test has been used to find the significance of homogeneity of study characteristics between three groups of patients. Analysis of variance has been used to find the significance of study parameters between three groups. Results were expressed as mean $\pm$ SD, p values are obtained by using the post-hoc Turkey test.

Significant figures + Suggestive significance $0.05<p<0.10$. * Moderately significant $0.01<p \leq 0.05$. ** Strongly significant $p \leq 0.01$.

**Statistical software**

The Statistical software namely SPSS 15.0, Stata 8.0, MedCalc 9.0.1 and Systat 11.0 were used for the analysis of the data and Microsoft word and Excel have been used to generate graphs, tables etc.

**RESULTS AND DISCUSSION**

A Comparative three-arm study with 30 in Controls, 30 in diabetic patients without complications and another 30 patients in Diabetics with complications is undertaken to study the Biochemical parameters.

**Table-1: Basic demographic variable in the three study groups**

| Basic characteristics | Controls | DM without complications | DM with Complications | p value |
|---|---|---|---|---|
| Age in years | 55.53±8.47 | 54.30±9.48 | 58.03±9.74 | 0.286 |
| Gender | 16:14 | 19:11 | 18:12 | 0.725 |
| BMI (kg/m$^2$) | 22.25±1.76 | 27.11±2.78 | 29.01±2.27 | <0.001** |

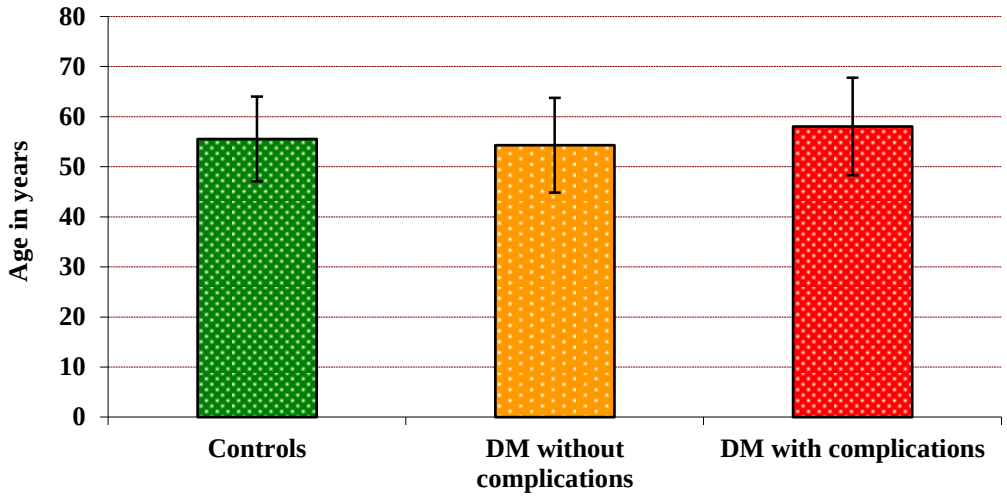


**Fig-1a: Age distribution**

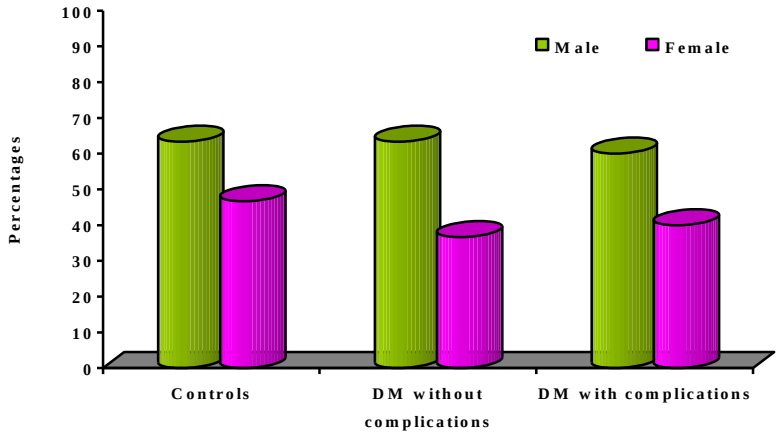


**Fig-1b: Gender distribution**

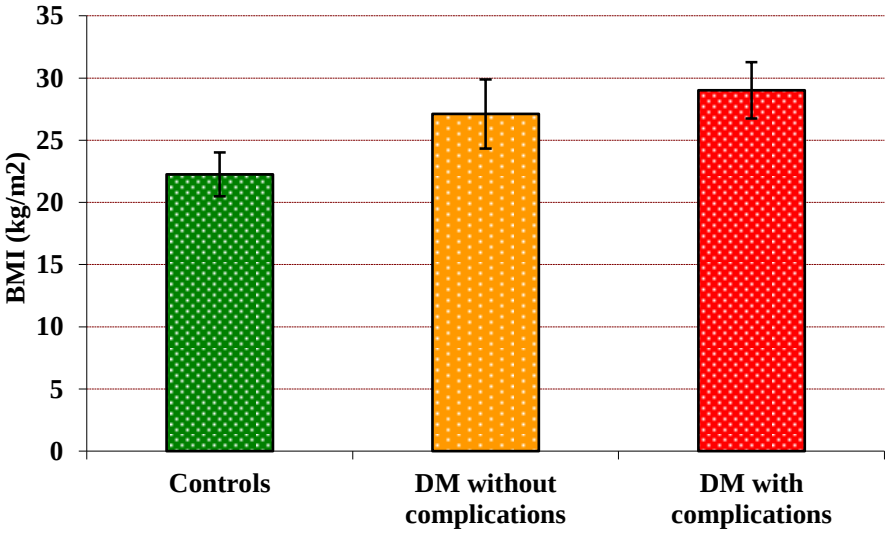


**Fig 1c: BMI distribution**

**Table-2: FBS and PPBS in the three study groups**

| Study parameters | Controls | DM without complications | DM with Complications |
|---|---|---|---|
| FBS mg/dl | 88.13±18.95 | 142.97±12.48 | 187.83±29.89 |
| PPBS mg/dl | 127.03±21.42 | 230.70±26.84 | 317.00±48.32 |

Results are presented in Mean ± SD

| Study parameters | Controls Vs DM without complications | Controls Vs DM with complications | DM without Complications Vs DM with Complications | Effect size | |
|---|---|---|---|---|---|
| | | | | Controls Vs DM without complications | Controls Vs DM with complications |
| FBS mg/dl | <0.001** | <0.001** | <0.001** | 3.37 | 3.93 |
| PPBS mg/dl | <0.001** | <0.001** | <0.001** | 4.21 | 5.02 |

p values are obtained by using the Post-hoc Tukey test

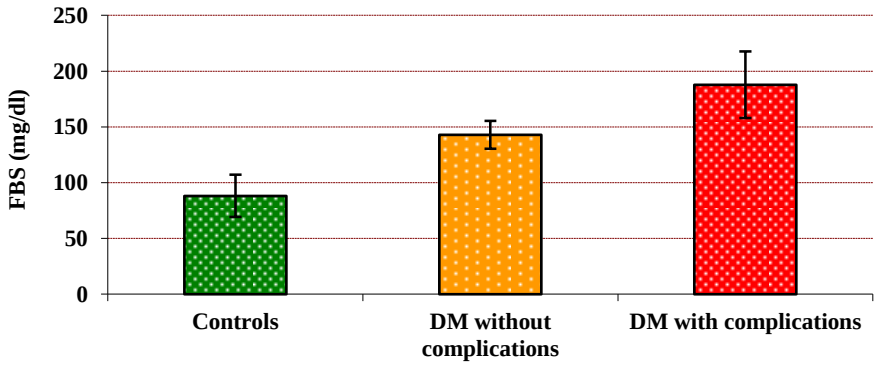


**Fig-2a: FBS in the three study groups**

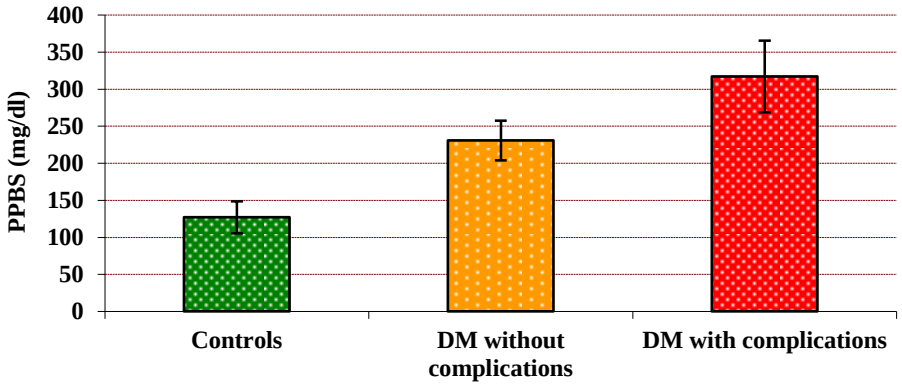


**Fig-2b: PPBS in the three study groups**

**Table-3: Lipid parameters in the three study groups**

| Study parameters | Controls | DM without complications | DM with Complications |
|---|---|---|---|
| TC mg/dl | 179.50±44.64 | 239.23±36.08 | 267.07±31.89 |
| TG mg/dl | 121.47±28.74 | 186.80±58.17 | 257.80±71.05 |
| HDL mg/dl | 47.87±4.24 | 35.07±5.56 | 28.97±6.72 |
| LDL-C mg/dl | 103.03±33.95 | 164.13±37.28 | 187.60±28.96 |
| VLDL mg/dl | 24.40±5.71 | 37.33±11.60 | 52.90±14.12 |

Results are presented in Mean±SD

| Study parameters | Controls Vs DM without complications | Controls Vs DM with complications | DM without Complications Vs DM with Complications | Effect size | |
|---|---|---|---|---|---|
| | | | | Controls Vs DM without complications | Controls Vs DM with complications |
| TC mg/dl | <0.001** | <0.001** | 0.015* | 1.45 | 2.25 |
| TG mg/dl | <0.001** | <0.001** | <0.001** | 1.41 | 2.48 |
| HDL mg/dl | <0.001** | <0.001** | <0.001** | 2.56 | 3.32 |
| LDL-C mg/dl | <0.001** | <0.001** | 0.022* | 1.69 | 2.65 |
| VLDL mg/dl | <0.001** | <0.001** | <0.001** | 1.40 | 2.61 |

p values are obtained by using the Post-hoc Tukey test

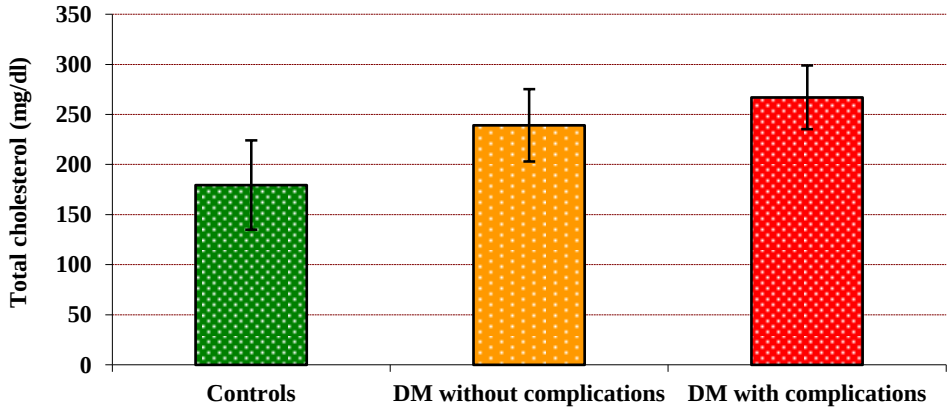


**Fig-3a: Serum total cholesterol levels (mg/dl) in the three study groups**

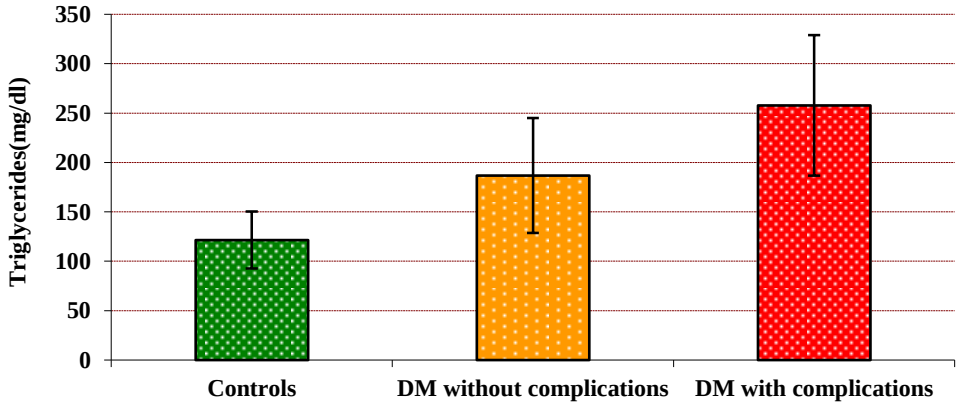


**Fig-3b: Serum Triglycerides levels (mg/dl) in the three study groups**

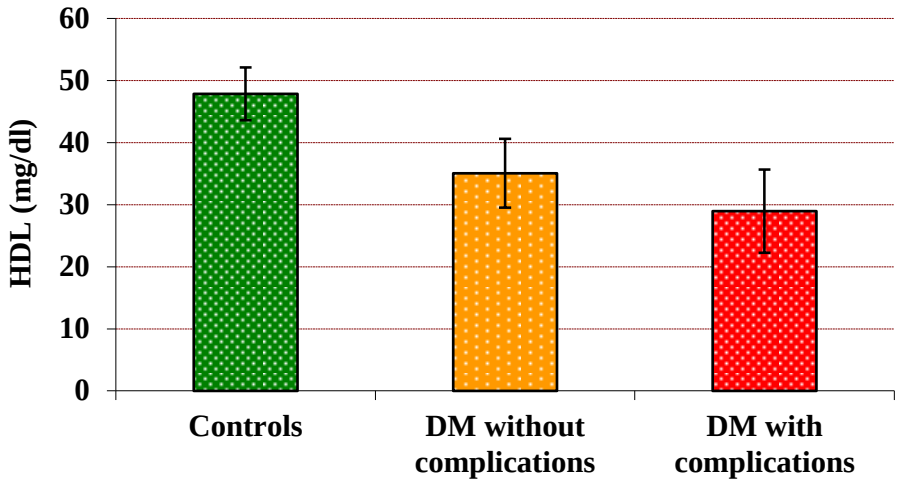


**Fig-3c: Serum HDL Cholesterol levels (mg/dl) in the three study groups**

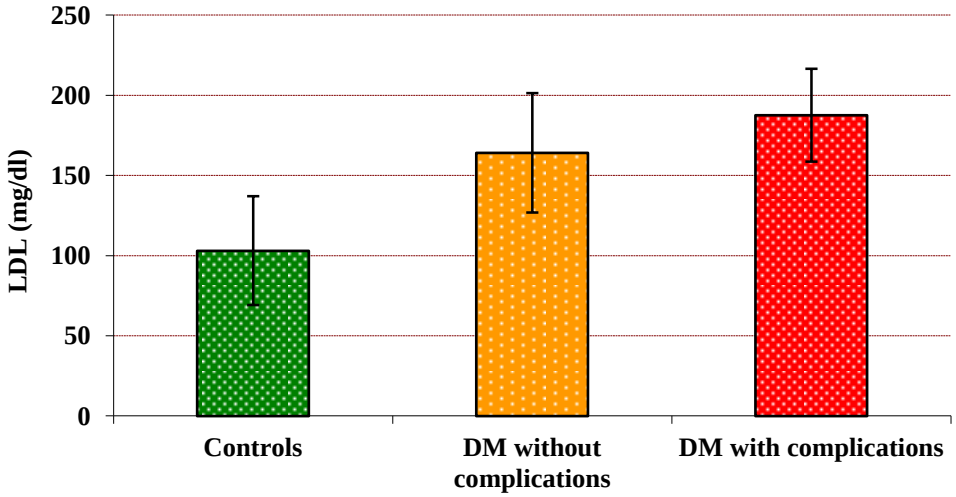


**Fig-3d: Serum HDL Cholesterol levels (mg/dl) in the three study groups**

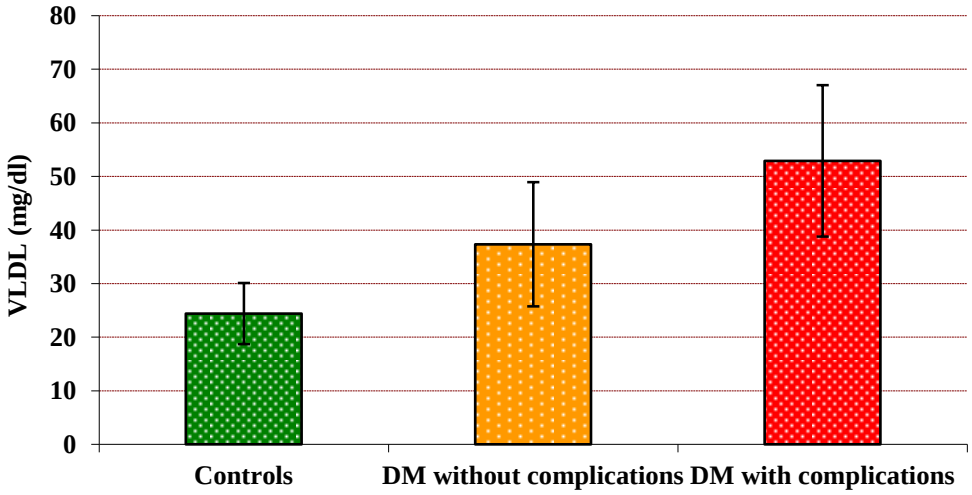


**Fig-3e: Serum VLDL Cholesterol levels (mg/dl) in the three study groups**

**Age, Gender and Body mass index (BMI)**

The values of age, gender and BMI in controls and cases are presented in Table 1. The mean age in diabetic cases without complications and with complications compared to controls was not statistically significant, ($p<0.286$) and is presented in Fig.1a. Gender distribution is projected graphically in Fig.1b.

The mean BMI value among cases without and with complications as compared to controls were statistically significant. p value for both the groups is <0.001 compared to controls. The BMI in control and cases is graphically depicted in Fig 1c.

**Blood glucose values**

The values of fasting blood glucose and postprandial blood glucose in the cases and controls are indicated in Table 2. The mean fasting blood glucose levels in the cases without and with complications compared to controls is statistically significant, (p value <0.001 in both the groups).

Similarly the mean PPBS levels in the study groups as compared to the controls is statistically significant, (p value in both the groups<0.001).FBS and PPBS values in the different groups is also presented graphically (Fig. 2a and 2b).

**Lipid parameters**

The values of lipid parameters in serum of the different study groups are projected in Table 3. When compared to the controls, rise in the total cholesterol level in the serum, in the two study groups, is highly significant (p value for both the groups<0.001). These values have been presented in Fig. 3a.

Serum Triglyceride levels are higher among diabetic cases without and with complications as compared to controls. The difference is statistically significant in both the groups (p value for both the groups<0.001). These data is pictorially presented in Fig. 3b.The serum HDL-C levels are lowered in both the groups of cases compared to controls. This difference is statistically significant with p value <0.001 in both the groups. These values are also pictured in Fig 3c.

The serum LDL-C levels in the groups of diabetics without and with complications is higher and is statistically significant in both the groups. The data is presented in Fig. 3d. Rise in the serum VLDL-C levels in the two groups of diabetics, as compared to the controls is statistically significant, and the details are projected graphically in Fig.3e.

The present study is conducted on 60 diabetic patients without and with complications. Our findings suggests that the serum levels of total cholesterol, triglycerides, LDL and VLDL were significantly increased and HDL-C levels were significantly reduced.

Several studies across the world projected similar results, a study by Otamere HO et al also documented an increase in total cholesterol, triglycerides, LDL and VLDL and decrease in HDL-C which was similar to the findings of the present study[8]. Another study conducted by Albrki WM et al also documented similar results [9].

In the present study HDL-C levels were significantly reduced in diabetic patients, studies conducted by Chahil TJ and Verges B were also got similar results [10,11,]

Different mechanisms are responsible for the development of dyslipidemia in individuals with diabetes. Defects in insulin action and hyperglycaemia could lead to dyslipidemia in patients with diabetes. Insulin controlled apoprotein production in the liver, regulation of lipoprotein lipase, actions of cholesteryl ester transfer protein and peripheral actions of insulin on adipose tissue and muscles are considered to be important mechanisms for diabetic dyslipidemia.

The typical pattern is that of the dyslipidemia of the metabolic syndrome with hypertriglyceridemia and reduction in HDL cholesterol, lipoprotein alterations include increases in LDL particle number, small dense LDL, and apolipoprotein(apoB) [12].Recently there has been interest in role of reduced levels of adipokines such as adiponectin as seen in insulin resistance states in the pathogenesis of dyslipidemia in diabetics, as FFA levels increases which leads to VLDL production[13].Remnant particles formed as a result of hydrolysis of triglycerides rich lipoproteins are rich in cholesteryl ester and thus cannot cross endolitheium efficiently. Raised level of these remnant particles as seen in diabetics may increase cardiovascular risk [14]. The presence of small, dense LDL particles has been reported to be associated with increased cardiovascular risk and progression of atherosclerosis[15].They are more likely to undergo glycation and oxidation than larger LDL particles, which promotes the generation of foam cells [16].

HDL-C levels are reduced in patients with type 2 diabetes have been reported to be associated with both hypertriglyceridaemia and obesity, kinetic studies have demonstrated that the decrease in HDL-C in diabetic patients is due to increased catabolism of HDLs. The activity of hepatic lipase is augmented in insulin resistant states, which is responsible for increase in HDL catabolism. It has recently demonstrated that both increased VLDL production and reduced VLDL catabolism are independent factors associated with

increased HDL catabolism in insulin resistant states [17].

## CONCLUSION

Present study was carried out to assess the usefulness of the serum levels of Lipid profile in diabetic patients. Compared to controls, cases without complications had significantly higher levels of total cholesterol, triglycerides and LDL cholesterol. Cases with complication had a higher margin of difference. HDL-C was significantly lowered among cases compared to controls. The values are much lower in diabetic cases with complications.

The altered lipid profile levels in diabetic patients, which is known to predispose the diabetics to cardiovascular diseases, it is suggested that the changes in the parameters of our study seem to predict the coronary artery diseases as well as the severity of other complications.

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