

**Original article**

**Dyslipidemia in Type II Diabetes Mellitus - An assessment of the main lipoprotein abnormalities**

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**Abstract**

**Background:** Diabetes is associated with a high risk of cardiovascular diseases and underlying lipid abnormalities. Dyslipidemia, a modifiable risk factor is often underdiagnosed and undertreated in our patients. Its early identification can make aggressive cardiovascular preventive management possible. This report seeks to determine the prevalence and pattern of lipid abnormalities in type II diabetes mellitus. **Methods:** The lipid profiles and fasting blood sugar values of 100 known diabetics were studied. Their serum samples were assessed for fasting blood glucose [FBG], total cholesterol [TC], triacylglycerol [TG], low density lipoprotein cholesterol [LDL-C] and high density lipoprotein cholesterol [HDL-C] by using standard biochemical methods. **Results:** 83% of study subjects had lipid abnormalities. The mean TC, TG, LDL-C, and FBG levels were highly significant in the diabetics as compared to those in controls. It was found that 28% had hypercholesterolemia and 44% had hypertriglyceridemia. The mean HDL-C concentration was significantly high in female diabetics as compared to that in male diabetics. The correlation studies showed a non-significant negative correlation of FBG with TC, TG and LDL-C. **Conclusion:** In the diabetics higher frequencies of high TC, high TG and high LDL-C levels are noted indicating diabetic patients were more prone for dyslipidemia which could cause cardiovascular disorders.

**Keywords:** type II diabetes mellitus; dyslipidaemia; cholesterol; lipid profile

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**Introduction:**

Diabetic mellitus [DM] is one of the leading health problems in India contributing significantly to morbidity and mortality<sup>1</sup>. Studies have shown that India is close to become the diabetic capital of world with a threefold rise in the diabetic prevalence in rural and urban areas<sup>2,3</sup>.

DM often coexists with obesity, hypertension and dyslipidemia. Abnormal serum lipid levels are likely to contribute to the risk of coronary artery disease<sup>4</sup> and measurement of serum lipid levels in diabetics is now considered as a standard of the diabetics care.<sup>5</sup> Characteristic abnormalities in lipids in type II DM include elevated TG levels, decreased atheroprotective HDL-C levels and increased levels

of LDL-C<sup>6,7</sup>.

Lipid profile assays form one of the special investigations in diabetics in most clinical laboratories worldwide. It has found useful application in the monitoring of diabetic patients. It is used as a screening test in obese individuals, and high risk patients of cardiovascular diseases.

The presence of elevated cholesterol levels is known to play a role in both the initiation and progression of atherosclerosis as well as in the clinical consequences such as myocardial infarction, stroke, peripheral vascular disease and heart failure<sup>8</sup>. Hypercholesterolemia and low HDL-C has also been implicated in the process of atherogenesis<sup>9-11</sup>. High levels of LDL-C not only cause atherosclerosis

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but drugs which reduce LDL-C are associated with stabilization and regression of atherosclerosis<sup>12</sup>.

The measurement of the lipid profile of diabetic patients is needed to investigate how their lipid metabolism is affected by diabetes as they have different genetic compositions and lifestyles. Hence the present work was taken up to assess the lipid profile of a randomly selected group of adult diabetic patients and compared them with that of controls.

#### **Material and methods:**

This is a cross-sectional study that included 100 subjects with DM attending Santosh medical college and Hospitals, Ghaziabad over a period of 7 months from Jan 2013-july 2013. Patients with other ailments and metabolic disorders were excluded from the study. All consenting patients were recruited in the study after ethical clearance was given by the ethics committee of the hospital.

All study subjects were given interviewer administered questionnaires that included information on biodata, duration and treatment type of DM. History of any lipid lowering drugs was also taken.

Fasting blood samples were taken for the determination of blood sugar and four parameters of the lipid profile viz total cholesterol [TCHOL], and high density lipoprotein cholesterol [HDL-C], triglyceride [TG] and low density lipoprotein cholesterol [LDL-C]. Total cholesterol was determined by modified method of Liebermann-Burchard,<sup>[13]</sup> HDL Cholesterol by precipitation method<sup>14</sup> and TG was estimated using a kit employing enzymatic hydrolysis of TG with lipases.<sup>15</sup> LDL-C was calculated using the Friedewalds formula<sup>16</sup>  $LDL = [TCHOL - HDL - C] - TG/5$  when the values of TG were less than 400 mg%. Serum glucose was determined using the glucose oxidase enzymatic method<sup>17</sup>

#### **Operational definitions:**

Type I DM-refers to patient of diabetes and have been requiring insulin since diagnosis Type II DM-patients with history of usage of oral hypoglycemic drugs or in combination with insulin

Dyslipidemia: abnormal lipid profile consists of following abnormalities either singly or in combination. These include HDL-C [for men  $\leq 40$ mg% and women  $\leq 50$  mg%], TG levels  $\geq 150$ mg% , LDL-C  $\geq 100$ mg %<sup>[9,18,19]</sup>, TCHOL  $\geq 200$ mg% is abnormal. The lipid profile of the subjects were classified based on ATP III model<sup>20</sup>. Atherogenic indices refer to TCHOL/HDL-C and LDL-C/HDL-C ratios. For men  $> 4.5$  was considered abnormal and for women ratio  $> 4$  was abnormal

Age group-for this study, patients were classified

according to their ages in three groups viz young [ $< 40$  yrs], middle aged [40-60yrs], and elderly [ $> 60$ yrs]

#### **Results:**

Clinical characteristics of the study group:

The mean [SD] age and age range of the study subjects was 54.5 years and 29-78 respectively. The sex distribution showed females were 37 [37%] and males were 63 [63%]

There was a history of hypertension [66%], smoking [8%] and alcohol intake [6%].only 20% did regular exercise. The mean duration of diabetes was 5yrs with a range of 1-10 yrs.

Young, middle aged and elderly made 12%, 53%, 35% of the study population. Triglyceride was noted to be significantly different in the three age groups.

#### *Lipid abnormalities*

One hundred patients with DM participated in the study of whom 37% were females and 63% were males.

83% of the subjects had varying degree of lipid abnormalities. The percentage of subjects with elevated total cholesterol, elevated LDL-C, elevated TG and reduced HDL-C are 28%, 50%, 44% and 60 % respectively.

The mean HDL, TG, TCHOL and LDL-C levels were 38.5mg/dl, 164.2mg/dl, 177.3mg/dl and 105.9mg/dl respectively.

**Table 1:** Biochemical parameters in the study group

parameters(mg/dl)	diabetics(n=100)
	mean $\pm$ SD
total cholesterol	177.35 $\pm$ 44.55
triacylglycerol	164.26 $\pm$ 87.65
HDL-C	38.53 $\pm$ 6.88
LDL-C	105.95 $\pm$ 39.32
FBS	74.6 $\pm$ 54.09

Of the combined lipid abnormalities the combination of elevated LDL and reduced HDL-C was the most common abnormality [34%] among the subjects. The combination of elevated LDL-C and TG was noted in 28% and the combination of elevated TG, LDL-C and low HDL-C was found in 21% of the study subjects. Least documented lipid abnormality was the combination of elevated TCHOL, TG, LDL-C and low HDL [12%]

Sex distribution of lipid abnormalities showed notable differences in some of the components of lipid parameters. However except for HDL they were not statistically significant [Fig2]. The results showed that the mean HDL-C concentration was high in the female diabetics as compared to male diabetics.

**Table 2: Comparison of the biochemical parameters among male and female diabetic patients**

parameters(mg/dl)	diabetics(n=100)		t table value	p value
	males [n=63]	female[n=37]		
	mean ± SD	mean ± SD		
total cholesterol	176 ± 48.25	183 ± 42.47	1.244	0.216
triacylglycerol	163 ± 97.38	156 ± 46.99	0.485	0.628
HDL-C	38 ± 7.02	41 ± 6.63	2.012	0.046*
LDL-C	106 ± 40.42	111 ± 42.78	0.707	0.48
FBS	166 ± 52	165 ± 57.55	0.041	0.967

\*p value <0.05 is significant

statistically higher abnormal TCHOL/HDL-C ratio was documented in men compared to women [p value=0.824]. However abnormal LDL-C/HDL-C ratios were noted more in females than in males and this was not a statistically significant difference [p value=0.935]

**Discussion:**

Abnormal lipid levels especially elevated TC, LDL-C, TG and decreased

HDL-C contributes additional risk to the patients with DM and CHD. Atherosclerotic complications particularly coronary artery disease are the leading causes of death in individuals with diabetes.<sup>21</sup> Alteration in lipoproteins observed among diabetics<sup>22</sup> is one of the most important factors contributing to the greater severity and frequency of cardiovascular disease and heart failure. Both qualitative and quantitative lipid abnormalities are associated with NIDDM.<sup>[23]</sup> The prevalence of dyslipidemia is very common in NIDDM<sup>24-27</sup> Data from the United Kingdom Prospective diabetics study [UKPDS] have shown that the effect of NIDDM on plasma lipoprotein levels is more pronounced in females than in males<sup>28</sup> which partly explains proportionately higher cardiovascular risk seen in female diabetic patients. Hyperglycemia and insulin resistance supposedly play important roles in the pathophysiology of dyslipidemia in NIDDM. Detection of important lipid levels involves an attempt to reduce cardiovascular risk by providing dietary counselling, timely intervention by lipid lowering drugs and life style changes and assessing patients response by follow up measurements.

We studied the pattern of lipid abnormalities in 100 patients. Our observations clearly revealed that percentage of lipid abnormalities occurring singly or in combination was as high as 83% and this was comparable to that reported in a Nigerian study<sup>29</sup> which gave a figure of 89%. The magnitude of detected abnormalities showed that LDL-C and HDL were the parameters most affected which was followed by hypercholesterolemia which was noted in 30% of participants. Elevated cholesterol though not usually regarded as highly predictive of cardiovascular disease can serve as a valuable screening measure for dyslipidemia. Similar findings have been noted by Ogbera et al and Okafor et al<sup>29,30</sup>.

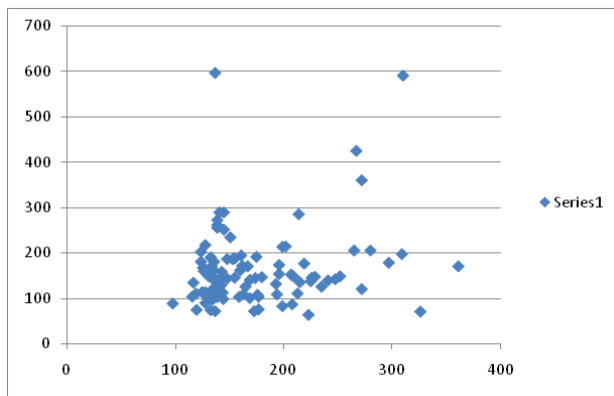


Fig 1: Correlation between FBS and Triglyceride

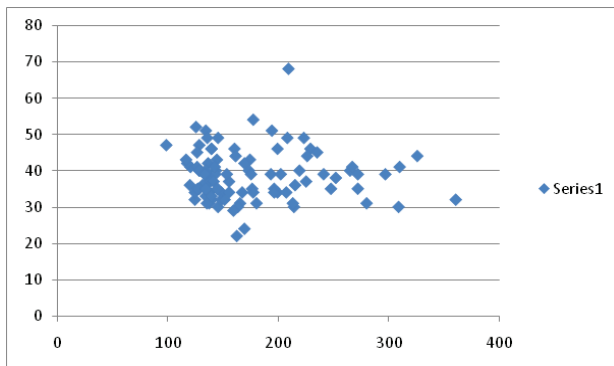


Fig 2 : Correlation between FBS and HDL

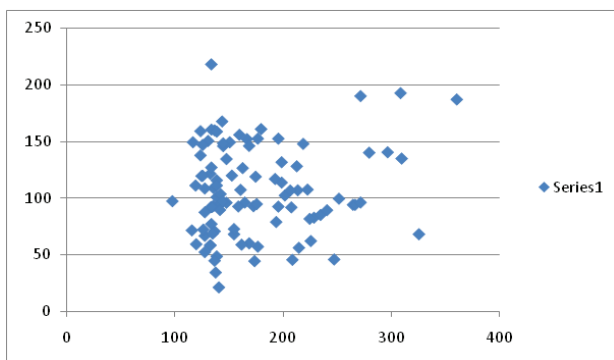


Fig 3 : Correlations between FBS and LDL-C  
50% of the study subjects had abnormal TCHOL/HDL-C ratios. Abnormal LDL-C/HDL-C ratios were noted in 6% of the study subjects.A

Although the habits of smoking cigarettes and alcohol intake were not widely practiced by our patients, significant alcohol and smoking histories were found to be contributing to the occurrence of dyslipidemia.

Clinical parameters like age, sex, BMI and glycemic control were possible determinants of the presence of an abnormal lipid profile. In this report we noted that females showed higher elevation of TCHOL, LDL-C and reduced HDL-C as compared to males. Cook et al<sup>31</sup> has also reported similar findings. Although the mean values of lipid parameters were significantly higher in females, the proportion of men with abnormal atherogenic indices was significantly higher than women.

The combination of higher LDL and reduced HDL was the most prevalent [42%] followed by elevated

TG and reduced HDL, two defining parameters of metabolic syndrome.<sup>19</sup> Triglyceride levels were more significantly elevated in the middle and elderly age group than in the younger age group.

The results of present investigations are presented in the table 1 and table 2. The results show that prevalence of lipid abnormalities in our patients of DM were unacceptably high and only few people with these abnormalities were on treatment.

**Conclusion:**

Reduced HDL-C and elevated LDL-C were the prevalent lipid abnormalities in our patients with DM. Lipid profiling for all persons with type II DM should be a routine test. DM patients should be screened and appropriate intervention should be done to reduce the risk of CHD and atherosclerosis

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