DOI:10.14260/jemds/2014/1845

ORIGINAL ARTICLE

A STUDY OF CORRELATION OF BMI AND LIPID PROFILE IN TYPE 2 DIABETES MELLITUS SUBJECTS AT A TERTIARY CARE HOSPITAL

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HOW TO CITE THIS ARTICLE:
Satyanarayana N, Arun Kumar I.U, Anil Mudda, Sanjeev Kumar S. Gunjigavi, Anil Kumar T, "A study of correlation of BMIand Lipid Profile in Type 2 Diabetes Mellitus Subjects at a Tertiary Care Hospital". Journal of Evolution of Medical and Dental Sciences 2014; Vol. 3, Issue 02, January 13; Page: 422-434, DOI:10.14260/jemds/2014/1845

ABSTRACT: OBJECTIVES:1)To study lipid profile in patients with type2 diabetes mellitus. 2) To study BMI in patients with type-2 diabetes mellitus. 3) To correlate BMI and lipid profile in type-2 diabetes mellitus subjects.**Design:** A hospital based study was done for 1 year.**SETTING:** ESIC MEDICAL COLLEGE & POST GRADUATE INSTITUTE OF MEDICAL SCIENCE & RESEARCH RAJAJINAGAR, BENGALURU.**METHODS:** Fasting lipid profile was studied in 100 patients of Type-2 diabetes mellitus and none of them were on hypolipidemic drugs. Different fractions of lipid profile were compared between male and female, duration of diabetes and glycemic control.**RESULTS:** Out of 100 cases, 41 were males and 59 females. Most of individuals were obese. Most individuals had poor glycemic control (67%). Prevalence of hypercholesterolemia, hypertriglyceridemia, raised LDL-C was 62%, 63%, 76% respectively with no significant difference between male and female patients. Prevalence of low HDL-C was 94%, more in females than males with statistically significant difference. There was no correlation between dyslipidemia and glycemic control (HbA1c). As duration of diabetes increased there was increase in serum TG. Other parameters like TC, LDL-C, and HDL-C were not affected by duration of diabetes. Though statistically not significant, compared to males, females were more obese (BMI 24.72±3.82 vs. 26.33±4.62).**CONCLUSION:** Most of our patients had dyslipidemia irrespective of duration of diabetes. Female patientshad high frequency of low HDL which is an important risk factor for Coronary Heart Disease especially in type-2 diabetic patients. It is therefore recommended that every type-2 diabetic patients should have a fasting lipid profile measured especially the female to reduce risk of CHD.

KEY WORDS: Type-2 diabetes mellitus, hypercholesterolemia, hypertriglyceridemia, LDL-C, HDL-C, Coronary Heart Disease.

INTRODUCTION: Diabetes mellitus (DM) is a major cause of various coronary heart diseases (CHD); it is associated with two to four fold excess risk of death from coronary heart disease(CHD) [1-5]. The incidence of type 2 DM is increasing rapidly reaching epidemic proportions[6-8]. The estimated prevalence of diabetes among adults is expected to rise about 100% in future.

Usually low High-density lipoprotein-Cholesterol (HDL-C) levels with elevated triglyceride(TG) levels are the most predominant pattern of dyslipidemia in patients with type 2 DM, but these patients have relatively similar levels of LDL-C compared with non-diabetic individuals[9, 10]. Therapeutic management aims to reduce LDL-C and TG and to elevate HDL-C with other modifiable risk factors. This will reduce cardiovascular events and even mortality in patients with type 2 DM[11-13]. About 97% of adults with DM have one or more lipid abnormalities[14].Type 2 diabetes accounts for over 95% of all diabetes in India. Due to its insidious onset and lack of alarming symptoms, the disease often remains undiagnosed for many years.

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Type 2 diabetes mellitus has significant relationship with obesity and almost 90% type 2 diabetics are obese although only a minority of obese people is diabetic[15].Research workers have blamed obesity and sedentary life style is linked to each other and is responsible for the dramatic increase in Type 2 diabetes over the past 2 years.

Diabetes and dyslipidemia are independently major risk factors in macro vascular disease but when they occur together the risk is significantly increased and adverse effects of diabetes on serum lipids are more pronounced than in normal subjects. Dyslipidemia is observed in practically all patients of type-2 diabetes mellitus and every high level of cholesterol in diabetics has 2-3 times higher risk of coronary artery disease (CAD) than non-diabetic individuals[16].

Observational studies have shown that HDL may be the best predictor of CAD in type-2 diabetes mellitus, followed by triglycerides and total cholesterol(TLC). The concentration of LDL cholesterol in type-2 diabetic patients is usually not significantly different from non-diabetic individuals. However, type-2 diabetic patients typically have a preponderance of small, denser LDL particles, which increases atherogenicity even if concentration of LDL is not significantly increased. Insulin resistance is a strong candidate as the underlying abnormality responsible for all these changes, the dyslipidemia seen in many diabetic patients - high triglycerides and low HDL cholesterol is associated with low lipoprotein lipase(LPL) activity. CAD is the leading cause of death in patients with type-2 diabetes mellitus.

Diabetes is a major cause of mortality, but several studies indicate that diabetes is likely underreported as a cause of death. In the United States, diabetes was listed as the seventh leading cause of death in 2007; a recent estimate suggested that diabetes was the fifth leading cause of death worldwide and was responsible for almost 4 million deaths in 2010 (6.8% of deaths were attributed to diabetes worldwide)[17].

The Framingham heart study assessed that patients with diabetes, particularly women exhibited an increased risk, in coronary events including angina, stroke, claudication, heart failure, myocardial infarction, and sudden death. The prevalence of CAD in Indians is higher than in any other population in the world. In the recent past, the prevalence has risen from 1.5-6.5% to 8-12%. There is difference in the prevalence of CAD in urban and rural India (8-9.6% to 3.5%) more common in south than north India.

AIMS AND OBJECTIVES: The present study has been under taken with the following aims and objectives.

1. To study lipid profile in patients with type-2 diabetes mellitus.
2. To study BMI in patients with type-2 diabetes mellitus.
3. To correlate BMI and lipid profile in type-2 diabetes mellitus subjects.

MATERIALS AND METHODS:

Source of data: The present study was under taken at ESIC MC & PGIMSR rajajinagar, Bangalore during the period -November 2012 to November 2013.

100 cases of type-2 diabetes mellitus were studied by using simple random procedure. Adult patients admitted to the medical wards or OPD patients were included.

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Inclusion criteria: Type-2 diabetes mellitus patients with the following features:

- Fasting plasma glucose >126mg/dl (on more than one occasion)
- Post prandial plasma glucose (after 2 hrs.) >200mg/dl (on more than one occasion)

All the patients with type-II diabetes mellitus were included in the study (newly diagnosed, on treatment, irregular treatment and discontinued treatment) who are admitted in hospital or came to OPD irrespective of duration of disease.

Exclusion criteria:

- Patients with type-I diabetes mellitus
- Gestational diabetes mellitus
- Hypothyroid patients.
- Patients on hypolipidemic drugs.
- Patients with chronic renal failure.

Exclusion criteria were determined by adequate history, examination, relevant investigations.

Clinical History:

- Detailed history was taken regarding the symptoms of diabetes (polyuria, polydipsia, polyphagia, weight loss).
- History of vascular disease (peripheral vascular disease, coronary artery disease and cerebrovascular accidents) was taken in detail.
- History of any other associated disease and hypertension was taken.
- Past history of DM and its complications, hypertension, IHD and CVA were taken.
- History of smoking, tobacco chewing and alcohol intake was taken.

Clinical examination: General physical examination was done and body mass index was calculated in all patients and vital data of patient was taken as per proforma.

Investigations: History and clinical examination were supplemented by biochemical and other investigations.

1. Estimation of haemoglobin, total and differential count was done by auto analyser, Sysmax (K - 1000).
2. Blood sugar levels were estimated on all patients using Roche Cobas Integra – 400Auto Analyser. RBS, FBS, and PPBS were done for the diagnosis of diabetes.
3. Lipid profile: total cholesterol, triglycerides, HDL and LDL cholesterol weremeasured by Roche Cobas Integra - 400 Auto Analyser Fasting lipid profile wasdone in all patients.
4. Renal function tests like blood urea and serum creatinine estimation was done byRoche Cobas Integra - 400 Auto Analyser.
5. Glycosylated hemoglobin was done in all patients.
6. Routine examination of urine for protein, sugar and microscopy was done in allPatients
7. Chest X – ray, ultrasound-abdomen, ECG, Echocardiography, Colour DopplerStudy and CT scan head was done whenever required.

Statistical Methods: Descriptive and inferential statistical analysis has been carried out in the present study. Results on continuous measurements are presented on Mean SD (Min-Max) and results on categorical measurements are presented in Number (%).

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Analysis of variance (ANOVA) has been used to find the significance of study parameters between three or more groups of patients, Student t test (two tailed, independent) has been used to find the significance of study parameters on continuous scale between two groups.

Chi-square/ Fisher Exact test has been used to find the significance of study parameters on categorical scale between two or more groups.

RESULTS: Out of 100 cases, 41 were males and 59 were female patients. Maximum numbers of patient were in between the age group 35 to 45 years (table 1). Most of individuals were obese, females more than males(Table 2). Most individuals had poor glycemic control (67%) (Table 3, Figure 1).

Age in years	Males (%)	Females (%)	Total
35 – 44	13(31.7)	20(33.9)	33(33.0)
45 – 54	8(19.5)	22(37.3)	30(30.0)
55 – 64	12(29.3)	12(20.3)	24(9.0)
65 – 74	5(12.2)	4(6.8)	9(9)
75 and above	3(7.3)	1(1.7)	4(4)
Total	41(100)	59(100)	100

Table 1: Age wise distribution of cases.

In our study maximum no of cases were in between 35-44yr (33%) and 45-54yr (30%). Mean age was 51.69 ± 11.184 years.

VARIABLES	GENDER		P VALUE
	MALE	FEMALE	
BMI	24.72±3.82	26.33±4.62	0.069

Table 2: comparison of BMI between male and female

Compared to males, females were more obese (24.72±3.82 vs. 26.33±4.62) which is not statistically significant.

HbA_1c in %	Male	Female	Total
Good: 5 – 8	13(31.7)	10(16.9)	23
Fair: 8.1 – 10	15(36.6)	20(33.9)	35
Poor:10.1 – 12	8(19.5)	13(22.0)	21
Very poor:> 12	5(12.2)	16(27.1)	21
Total	41	59	100

Table 3: Glycemic control (HbA1c)

DOI:10.14260/jemds/2014/1845

Fig. 1: Glycemic control (HbA1c)

In this study maximum no of cases (35%) had fair glycemic control, 23% had good control and 21% of cases were in each poor and very poor group.

Most of the individuals were on OHA+Diet control (67%), 19% were newly detected. Only 14% were on OHA+Insulin and none were only on insulin (Table 4, Figure 2).

Cases	Male	Female	Total
Newly diagnosed	6(14.6)	13(22.0)	19(19)
OHA+Diet	29(70.7)	38(64.4)	67(67)
OHA + Insulin	6(14.6)	8(13.6)	14(14)

Table 4: Treatment of cases

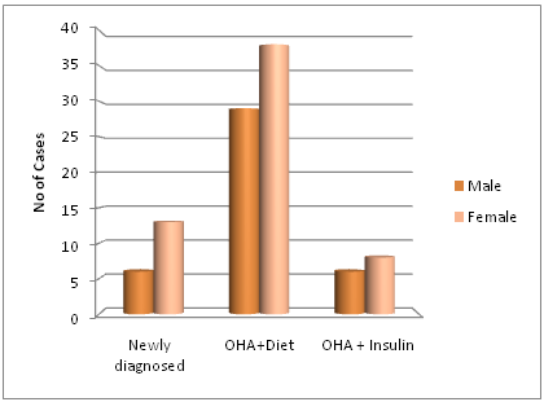

Fig. 2: Treatment of cases

Prevalence of hypercholesterolemia was 62% with no significant difference between male and female patients (Table 5, Figure 3). Prevalence of hypertriglyceridemia was 63% with no significant difference between male and female patients (Table 6, figure 4), so also prevalence of raised LDL-C was 76% with no significant difference betweenmale and female patients (Table 7, Figure 5).

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Cholesterol	Male	Female	Total
Desirable:<200	16(39.0)	22(37.3)	38(38)
Borderline high:200-239	15(36.6)	20(33.9)	35(35)
High: ≥240	10(24.4)	17(28.8)	27(27)
Total	41	59	100

Table-5: Difference in Serum Total Cholesterol (TC)

In This study maximum no of cases (38%) had serum TC in desirable range, 35% of cases were in borderline high and 27% cases were in high group. Prevalence of hypercholesterolemia was 62%.

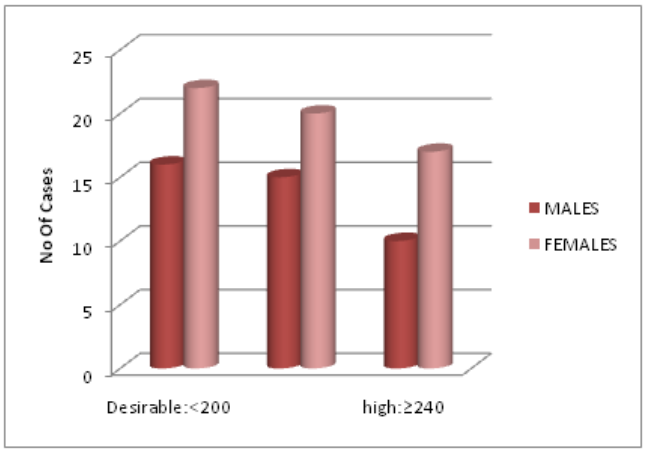

Fig. 3: Difference in Serum Total Cholesterol (TC)

Triglycerides. (mg %)	Male	Female	Total
Normal: <150	18(43.9)	19(32.2)	37
Borderline high:150-199	6(14.6)	14(23.7)	20
High:200-499	13(31.7)	23(39.0)	33
Very high:≥ 500	4(9.8)	3(5.1)	7
Total	41()	59()	100

Table 6: Difference in Serum Triglycerides

In this study maximum number of cases (37%) had serum TG in normal range, 33% of cases were in high, 20% of cases were in borderline high, and only 7% cases were in very high group. Prevalence of hypertriglyceridemia was 63%.

DOI:10.14260/jemds/2014/1845

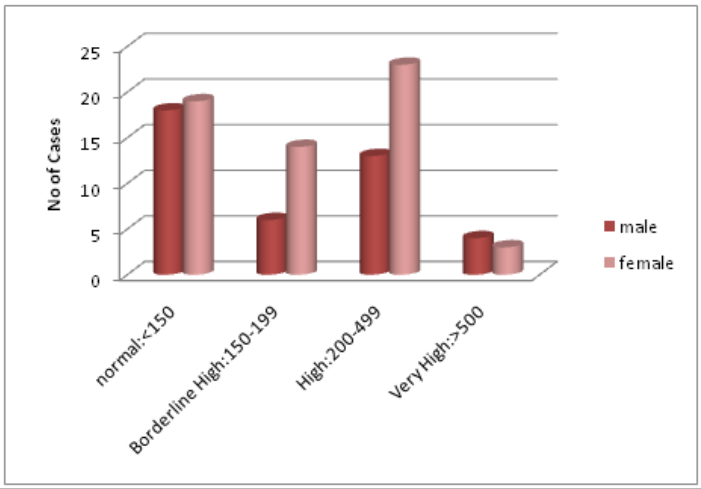

Fig. 4: Difference in Serum Triglycerides in Male and Female

LDL Cholesterol (mg %)	Male	Female	Total
Optimal: <100	10(24.4)	14(23.7)	24(24)
Near optimal:100-129	14(34.1)	15(25.4)	29(29)
Borderline high:130-159	11(26.8)	17(28.8)	28(28)
High:160-189	4(9.8)	7(11.9)	11(11)
Very high:≥190	2(4.9)	6(10.2)	8(8)
Total	41(100)	59(100)	100

Table 7: Difference in serum LDL Cholesterol

In This study maximum no of cases (29%) had serum LDL-C in near optimal range, 28% of cases were in borderline high range, 24% of cases were in optimal range, only 8% cases were in very high group. Prevalence of raised LDL-C was 76%.

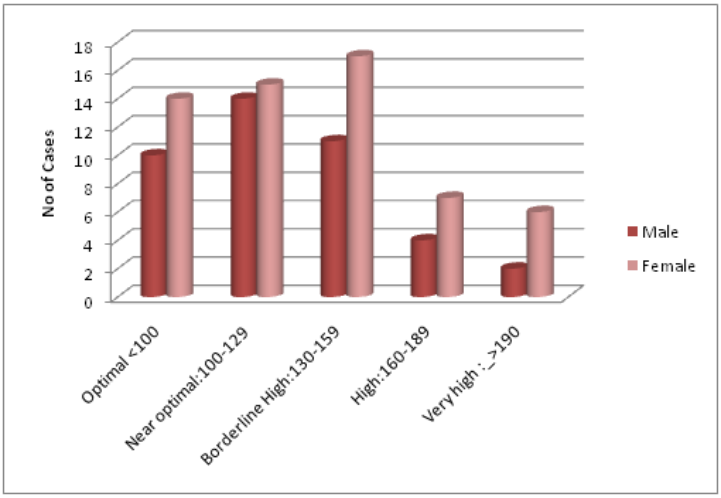

Fig. 5: Difference in serum LDL Cholesterol (mg%)

DOI:10.14260/jemds/2014/1845

Prevalence of low HDL-C was 94%. Female diabetic patients had low HDL-C compared to males with statistically significant difference, which is an important risk factor for CHD (Table 8, figure 6).

HDL Cholesterol (mg %)	Male	Female	Total
High: > 60	2(4.9)	4(6.8)	6
Low: Male < 40, Female <50	39(95.1)	55(93.5)	94
Total	41	59	100

Table 8: Difference in serum HDL Cholesterol

In This study maximum number of cases (94%) had serum HDL-C in low range and only 6% of cases were in high group. Prevalence of low HDL-C was 94%.

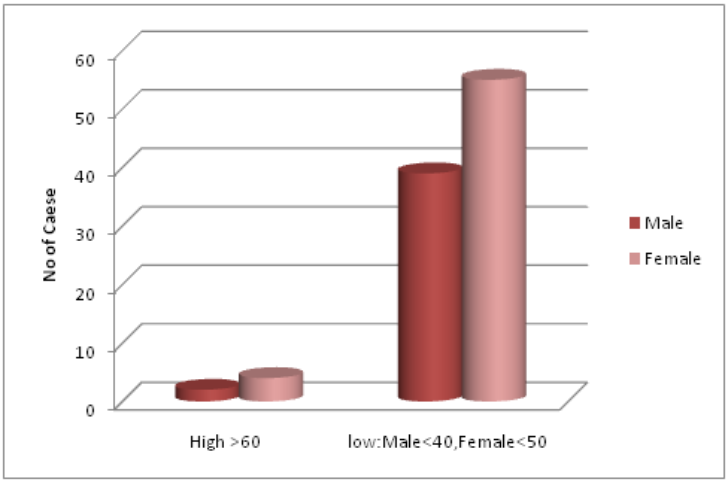

Fig. 6: Difference in serum HDL Cholesterol (mg%)

There was no correlation between dyslipidemia and HbA1c (Table 9, Figure 7).

VARIABLE	Male	Female	p-value
RAISED T.CHOLESTEROL >200mg/dl	247.9±45.1 (n = 25)	240.2±30.1 (n = 37)	0.422
RAISEDTG >150 mg/dl	330.3± 213.3 (n = 23)	273.58± 141.8 (n = 40)	0.210
RAISED LDL-C >100 mg/dl	136.52±30.7 (n = 31)	144.93±32.0 (n = 45)	0.256
LOW HDL-C <40 mg/dl	33.61±4.8 (n = 18)	39.42±6.3 (n = 50)	0.001

Table 9: Dyslipidemia in male and female diabetics.

There was no statistically significant difference between male and female for raised TC, TG, LDL-C but HDL-C was low in female than male which was statistically significant ($p < 0.05$).

DOI:10.14260/jemds/2014/1845

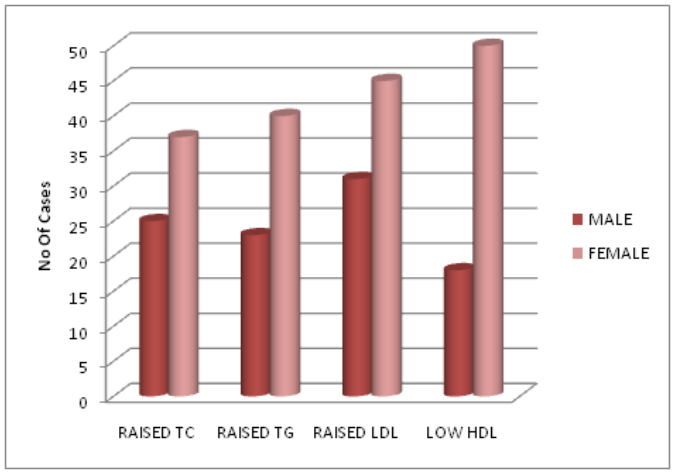

Fig. 7: Dyslipidemia in male and female diabetics

As duration of diabetes increased there was increase in serum TG, but there was no difference between newly detected and known diabetics. Other parameters like total cholesterol(TC), LDL cholesterol(LDL- C) and HDL cholesterol (HDL-C) did not get affected by duration of diabetes (Table 10-12, Figure 8).

VARIABLE	NEW	1-5YR	6-10YR	>10YR	p-value
RAISED TOTAL CHOLESTEROL >200mg/dl	257.0 ±48.9 (n = 21)	237.9 ±28.8 (n = 18)	234.9 ±26.1 (n = 20)	237.0 ±27.7 (n = 03)	0.218
RAISED TG >150 mg/dl Median (IQR)	220.0 (184, 302) (n = 23)	250.0 (184, 293) (n = 19)	211.5 (175.5, 281) (n = 16)	446.0 [a, b] (373, 570.5) (n = 5)	0.034
RAISED LDL-C >100 mg/dl	143.1±38.9 (n = 25)	139±28.7 (n = 26)	144.2±27.1 (n = 23)	122.5±24.8 (n = 2)	.778
LOW HDL-C <40 mg/dl	39.4±7.1 (n = 21)	36.1±6.6 (n = 23)	39.4±5.2 (n = 19)	33.6±5.4 (n = 5)	0.103
a, b significant when compared with the group 1-5yr & 6-10yr respectively.					

Table 10: Variation of dyslipidaemia with respect to duration of diabetes.

There was no significant difference between duration of diabetes for raised TC, LDL-C and low HDL-C. But raised TG was more in >10YR group when compared 1-5 YR and 6-10 YR group which was statistically significant ($p < 0.05$).

DOI:10.14260/jemds/2014/1845

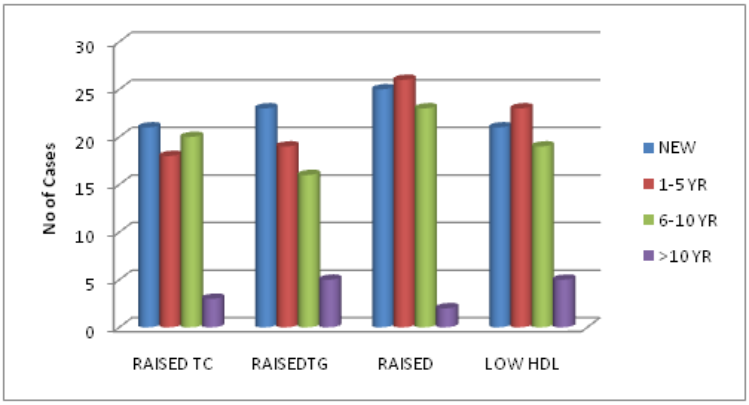

Fig. 8: Variation of dyslipidemia with respect to duration of diabetes

Variable	Correlation with HbA1c	Inference (direct or indirect)
RAISED TOTAL CHOLESTEROL >200mg/dl	r = -0.041 p = 0.753 (n = 62)	Inverse but No significant Correlation
RAISED TG >150 mg/dl	r = 0.101 p = 0.431 (n = 63)	Direct but No significant Correlation
RAISED LDL-C >100 mg/dl	r = 0.058 p = 0.620 (n = 76)	Direct but No significant Correlation
LOW HDL-C <40 mg/dl	r = 0.005 p = 0.967 (n = 68)	Direct but No significant Correlation

Table 11: Correlation of dyslipidaemia with respect to glycaemic control of diabetes

Raised TG, raised LDL-C and low HDL-C were directly correlated but raised TC was indirectly correlated with HbA1c which were statistically not significant.

Glycated hemoglobin (HbA1c)			
Variables	**Good control (<7.00) Mean ± SD**	**Poor control (>7.00) Mean ± SD**	**P value**
RAISED TOTAL CHOLESTEROL >200mg/dl	229.4±20.6 (n = 8)	245.4±38.2 (n = 54)	0.252
RAISED TG >150 mg/dl Median (IQR)	189.5(170, 275.3) (n = 8)	233.0(199.0, 312.0) (n = 55)	0.137[b]
RAISED LDL-C >100 mg/dl	139.3±28.0 (n = 8)	141.8±32.1 (n = 68)	0.833

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LOW HDL-C <40 mg/dl	41.1±7.4 (n =7)	37.5±6.3 (n = 61)	0.162
b :Mann Whitney U test			

Table 12: Dyslipidemia categorized by patients' glycemic control (HbA1c)

Dyslipidemia in type-2 DM was not statistically different between good control and poor control of blood sugars ($p > 0.05$).

DISCUSSION:A total of 100 type 2 DM cases were studied with mean total age 51.69 ± 11.18 years.

Age	Present Study	Aliqaisblebil et al[18]	Syed YHG et al[19]
Mean age	51.69±11.18	56.7±8.9	65.67±11.29
Males (%)	49	49	53.3
Females (%)	51	51	46.7
Mean BMI	25.67±4.3	27.6± 5.4	28.45±3.30
Mean duration of diabetes (years)	3.5±11.12	11.1± 7.2	

Table 13: Showing demographic parameters (mean) of patients in present study and other studies.

The mean age in our study was slightly less compared with other studies. Females were more than males in our study and results are same as study done in Malaysia[18].Most of our patients were obese. Females had higher BMI when compared to males. Mean duration of diabetes was less compared to other studies.

	Present Study	Aliqaisblebil et al[18]	Bhode C et all[20]
Mean FBS	220.32±97.72		143.84± 4.89
Mean HbA1c	10.22±2.96	8.4± 1.9	7.53± 0.27

Table 14: Showing glycemic control (mean) of patients in present study and other studies.

Most of our patients had uncontrolled blood sugar compared with study done in Miraj, India[19] as well as in Malaysian study[18].

	Present Study	**Aliqaisblebil et[18]al**	**Syed YHG et al[19]**	**Bhode C et all[20]**
Mean TC	215.13±48.40	180.97±42.53	150.81± 50.65	185.16±8.09
Mean TG	226.17±163.23	65.73±11.60	115.23± 44.08	152.66±6.96
Mean LDL-C	124.35±42.20	104.79±34.80	126.83± 33.25	107.02±4.49
Mean HDL-C	42.46±10.54	46.09±11.60	36.73±0.77	37.96±1.06

Table15: Showing lipid profile (mean) of patients in present study and other studies

In our study mean TC, TG were high compared to all 3 study.Mean LDL-C was more compared to Malaysian and other Indian study. In our study prevalence of raised TC, TG, LDL-C and

low HDL-C were 62%, 63%, 76%, 94% respectively which was high, compared with Iran study(34%, 63%, 69%, 54%).[21]

There was no significant difference between male and female for raised TC, TG and LDL-C but low HDL-C was more in females than inmales, which was statistically significant ($p < 0.05$). Same results were found in Malaysian but Iran study[21] showed no significant difference in HDL-C but the drawback of this study was inclusion of patients on hypolipidemic drugs.

In our study there was no significant difference of dyslipidaemia between good and poor glycaemic control, but one Indian study[20] showed significant difference.

CONCLUSION: Most of our patients had dyslipidemia irrespective of duration of diabetes. Female patients had high frequency of low HDL which is an important risk factor for Coronary Heart Disease especially in type-2 diabetic patients. It is therefore recommended that every type-2 diabetic patients should have a fasting lipid profile measured and treated appropriately to reduce risk of CHD.

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Date of Submission: 18/12/2013.
Date of Peer Review: 19/12/2013.
Date of Acceptance: 31/12/2013.
Date of Publishing: 10/01/2014