A Study of Fasting and Postprandial Lipid Profile among Patients with and without Diabetes Mellitus in a Tertiary Care Hospital - Kottayam, Kerala

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ABSTRACT

BACKGROUND

Type 2 diabetes mellitus (DM) is characterized by insulin resistance which is associated with glucose intolerance, hypertension, dyslipidaemia, a procoagulant state, and an increase in the microvascular and the macrovascular disease. The high cardiovascular mortality which is associated with type 2 DM is due to a prolonged, exaggerated, postprandial state. The abnormal lipid profile in the postprandial state is more significant than the abnormal lipid profile in the fasting state in causing atherosclerotic complications in type 2 diabetes. Very few studies are available on the estimation of the postprandial lipid profile in type 2 diabetes patients. The purpose of this study was to compare fasting and postprandial lipid levels among patients with and without diabetes mellitus and find out the correlation between duration of detection of diabetes mellitus and postprandial lipid levels among patients with diabetes mellitus.

METHODS

This is a cross sectional analytical study of a study population of 200 subjects including in patients and out patients of wards and diabetic clinic of Government Medical College, Kottayam from April 2017 to March 2018. Data was coded and entered in Microsoft Excel and IBM Statistical Package for Social Sciences (SPSS version 22) for statistical analysis.

RESULTS

Diabetic patients had impaired fasting and postprandial lipid profiles. Impairment in postprandial lipid profile when compared to non-diabetics was statistically significant. Duration of detection of diabetes and postprandial lipid levels showed weak positive correlation.

CONCLUSIONS

The postprandial lipid profile in diabetes mellitus patients is significantly deranged compared to fasting state and is an important factor in assessing their cardiovascular risk. Hence, there is a need to stress on postprandial lipid profile estimation in diabetic patients.

KEYWORDS

Fasting Lipid Profile, Postprandial Lipid Profile, Type 2 Diabetics, Nondiabetics

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BACKGROUND

The present study suggests that it is important to routinely estimate the postprandial lipid profile, in addition to the fasting lipid parameters, in the cardiovascular risk assessment in type 2 DM. India is one of the rapidly developing countries standing in second highest diabetes prevalence in the world which could be due to rapid urbanization that brought along with it a sedentary lifestyle is an important factor inducing diabetes mellitus. According to a study in 2011, the estimated number of patients with diabetes in India was 62.4 million which is projected to rise to a staggering 101.2 million by 2030. Diabetes mellitus is an important risk factor for cardiovascular disease and atherosclerosis as it is a common secondary cause of hyperlipidaemia when the glycaemic control is poor.[1] The prevalence of dyslipidaemia in type 2 diabetes is double with respect to the general population.[2] Approximately 80 % of deaths in patients with diabetes are prone to coronary vascular diseases and the Asian Indians have high risk of coronary heart disease than whites.[3,4]

Objectives

1. To compare fasting and postprandial lipid levels among patients with and without diabetes mellitus.
2. To find out the correlation between duration of detection of diabetes mellitus and postprandial lipid levels among patients with diabetes mellitus.

METHODS

The study was a cross sectional analytical study of diabetes mellitus patients who attended out-patient department (OPD) of diabetic clinic and inpatients of Department of General Medicine, Kottayam and normal individuals attending OPD from April 2017 to March 2018. Sample size was estimated using formula-

$$N = \frac{\left(Z_{1-\alpha/2} + Z_{1-\beta}\right)^2 \times 2\sigma^2}{(\mu^1 - \mu^2)^2}$$

In reference study conducted by Lokhande Suryabhan L et al. at Government Medical College, Nagpur, Maharashtra,
Mean +/_ SD of postprandial triglycerides (TGL) values of non-diabetic population
μ_1 +/_ SD_1 = 139.50 +/_ 34.32 and diabetes mellitus patients was
μ_2 +/_ SD_2 = 209.50 +/_ 74.48
Pooled variance was found to be 60488
Sample size was found to be 200.
100 satisfied inclusion criteria and 100 were normal age group and sex matched controls.

Inclusion Criteria

DM patients in the age group more than 18 years who had duration of detection of diabetes more than 5 years who were not on statins and were on treatment with insulin were taken as cases.
Control group was age group, sex and body mass index (BMI) matched with fasting blood sugar (FBS) < 126 mg/dl, postprandial blood sugar (PPBS) < 200 mg/dl and fasting serum cholesterol < 200 mg/dl, low density lipoprotein (LDL) < 100 mg/dl, TGL < 150 mg/dl and HDL < 40 mg/dl. (NCEP-ATP III guidelines)

Exclusion Criteria

1. Individuals with history of hypertension, hepatic, renal and cardiac disorders.
2. Individuals with history of substance abuse or dependence, family history of dyslipidaemia.
3. Individuals on medications like betablockers, steroids, hypolipidemic, biguanides, alpha glucosidase inhibitors.

Study Procedure

Informed consent was obtained from patients satisfying inclusion criteria and from normal age group, sex and BMI matched controls. Information was obtained by interview of the patients and control group. Blood was collected at the time of OP visit after 12 hours overnight fasting for fasting lipid profile and 6 hours after food intake for postprandial lipid level estimation. Fasting and postprandial blood sugars also was done in non-diabetic study group. Both the study groups were advised to take the same breakfast containing a total of approximately 420 calories [Example: 3 idlis (120 calories), 1/2 cup sambhar (150 calories), 1 glass of tea without sugar (43 calories), coconut chutney – 2 tablespoons (104 calories)].Also measurement of height, weight, BMI and blood pressure was done. Since biguanides and alpha glucosidase inhibitors influenced lipid profile patients taking these drugs were excluded from the study.

Data Management and Statistical Analysis

Data was coded and entered in Microsoft Excel, IBM SPSS version 22 was used for statistical analysis. Descriptive analysis was carried out by mean and standard deviation for quantitative variables, frequency and proportion for categorical variables. Non normally distributed quantitative variables were summarized by median and interquartile range (IQR). Data was also represented using appropriate diagrams like bar diagram.

All quantitative variables were checked for normal distribution within each category of explanatory variable by using visual inspection of histograms and normality Q-Q plots. Shapiro-wilk test was also conducted to assess normal distribution. Shapiro-wilk test P value of > 0.05 was considered as normal distribution.

For normally distributed quantitative parameters, the mean values were compared between study groups using independent sample t-test (2 groups) and for non-normally distributed quantitative parameters, Medians and interquartile range (IQR) were compared between study groups using Mann Whitney u test (2 groups).

Categorical outcomes were compared between study groups using chi square test/Fisher's exact test (If the overall sample size was < 20 or if the expected number in any one of the cells is < 5, Fisher's exact test was used.

Association between quantitative explanatory and outcome variables was assessed by calculating spearman correlation coefficient and the data was represented in a scatter diagram. P value < 0.05 was considered statistically significant.

RESULTS

A total of 200 subjects were included in the final analysis. Among the study population, 100 (50 %) were diabetic patients and, 100 (50 %) were non-diabetic patients. Among the study population, 49 (24.5 %) patients were aged up to 40, 86 (43 %) were aged from 41 to 60 and 65 (32.5 %) patients were aged more than 60. Maximum number of males belonged to age group from 20 to 40 (57.14 %) and maximum number of females belonged to age group more than 60 years (45.24 %). In the control group, maximum number of males belonged to age group 20 to 40 years (59.52 %) and maximum number of females belonged to age group more than 60 years (52.17 %).

Out of 100 patients with diabetes, 56 (56 %) were males and 44 (44 %) were females. Out of 100 patients without diabetes, 56 (56 %) were males and 44 (44 %) were females. The mean of BMI was 22.7 ± 3.83 in diabetic patients and it was 21.35 ± 3.3 in non-diabetic patients, the difference between two groups was statistically not significant. (P value 0.008). Among the patients with diabetes, the median FBS was 148.5 (114.25, 200) and it was 92 (85.25, 98.75) in patients without diabetes. The difference in study group between FBS was statistically significant. (P value < 0.001). Among the patients with diabetes, the median PPBS was 218 (178.5, 260) and it was 115.5 (102.25, 126.75) in patients without diabetes. The difference in study group between PPBS was statistically significant. (P value < 0.001).

Among the patients with diabetes, the median fasting total cholesterol (FTC) was 239 (205, 259.5) and it was 156 (142.25, 172.75) in patients without diabetes. The difference in study group between FTC was statistically significant. (P value < 0.001). Among the patients with diabetes, the median fasting triglycerides (FTG) was 129 (104.25, 155.5) and it was 112 (89.25, 135.75) in patients without diabetes. The difference in study group between FTG was statistically significant. (P value < 0.001). The mean of FHDL-C was 41.98 ± 7.42 in diabetic patients and it was 47.9 ± 6.49 in patients without diabetes, the difference between two groups was statistically significant. (P value < 0.001). Among the people with diabetes, the median fasting non-HDL was 192.5 (167, 217.75) and it was 108.5 (96,122.75) in people without diabetes. The difference in study group between fasting non-HDL was statistically significant. (P value < 0.001).

Among the people with diabetes, the median FLDL-C was 140 (111.25, 167.75) and it was 91 (82, 96.75) in people without diabetes. The difference in study group between FLDL-C was statistically significant. (P value < 0.001). Among the people with diabetes, the median PPTC was 263 (240.5, 288.75) and it was 185 (165.25, 204) in people without diabetes. The difference in study group between PPTC was statistically significant. (P value < 0.001). Among the people with diabetes, the median PPTG was 190 (156, 211.5) and it was 164 (146.5, 170.75) in people without diabetes. The difference in Study group between PPTG was statistically significant. (P value < 0.001).

Among the people with diabetes, the median PPHDL-C was 41 (38, 47) and it was 42 (37, 46) in people without diabetes. The difference in study group between PPHDL-C was statistically not significant. (P value 0.346). Among the people with diabetes, the median PP non-HDL was 222 (198.25, 244) and it was 143.5 (121.5, 166) in people without diabetes. The difference in study group between PP non-HDL was statistically significant. (P value < 0.001). Among the people with diabetes, the median PPLDL-C was 167 (140, 199.75) and it was 122 (99, 143.75) in people without diabetes. The difference in study group between PPLDL-C was statistically significant. (P value < 0.001).

Parameter	(Mean ± SD) Diabetic (N = 100)	Non-Diabetic (N = 100)	P Value
BMI	22.7 ± 3.83	21.35 ± 3.3	0.008

Table 1. Comparison of Mean of BMI between the Study Groups (N = 200)

Parameter	Diabetic Median (IQR)	Non-Diabetic Median (IQR)	Mann Whitney U Test (P Value)
FBS	148.5 (114.25, 200)	92 (85.25, 98.75)	< 0.001
PPBS	218 (178.5, 260)	115.5 (102.25, 126.75)	< 0.001

Table 2. Comparison of FBS and PPBS between the Two Groups in the Study Population

Parameter	Diabetic Median (IQR)	Non-Diabetic Median (IQR)	Mann Whitney U Test (P Value)
FTC	239 (205, 259.5)	156 (142.25, 172.75)	< 0.001
FTG	129 (104.25, 155.5)	112 (89.25, 135.75)	< 0.001
FLDL-C	140 (111.25, 167.75)	91 (82, 96.75)	< 0.001
Fasting non-HDL	192.5 (167, 217.75)	108.5 (96, 122.75)	< 0.001

Table 3. Comparison of FTC, FTG, FLDL-C, Fasting Non-HDL between the Two Groups in the Study Population (N = 200)

Parameter	(Mean ± SD) Diabetic (N = 100)	Non-Diabetic (N = 100)	P Value
FHDL-C	41.98 ± 7.42	47.9 ± 6.49	< 0.001

Table 4. Comparison of Mean of FHDL-C between the Study Groups (N = 200)

Parameter	Diabetic Median (IQR)	Non-Diabetic Median (IQR)	Mann Whitney U Test (P Value)
PPTC	263 (240.5, 288.75)	185 (165.25, 204)	< 0.001
PPTG	190 (156, 211.5)	164 (146.5, 170.75)	< 0.001
PPLDL-C	167 (140, 199.75)	122 (99, 143.75)	< 0.001
PP Non-HDL	222 (198.25, 244)	143.5 (121.5, 166)	< 0.001
PPHDL-C	41 (38,47)	42 (37,46)	0.346

Table 5. Comparison of PPTC, PPTG, PPLDL-C, PP Non-HDL, PPHDL-C between the Two Groups in the Study Population (N = 200)

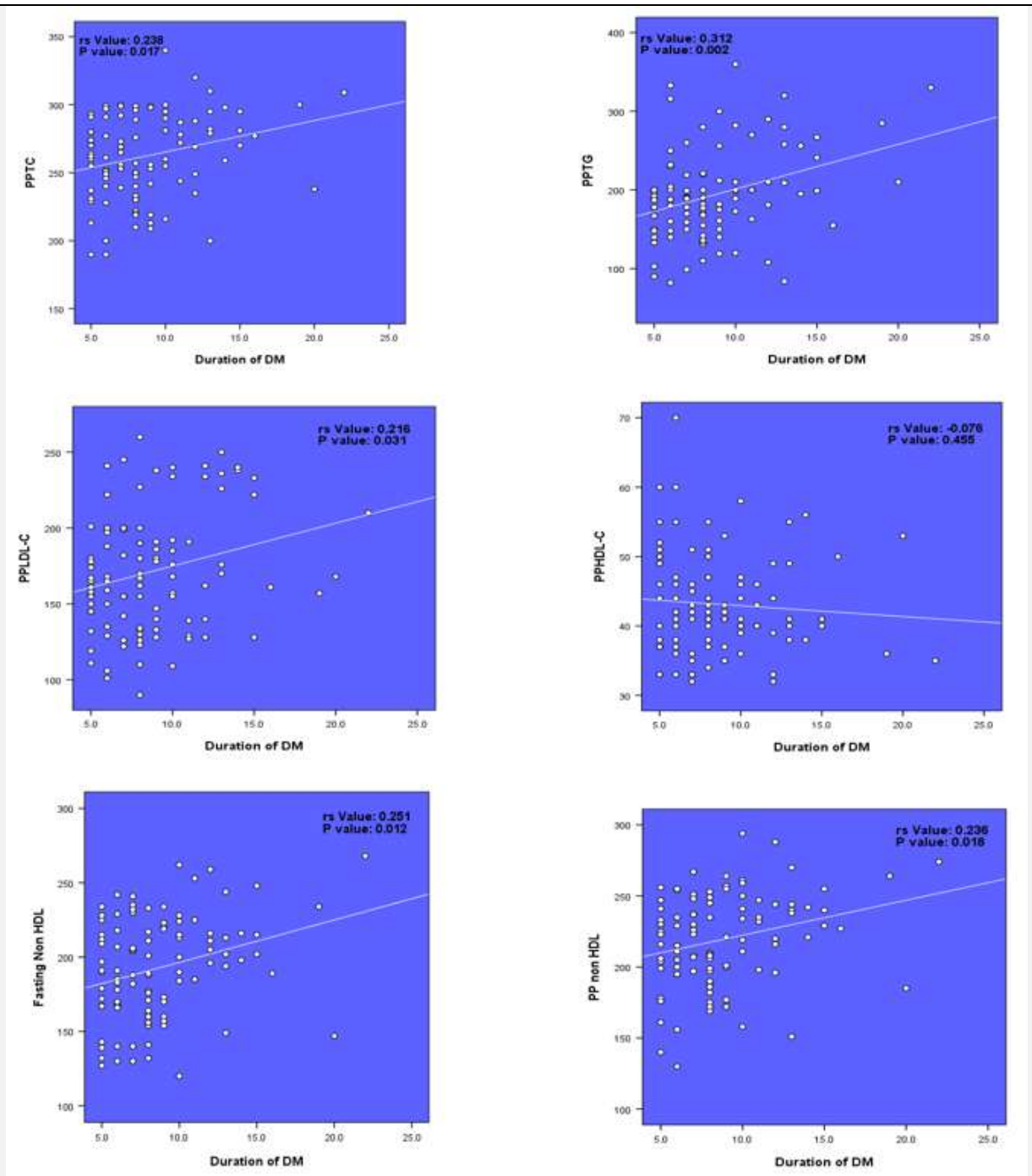

Table 7. Scatter Plot for Correlation between Duration of Detection of DM and PPTC, PPTG, PPLDL-C, PPHDL-C, Fasting Non-HDL, PP Non-HDL in the Study Population (N = 100)

There was a weak positive correlation between duration of detection of DM and PPTC (rs value: 0.238, P value: 0.017).
There was a weak positive correlation between duration of detection of DM and PPTG (rs value: 0.312, P value: 0.002).
There was a weak negative correlation between duration of detection of DM and PPHDL-C (rs value: -0.076, P value: 0.455).
There was a weak positive correlation between duration of detection of DM and PPLDL-C (rs value: 0.216, P value: 0.031).
There was a weak positive correlation between duration of detection of DM and fasting Non-HDL (rs value: 0.251, P value: 0.012).
There was a weak positive correlation between duration of detection of DM and PP non-HDL (rs value: 0.236, P value: 0.018).

Parameter	Spearman's Rank Correlation (rs)	P Value
PPTC	0.238	0.017
PPTG	0.312	0.002
PPLDL-C	0.216	0.031
PPHDL-C	-0.076	0.455
Fasting non-HDL	0.251	0.012
PP non-HDL	0.236	0.018

Table 6. Correlation between Duration of Detection of DM and PPTC, PPTG, PPLDL-C, PPHDL-C, Fasting Non-HDL and Postprandial Non-HDL in the Study Population (N = 100)

DISCUSSION

The present study included 100 patients with diabetes and 100 age group and sex matched controls in comparison to the study conducted by Lokhande[5] et al. at Government Medical College, Nagpur which consisted of 50 cases and 50 controls. In the present study, maximum number of females belonged to age group more than 60 (19 females, 45.24 %),

maximum number of males belonged to age group 20 to 40 (4 males, 57.14 %). The difference in the proportion of gender between different age groups was statistically not significant (P value 0.653).

Lokhande et al. observed that the waist hip ratio of diabetic males (0.96 ± 0.048) and females (0.86 ± 0.048) were significantly higher than their control group and it was statistically significant. In the present study, the mean BMI was 22.7 ± 3.83 in diabetic patients and it was 21.35 ± 3.3 in non-diabetic patients, the difference between two groups was statistically not significant. (P value 0.008).

The mean FBS in Lokhande et al. study group was 185.00 ± 45.00, mean PPBS was 235.40 ± 47.68, in the control group FBS was 90.60 ± 13.38 and PPBS was 137.90 ± 21.12. In the present study, the median FBS was 148.5 (114.25, 200) and median PPBS was 218 (178.5, 260) in the study group, and in the control group median FBS was 92 (85.25, 98.75) and median PPBS was 115.5 (102.25, 126.75).

In the present study, the mean of FHDL-C was 41.98 ± 7.42 in diabetic patients and it was 47.9 ± 6.49 in patients without diabetes, the difference between two groups was statistically significant. (P value < 0.001) and among the people with diabetes, the median PPHDL-C was 41 (38,47) and it was 42 (37, 46) in people without diabetes. The difference in study group between PPHDL-C was statistically not significant. (P value 0.346).

In Lokhande et al. study, the fasting as well as postprandial HDL cholesterol was decreased compared to the control group. The mean FHDL-C in the control group was 50.82 ± 6.05 and in study group was 45.72 ± 8.82 and P value was 0.001, the mean PPHDL-C was 41.88 ± 4.62 in control group and 35.30 ± 7.25 in study group and P value was 0.000 which was statistically significant. Eda dayakar[6] et al. studied the prevalence of dyslipidaemia in type 2 diabetes mellitus patients and the average fasting total cholesterol (TC), triglycerides (TG), low-density lipoprotein (LDL), high-density lipoprotein (HDL) and very low density lipoprotein (VLDL) were 200 ± 42 mg/dl, 169.62 ± 89.79 mg/dl, 132.45 ± 36.38 mg/dl, 39.1 ± 16.6 mg/dl and 35.85 ± 17.09 mg/dl respectively. In this study of 46 diabetic patients, all the participants were having dyslipidaemia as one or two parameters of the lipid profile were outside the target recommended by the guidelines of national cholesterol education programmed. Out of 46 diabetic patients, 27 (58.6 %) were having hypercholesterolemia, 17(36.9 %) patients were having hypertriglyceridemia, 30 (65.2 %) patients were having increased LDL levels, and 43 (93.4 %) patients were having reduced HDL levels in the fasting state. In the present study, 86 % of diabetic patients had fasting hypercholesterolemia, 31 % had fasting hypertriglyceridemia, 40 % had decreased HDL-C, 91 % had increased LDL-C in the fasting state. 14 % of diabetic patients had all parameters of lipid profile deranged in the fasting state. 5 % of the diabetic patients had no dyslipidaemia in the fasting state. Shabana[7] et al. studied the effect of age, gender and duration on dyslipidaemia in type 2 diabetes mellitus patients at Vijayawada, the mean age in years of the male diabetics 54.53 ± 10.23 was slightly lower than the mean age 55.27 ± 9 of the female diabetics, and the duration of diabetes was longer in the female than male diabetic subjects, 5.9 ± 3.67 and 5.35 ± 3.34 respectively. The prevalence of dyslipidaemia was higher in diabetic females (78 %) when compared to diabetic males (69 %). In the present study, the prevalence of fasting dyslipidaemia in diabetic males were higher (58 %) when compared to diabetic females (42 %). In the present study, the mean age of diabetic males were 56.5 ± 10.63 and the mean age of diabetic females were 58.34 ± 11.17, the mean age of males were lower than that of females. The mean duration of detection of diabetes in our study population was 8.8 ± 3.4 in diabetic males and 8.61 ± 3.5 in diabetic females, the duration of detection of diabetes was higher in males. Prevalence of dyslipidaemia by duration showed that incidence was slightly higher in the subgroup with 5 - 10 years duration of diabetes in both the genders in Shabana et al. study group. In the present study, 77 diabetic patients had fasting dyslipidaemia in the subgroup with duration of detection of diabetes mellitus between 5 - 10 years of which 43 (56 %) were males and 34 (44 %) were females and 23 patients were in the subgroup with duration of detection of diabetes beyond 10 years, with 14 (61 %) males and 9 (39 %) females. In the present study, duration of detection of diabetes had a weak positive correlation with postprandial LDL-C, TC, TG and there was a weak negative correlation with postprandial HDL-C. Fasting as well as postprandial non-HDL-C showed a weak positive correlation with duration of detection of diabetes mellitus.

Sujaya Raghavendra[8] et al. did a comparative study of fasting and postprandial lipid profiles among type 2 diabetes mellitus patients at Puducherry and analysis proved that the postprandial HDL-C (36.69 ± 7.86) levels were significantly decreased compared to fasting HDL-C (43.41 ± 7.46) levels in diabetes mellitus patients. In the present study, postprandial HDL-C had no significant decrease from fasting HDL-C in diabetes mellitus patients.

Pandeya[9] et al. conducted a cross sectional study of the pattern of dyslipidaemia and evaluated non-HDL cholesterol as a marker of risk factor for cardiovascular disease in 82 type 2 diabetes mellitus patients of Kathmandu. This study showed significantly increased level of serum fasting non-HDL-C (156.0 ± 46.2) and TC to HDL-C ratio in diabetics compared to the values in control group (124.1 ± 39.0). In the present study, median fasting non HDL 192.5 (167, 217.75) and median postprandial non HDL-C was 222 (198.25, 244) in diabetic patients and showed significant derangement from the control group in which fasting median non HDL-C was 108.5 (96, 122.75) and median postprandial non-HDL-C was 143.5 (121.5, 166).

C. S. Nagalakshmi[10] et al. analysed the correlation of blood sugar levels with fasting non-HDL-C and the correlation was statistically significant thus confirming that it's an important cardiovascular risk factor in diabetic patients.

Thakur Abhimanyu[11] et al. analysed the non HDL-C levels and LDL/HDL ratio in 100 diabetic patients at a tertiary health care facility at Andhra Pradesh and emphasized that there was a significant increase in non-HDL cholesterol (P < 0.0001) and LDLC/HDL-C ratio (P < 0.05) in diabetic patients compared to age and sex matched controls, thus indicating

an impending cardiovascular risk in those patients. In the present study, the difference in fasting non-HDL-C between the diabetic patients and controls was statistically significant. ($P < 0.001$). Vijay Vishwanathan[12] et al. analysed the non HDL-C levels among 808 type 2 DM patients at a tertiary care center at Chennai, 58 (7.2 %) of them had previous cardiovascular events and were on statin therapy, despite treatment, 47 % of them had elevated non HDL-C levels and optimal LDL-C levels, placing them at risk for future cardiac events.

CONCLUSIONS

The postprandial lipid profile in diabetes mellitus patients is significantly deranged compared to fasting state and is an important factor in assessing their cardiovascular risk, hence there is a need to stress on postprandial lipid profile estimation in diabetic patients. The study also showed weak positive correlation between the duration of detection of diabetes and post prandial TC, HDL, LDL, TG, non-HDL and weak negative correlation with HDL.

Data sharing statement provided by the authors is available with the full text of this article at jebmh.com.
Financial or other competing interests: None.
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