INTRODUCTION

It is currently estimated that diabetes prevalence by 2030 will include 439 million adults worldwide.1 Cardiovascular disease (CVD) is the leading cause of death worldwide, and mortality due to CVD is higher in low- and middle-income countries.2,3 In India, there has been an alarming increase in the prevalence of CVD over the past two decades so much so that accounts for 34.2% of all deaths among adults aged 25–69 years.4 The risk for coronary artery disease (CAD) is 2–4 times higher in diabetic subjects, and in Indians, CAD occurs prematurely, i.e. one to two decades earlier than in the West.5 Dyslipidemia is an abnormally increased amount of lipids (e.g. cholesterol and/or triglycerides) and is one of the major risk factors for CVDs in Diabetes. Diabetic dyslipidemia consists of specifically mild to marked elevation of triglyceriderich lipoproteins- very low density lipoprotein-cholesterol (VLDL-C) and VLDL-C remnants, and low levels of high density lipoprotein-cholesterol (HDL-C). Raised serum triglycerides (TG) and low HDL-C often precede the onset of T2DM. In addition, low density lipoprotein cholesterol (LDL-C) particles are converted to smaller, perhaps more atherogenic, lipoproteins termed ‘small dense LDL-C’ (sd-LDL-C).6 This combination of hypertriglyceridemia, low HDL-C and high levels of LDL-C, termed as ‘Atherogenic Dyslipidemia’ – better addressed as Atherogenic Diabetic Dyslipidemia (ADD), is particularly seen in Asian Indians. Although precise reason for such dyslipidemia is unknown, genetic predisposition and characteristic body composition (excess intra-abdominal fat) may be important contributors. A common
outcomes of such a body composition and dyslipidemia in
Asian Indians is the tendency to develop insulin resistance.7

A study by Parikh R M et al8 found that the majority of
Indian type 2 diabetics are dyslipidemic at baseline. Majority
of these diabetic patients failed to achieve all standard goals
of dyslipidemia management. In a substantial number of
patients this was attributable to the fact that the HDL-C
target was not met.8 Hence this study was done to identify
pattern of dyslipidemia and prevalence of ADD in
treatment naïve diabetic patients.

MATERIALS AND METHODS

This was cross sectional study carried on the patients
attending the Medicine OPD of East Point College of
Medical Sciences and Hospital, Bangalore during 6 months
period of October 2018 to March 2019. Patients with
type 2 diabetes mellitus visiting consecutively in the
Medicine OPD were enrolled for this study. The patients
enrolled in the study were newly detected Diabetes
patients. The patients of type 1 diabetes mellitus were not
considered for this study. The patients who were
also suffering from coronary artery disease (CAD) or
had history of cerebrovascular accident (CVA) or were
diagnosed as having CAD or CVA after enrolment and
those patients already taking statins or other drugs for
lipid lowering were excluded from this study. Diabetic
patients suffering from metabolic disorders or chronic
systemic diseases were also excluded from the study. In
those patients included in the study, detailed history was
taken and clinical examination was done. The demographic
parameters of the patients were recorded and their weight,
height and BMI were recorded using standard methods.
Fasting blood sample of the patients after at least 8 hours
overnight fast was taken to measure serum lipid profile
parameters of total cholesterol (TC), triglycerides (TG),
low density lipid cholesterol (LDL-C) and high density
lipid cholesterol (HDL-C). The cut-off normal values for
individual lipid levels were taken as per guidelines of the
National Cholesterol Education Program (NCEP) Expert
Panel on Detection, Evaluation and Treatment of High
Blood Cholesterol in Adults (Adult Treatment Panel III).9

The body mass index (BMI) was calculated by the Quetelet
Index, BMI = Weight (Kg)/Height (m²) from weight and
height measurements. The data of the individual patients
was entered in the Microsoft Excel sheet and was analysed
statistically using SPSS software. Prevalence and pattern of
dyslipidemia was analysed in the study population. Various
sociodemographic characters associated with dyslipidemia,
atherogenic diabetic dyslipidemia and high Non-HDL
cholesterol were analysed using appropriate statistical tests.

RESULTS

We studied a total of 120 patients, out of which 63 (52%)
of them were males and 57 (48%) were females. Mean age
of the patients was 47.8 yrs. 64 (53.3%) patients were urban
dwellers and 56 (46.6%) were from rural areas. Prevalence
of dyslipidemia was 89.2% with 107 patients having
abnormalities in lipid profile either alone or in combination.
Out of 107 patients, 60 were male and 47 were female with
significant p-value of 0.024. Dyslipidemia was highest in age
group of 51-60 years (n=39). It was higher among urban
population with 55.1% (n=59) prevalence. Prevalence of
dyslipidemia was analysed with various variables as depicted
in Table 1.

Atherogenic diabetic dyslipidemia defined as a
combination of high TG, high LDL, low HDL, was seen in
34.2% (n=41) of patients out of which 58.5% (n=24)
were males and 41.5% (n=17) were females. 56.1%
(n=23) were urban population and 43.9% (n=18) were
from rural areas. Atherogenic diabetic dyslipidemia
had significant association (p value=0.036) with
Hypertension when compared with the other variables
as depicted in Table 2.

Non-HDL-C was elevated in 73.3% (n=88) of the
patients out of which 53.3% (n=46) were males and
47.7% (n=42) were females. Among the total 88 patients
56.8% (n=50) were urban population and 43.2% (n=38)
were rural population. Among patients having elevated non-
HDL-C, increasing BMI and higher waist circumference
showed significant association with p-values of <0.001 and
0.027 respectively as depicted in Table 3.

The various sociodemographic details associated with
dyslipidemia are detailed below in Table 4.

Prevalence of Atherogenic Diabetic Dyslipidemia (ADD)
was 34.2% in our study. On comparing different lipid
parameters with the diabetic control status, only ADD
had significant correlation with poor glycemic control
(HbA1c >8) with a significant p-value as depicted in Table 5.

DISCUSSION

According to IDF Diabetes Atlas Update 2017, 425 million
people have diabetes worldwide and half of the people
with diabetes remain undiagnosed and two-thirds i.e. 279
million live in the urban areas.10 Patients with DM have a
2- to 4-fold increased risk of cardiovascular, peripheral
vascular and cerebrovascular disease, which are the leading
causes of morbidity and mortality in this population. Many
Western epidemiological studies have shown an association
between diabetic dyslipidemia, which is characterized
by hypertriglyceridemia; low levels of HDL cholesterol; postprandial lipemia and small, dense LDL cholesterol particles and the occurrence of cardiovascular disease.\textsuperscript{11-15}

The 'Chennai Urban Population Study' showed 11% prevalence of CAD, which is 10 times more than what it was in 1970. Clustering of risk factors for CAD such as hyperglycemia, central obesity, dyslipidemia, and hypertension (HTN) tend to occur, and, interplay of these risk factors could explain the enhanced CAD risk in Indians. Additionally, low-grade inflammation and a possible inherent genetic susceptibility are other contributing factors.\textsuperscript{14}

Our study showed a high prevalence of dyslipidemia of 89.2% among the 120 patients enrolled of which 56.1% were males and 43.9% were females which were statistically significant. In our study prevalence was higher in urban population with 92% of newly detected diabetics being dyslipidemic compared to 85% in the rural diabetics. According to ICMR INDIAB study, prevalence of dyslipidemia was 79% and there was no urban rural difference observed in the four regions studied in ICMR study.\textsuperscript{15}

Most of subjects of our study had mixed pattern of dyslipidemia. On analysis of Individual parameters, total cholesterol was elevated in $43.3\%(n=52)$ of patients,
Our study showed a high prevalence of dyslipidemia at 89.2% in newly diagnosed diabetics indicating the importance of screening for dyslipidemia in newly diagnosed cases and institution of timely lipid lowering therapies.

**CONCLUSION**

According to ICMR-INDIAB increased TC was 13.9%, increased TG in 29.5%, low HDL was the most common abnormality with 72.3% and high LDL in 11.8%, 4.8% of patients had all four lipid abnormalities in form of high TC, high TG, high LDL and low HDL. Our study showed much higher prevalence of 28% for the four lipid abnormalities mentioned above. In our study, most of the diabetic patients had mixed dyslipidemia i.e. more than one lipid abnormality. The most common mixed abnormality detected was hypertriglyceridemia and low HDL levels (41.6%) which was in similarity with the western studies where similar pattern was observed, whereas study done by Pandya et al among the Gujarati population showed that the most common mixed lipid abnormality was high TG and high LDL.

Prevalence of Atherogenic Diabetic Dyslipidemia (ADD) was 34.2% in our study which was comparable to study done by Parikh et al where the prevalence of ADD was 36.1%. On comparing different lipid parameters with the diabetic control status, only ADD had significant correlation with poor glycemic control (HbA1c >8) with a significant p-value. Hence control of diabetes is of prime importance, as it can lead to reduced incidence of Atherogenic Diabetic dyslipidemia.

In recent times the focus is shifting on reducing the non-HDL–C (all the atherogenic lipoproteins), as many trials have demonstrated non-HDL–C levels as a better predictor of CVD risk than is LDL-C. LDL–C may actually be underestimating the burden of atherogenic, cholesterol-carrying lipoproteins. Our study had significant correlation of non-HDL–C levels with BMI and waist circumference.
therapy to prevent ASCVDs. Our study also highlights the importance of pattern of dyslipidemia called Atherogenic diabetic dyslipidemia and raised Non-HDL cholesterol which is shown to have higher prevalence in our study. Non HDL-C is now being set as co-primary target especially in patients with triglyceride levels of more than 200mg/dl, indicating the role of newer combined PPAR-α/γ agonists which are effective in managing lipids and insulin sensitization that control hyperglycemia simultaneously, when the LDL and Non-HDL are not reached even after optimum dose of statins. Hence it is of paramount importance to aim for strict goals, specific thresholds, early and regular screening for dyslipidemia in Indian diabetics so that early, prompt and appropriate preventive measures can be instituted to reduce the occurrence of Atherosclerotic cardiovascular diseases.

REFERENCES

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