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ASSESSMENT OF FASTNG BLOOD SUGAR AND SERUM LIPID PROFILE AMONG DIABETIC PATIENTS ATTENDING FEDERAL MEDICAL CENTRE, MAKURDI

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ABSTRACT

Type-2 diabetic patients (T2DM) have increased prevalence of dyslipidemia resulting to their high risk of cardiovascular disease. Dyslipidemias in T2DM are responsible for both macrovascular and microvascular complications. This study is aimed at assessing the serum fasting blood sugar and lipid profile of non-diabetic and diabetic subjectsvisiting Federal Medical Centre Makurdi.A total of 203 subjects participated including 109 non-diabetic patients (68 females and 41 males) and 94 (54 females and 40 males) who consented to participate. There was statistically significant difference in the fasting blood sugar (FBS) of the male and female diabetic patients as the mean ± SD FBS (mMol/L) of the Diabetic male was 8.33 ± 3.189, P value 0.025 and10.38 ± 4.961, P value 0.017 for the female diabetic patients. The mean ±SD of the FBS for the non-diabetic patients were comparable. The fasting lipid profile of both thediabetic and non-diabetic patients were comparable. The TC, TG, HDL-C, LDL-C, VLDL-C were 0.115, 0.206, -0.146, 0.306, -0.229 and P-Value 0.268, 0.046, 0.160, 0.003, 0.306 respectively. The TC, and HDL–C were not statistically significant. The study presents the linkage between FBS and lipid profiles among T2DM patients and contributes to risky situation for cardiovascular disease progression. Therefore, lipid profiles should not be ignored in the screening and management of type-2 diabetes mellitus.

Key words:*Diabetes, Serum Lipid Profile, Fasting Blood Sugar, Type 2 Diabetes Mellitus*

INTRODUCTION

The term diabetes mellitus has been described as a metabolic disorder of multiple etiology which is characterized by chronic hyperglycemia, with disturbances of carbohydrate, fat and protein metabolism, which result from defects in insulin secretion, insulin action, or both. Diabetes causes about 5% of all deaths globally each year. The chronic hyperglycemia of diabetes is associated with long-term damage, dysfunction, and failure of various organs, especially the eyes, kidneys, nerves, heart, and blood vessels. Fifty percent of people with diabetes die of cardiovascular disease such as coronary heart disease and stroke.

It has been defined by World Health Organization on the basis of laboratory findings, as a fasting venous plasma glucose concentration greater than 7.8mmol/L (140mg/dl) or greater than 11.1 mmol/L (200mg/dl) two hours after a carbohydrate meal and therefore fasting glucose between 100 mg/dL (5.5 mmol/L) and 125mg/dL (7mmol/L) is diagnostic of impaired fasting glucose (IFG), and a 2-hour post-glucose load of 140–199 mg/dL (7.8–11.0 mmol/L) is called impaired glucose tolerance (IGT). Both of these conditions predict increased risk of subsequent progression to diabetes (Angel *etal* 2019;Bhargyashree 2017).

Type 2 diabetes makes up about 90% of cases of diabetes, with the other 10% due primarily to diabetes mellitus type 1 and gestational diabetes. Obesity is thought to be the primary cause of type 2 diabetes, in people who are genetically predisposed to the disease. Rates of type 2 diabetes have increased markedly since 1960 in parallel with obesity (Hall *et al* 2011). According to International Diabetes Federation in 2013, an estimated 382 million people had diabetes worldwide, with type 2 diabetes making up about 90% of the cases. This is equal to 8.3% of the adult population, with equal rates in both women and men. A further 316 million (6.9%) people with impaired glucose tolerance are at high risk from the disease – an alarming number that is set to reach 471million by 2035. This indicates a pandemic in full flight and the greatest increase in rates is expected to occur in Asia and Africa, where most people with diabetes will probably be found by 2030.Currently, sub-Saharan Africa is estimated to have 20 million people with diabetes, about 62% are not diagnosed and the number is expected to reach 41.4 million by 2035 or an increase of 109.1%. In sub-Saharan Africa, Nigeria has the highest number of people with diabetes with an estimated 3.9 million people (or an extrapolated prevalence of 4.99%) of the adult population aged 20-79-year-old (WHO, 2013). Further, in terms of morbidity, diabetes contributes to the development of heart disease, renal disease, pneumonia, bacteremia, and tuberculosis (TB). It is known that people with diabetes are 3 times more likely to develop tuberculosis and approximately 15% of TB globally is thought to have background diabetes as a predisposing factor (Dahiru,*et al*., 2016).

Type 2 diabetics have a higher risk of developing cardiovascular disease (CVD). In this subset of population, cardiovascular deaths represent the top killer. Globally, type 2 diabetes mellitus (T2DM) is a swiftly escalating public health issue with noteworthy effects on human health, living standards, the economy and health care system. Statistics from the International Diabetes Federation (IDF) indicate that 425 million adults worldwide have diabetes mellitus (DM) and that by 2045, the number of DM patients will be 629 million and 352 million people were at risk of developing T2DM (International Diabetes Federation, 2017). T2DM patients are prone to diabetic dyslipidemia, which puts them at risk of developing macrovascular (stroke, peripheral vascular disease and coronary artery disease (CAD) and microvascular (nephropathy, neuropathy and retinopathy) diseases (Kundu, and Kundu, 2022). Naqvi *et al.,*(2017) have reported that, for T2DM patients, one of the most common complications linked with uncontrolled hyperglycemia is dyslipidemia.

Diabetic patients with accompanied (unobserveddyslipidemiais soft targets of cardiovascular deaths). Patients with type 2 diabetes often exhibit an atherogenic lipid profile (i.e. high triglyceride, TG and low high-density lipoprotein cholesterol), which greatly increases their risk of CVD compared with people without diabetes. An early intervention to normalize circulatory lipids has been shown to reduce cardiovascular complications and mortality. A significantly higher levels of hypercholesterolemia and hyperlipidemia was observed in type 2 diabetic patients with CVD as compared to diabetic patients without CVD (Ahmad *etal*, 2021). Dyslipidemia in diabetes commonly manifest as raised low density lipoprotein cholesterol (LDL – C), decreased high density lipoprotein cholesterol (HDL – C) or elevated triglyceride (TG) levels.

Diabetic complication encompasses cardiovascular diseases mediated by dyslipidaemia. However, diabetic control using antidiabetic drugs could prevent the development of these cardiovascular diseases posed by dyslipidaemia. However, maintaining healthy glucose levels for type 2 diabetes is of paramount importance and may help in preventing micro and macrovascular complications. Prevention of dyslipidaemia involves maintaining normal levels of plasma glucose (Enkhmaa*etal*, 2017) and table 1 presents a guide.

Table 1. Lipid Abnormalities in Patients with Diabetes

T1DM	Lipid profile is similar to controls if glycemic control is good
T2DM	Increased triglycerides, VLDL, IDL, and non-HDL-C. Decreased HDL-C. Normal LDL-C but increase in small dense LDL, LDL particle number, and apolipoprotein B.
Poor glycemic control	Increased triglycerides, VLDL and IDL and decreased HDL-C. Modest increase in LDL-C with increase in small dense LDL and particle number.

The objectives of this study is to determine the association between glycaemia and serum lipid profile in type 2 diabetic patients attending FMC Makurdi. Also, to present lipid profile as a good biomarker for glycemic control.

MATERIALS AND METHODS

The study was carried out in the Medical Outpatient Department(MOPD) of Federal Medical Centre Makurdi, Benue State, Nigeria.

The study design is a cross-sectional study in which the subjects were selected randomly involving T2DM patients and the non-diabetic patients as control

Ethical approval was obtained from the Health Research Ethics Committee (HREC) of the Center.

All adult male and female T2DM patients aged 35-87 years attending FMC Makurdi, who met the inclusion criteria, were included in the study.

The sample size was determined using the Fisher's formula and arrive at 76 to be the minimum number, however, atotal of 203 participants were recruited.

The sample size calculation was determined using 95% confidence interval, 0.05 precision and prevalence rate.Where; n= minimum sample size; Z= 1.96, P= prevalence rate

d= margin of error (desired absolute precision of 5%, i.e., 0.05)

$$n = \frac{(Z^2)P\,(1-P)}{d2}$$

The study included adult males and females with confirmed type 2 diabetic patients between ages of 35 – 87 years that are visiting the Center for medical attention while(non-diabetic) patients within the same age group served as control.

The patients confirmed type 1 diabetic patients, Diabetic and non – diabetic patients receiving medical attention in other health care facilities, Patients with haemoglobinopathies like sickle cell anaemia and Pregnant patients were excluded.

Informed consent was obtained from participants who were counselled and their samples collected for analysis.

2ml of the blood was dispensed into fluoride oxalate vacutainer tube for blood glucose analysis5ml was dispensed into plain vacutainer tube for serum lipid profile (total cholesterol, high density lipoprotein cholesterol, low density lipoprotein cholesterol, very low-density lipoprotein cholesterol, and triglyceride) analysis.

Fasting blood glucose was measured using Chemwell semi-automated analyzer and fasting lipid profile were measured using Roche Cobas C311 Chemistry auto-analyzer machine (Roche Diagnostic GmbH, Mannheim, Germany) using enzymatic assays.

3.0 RESULTS

A total of 203 patients, attending medical out patients' clinic, who meet the inclusion criteria and were willing to participate in the research were randomly selected. One hundred and nine of these patients (68 females and 41 males) were normal patients (non-diabetics) while a total of 94 patients (54 females and 40 males) were types 2 diabetic patients. In total 122 females and 81 males participated in the study as shown in Table 2.

Table3shows the mean ± standard deviations of the FBS (mmol/L) and

fasting lipid profile (mmol/L) of non - diabetics and T_2DM patients.

The results show the mean ±SD FBG of non-diabetic males as 5.37 ±1.688, P value 0.540 and mean ±SD of FBG (mmol/L) of non-diabetic female as 5.18 ±1.685, P value 0.591. These were not statically significant. While the mean ± SD FBG (mmol/L) of the Diabetic male was 8.33 ± 3.189, P value 0.025 and the mean ± SD FBG (mmol/L) of the diabetic female was 10.38 ± 4.961, P value 0.017, both were statistically significant.

Figure 1 shows the graphical representation of mean ± SD T. cholesterol (mmol/L) among the study groups.

Figure 2 shows the graphical representation of HDL – C (mmol/L) among the study groups.

Figure 3 shows the graphical representation of LDL – C (mmol/L) among the study groups.

Figure 4 shows the graphical representation of VLDL – C in (mmol1L) among the study groups.

Figure 5 shows the graphical representation of T.G (mmol1L) among the study groups.

Table 2: Gender of Patients' Participants

Variable	Number of Subjects	NormalHyperglycemicTotal
GENDER		
Males	41 (38)	40 (43) 81 (40)
Females	68 (62)	54 (57) 122 (60)
TOTAL	109 (100)	94 (100) 203 (100)

Figures in parenthesis are the equivalent values in %

Table 3:Table Showing Mean ± SD of FBG and Serum Lipid Profile of T2DM and Non Diabetes Patients

	Non Diabetic			Diabetics		
Variable	Male (N=41)	Female (N=68)	Total (N=109)	Male (N=40)	Female (N=54)	Total (N=94)
FBG(mmol/L)	5.37±1.666	5.18±1.685	5.3±1.2	8.33±3.189*	10.38±4.961*	13.5±4.1
T-CHOL(mmol/L)	4.12±0.927	4.21±0.760	4.2±0.8	4.41±1.081	4.61±0.998	4.5±0.1
HDL-C(mmol/L)	1.14±1.315	0.90±0.209	1.0±1.0	1.87±1.6553	1.57±1.241	1.7±0.4
LDL-C(mmol/L)	2.73±0.809	2.08±0.722	2.4±0.8	1.79±1.074	2.16±1.088	2.0±1.1
VLDL-C(mmol/L)	0.48±0.159	0.48±0.183	0.48±0.2	1.11±0.965	1.24±1.011	1.2±1.0
TG(mmol/L)	1.08±0.391	1.13±0.463	1.1±0.4	1.39±0.509	1.48±0.618	1.4±0.6

Values are expressed as mean ± SD; NS= not significant, * = Significant at P<0.05

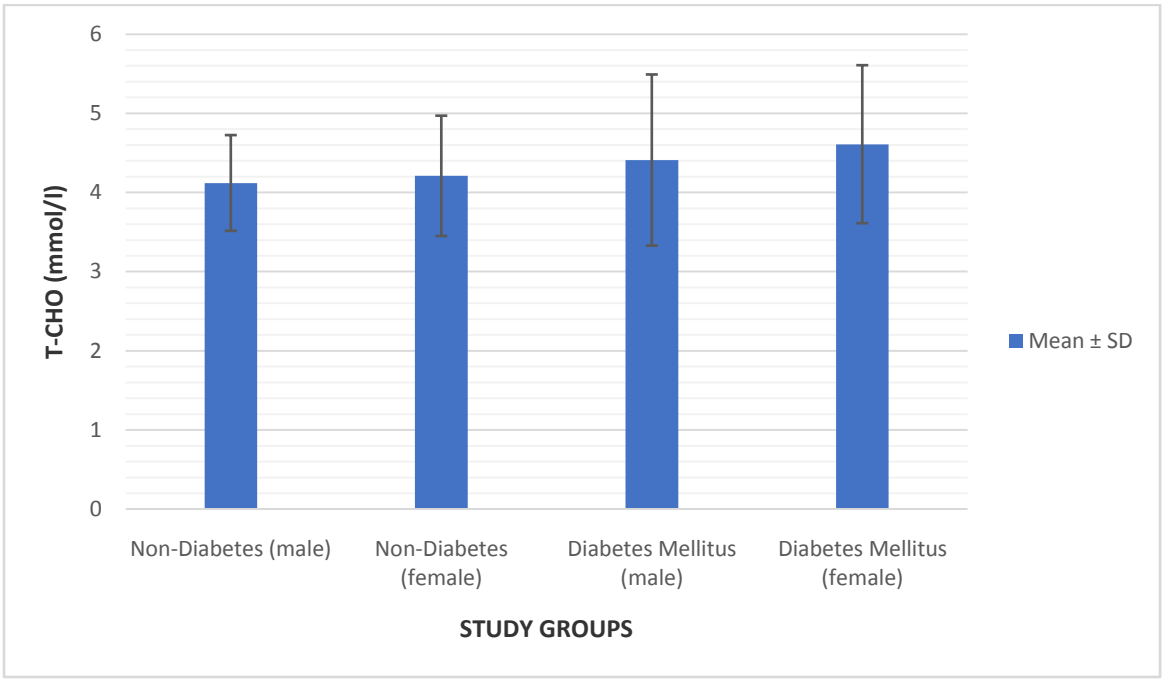

Figure 1: Shows the graphical representation of T-CHO among the study groups

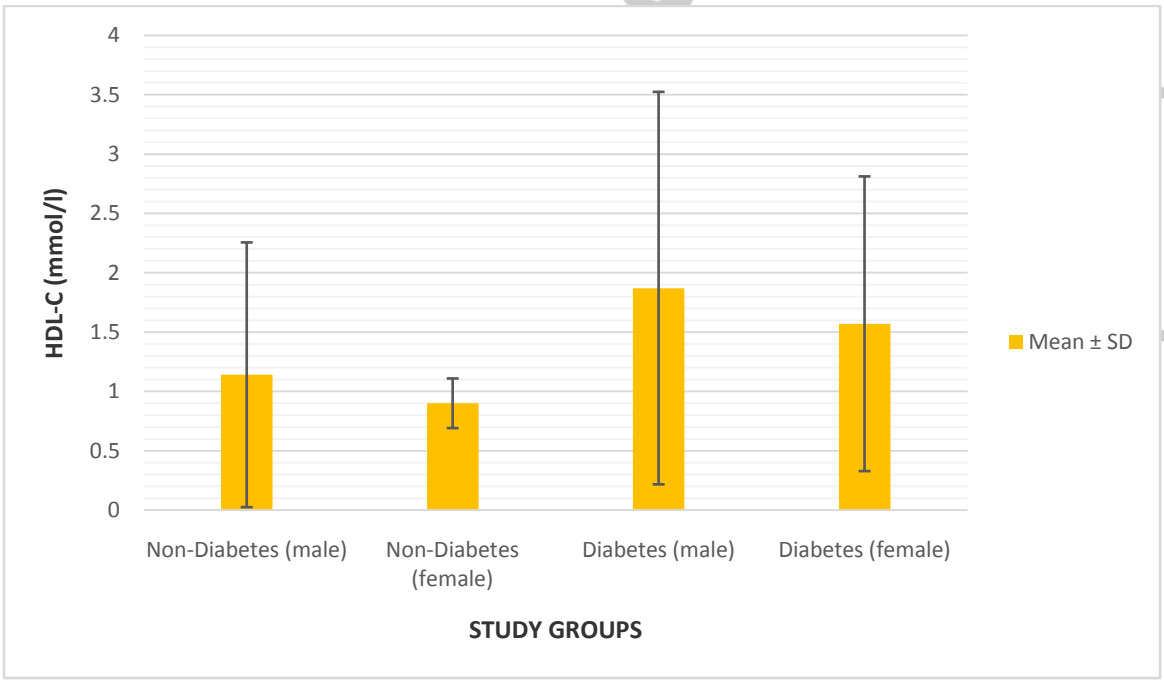

Figure 2: shows the graphical representation of HDL-C among the study groups.

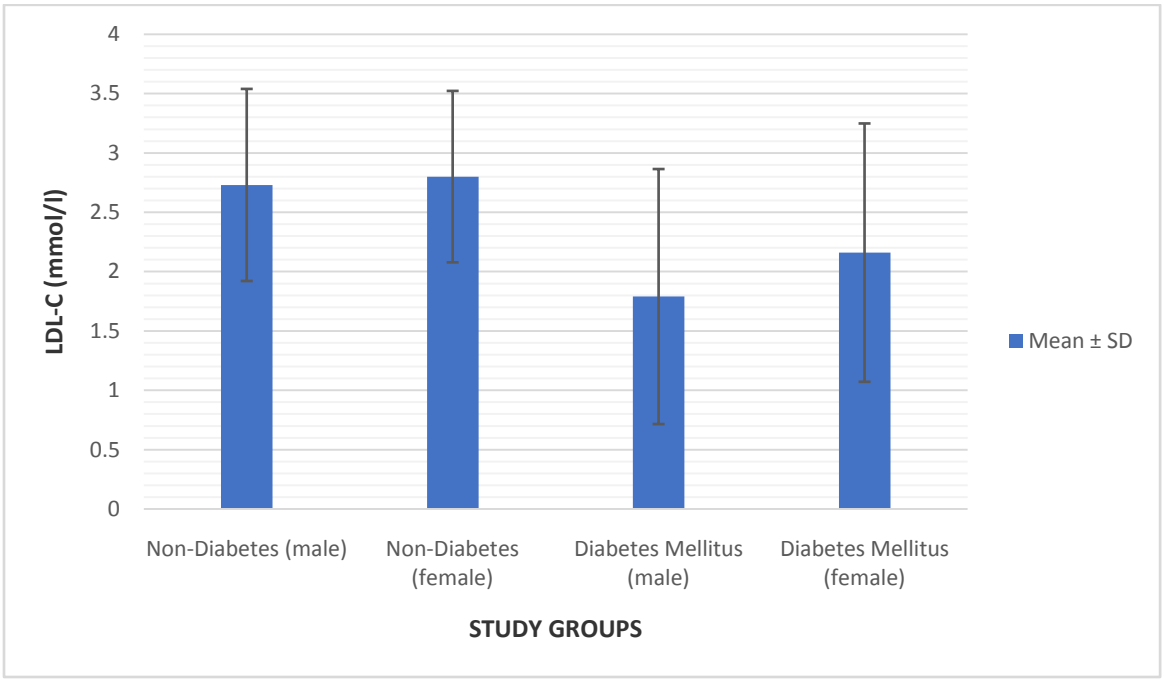

Figure 3: Shows the graphical representation of LDL-C among the study groups.

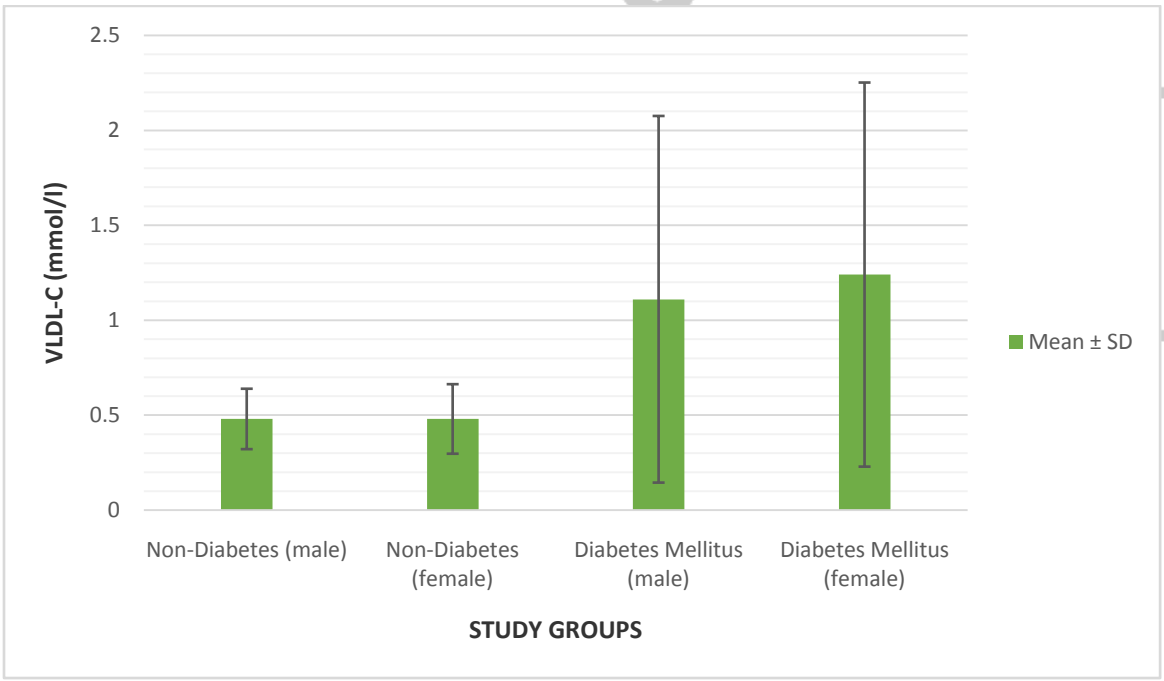

Figure 4: Shows the graphical representation of VLDL-C among the study groups.

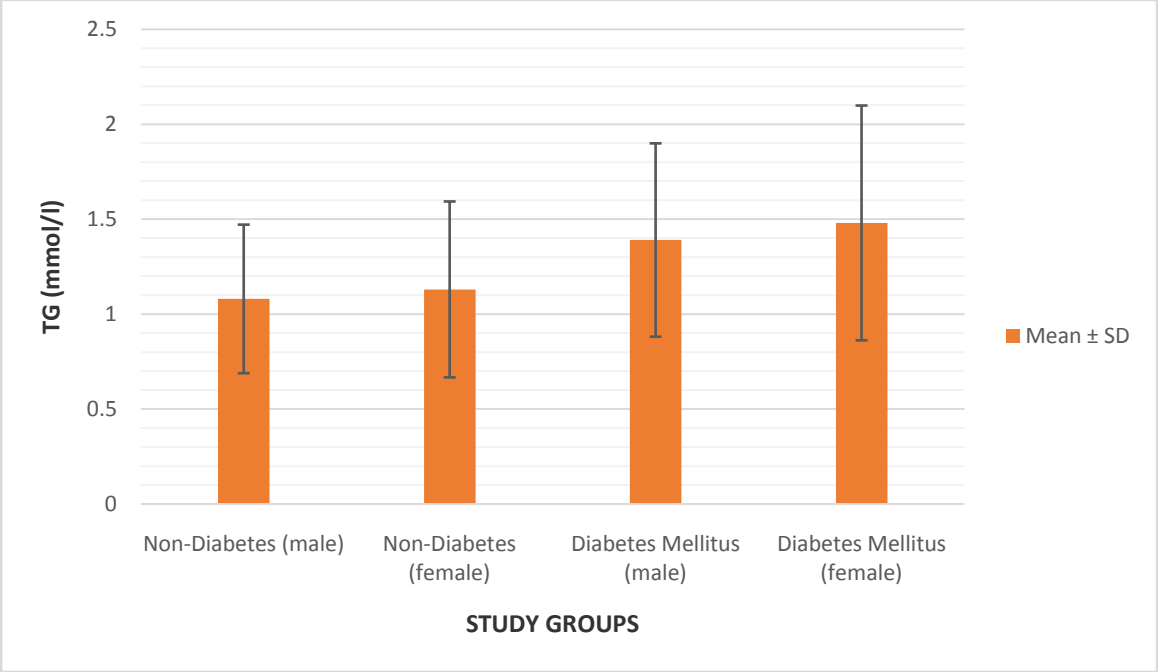

Figure 5: Shows the graphical representation of TG among the study groups.

DISCUSSION

The study found that there was significantly high level of fasting blood sugar(FBS) otherwise called fasting blood glucose (FBG) in the female and Male T2DM compared to the non-diabetic patients. In comparison of the males and females T2DM patients, the Mean± SD of the FBG was higher in the females T2DM patients compared to the males. The study shows that there was significant high level of FBG in both Males and Females T2DMpatients when compared withthe non-diabetic group. This could be explained by the impaired insulin function seen in T2DM (Evert *etal*, 2019).

Lipoprotein lipase which plays an important role in breaking down TG present in chylomicrons and VLDL particles is less effective in insulin resistant T2DM leading to poor clearance of TG, hence the high values in circulation(Sultan, *et al*., 2017).

The finding of this study showed increased prevalence of dyslipidemia is high in femaleT2DM patients. It wasfound thatlow levels of HDL-C in T2DM.Values less than 40mg/dl(<1mmol/L) were considered as independent risk factor for cardiovascular events in diabetic patients.Higher values of HDL-C are said to be protective against cardiovascular complications.Ganjali, et al.,2017 found modestly increased values of HDL-C in T1DM patients. Thisis in agreement to T2DM patients' values when compared with non-diabetic patients' values as seen in the study.

The figures 1-5 presents the graphical representation of diabetic and non-diabetic males and females in comparison for T.CHOL, HDL-C, LDL-C, VLDL-C and TG with T.CHOL, HDL-C, VLDL-C and TG having increase when compared to the normal for both males and females while LDL-C had a decrease, though had no statistical

significance, it shows relationship between FBS and Lipid profile in T2DM which agrees with other studies (Unadike*etal*, 2013; Fumilayo& Grace, 2016; Olaniyan*etal* 2023).

Thus the result of this study suggest the importance of controlling hyperglycemia in order to manage altered lipid profile levels. Thus, it can reduce the risk for cardiovascular diseases in type 2 diabetic subjects.As in the non-diabetic population, epidemiological studies have shown that increased LDL-C, Non-HDL-C levels and decreased HDL-C levels are associated with an increased risk of cardiovascular disease in patients with diabetes. In the UKPDS cohort LDL-C levels were the strongest predictor of coronary artery disease. While it is universally accepted that elevated levels of LDL-C and non-HDL-C cause atherosclerosis and cardiovascular disease the role of HDL-C is uncertain. Genetic studies and studies of drugs that raise HDL-C have not supported low HDL-C levels as a causative factor for atherosclerosis (Hovingh*et al*., 2015). It is currently thought that HDL function is associated with atherosclerosis risk and that this does not precisely correlate with HDL-C levels (Hovingh*et al.*, 2015). In patients with diabetes, elevations in serum triglyceride levels also are associated with an increased risk of cardiovascular disease. With regard to triglycerides, it is not clear whether they are a causative factor for cardiovascular disease or whether the elevation in triglycerides is a marker for other abnormalities. Recent Mendelian randomization studies have provided support for the hypothesis that elevated triglyceride levels play a causal role in atherosclerosis (Nordestgaard, 2016).

In patients with T1DM in good glycemic control, the lipid profile is very similar to lipid profiles in the general population (De Ferranti, *et al*., 2014). In some studies, HDL-C levels are modestly increased in patients with T1DM (Ganjali, *et al*., 2017). In contrast, in patients with T2DM, even when in good glycemic control, there are abnormalities in lipid levels. It is estimated that 30-60% of patients with T2DM have dyslipidemia. Specifically, patients with T2DM often have an increase in serum triglyceride levels, increased VLDL and IDL, and decreased HDL-C levels. Non-HDL-C levels are increased due to the increase in VLDL and IDL. LDL-C levels are typically not different than in normal subjects but there is an increase in small dense LDL, a lipoprotein particle that may be particularly pro-atherogenic. As a consequence, there are more LDL particles, which coupled with the increases in VLDL and IDL, leads to an increase in apolipoprotein B levels (Wu &Parhofer 2014). Additionally, the postprandial increase in serum triglycerides is accentuated and elevations in postprandial lipids may increase the risk of cardiovascular disease. It should be recognized that these lipid changes are characteristic of the alterations in lipid profile seen in obesity and the metabolic syndrome (insulin resistance syndrome). Since a high percentage of patients with T2DM are obese, insulin resistant and have the metabolic syndrome, it is not surprising that the prevalence of increased triglycerides and small dense LDL and decreased HDL-C is common in patients with T2DM even when these patients are

in good glycemic control (Ference etal., 2018).

In both T1DM and T2DM, poor glycemic control increases serum triglyceride levels, VLDL, and IDL, and decreases HDL-C levels. Poor glycemic control can also result in a modest increase in LDL-C, which because of the elevation in triglycerides is often in the small dense LDL subfraction. It is therefore important to optimize glycemic control in patients with diabetes because this will have secondary beneficial effects on lipid levels.

Lp(a) levels are usually within the normal range in patients with T1DM and T2DM (Enkhmaa, *et al.*, 2016). Some studies have observed no impact of diabetes mellitus on Lp(a) concentrations while other studies reported an elevation or a decrease in Lp(a) concentrations (Enkhmaa, *et al.*, 2016). The development of microalbuminuria and the onset of renal disease are associated with an increase in Lp (a) levels. Of note low Lp(a) levels are associated with an increased risk of developing T2DM (Enkhmaa*et al.,* 2016). A recent very large case control study found that Lp(a) concentration in the bottom 10% increases T2DM risk. Many studies have emphasized on the importance of glycemic control of T2DM using lipid profile assessment of patients (Chatriwala*et al.*, 2019; Lokendra, *et al.*, 2019)and this study tands out to add to the body of knowledge in inclusion of lipid profiles of T2DM patients during prognosis, diagnosis and management.

CONCLUSION

There was significant direct proportional relationship between FBS and plasma levels of TG, LDL-C, and VLDL-C in T2DM diabetic patients.There could be a clusterof interrelated plasma lipid and lipoprotein abnormalities associated with alterations in VLDL metabolism and should bemanaged to reduce the risk for atherosclerosis and coronary heart disease in somepatients with type 2 diabetes. Notably, Insulin resistance among diabetic patients may play a key role in the development of diabetic dyslipidemia.

It is recommendable that Fasting lipid profile should be considered in the screening and monitoring of T2DM patients.It is also recommended that dyslipideamiain T2DM patients can be improve by a variety of therapeutic modalities such as weight loss,and physical activities as well as the use of the necessary medication. The clinicians and caregivers should monitor LDL-C as it can contribute significantly to reduction of the prevalence of coronary artery diseases especially among diabetic patients.

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