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Exploring Lipid Profile Abnormalities at First Clinical Visit in Patients with Type 2 Diabetes Mellitus. A Regional Retrospective Cohort Study

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Author's contribution

This work was carried out in collaboration among all authors. Author DAO conceptualized the study, Team leader and writing of manuscript. Author AMA did the supervision of data collection, revision of discussion. Author FOA did the data revision, arrangements of tables, correspondence. Author OBO did the revision of manuscript. Author OK did the data analysis. All authors read and approved the final manuscript.

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ABSTRACT

Background: Dyslipidemia portends an elevated risk for type 2 diabetes mellitus patients in developing various cardiovascular complications thus leading to increased morbidity, mortality and poor quality of life in this subset of patients. Dyslipidemia is a precursor to the development of atherosclerosis which is a major cause of cardiovascular disease. This study looks at the prevalence and pattern of dyslipidemia in type 2 diabetes mellitus patients at their first clinic contact in a tertiary hospital setting.

Methodology: This is a retrospective study conducted in a medical outpatient endocrinology clinic of a tertiary referral health center (LASUTH), after approval was gotten from the Institution ethical committee. NO: LREC/06/10/1987. Cases within the period from November 2021 to June 2022 were studied. Data Analyses were performed using SPSS statistics version 23.0. $P < 0.05$ was considered statistically significant.

Results: A total number of 252 subjects attending the Endocrinology clinic were included in this study. The mean age was 56.7 ± 12.9 years with the youngest being 19 years and oldest being 90 years of age. Female to male ratio was 1.3:1. The mean TC was 181.0 ± 51.3mg/dl, mean of HDL-C was 48.6 ± 12.5mg/dl, mean of LDL-C was 121.5 ±41.8 and mean of TG 102.6 ± 41.9mg/dl. The mean HBA1C was 8.6 ± 2.3%, mean BMI was 27.9 ± 5.6 Kg/m^2 and mean FBS was 173.6 ± 72.7mgdl. The pattern of lipid derangement was low HDL-C in 113(44.8%), high LDL-C 100 (39.7%), high TC 78(31.0%) and high TG 30 (11.9%). Prevalence of dyslipidemia was 72.6/%. The odds of having deranged HDL-C were 3. 87 (95% Cl: 2.170 – 6.902) times significantly higher in females. Odds of having deranged HDL-C were 3.0 (95% Cl: 1.641 – 5.528) times significantly higher in subjects who are obese.

Conclusion: Our study found high prevalence of lipid profile derangement in patients with type 2 diabetes. Therefore, early screening, appropriate medical intervention and routine monitoring should form part of patient care to control the dyslipidemia and avoid cardiovascular complications.

Keywords: Type 2 diabetes mellitus; dyslipidemia; cardiovascular disease; fasting blood glucose; glycosylated hemoglobin.

1. INTRODUCTION

Diabetes mellitus (DM) with its attendant complications continues to be an increasing global health challenge. An estimated 15 million people are living with diabetes in Africa [1]. Diabetes is known to be associated with a 2-4fold increased risk of cardiovascular mortality independent of other factors [2]. About 90% or more of diabetes cases are diagnosed as type 2 diabetes mellitus (T2DM) in the world, including Africa [3]. Type 2 diabetes is associated with various complications leading to cardiovascular morbidity and mortality [4]. Dyslipidemia, which is a well-known risk factor for cardiovascular disease is commonly associated with type 2 diabetes [5]. This co-existence further magnifies the cardiovascular complications that accompany each disorder [6]. The prevalence of dyslipidemia in type 2 diabetes varies across countries and regions. A prior study in Jordan reported that the prevalence rate of high LDL-C, reduced HDL-C, high TC, and elevated TG were75.9%, 59.5%, 44.3%, and 41.9 respectively [7]. Other studies in Pakistan and South Africa also show diverse variations of derangement in lipid profiles among patients with type 2 diabetes [8,9]. Diabetic dyslipidemia, also known as atherogenic dyslipidemia is a peculiar lipid pattern noted in type 2 diabetes mellitus patients. It is characterized by elevated TG, reduced level of HDL-C, and increased propensity of small dense LDL-C. It is particularly associated with high cardiovascular mortality. Across the globe, there are numerous studies implicating body mass index, fasting blood glucose, age, gender as well as some lifestyles as prime risk factors contributing to the rise in the prevalence of dyslipidemia among T2DM patients [10-12]. Generally, there is inadequacy of data in Nigeria on the prevalence and patterns of lipid profile derangement among patients with type 2 diabetes. Dyslipidemia is associated with cardiovascular complications in these patients, and some of the complications can be prevented if diagnosed early enough and thus managed by appropriate intervention. This study sets out to determine the prevalence and patterns of lipid profile abnormalities found in type 2 diabetes mellitus patients during their first visit at an endocrinology outpatient clinic of a tertiary hospital.

2. METHODOLOGY

This was a retrospective study carried out among adult type 2 diabetes mellitus patients presenting for the first-time clinic visit to the diabetes out-patient clinic in Lagos State University Teaching Hospital (LASUTH) Ikeja between November 2022 to June 2023.

2.1 Inclusion Criteria

All consecutive type 2 diabetes mellitus patients that presented for their first visit within the time frame of the study.

Patients case notes were recruited consecutively from the Medical Records Department of the Institution and only those that satisfied the inclusion criteria were used for the study. Approval was given by the Ethics Committee of the Institution before commencement of the study. REF. NO: LREC/06/10/1987.

Serum lipid profile and blood glucose were estimated in the fasting state of at least 8 hours fast over-night. Demographic data recorded includes the gender, height, weight and body mass index. Biochemical parameters were performed in the institution clinical biochemistry laboratory using international standard method. The biochemical parameters performed includes the different subfractions of the lipid profile (TG, HDL-C, TC, LDL-C), fasting blood glucose and glycosylated hemoglobin (Hba1c). The values of the subfractions of the lipid profile were recorded using the NCEP ATP 111 recommended normal ranges as standards.

2.2 Exclusion Criteria

Adult type 1 diabetic patients, pregnant diabetic patients, patients with thyroid dysfunction and drug induced diabetes mellitus. Type 2 diabetic patients on lipid lowering drugs were also excluded.

Data was analyzed using SPSS statistics version 23.0. P-value < 0.05 was considered statistically significant. Chi-squared test was used to compare continuous and categorical data respectively. logistic regression was used to predict the odds of dyslipidemia compared with the risk factors.

3. RESULTS

A total number of 252 subjects attending Endocrinology clinic were recruited for this study.

The mean of the subjects was 56.7 ± 12.9, with the highest majority 138 (54.8%) within the age group of 45 - 64 years. There were more females 142 (56.3%) than males (43.7%) with a male-to-female ratio of 1:1.3. Majority 96 (38.1%) of the subjects were overweight with an average body mass index of 27.9 ± 5.6kg/m^2.

Seventy-eight (31.0%) subjects presented with high total cholesterol levels, with mean total cholesterol of 181.0 ± 51. More than half of the subjects 139 (55.2%) had normal High-Density Lipoprotein (HDL), with an average HDL of 48.6 ± 12.5. One hundred (39.7%) subjects came up with high Low-Density Lipoprotein (LDL) levels, while the Overall Prevalence of dyslipidemia (as defined by at least one abnormal lipid Profile) was 183 (72.6%).

In all lipid profile parameters, as shown in Table 4 and Fig. 1, the female subjects had the highest level of derangement with 64.1%, 73.5%%, 65.0%, and 56.7% derangement in Total cholesterol, High-density lipoprotein, Low-density lipoprotein, and Triglycerides respectively.

Generally, the highest level of lipid profile derangement was in High-density lipoprotein 44.8%, Low-density lipoprotein 39.7%, Total cholesterol 31.0%, and Triglycerides 11.9%.

There was a statistically significant association between derangement in age (P=0.02), body mass index (P=0.04), and total cholesterol. There was however no significant association between gender, HBA1C, and total cholesterol. Also, there was a statistically significant association between derangement in gender (P=0.01), body mass index (P=0.01), and high-density lipoprotein. There was however no significant association between derangement in age, HBA1C, and HDL. There was a statistically significant association between derangement in gender (P=0.02), age (P=0.02) body mass index (P=0.01), and LDL. There was however no significant association between HBA1C and LDL.

Table 1. Demographic and Clinical characteristics of the subjects

	Variable	Freq (N= 252)	Percentage (%)
Age Group (Years)	18 – 44	41	16.2
	45 – 64	138	54.8
	≥65	73	29.0
	Age range	19 – 90	
	Mean ± SD	56.7 ± 12.9	
Sex	Male	110	43.7
	Female	142	56.3
Religion	Christianity	196	77.8
	Islam	56	22.2
BMI(Kg/m^2)	Under Weight	10	4.0
	Normal Weight	65	25.8
	Overweight	96	38.1
	Obese	81	32.1
	Mean ± SD	27.9 ± 5.6	

Table 2. Lipid Profile parameters of the subjects

Variable (mg/dl)	Freq (N= 252)	Percentage (%)
Total Cholesterol (TC)		
High Cholesterol	78	31.0
Normal TC	174	69.0
Range	91 – 370	
Mean ± SD	181.0 ± 51.3	
High-density lipoprotein (HDL)		
Low HDL	113	44.8
Normal HDL	139	55.2
Range	22 – 95	
Mean ± SD	48.6 ± 12.5	
Low-density lipoprotein (LDL)		
High LDL	100	39.7
Normal LDL	152	60.3
Range	34 – 325	
Mean ± SD	121.5 ±41.8	
Triglyceride (TG)		
High TG	30	11.9
Normal TG	222	88.1
Range	20 – 299	38.1
Mean ± SD	102.6 ± 41.9	32.1
Overall Prevalence of dyslipidemia (At least one abnormal lipid Profile)		
Dyslipidemia	183	72.6
Normal Lipid	69	27.4

***NCEP ATPIII (2002). Circulation 106, 3143-3421**

Table 3. Glycemic parameters of the subjects

Variable	Freq (N= 252)	Percentage (%)
HBAIC (%)		
Uncontrolled	213	84.6
Controlled	39	15.5
Range	4.3 – 16.4	
Mean ± SD	8.6 ± 2.3	
Fasting blood sugar(mg/dl)		
Abnormal	164	65.1
Normal	88	34.9
Range	72 – 300	
Mean ± SD	173.6 ± 72.7	

**Diabetes care. 32 (Suppl 1): S6 -S12. 2009*

Deranged HBA1C level was found in most subjects 213 (84.5%) with an average HBA1C of 8.6 ± 2. However, the majority 164 (65.1%) presented with an abnormal fasting blood sugar level.

Table 4. Patterns of derangement by gender distribution

Variable	Male (freq(%)	Female (freq(%)
Total Cholesterol	28(35.9)	50(64.1)
High-Density Lipoprotein	30(26.5)	83(73.5)
Low-Density Lipoprotein	35(35.0)	65(65.0)
Triglyceride	13(43.3)	17(56.7)

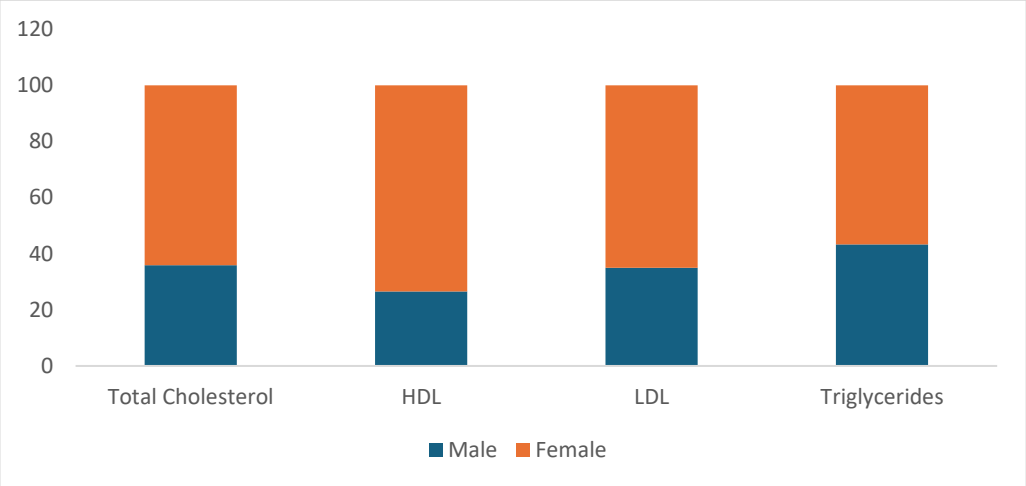

Fig. 1. Patterns of lipid profile derangement by gender distribution

Table 5. Factors that predicted Deranged lipid Profiles among subjects

Variable	Gender		
	Male	Female	P-Value
TC (mg/dl)	28 (35.9)	50 (64.1)	0.06
HDL (mg/dl)	30 (26.5)	83 (73.5)	0.01*
LDL (mg/dl)	35 (35.)	65 (65.0)	0.02*
TG (mg/dl)	13 (43.3)	17 (56.7)	0.565
Variable	**Age**		
	≤60	>60	P-Value
TC (mg/dl)	42 (53.8)	36 (46.2)	0.02*
HDL (mg/dl)	72 (63.7)	41 (36.3)	0.53
LDL (mg/dl)	56 (56.0)	44 (44.0)	0.02*
TG (mg/dl)	18 (60.0)	12 (40.0)	0.39
Variable	**BMI**		
	<30		P-Value
TC (mg/dl)	32 (41.0)		0.04*
HDL (mg/dl)	52 (46.0)		0.01*
LDL (mg/dl)	42 (42.0)		0.01*
TG (mg/dl)	14 (46.7)		0.06
Variable	**HBA1C (%)**		
	<7.0		P-Value
TC (mg/dl)	19 (24.4)		0.320
HDL (mg/dl)	30 (26.5)		0.360
LDL (mg/dl)	26 (26.0)		0.446
TG (mg/dl)	5 (16.7)		0.489

*TC=Total Cholesterol, HDL= High Density Lipoprotein-C, LDL= Low Density Lipoprotein-C, BMI=Body Mass Index, *=Statistically Significant*

The odds of having deranged TC were 1.855(1.072 – 3.208) significantly higher in subjects who are ≥60 compared to those <60. This association was lost upon adjusting

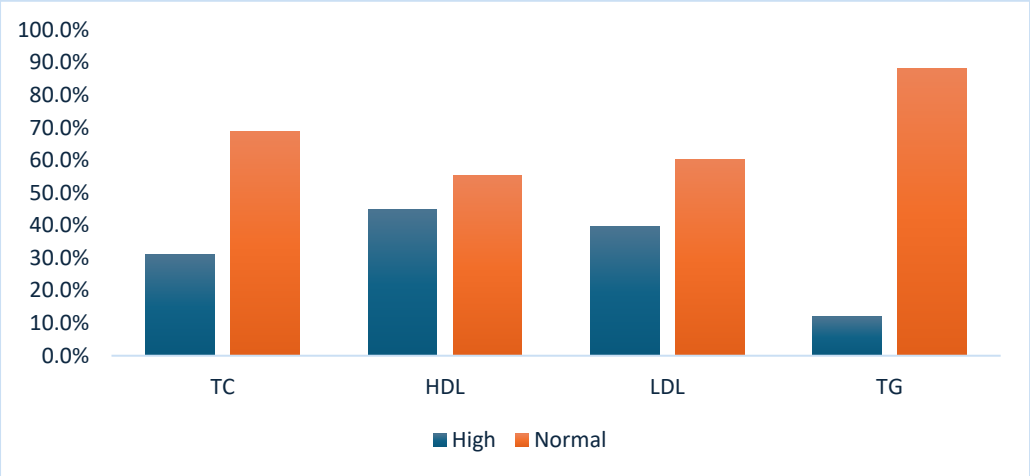

Fig. 2. General Patterns of Lipid Profile Derangement

TC= Total cholesterol, HDL = High density lipoprotein, LDL = Low density lipoprotein, TG = Triglyceride

Table 6. Logistics regression Model for factors that Predict Lipid Profile Derangement.

		Total Cholesterol		COR (95% C.I)	AOR (95% C.I)
		High	**Normal**		
Age	>60	36	55	1.855(1.072 – 3.208)	1.631(.761 – 3.498)
	<60	42	119		
BMI	≥30	46	124	1.725(.987 – 3.014)	1.466(.635 – 3.383)
	<30	32	50		
		HDL		**COR (95% C.I)**	**AOR (95% C.I)**
Gender	Female	83	59	3.751(2.195 – 6.413)	3.870(2.170 – 6.902)
	Male	30	80		
BMI	≥30	61	109	3.097(1.791 – 5.357)	3.012(1.641 – 5.528)
	<30	52	30		
		LDL		**COR (95% C.I)**	**AOR (95% C.I)**
Gender	Female	65	77	1.809(1.076 – 3.041)	1.549(.733 – 3.273)
	Male	35	75		
Age	>60	44	47	1.755(1.040 – 2.963)	1.424(.696 – 2.915)
	≤60	56	105		
BMI	≥30	58	112	2.028(1.185 – 3.468)	1.741(.818 – 3.707)
	<30	42	40		

HDL=High Density Lipoprotein, LDL=Low Density Lipoprotein, OR=Odd Ratio, AOR=Adjusted Odd Ratio

(multivariate regression) for other variables. The odds of having deranged HDL were 3.751 (2.195 – 6.413) significantly higher in subjects who are female compared to the male. This association was lost upon adjusting (multivariate regression) for other variables. The odds of having a deranged BMI were 3.012 (1.641 – 5.528) significantly higher in subjects who are ≥30 compared to those <30.

4. DISCUSSION

Cardiovascular disease is the most prevalent cause of morbidity and mortality in the diabetic population [13]. Dyslipidemia characterized by an abnormal lipid profile, is one of the major risk factors for cardiovascular disease in patients with diabetes [14]. In this current study, we determined the prevalence and patterns of lipid profile derangement among type 2 diabetic patents. In our study, the mean age was 56.7 ± 12.9 years with the youngest being 19 years and the oldest being 90 years of age which is higher than the mean age submitted in a similar study in Lalitpur, Nepal but lower than the mean age obtained in Tanzania [15,16]. Results obtained in the present study showed that subjects who are above sixty years were 1.855 times likely to present with deranged Total cholesterol. This might be due to the fact that there is drastic

reduction of testosterone in this subset of people and testosterone may have an impact on cholesterol even though the reasons are not completely clear. This observed association was however lost after adjusting for other factors. A previous study reported a higher prevalence of dyslipidemia in females with type 2 diabetes in comparison with males [17]. The current study submitted a female-to-male ratio of 1.3:1 with female subjects presenting with higher incidence of lipid derangements in all lipid profile parameters analyzed. This might be due to the fact that during menopause(50-55yrs) women's lipid subfractions especially total cholesterol and LDL cholesterol tend to rise while HDL cholesterol reduces because of the decline in oestrogen level. Majority of type 2 diabetes mellitus patients are in the older age group worldwide. Among the 78 subjects with deranged lipid profile pattern TC, 50(19.9%), 83(32.9%) of 113 subjects with HDL-C derangement, 65(25.8%) of 100 with LDL-C derangement and 17(6.8%) of 30 with TG derangement were female. Furthermore, findings from the present study reveal that the odds of having deranged HDL-C were 3.87 (95% CI: 2.170 – 6.902) times significantly higher in females. This finding correlates with works done in Kushtia, Bangladesh but differs from the study by Gazza et al in Saudi Arabia which reported no statistically significant association between risk factors and dyslipidemia [18,19]. Cheh,ade JM, Gladysz M, and Mooradian AD [20] reported that basic elements seen in diabetic dyslipidemia include elevated total cholesterol, high concentration of small dense LDL-C particles, decreased HDL-C concentration, and elevated triglyceride concentration. The results of the present study showed that the mean TC was 181.0 ± 51.3mg/dl. This is lower than the values submitted in similar studies done in Egypt and India [21,22]. Majority of the subjects (n=138, 69.3%) had desirable total cholesterol levels which correlates with results presented in Nepal [15]. In the current study, 44.8% of the subjects presented with deranged HLD-C with a mean of 48.6 ± 12.5mg/dl. This is below the prevalence submitted in Bangladesh but exceeds the prevalence submitted in a similar study by Noubiap JJ et al [23]. Our study found a 39.7% dyslipidemia in LDL-C with a mean of 121.5 ±41.8 which is higher than the prevalence obtained in Jordan, but lower than the result obtained in Egypt [21,24]. Additionally, our study also reveals that the odds of having deranged LDL-C were 1.81 (1.076 – 3.041) times significantly higher in females, this association was however lost upon adjusting for other factors. In this present study, 11.9% had high triglyceride with a mean of 102.6 ± 41.9mg/dl. This value is higher than the values presented in Jordan but lower than the results obtained in Pakistan and Ethiopia [23-25]. This result is not in line with some previous studies. 16,18, 20, 21, 24 But, it however correlates with the result obtained in Ethiopia [25]. These observed differences with the studies cited may be due to the sample size, the diet of the study subjects, and other modifiable risk factors. The current study submitted an overall prevalence of 72.6% dyslipidemia which is lower than the value reported in Tanzania and Jordan but higher than the result reported in Southwest Ethiopia and Ghana. [16,24-26]. It is a well-established fact that patients with type 2 diabetes are vulnerable to cardiovascular disease due to sustained hyperglycemia resulting from derangement in glucose metabolism and associated dyslipidemia due to deranged lipid metabolism. Chronic hyperglycemia with associated dyslipidemia may result in atherosclerosis by initiating endothelial tissue damage [27,28]. In the current study, 84.6% of the subjects came up with uncontrolled Hba1c, and 90.5% presented with elevated FBS with a mean of 8.6 ± 2.3% and 173.6 ± 72.7mg/dl respectively. This exceeds the mean value submitted by Asamoah-Boakye O and Apprey C, but is lower than the result obtained in previous studies conducted in Ghana and South Africa [26,29,30]. The relationship between obesity and dyslipidemia in type 2 diabetes mellitus has been documented in previous studies [31,32]. Our study found a mean BMI of 27.9 ± 5.6 Kg/m2, 32.1% obesity, 38.1% overweight and 25.8% normal weight. This finding is slightly in line with previous studies done in Tanzania, Ghana, and South East Nigeria, but however, not in concordance with the study done in Jordan [16,24,29,33]. Also, the present study reveals that the odds of having deranged HDL-C were 3.0 (95% CI: 1.641–5.528) times significantly higher in subjects who are obese.

5. CONCLUSION

Our study found a high prevalence of dyslipidemia in patients with type 2 diabetes mellitus. The most common type of lipid profile derangement found in our study was low HDL-C followed by high LDL-C, high total cholesterol, and high triglyceride. The odds of having deranged HDL-C were 3.87 times significantly higher in females. Also, the odds of having deranged HDL-C were 3.0 times significantly

higher in subjects who were obese. Therefore, early screening and intervention in the management of dyslipidemia in type 2 diabetes patients is sacrosanct in preventing cardiovascular complications.

6. LIMITATION

Our study is retrospective and was limited to patients in one health center which might limit the general application of the study findings to other centers. A multicenter study will be of more benefit for practicability and application of the study findings. This study was carried out on patients already diagnosed with Type 2 diabetes mellitus at primary and secondary health care centers with drugs treatment already initiated before presenting for the first time in our endocrinology outpatient clinic on referral. The time frame before presentation and drug use might partly explain the reasons why there are no significant associations between fasting blood glucose, glycosylated hemoglobin and lipid profile abnormalities in this study population.

DISCLAIMER (ARTIFICIAL INTELLIGENCE)

Author(s) hereby declare that NO generative AI technologies such as Large Language Models (ChatGPT, COPILOT, etc) and text-to-image generators have been used during writing or editing of this manuscript.

CONSENT

As per international standards or university standards, patient(s) written consent has been collected and preserved by the author(s).

ETHICAL APPROVAL

As per international standards or university standards written ethical approval has been collected and preserved by the author(s).

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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