Pattern of serum lipid profile of type 2 diabetes patients in a tertiary hospital in Nigeria

Rifkatu S. Reng, Gerald A. Onwuegbuzie*, Felicia Anumah

Department of Medicine, University of Abuja Teaching Hospital, Gwagwalada, Abuja, Nigeria

Received: 08 May 2021
Revised: 10 June 2021
Accepted: 11 June 2021

*Correspondence:
Dr. Gerald A. Onwuegbuzie,
E-mail: gerawele@yahoo.com

ABSTRACT

Background: Diabetes mellitus is a metabolic disorder characterised by chronic hyperglycaemia and disturbances of carbohydrate, lipid and protein metabolism. Diabetic patients have an increased risk of developing dyslipidemia with various lipid abnormalities which makes them prone to develop cardiovascular disease. The aim of the study is to determine the patterns of lipid profile in patients with Type 2 diabetes mellitus.

Methods: Lipid profile data for a total of 104 known type 2 DM patients from the medical outpatient clinic were collected. The profile of the study sample was analysed for dyslipidemia using the ATP III classification. Data obtained were analysed using Analyse-it v3.0 statistical software for Microsoft Excel.

Results: This study showed that there were more females 53.8% than males 46.2% with type 2 diabetes mellitus with the mean age of 52.5±11.9 years. The pattern of dyslipidaemia revealed elevated LDL 51.9%, TG 37.5%, TC 36.5% and low HDL 27.9%. We had more patients who were overweight 33.7% than obese 32.7%.

Conclusions: It was observed from the study that a significant number of diabetic patients have dyslipidaemia and most common lipid abnormalities are elevated LDL, triglyceride and low HDL.

Keywords: Diabetes mellitus, Dyslipidemia, Glycated haemoglobin

INTRODUCTION

Diabetes mellitus is characterized by chronic hyperglycaemia with disturbances in carbohydrate, lipid and protein metabolism resulting from defects in insulin action or both.1 Approximately 463 adults are currently living with diabetes; by 2045 this will rise to 700 million with 79% of adults with diabetes living in low-and middle-income countries.2 Dyslipidemia is known to be a major risk factor for macrovascular complications in type 2 Diabetic patients and affects 10-73% of this population.3,4 Diabetic dyslipidemia consist of reduced high density lipoprotein (HDL), raised triglycerides (TG) and excess of small dense low density lipoprotein (LDL) particles. Lipid abnormalities are common in patients with diabetes mellitus because insulin resistance or deficiency affects key enzymes and pathways of lipid metabolism.5 Microvascular and macro-vascular complications, including cardiovascular disease (CVD), retinopathy, nephropathy, and neuropathy, occur due to chronic uncontrolled hyperglycaemia in diabetics.6,7 Glycated haemoglobin (HbA1c) is used to monitor long term glycaemic control routinely, predict the risk of complications development, and also function as the indicator for the mean blood glucose level.8 This study aimed to find out the lipid profile pattern in patients with type 2 diabetes mellitus attending the Endocrine and diabetes division of medical outpatient clinic.
METHODS

Study location and data collection

The study was carried out at the University of Abuja Teaching Hospital, a tertiary health centre, between June 2018 and October 2020. It is a retrospective study. A total of one hundred and four lipid profile data with Type 2 diabetes were accessed from the medical records of the Endocrine unit of Department of Medicine, University of Abuja Teaching Hospital, Gwagawala.

Diabetes mellitus was confirmed using fasting blood glucose and glycated haemoglobin.

All patients had full clinical assessment and investigations done including fasting lipid profile. One hundred and four patients had complete data in terms of fasting blood glucose, fasting lipid profile and glycated haemoglobin for analysis.

As part of routine in the Endocrine unit, patient is advised to fast for at least 12-14 hours overnight and the 5ml venous blood sample were collected in a disposable syringe on next morning (before breakfast) for the serum lipid profile and fasting blood sugar.

Inclusion criteria

A hundred and four patients between 30 to 100 years of age who were seen at the clinic with complete records were included. All patients who had full clinical assessment and laboratory investigation for diabetes and lipid profile from June 2018 to October 2020 were included in the study.

Exclusion criteria

Patients who had normal blood glucose and impaired fasting glucose.

Statistical analysis

Statistical analysis of data collected was performed using Analyse-it v3.0 statistical software for Microsoft Excel. Data collected was analysed by frequency, mean, standard deviation and chi-square test. For all statistical tests, the threshold of significance is fixed at 5%.

RESULTS

Table 1 critical values of lipid profile and other parameters in patients with Type 2 diabetes Mellitus. The general characteristics of the study population are shown in Table 2.

There were more females 56 (53.8%) with type 2 diabetes than males 48 (46.2%) out of the 104 participants. Majority 66 (63.5%) were between 40 and 60 years of age. The overall mean age of the patients is 52.0±11.9 years but mean age for male is 52.7±10.8 years, while female is 52.3±12.8 years.

Table 1: Critical values of lipid profile and other parameters in patients with Type 2 DM.

| Parameters | Critical values (mmol/L) | Remark |
|------------|--------------------------|--------|
| TC         | >5.18                    | Abnormal |
| LDL        | >2.59                    | Abnormal |
| HDL        | <1.04                    | Abnormal |
| TRIG       | >1.5                     | Abnormal |
| FBS        | >7.00                    | Diabetes |
| HBAIC      | (> 6.5%)                 | Poor DM control |

Table 2: Demographic and anthropometric characteristics of patient stratified by gender.

| Variables | Sex of patients (n, %) | Total (104,100) |
|-----------|------------------------|-----------------|
|           | Female (56, 53.8)      | Male (48, 46.2) |
| Age group (years) |              |                |
| <40       | 10 (9.6) 3 (3.8)       | 14 (13.5)       |
| 40-60     | 34 (32.7) 32 (30.8)    | 66 (63.5)       |
| >61       | 12 (11.5) 12 (11.5)    | 23 (23.1)       |
| BMI       |                        |                 |
| Underweight | 2 (1.9) 0 (0.0)     | 2 (1.9)         |
| Normal weight | 12 (11.5) 21 (20.2) | 33 (31.7)       |
| Overweight | 18 (17.3) 17 (16.3)   | 35 (33.7)       |
| Obese     | 24 (23.1) 10 (9.6)    | 34 (32.7)       |

Table 3: Lipid profile parameters in patients with Type 2 DM (n =104).

| Parameter | Mean | SE  | SD  | Min  | Median | Max  | IQR  |
|-----------|------|-----|-----|------|--------|------|------|
| LDL       | 2.90 | 0.13| 1.29| 0.18 | 2.71   | 6.99 | 1.63 |
| HDL       | 1.33 | 0.06| 0.58| 0.47 | 1.20   | 3.91 | 0.53 |
| TRIG      | 1.38 | 0.06| 0.60| 0.25 | 1.22   | 3.09 | 0.75 |
| TC        | 4.80 | 0.14| 1.48| 1.43 | 4.80   | 9.80 | 2.02 |

TC = Total cholesterol, LDL = Low density lipid, HDL = High density lipid, TRIG = Triglyceride
There were 35 (33.7%) overweight patients (male-17.3%, female-16.3%) while obese patient accounted for 34 (32.7%) with 24 (23.1%) in females compared with 10(9.6%) in males.

Figure 1: Percentages of overall DM patients with critical levels of lipid profile and HbA1c.

Figure 1 shows the percentage of overall diabetic patients with critical values of lipid profile as HDL 29 (27.9%), TC 38 (36.5%), TRIG39 (37.5%) LDL54 (51.9%) and HbA1c 50 (48.1%). The mean concentration of the lipid profile parameters are LDL 2.90±1.29 mmol/l, HDL 1.33±0.58 mmol/l, TG 1.38±0.60 mmol/l and TC 4.8±1.48 mmol/l as shown in Table 3. There was no significant correlation seen between HbA1c and TG, TC, LDL, TG and HDL as shown in Table 4.

Table 4: Correlation between HbA1c and lipid profile.

| Lipid parameters | Correlation | P value (t-test) |
|------------------|-------------|-----------------|
| TRIG             | -0.01       | 0.93            |
| TC               | 0.15        | 0.13            |
| LDL              | 0.13        | 0.20            |
| HDL              | 0.02        | 0.88            |

The cut off values for HbA1c according to American association of clinical endocrinologist (AACE) is:

4.5-6.6%=Normal range, 5.7- 6.4%=increased risk of DM, 6.5% and higher=DM.

Critical values of lipid profile and HbA1c: TC >5.18 mmol/l, LDL >2.59 mmol/l, HDL >1.04 mmol/l, TRIG >1.5 mmol/l, HbA1c >6.5%.

**DISCUSSION**

Abnormalities of lipid metabolism have been reported in patients with diabetes mellitus accompanied by the risk of cardiovascular arteriosclerosis. Many factors may affect blood lipid levels in diabetes because of interrelationship between carbohydrates and lipid metabolism and vice versa. Dyslipidaemia as a metabolic abnormality is frequently associated with diabetes mellitus.

This study revealed that there were more females 53.8% than males 46.2% with type 2 diabetes mellitus with the mean age of 52.5±11.9 years. These findings are similar to the findings of Ozder who reported more female preponderance.16 Several studies reported that the cluster of lipid abnormalities associated with type 2 DM is defined by a high concentration TG and small dense LDL and a low concentration of HDL.10,11 The pattern of dyslipidaemia in our study revealed LDL 51.9%, TG 37.5%, TC 36.5% and HDL 27.9% which compares with other studies that demonstrates the typical diabetic dyslipidaemia.12,13 Although obesity and type 2 diabetes commonly co-exist.14 We had more patients who were overweight 33.7% than obese 32.7% which is comparable with other findings, increased physical activity and dietary modifications were discussed and re-emphasised to our patients early at diagnosis of T2M and this could contribute to why our patients were overweight than obese which still buttress the need for more lifestyle modification.10,15

Dyslipidemia is a common feature of diabetes.16 The risk of cardiovascular disease is greater at any given level of serum cholesterol in patients with diabetes and its association with hypertriglyceridemia is stronger than in the general population.17 Numerous factors are related to diabetic dyslipidaemia including insulin effects on liver apoprotein production, regulation of apoprotein lipase, action of cholesteryl ester transfer protein (CETP), and peripheral actions of insulin on adipose tissue and muscle.18 The process for the development of the cardiac complication is based on the dyslipidaemia-insulin resistance (IR)-hyperinsulinemia cycle, well known as the ‘‘ vicious cycle hypothesis’’.19 In an insulin-resistant state, hypertriglyceridemia is primarily due to an increased hepatic production of very low lipoprotein lipase (VLDL) particles, postprandial hyperlipidaemia, and low lipoprotein lipase (LPL) levels. This hypertriglyceridaemia enhances the CETP mediated intercharge of Tg from Tg-rich lipoprotein lipoproteins to HDL–L/HDL–VL and the subsequent Tg-enrichment of the HDL-C. Hepatic lipase has greater activity against Tg and will thus, convert large HDL particles to small HDL particles, which are also cleared more rapidly from the circulation by the kidney, consequently reducing the concentration of HDL particles (HDL–P).20,21

Abnormal glucose control accompanied by elevated LDL, hypertriglyceridaemia, hypercholesterolaemia and low HDL is the commonest metabolic abnormality in T2DM Patients. Thus, improving glycaemic control will significantly cause an improvement in dyslipidaemia and lowers the risk of cardiovascular events in patients with T2M.22,24 Coronary artery calcification in asymptomatic patients with newly diagnosed T2DM has been
demonstrated to a larger extent. Dyslipidaemia is not only an important risk factor in macrovascular complications; studies have also shown the association of dyslipidaemia with microvascular complications related to T2DM namely diabetic retinopathy, diabetic nephropathy and diabetic neuropathy. Our study demonstrated that lipid profiles are abnormal in diabetic patients and is very essential for proper monitoring of the patient’s glycaemic and lipid control to prevent Cardiovascular and cerebrovascular complications.

CONCLUSION
We acknowledge the limitations in our study with a relatively small sample size and being single-centered hospital-based retrospective study, but despite these limitations, it still highlight risk of dyslipidemia in T2DM. The risk of atherosclerosis in type 2 diabetic patients is associated with clusters of inter-related plasma lipids and lipoprotein abnormalities with alterations in VLDL metabolism with insulin resistance playing a role in the development of diabetic dyslipidaemia. This study showed that a significant number of diabetic patients have dyslipidemia and the most common lipid abnormalities are elevated LDL, triglyceride and low LDL. Periodic check of Fasting Plasma lipids in diabetic patients, coupled with optimum treatment of plasma glucose with lifestyle intervention should go along side with lipid lowering drugs.

Funding: No funding sources
Conflict of interest: None declared
Ethical approval: The study was approved by the Institutional Ethics Committee

REFERENCES
1. Bennett HP, Knowler WC. Definition, Classification of Diabetes Mellitus and Glucose Homeostasis. In CR Kahn, GC Weir, GL King, AC Moses, RJ Smith and AM Jacobson editors. Joslin’s Diabetes Mellitus, Philadelphia: LWW. 2000;331.
2. International Diabetes Federation. IDF Diabetes Atlas 9th Edition. www.diabetesatlas.org. Accessed on 08 April, 2021.
3. Sultania S, Thakur D, Kulshreshtha M. Study of lipid profile in type 2 diabetes mellitus patients and its correlation with HbA1c. International Journal of Contemporary Medical Research. 2017;4(2):437-9.
4. Mukhopadhyay J, Kanjilal S, Biswas M. Diabetic dyslipidaemia-priorities and targets in India. http://www. apiindia.org/content- nu-2010.html. Accessed on 08 April, 2021.
5. Taskinen MR. Diabetic dyslipidemia. Atherosclerosis. 2002;3:47-51.
6. Folli F, Corradi D, Fanti P, Davalli A. The role of oxidative stress in the pathogenesis of type 2 diabetes mellitus micro- and macrovascular complications: avenues for a mechanistic- based therapeutic approach. Curr Diabetes Rev. 2011;7:313-324.
7. Maritim AC, Sanders RA, Watkins JB. Diabetes, oxidative stress, and antioxidants: A review. J Biochem Mol Toxicol. 2003;17:24-38.
8. Selvin E. Meta-analysis: Glycosylated hemoglobin and cardiovascular disease in diabetes mellitus. Annals of Internal Medicine. 2004;141:421.
9. Krauss RM. Lipids and lipoproteins in patients with type 2 diabetes. Diabetes Care. 2004;27(6):1496-504.
10. Ozder A. Lipid Profile abnormalities seen in T2DM patients in primary healthcare in Turkey: a cross-sectional study. Lipid Health Dis. 2014;13:183.
11. Bitzur R, Cohen H, kamari Y, Shaish A, Harats D. Triglycerides and HDL. Cholesterol: Stars or second leads in diabetes? Diabetes Care. 2009;32(2):273-377.
12. Okafor CI, Fasanmade OA, Oke DA. Pattern of dyslipidaemia among Nigerians with Type 2 diabetes mellitus. Niger J Clin Pract. 2008;11(1):25-31.
13. Ogbera AO, Olufanmade OA, Chinenye S, Akindele A. Characterization of lipid parameters in diabetes mellitus-a Nigerian report. Int Arch Med. 2009;2:19.
14. Sattar N, Gill JMR. Type 2 diabetes as a disease of ectopic fat? BMC Med. 2014;12:123.
15. Nyasatu G, Shao ER, Sonda T, Lyaruu IA. Lipid profile of Type 2 Diabetic patients at a Tertiary Hospital in Tanzania: Cross Sectional Study. J Endocrinol Diab. 2017;4(1):1-6.
16. Chapman MJ, Ginsberg HN, Amarenco P. Triglyceride-rich lipoproteins and high-density lipoprotein cholesterol in patients at high risk of cardiovascular disease: evidence and guidance for management. Eur Heart J. 2011;32:1345-61.
17. Stamler J, Vaccaro O, Neaton JD, Wentworth D. Diabetes, other risk factor, and 12 year cardiovascular mortality for men screened in Multiple Risk Factor Intervention Trial. Diabetes Care. 1993;16:434-44.
18. Goldberg I. J. Diabetic Dyslipidemia: Causes and Consequences. JCEM. 2001;86:965-71.
19. Li N, Fu J, Koonen DP, Kuivenhoven JA, Snieder H, Hofker MH. Are hypertyglyceridaemia and low HDL causal factors in the development of insulin resistance? Atherosclerosis. 2014;233:130-8.
20. Badimon JJ, Santos-Gallego CG, Badimon L. Importance of HDL cholesterol in atherothrombosis: How did we get here? Where are we going? Rev Esp Cardiol. 210:63:20-35.
21. Santos-Gallego CG, Ibanez B, Badimon JJ. HDL – cholesterol: Is it really good? Difference between apoA-I and HDL. Biochem. Pharmacol. 2008;76:443-52.
22. Mooradian Ad. Dyslipidaemia in type 2 diabetes mellitus. Nat Clin Pract Endocr Metab. 2009;5:150-9.
23. Siraj ES, Seyoum B, Saenz C, Abdulkadir J. Lipid and lipoprotein Profile in Ethiopian patients with diabetes. Metabolism. 2006;55(6):706-10.
24. Al-Habori M, Al-Mmari M, Al-Meeri A. Type 11 diabetes mellitus and impaired glucose tolerance in
Yemen: frequency, associated metabolic changes and risk factors. Diabetes Res Clin Pract. 2004;65:275-81.
25. Mrgan M, Funck KL, Gaur S, Ovrehus KA, Dey D, Kusk MW. High burden of coronary atherosclerosis in patients with a new diagnosis of type 2 diabetes. Diabetes Vasc Dis Res. 2017;14:468-76.
26. Wu L, Parhofer KG. Diabetic dyslipidemia. Metabolism. 2014;63:1469-79.
27. Rema M, Srivastava BK, Anitha B, Deepa R, Mohan V. Association of serum lipids with diabetic retinopathy in urban South Indians—The Chennai Urban Rural Epidemiology Study (CURES) Eye Study-2. Diabetes Med. 2006;23:1029-36.
28. Rutledge JC, NgKF, Aung HH, Wilson DW. Role of triglyceride-rich lipoproteins in diabetic nephropathy. Nat. Rev. Nephrol. 2010;6:361-70.
29. Al-Ani FS, Al-Nimer MS, Ali FS. Dyslipidemia as a contributory factor in etiopathogenesis of diabetic neuropathy. Indian J Endocrinol Metab. 2011;15:110-4.

Cite this article as: Reng RS, Onwuegbuzie GA, Anumah F. Pattern of serum lipid profile of type 2 diabetes patients in a tertiary hospital in Nigeria. Int J Res Med Sci 2021;9:1854-8.