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Original Research Article

An Investigation on the Lipid Profiles That Are Present in People Who Have Type 2 Diabetes Mellitus using an Analytical Case Control Approach

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Abstract

Aim: To determine the levels of lipid profiles in individuals with Type 2 Diabetes Mellitus.

Materials and Methods: The research was carried out at the Cardiology department of IGIMS, Patna, Bihar, India from January 2018 to December 2018. 160 diabetic patients (80 men and 80 females) with a 10-year history of diabetes and 160 healthy controls (80 males and 80 females) were randomly chosen for dyslipidaemia testing. GPO-PAP and CHOD-PAP colorimetric methods were used to measure triglycerides and total cholesterol. HDL cholesterol was determined using a precipitant technique and LDL using Friedewald's formula, as shown below: LDL-C = TC-HDL-C-TG/5.

Results: The mean HDL-C concentration was not substantially lower in female diabetics than males. Compared to controls, it was average. High TC was more common in diabetics (10% vs 1%). Low HDL-C was borderline greater in the control group than in the diabetes group. The mean TG was extremely significant and LDL-C was significant in male/female diabetics, whereas TC and LDL-C were significant in control groups. The correlation studies demonstrated that FBG correlated negatively with HDL-C and positively with TC, TG, and LDL-C.

Conclusion: Diabetics exhibited greater blood cholesterol, triacylglycerol, and LDL-C than controls, suggesting an increased risk of cardiovascular disease.

Keywords: Diabetes mellitus, Dyslipidaemia, Lipid profile, Triglycerides, HDL-C and LDL-C.

Introduction

Insulin resistance and decreased insulin secretion characterize type 2 diabetes mellitus (T2DM), a common metabolic condition. Due to its relationship with comorbidities, especially cardiovascular disease, it is a serious public health issue. Lipid profile changes in T2DM patients increase CVD risk. T2DM dyslipidemia is characterized by high triglycerides, low HDL-C, and typically high LDL-C. Effective ways to control and prevent cardiovascular problems in T2DM patients need understanding lipid profile changes. [1,2] Lipid abnormalities are a characteristic of T2DM and contribute to atherosclerosis. Taskinen (2002) found that insulin resistance, a hallmark of T2DM, disrupts lipid metabolism. Normally, insulin inhibits adipose tissue lipolysis, lowering free fatty acid levels. Insulin resistance increases lipolysis, free fatty acid levels, hepatic triglyceride production, and VLDL secretion in T2DM. [3-5]

High triglycerides are common in T2DM. Triglycerides increase the development of tiny, dense LDL particles, which are more atherogenic. These tiny, dense LDL particles quickly oxidise and enter the artery wall, promoting plaque development and atherosclerosis. Triglycerides are an independent CVD risk factor in T2DM patients, according to research. [6-9] In T2DM, HDL-C levels drop. HDL-C's reverse cholesterol transport, anti-inflammatory, and antioxidative characteristics protect against atherosclerosis. In T2DM patients, HDL-C levels fall due to increased HDL particle catabolism and decreased apolipoprotein A-I production. Low HDL-C levels strongly predict cardiovascular risk in T2DM patients. [10] T2DM patients' LDL-C values fluctuate. Some studies show that LDL-C levels are similar in T2DM patients and non-diabetics, although LDL particle quality is commonly changed. Patients with high rates of tiny, dense LDL particles are more atherogenic. [11] Lifestyle and pharmaceutical therapies treat T2DM dyslipidemia. Dietary adjustments, exercise, and weight reduction improve lipid profiles. Lipid levels improve with diets that reduce saturated fat, increase fibre, and include

omega-3s. Physical exercise lowers triglycerides, increases HDL-C, and improves insulin sensitivity. [12] Pharmaceuticals are typically needed to meet T2DM lipid objectives. Statins are the first-line treatment for high LDL-C levels and decrease cardiovascular events in diabetics. Fibrates, niacin, and omega-3 fatty acid supplements help reduce hypertriglyceridemia and HDL-C. The Action to Control Cardiovascular Risk in Diabetes (ACCORD) research showed that aggressive lipid-lowering medication reduces cardiovascular events in T2DM patients. [13,14]

Materials and Methods

The research was carried out at the Cardiology department of IGIMS, Patna, Bihar, India from January 2018 to December 2018. The participants in this research were individuals diagnosed with diabetes. 160 diabetic patients, consisting of 80 men and 80 females, who had been diagnosed with diabetes for a duration of 10 years, were randomly chosen. Additionally, 160 healthy controls, also consisting of 80 males and 80 females, were selected. The purpose of the selection was to assess the presence of dyslipidemia in both groups. The research excluded patients with comorbidities and metabolic problems. The absence of diabetes in the control group was confirmed by laboratory testing, as well as by inquiring about symptoms such as polyuria, polydipsia, and recent weight loss.

The research's objective was clarified to the participants, and only those who provided their permission were included in the study.

Methodology

Both the patients and the controls underwent venipuncture to extract about 5 ml of fasting blood. This was done using sterile disposable syringes and needles. The blood was gathered into centrifuge tubes. The sample was let to coagulate and thereafter subjected to centrifugation at a speed of 3000 revolutions per minute for a duration of 15 minutes at ambient temperature. The acquired serum was transferred into a sterile blood sample container and examined on the same day for serum glucose and lipid profile analysis. The serum total cholesterol levels were measured using an enzymatic (CHOD-PAP) colorimetric method[11], while the triglyceride levels were measured using an enzymatic (GPO-PAP) technique. HDL-Cholesterol was determined using a precipitant technique, whereas LDL-Cholesterol was approximated using Friedewald's formula, as shown below: The formula for calculating LDL-C is as follows: LDL-C equals the total cholesterol (TC) minus the high-density lipoprotein cholesterol (HDL-C) minus one-fifth of the triglycerides (TG).

The serum glucose level was measured using the glucose oxidase enzymatic technique. [15] The parameters being studied were measured in the individuals' serum using commercially available reagent kits. The lipid profile of the participants was categorised according to the ATP III model. [16]

The parameters were provided in milli grammes per deciliter (mg/dl) and were reported as the mean value plus or minus the standard deviation (mean ± SD). The statistical significance of the difference between the control and study groups was assessed using the student's t-test. A Pearson's correlation test was conducted to investigate different relationships.

Results

The average age of the participants was 51.04 ± 11.79 years for the diabetes group and 47.20 ± 10.65 years for the control group. The sex distribution exhibited a balanced proportion of men and females in all the groupings. [Table 1] displays the average values of total cholesterol, triacylglycerols, LDL-C, and fasting blood sugar levels, which were significantly higher in the diabetics compared to the controls. [Table 2] presents a comparison of the average biochemical variables between males and females in both the diabetes group and the control group. The findings indicated that the average HDL-C concentration was not substantially lower in female diabetics compared to male diabetics. Nevertheless, it was equivalent to the controls when compared. [Table 3] displays the frequencies of TC, TG, HDL-C, and LDL-C concentrations in both the diabetes and control groups. The findings indicated that the prevalence of elevated total cholesterol (TC) was greater in the diabetic group, with a frequency of 10% compared to 1% in the non-diabetic group. The control group had a slightly elevated occurrence of low HDL-C compared to the diabetes group. The average triglyceride (TG) level showed a strong statistical significance, and the low-density lipoprotein cholesterol (LDL-C) level showed a significant difference among the lipid profile of male/female individuals with diabetes. On the other hand, the total cholesterol (TC) and LDL-C levels showed a significant difference among the lipid profile of male/female individuals in the control groups. The correlation studies revealed a negative link between fasting blood glucose (FBG) and high-density lipoprotein cholesterol (HDL-C), and a positive correlation between FBG and total cholesterol (TC), triglycerides (TG), and low-density lipoprotein cholesterol (LDL-C).

Table 1: Biochemical Parameters of Diabetic and Control Groups

Parameters	Diabetics (n=160) Mean ± SD	Control (n=160 Mean ± SD	t table value
Total cholesterol (mg/dl)	184.27 ± 35.82	160.37 ± 27.34	6.69**
Triacylglycerols (mg/dl)	198.18 ± 111.02	131.98 ± 53.08	6.78**
HDL-C (mg/dl)	37.44 ± 4.47	37.68 ± 5.99	0.39
LDL-C (mg/dl)	106.96 ± 35.10	96.53 ± 25.71	3.02**
FBS (mg/dl)	170.29 ± 57.75	82.14 ± 12.83	18.79**

Table 2: Comparison of the Biochemical Parameters in the Males and Females in both Groups.

Parameters	Diabetics			Controls		
	Male (n=80) Mean ± SD	Female (n=80) Mean ± SD	T Table value	Male (n=80) Mean ± SD	Female (n=80) Mean ± SD	T Table value
Total cholesterol (mg/dl)	184.18 ± 38.59	184.36 ± 32.81	0.03	154.95 ± 25.90	165.79 ± 27.67	2.49
Triacylglycerols (mg/dl)	228.05 ± 137.09	168.30 ± 63.82	3.51**	129.16 ± 58.04	134.80 ± 47.44	0.67
HDL-C (mg/dl)	37.28 ± 6.17	37.08 ± 5.75	0.26	37.44 ± 5.06	37.45 ± 3.79	0.02
LDL-C (mg/dl)	100.29 ± 36.67	113.63 ± 32.08	2.63*	91.68 ± 25.08	101.38 ± 25.41	2.45
FBS (mg/dl)	175.61 ± 68.61	164.96 ± 43.63	1.16	80.90 ± 13.74	83.39 ± 11.72	1.22

Table-3]: Frequency of the Biochemical Variables in the Diabetic and Control Groups according to the ATP III classification

Parameter Total cholesterol (mg/dl	Diabetics (%)	Controls (%)
Desirable (<200)	113 (71%)	145 (91%)
Borderline high (200-239)	31 (19%)	13 (8%)
High (□240)	16 (10%)	2 (1%)
Triacylglycerols (mg/dl)		
Normal (<150)	61 (38%)	130 (81%)
Borderline high (150-199)	39 (24%)	17 (11%)
High (200-249)	60 (38%)	21 (8%)
HDL-C (mg/dl)		
Low (<40)	113 (71%)	100 (63%)
Borderline high (40-59)	45 (28%)	54 (34%)
High (□60)	2 (1%)	6 (3%)
LDL-C (mg/dl)		
Optimal (<100)	69 (43%)	103 (65%)
Near optimal (100-129)	51 (32%)	42 (26%)
Borderline high (130-159)	26 (17%)	11 (7%)
High (160-189)	7 (4%)	2 (1.25%)
Very high (□190)	7 (4%)	1 (0.75%)

Discussion

Diabetic individuals have many difficulties, such as increased levels of LDL-C and triacylglycerols, decreased levels of HDL-C, and a predominance of anomalies in the composition of smaller, dense particles. [17] The investigation revealed that the lipid and lipoprotein profiles of the individuals with diabetes were elevated compared to the control group. These findings were consistent with the results reported by Idogun et al. [18] and Albrki et al. [19]. This research also shown that the average (± standard deviation) of the variables were distinct for the male and female participants. However, the diabetes group exhibited substantial differences in TG and LDL-C levels. The results indicated a disparity in lipid metabolism between diabetic and non-diabetic individuals of both genders, aligning with the findings of Gustafsson et al. [20]. Nevertheless, Vinter-Repalust et al. [21] found no substantial disparities in the occurrence of type 2

diabetes mellitus between men and females. In the diabetic participants, the frequencies of high total cholesterol (TC), combined high and very high low-density lipoprotein cholesterol (LDL-C), and low high-density lipoprotein cholesterol (HDL-C) were 10%, 8%, and 71% respectively. In this research, the prevalence rates of elevated total cholesterol (TC) and triglycerides (TG) were 10% and 38% respectively. The correlation tests revealed a weak negative connection (r = -0.024) between fasting blood glucose (FBG) and high-density lipoprotein cholesterol (HDL-C), which was not statistically significant. However, there were statistically significant positive correlations observed between FBG and total cholesterol (TC) (r = 0.584) as well as FBG and triglycerides (TG) (r = 0.514). This research found that dyslipidaemia was present in the diabetic group, although there was no significant reduction in HDL-C.

Conclusion

The diabetes patients had a greater incidence of elevated blood cholesterol, elevated triacylglycerol, and elevated LDL-C compared to the controls, suggesting that diabetic patients were more susceptible to cardiovascular illnesses.

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