



Pattern of Dyslipidemia in Type 2 Diabetic Patients in Fayoum (Egypt)

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Authors' contributions

This work was carried out in collaboration between all authors. Author MM designed the study, performed the statistical analysis, wrote the protocol, and wrote the first draft of the manuscript. Authors RS and HAH managed the analyses of the study and managed the literature searches. All authors read and approved the final manuscript.

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ABSTRACT

Background: People with type 2 Diabetes (type II DM) have an elevated risk for developing cardiovascular disease (CVD) for which Dyslipidemia is the major contributor. Diabetic patients have characteristic pattern of dyslipidemia with Decreased level of high density lipoprotein cholesterol (HDL-C) and elevated triglycerides (TG) level, high serum VLDL-triglycerides and a preponderance of small, dense LDL.

This Study Aimed: To study the pattern of dyslipidemia in Egyptian type II diabetic patients.

Subject and Method: The study included 500 subjects: Four hundred type -2 diabetic patients of both sexes aged 20 - 65 years from different rural and urban areas of Fayoum governorate with no past or current history of lipid lowering agents and one hundred age & sex matched individuals as a control group. A Full medical history including the patient's age, sex, duration of diabetes, family history of diabetes, drugs used in treatment of diabetes and history of CVD.

An overnight fasting blood sample was obtained for (Total cholesterol, LDL-C, HDL-C, TGs), HbA1c, SGPT, SGOT, Creatinine and Urea, CBC.

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The Results: showed that 48.3% of the diabetics had hypercholesterolemia (TC \geq 200 mg/dL), 62.5% had hypertriglyceridemia (TG \geq 150 mg/dL) 61.8% had serum LDL-C \geq 100 mg/dL and 12.5% of diabetics had a an (HDL-C $<$ 40 mg/dL.

Conclusion: This study concluded that serum levels of total cholesterol and LDL-C are elevated, HDL levels are lowered in Egyptian diabetics compared to non-diabetics. So, we can recommend that measurement of serum lipid profile should be included in the management plan of diabetics.

Keywords: Type II DM; dyslipidemia and cardiovascular disease.

1. INTRODUCTION

By the year 2030, there will be more than 550 million type 2 diabetes sufferers worldwide [1]. Diabetes is in fact a serious vascular disease with poor prognosis, and not only a disease characterized by elevated blood glucose. It is mainly a cardiovascular disease [2]. The rising incidence of T2DM has resulted in CVD becoming the leading cause of morbidity and mortality worldwide [3]. One important cardiovascular risk factor in type 2 diabetic people is dyslipidemia. This is characterized by low HDL-cholesterol, high serum VLDL-triglycerides and a preponderance of small, dense LDL [4].

People with diabetes are more likely to develop atherosclerosis, heart disease, poor circulation and stroke.

Dyslipidemia not only raises the risk of atherosclerosis but of related complications too [5]. Even slight elevations of LDL-cholesterol in type 2 diabetic patients are associated with a substantial increase in cardiovascular risk. The composition of lipid particles in diabetic dyslipidemia is more atherogenic than in dyslipidemia in general. This means in turn that normal lipid concentrations are more atherogenic in diabetic than in non-diabetic patients [6].

Different mechanisms are responsible for the development of dyslipidemia in individuals with diabetes. Defects in insulin action and hyperglycemia could lead to dyslipidemia in patients with diabetes. In the case of T2DM, the obesity/insulin-resistant state that is at the basis of the development of this disease can in itself lead to lipid abnormalities independently of hyperglycemia. In poorly controlled T1DM hypertriglyceridemia and reduced HDL-C commonly occur, but in most cases insulin replacement in these patients correct these abnormalities. In T2DM, this phenotype is not usually fully corrected with glycemic control, suggesting that insulin resistance and not

hyperglycemia per se & are associated with this lipid abnormality are associated with this lipid abnormality [7].

Retrospective analyses show that, in terms of protection from cardiovascular endpoints, the benefit of lipid lowering in type 2 diabetic patients is at least as great as in the non-diabetic population. Lowering of LDL-cholesterol is a very attractive target for the reduction of coronary heart disease in type 2 diabetic people [8].

2. AIM OF THE WORK

Is to study the pattern of dyslipidemia in Egyptian type-2 diabetic patients.

3. PATIENTS AND METHODS

The study included 500 subjects (Four hundred type -2 diabetic patients of both sexes aged 20 - 65 years from different rural and urban areas of Fayoum governorate with no past or current history of lipid lowering agents. A Full medical history including the patient's age, sex, duration of diabetes, drugs used in treatment of diabetes and history of HTN, IHD and CVD.

And one hundred age matched individuals as a control group and they were volunteers working at Fayoum University.

3.1 Inclusion Criteria

Type-2 diabetic patients aged 20-65 years of both sexes with no past or current history of lipid lowering agents.

3.2 Exclusion Criter

Patients receiving statins or other lipid lowering medications or on diet . Patients with abnormal liver or kidney functions and patients who have other endocrinal diseases specially thyroid diseases.

All subjects were subjected to:

1. Complete physical examination (recording systolic and diastolic blood pressure, weight, height and BMI).
2. An overnight of not less than 12 hours Fasting blood sample will be obtained from all the patients for full lipogram (Total cholesterol, LDL-C, HDL-C, TGs), HbA1c, SGPT, SGOT, Creatinine and Urea, CBC.

3.3 Methods of Measurement of Lipid Profile

From both the patients and the controls, about 5 ml of fasting blood was obtained by venipuncture by using sterile disposable syringes and needles.

The blood was collected into centrifuge tubes. It was allowed to clot and it was then centrifuged at 3000 rpm for 15 min at room temperature. The serum which was obtained was pipetted into a clean blood sample bottle and analyzed on the day of collection for serum sugar and lipid profile tests. Serum total cholesterol was determined by an enzymatic (CHOD-PAP) colorimetric method, and triglycerides were determined by an enzymatic (GPO-PAP) method and HDL-Cholesterol was estimated by using (precipitant method).

LDL-Cholesterol was estimated by using Friedewald's formula:

$$\text{LDL-C} = \text{TC} - \text{HDL-C} - (\text{TG}/5)$$

4. STATISTICAL ANALYSIS

Data was collected and coded to facilitate data manipulation and double entered into Microsoft Access and data analysis was performed using SPSS software version 18 under windows 7.

Simple descriptive analysis in the form of numbers and percentages for qualitative data, and arithmetic means as central tendency measurement, standard deviations as measure of dispersion for quantitative parametric data, and inferential statistic test:

For quantitative parametric data

In-dependent student t-Test used to compare measures of two independent groups of quantitative data

For qualitative data

Chi square test to compare two of more than two qualitative groups.

Bivariate Pearson correlation test to test association between variables

The level $P \leq 0.05$ was considered the cut-off value for significance.

5. RESULTS

This study included 500 subjects, 400 type 2 diabetic patients and 100 healthy age and sex matched normal persons as control group. The study was conducted at Fayoum university hospitals from April 2014 to November 2015.

In this study males represent around 53% in both cases and the control group, while females represent around 47%. The mean age of cases was 51.1 ± 9.4 and the mean age of control was 49.5 ± 10.6 it was found that the BMI was significantly higher in the patient group compared to the control group ($p=0.02$) As regards the mean systolic and diastolic blood pressure it was significantly higher in the patient group compared to the control group and difference as statistically highly significant ($p<0.001$) (Tables 1,2).

Regarding the history of CVD, 120 out of the 400 patients gave a history of CVD (documented evidence of previous MI, Unstable angina or IHD diagnosed by angiography of stress ECG testing) while none in the control group (Table 1).

This study also showed that diabetic patients had a mean TC, LDL -C that was higher than that of the control group and the difference was statistically significant ($p < 0.05$). Diabetic patients also had a mean HDL -C that was lower than that of the control group and the difference was statistically significant ($p < 0.05$). Also a diabetic patient had a mean serum fasting serum triglycerides that was higher than that of the control group but the difference was statistically insignificant. This is may be related to the high BMI of the control group (Fig. 1).

Diabetes duration among patients ranged from few days up to 30 years the mean duration was (5.1 ± 5.5) years. In this study there was 100 newly diagnosed patients, 150 of a short duration that is less than 2 years and 150 patient of a longer duration than 2 years. There was no statistical significance as regards the mean values of all lipid parameters between newly

diagnosed patients or other patients of various disease duration (Table 3).

The results of the present study showed that the mean TC level was (203.1 ± 49.3) in diabetic patients compared to the control group (156.2 ±48) and the defference was statistically significant (p < 0.05). Also LDL- C was significantly highr and the HDL was significantly lower in diabetic patientsa compared to the control group (P<0.0001) and that newly diagnosed type-2 diabetics had a mean

Triglyceride level of (202.9 ± 120.1 mg /dl) compared to the control group (192 ± 113.5) but the differences were not statistically significant (p ≥0.5.) (Fig. 2).

As regards the treatment strategy, this study showed that patients on insulin therapy had a better lipogram compared to those on oral therapy and the difference was statistically significant (p<0.001) except the HDL C that is non-significant (p =0.7) (Fig. 3).

Table 1. Comparisons of sex distribution and history of CVD among study groups

Variables	Cases		Controls		p-value	Sig
	No	%	NO	%		
Sex						
males	209	52.3%	53	53%	0.5	NS
females	191	47.8%	47	47%		
History of CVD						
NO	280	70%	100	100%	<0.0001	HS
Yes	120	30%	0	0%		

Table 2. Comparisons of age, BMI, and blood pressure among study groups

Variables	Cases		Controls		P-value	Sig
	Mean	SD	Mean	SD		
Age	51.1	9.4	49.5	10.6	0.1	NS
BMI	32.4	5.7	31	4.7	0.02	S
Blood pressure						
Systolic(mmHg)	134	15.5	121.3	12.2	<0.001	HS
Diastolic(mmHg)	85	9.8	80.2	6.9	<0.001	HS

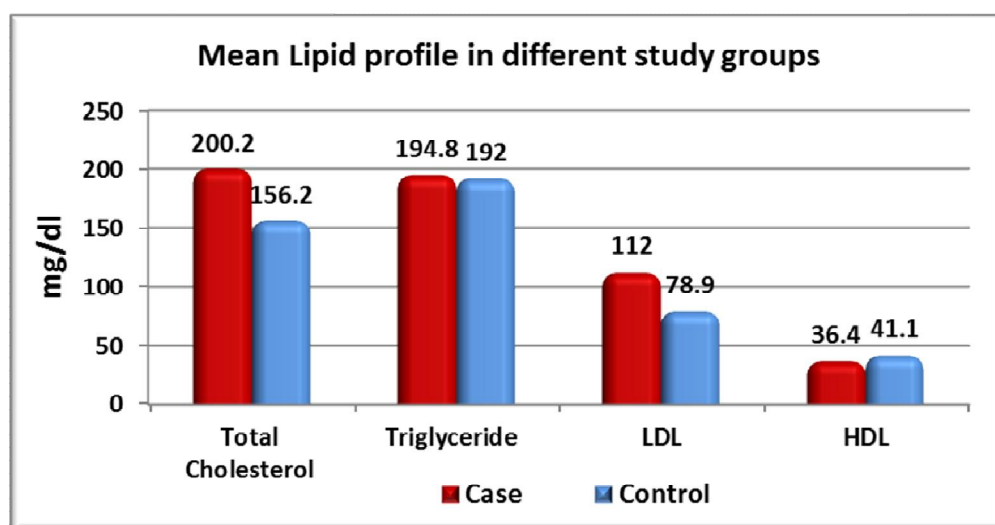


Fig. 1.

Table 3. Correlation between diabetes duration and lipid profile among cases of type II diabetes mellitus

Variables	Duration of diabetes			P-value
	Newly diagnosed	Up to 2 years	More than 2 years	
Total cholesterol	202.68±49.43	193.10±49.72	199.68±45.42	0.550
HDL	42.56±8.51	40.38±8.25	40.67±8.51	0.138
LDL	114.47±37.55	106.40±35.85	111.92±36.87	0.505
Triglycerides	202.59±120.71	197.18±101.26	191.28±96.49	0.641

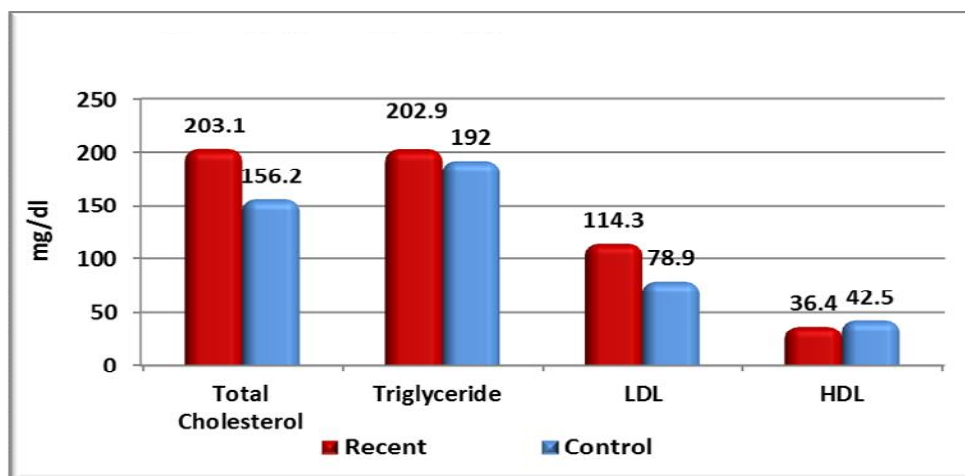


Fig. 2. Mean lipid profile in different study groups

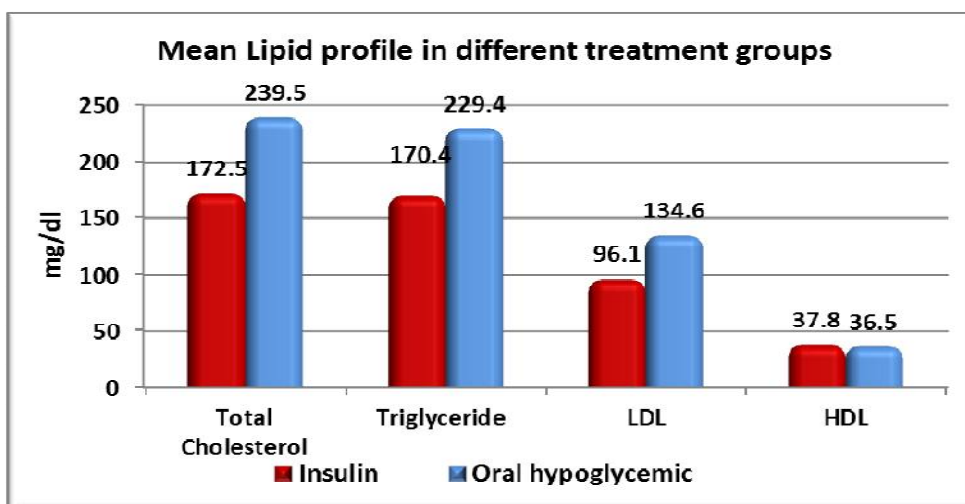


Fig. 3.

As regards the glycemic status, it was found that there was a statistically significant correlation between HbA1c and TC (r)=0.22, p-value<0.001, TGs(r)=0.28, p-value<0.001, LDL(r)= 0.16, p-value <0.001 as the rise of the level of HbA1c is

followed by rise of the level of TC, TGs, LDL, While the HDL-C levels were not significantly correlated with the HbA1c (r)=0.005,(p=0.9) (Figs. 4,5,6,7).

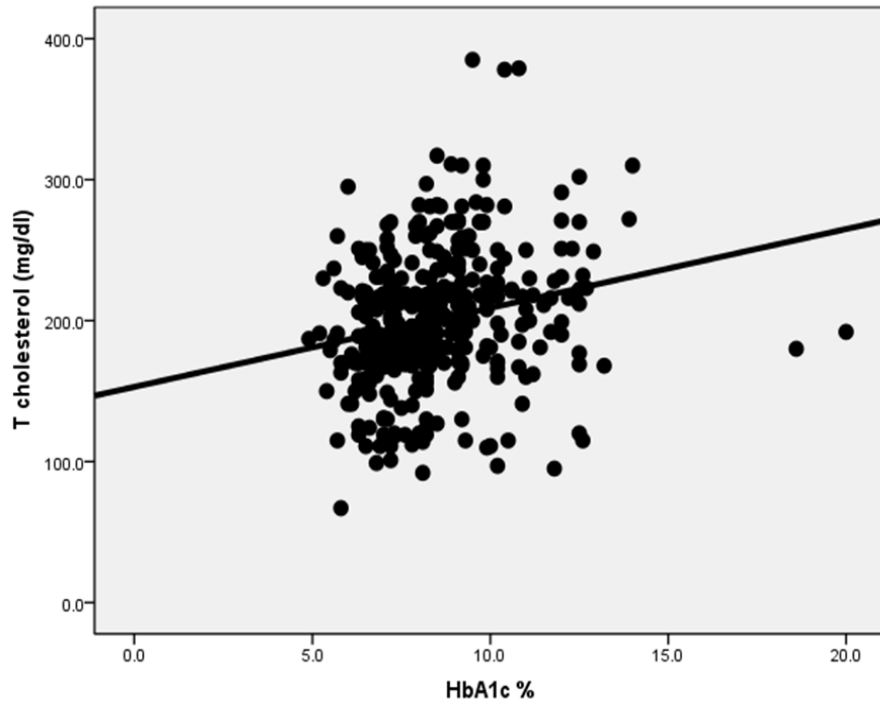


Fig. 4. Correlation between HbA1c % level and total cholesterol in the patients group

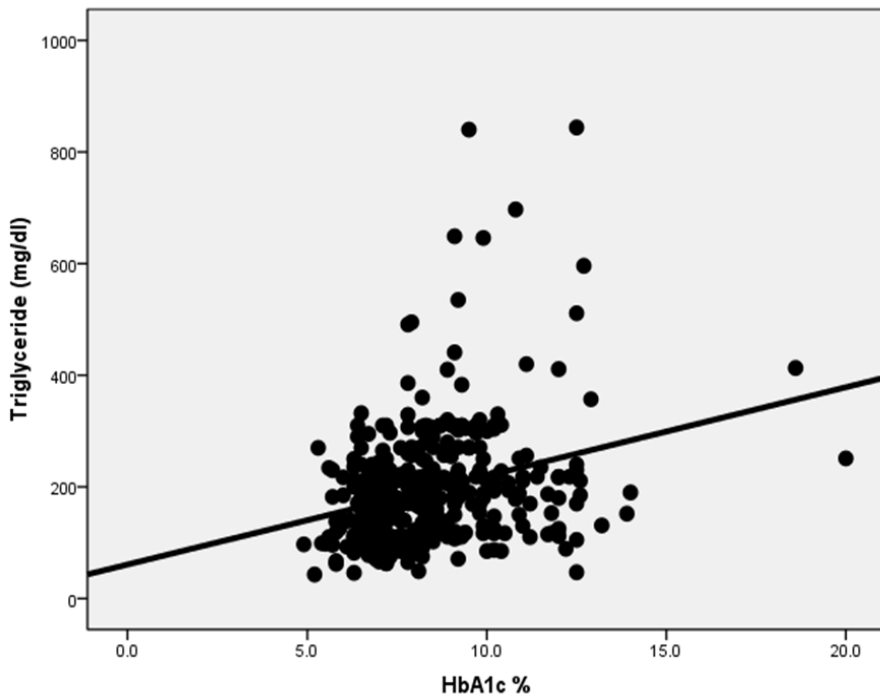


Fig. 5. Correlation between HbA1c % level and triglycerides in the patients group

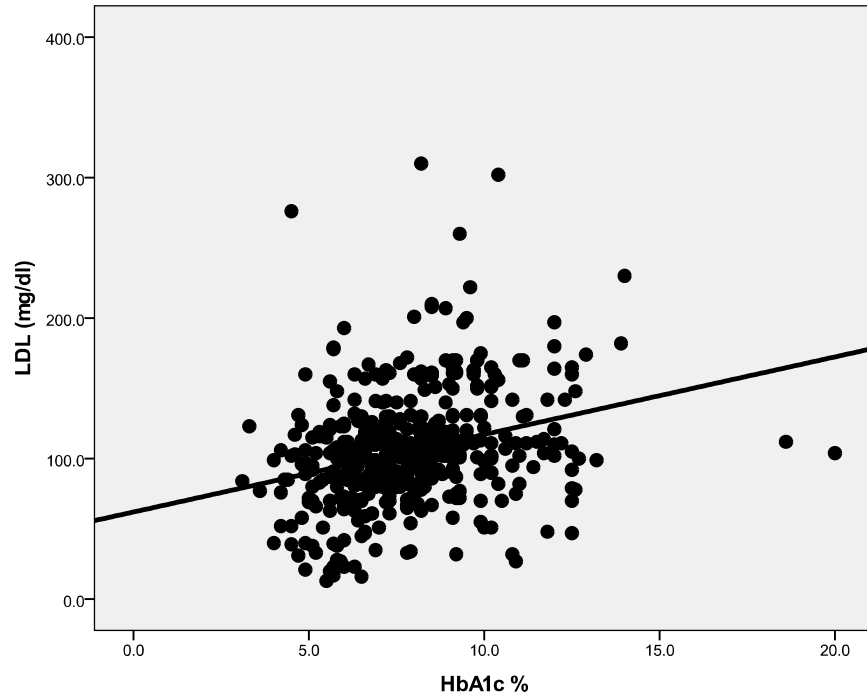


Fig. 6. Correlation between HbA1c % level and LDL in the patients group

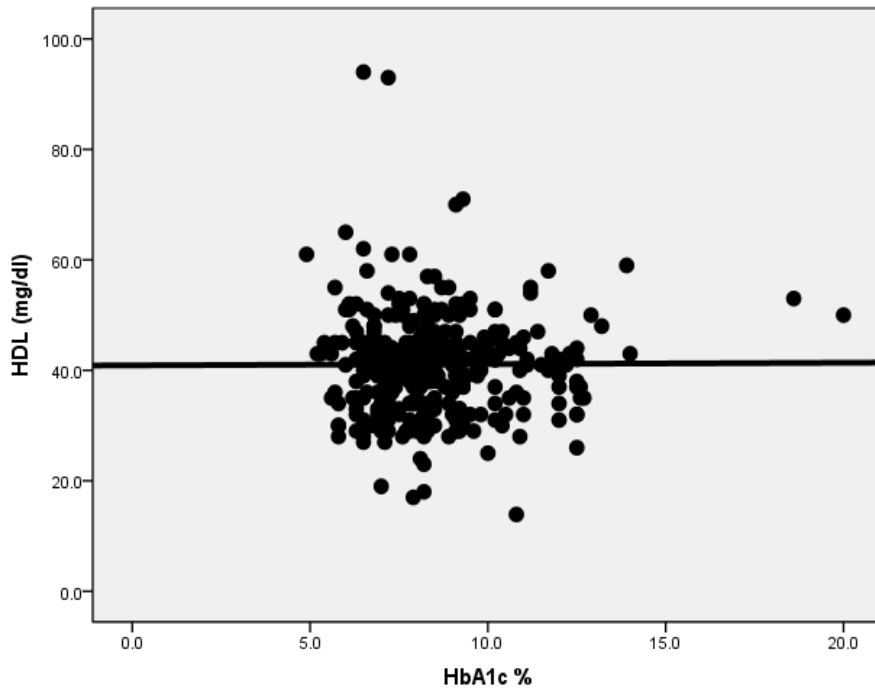


Fig. 7. Correlation between HbA1c % level and HDL in the patients group

This study included 213 patients from urban areas and 187 patients from rural areas and it was found that 83% of patients from urban areas resident had elevated TC level versus only

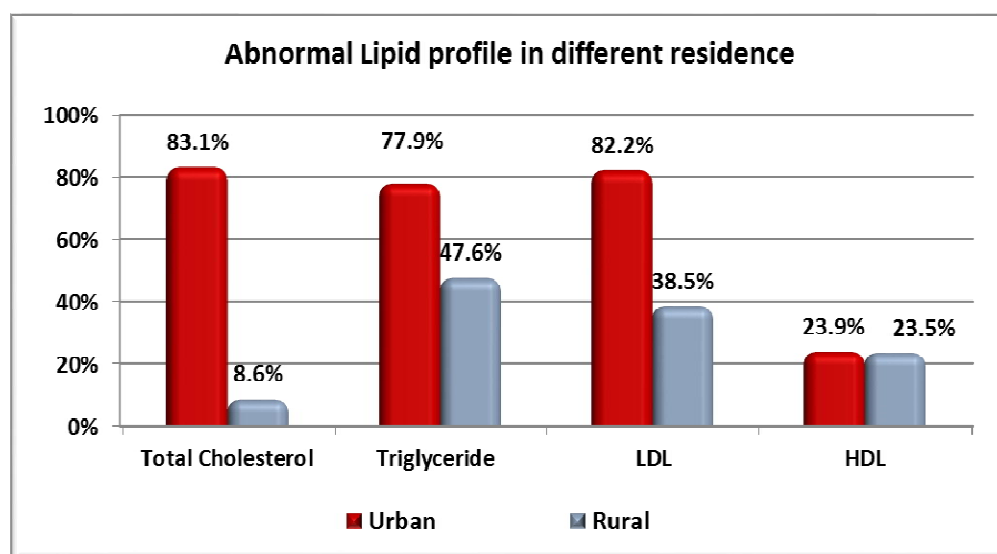


Fig. 8.

Table 4. Comparisons of lipid profile between different genders among cases

Variables	Males (n=209)		Females (n=191)		p-value	Sig.
	Mean	±SD	Mean	±SD		
Lipid profil						
Total Cholesterol (mg/dl)	199.1	± 47.5	201.3	± 46.1	0.6	NS
Triglyceride (mg/dl)	197.2	± 117.7	192.1	± 85.1	0.6	NS
HDL (mg/dl)	37.8	± 7.1	35.8	± 9.1	0.03	S
LDL (mg/dl)	109.6	± 34.7	114.6	± 39	0.2	NS

8.6% from rural areas ($p < 0.0001$), also 77.9% of patients from urban areas had elevated TGs level compared to 47.6% of patients living in rural ($p < 0.0001$) and 82.2% of patients from urban areas had elevated LDL-C compared to 38.5% of patients living in rural areas ($p < 0.0001$) finally 23.9% of patients from urban areas had HDL-C levels less than 40 mg/dl compared to 23.5% living in rural areas ($p < 0.9$).

Also, this study showed that patients living in urban areas had more significantly elevated mean TC, TGs, LDL-C than those living in rural areas, TC (225.9 ± 42.8) in patients living in urban areas versus (170 ± 31 mg/dl) in those living in rural areas ($p < 0.0001$), TGs was (219.7 ± 108.8 mg/dl) in patients living in urban areas versus (166.4 ± 88.8) in those living in rural ($p < 0.0001$) 108.8 mg/dl) in patients living in urban areas versus (166.4 ± 88.8) in those living in rural ($p < 0.0001$), LDL -C was (125.9 ± 36.6 mg/dl) in

patients living in urban areas versus (96.2 ± 30.3 mg/dl) those living in rural areas ($p < 0.0001$).

Regarding the HDL-C level the mean value for patients in urban area was (40.9 ± 7.3 mg/dl), versus (41.3 ± 9.6 mg/dl) for patients living in rural area and the difference was not statistically significant ($p = 0.7$) (Fig. 8)

Regarding the gender, this study included 209 males, 191 females, we found that the mean TC in males was (199.1 ± 47.5 mg/dl) versus (201.3 ± 46.1 mg/dl) in females, and the difference was statistically non significant (p -value > 0.05), the mean TGs in males was (197.2 ± 117.7 mg/dl) versus (192.1 ± 85.1 mg/dl) in females, and the difference was statistically non significant (p -value > 0.05), the mean LDL was (109.6 ± 34.7 mg/dl) in males versus (114.6 ± 39 mg/dl) in females, and the difference was statistically non significant (p -value > 0.05) and the mean HDL was (37.8 ± 7.1 mg/dl) in males versus (35.8 ± 9.1

mg/dl) and the difference was statistically significant (P-value < 0.05) (Table 4).

6. DISCUSSION

Type 2 diabetes and its complications lead to an elevated cardiovascular risk globally [9] and adults with diabetes have a two to four times higher risk of experiencing cardiovascular events than adults with no diabetes. Dyslipidemia is the major contributor among the various factors for developing increased cardiovascular risk in diabetes. A characteristic pattern, termed dyslipidemia, consists of increased triglycerides (TG), total cholesterol (TC), low density lipoprotein (LDL and very low density lipoprotein (VLDL) cholesterol and decreased high density lipoprotein (HDL). This pattern is most frequently seen in diabetes and may be a preventable risk factor for subsequent cardiovascular disease. Patients with T2DM are at greater risk of developing vascular diseases because of lipid changes. Lipid abnormalities and insulin use is critically discussed by diabetics [10].

This study included 500 individuals, 400 patients with type 2 diabetes mellitus and 100 healthy age and sex matched subjects as control group. The age ranged from 30-65 years. The subjects were subjected to full history, clinical examination, lipid profile, HbA1c, SGPT, SGOT, serum Creatinine and Urea, CBC. Our study showed that there was statistically significance difference in the BMI between the patients and the control group (p-value<0.05). Similar results were reported in other studies by Pendeya and colleagues [11] who reported statistically significance difference in the BMI between T2DM patients and the control group (p - value<0.001). The lipid profile in the present study was found to be altered as there was a statistically significance difference between patient group and the control group as regards lipid profile (cholesterol, LDL and HDL) level (p-value <0.05). On the other hand there is no statistically significance difference between patient and control group as regards to triglyceride level (p-value =0.02). These results agree with Pendeya and colleagues [11] who reported that the lipid profile was found to be altered with statistically significant increase in TC and non-HDL-C but with significant decrease in HDL-C in diabetics compared to controls (p value<0.001). Our study stated that there is statistically significance positive correlation between HbA1c % level and lipid profile (total cholesterol, triglyceride, LDL) level among cases. On the other hand there is no statistically

significance correlation between HbA1c % level and HDL. In diabetic patient group there is statistically significance correlation between HbA1c % level and lipid profile (total cholesterol, triglyceride, LDL) level and there is no statistically significance correlation between HbA1c % level and HDL.

Our results were in agreement with Rathod and colleagues [12] that stated that more than two thirds of the patients with poor glycemic control (HbA1c>7%) had dyslipidemia. Also Our results were also consisted with Blebil and colleagues [13] who stated that TC, TG, LDL-C were significantly correlated with HbA1c in apposite manner. Our study illustrates that there is no statistically significance correlation between disease duration and lipid parameters (total cholesterol, triglyceride, LDL, and HDL) level among cases of type II diabetes mellitus.

Our results were similar to another study done by Blebil and colleagues [13] who stated that the duration of DM did not affect the level of plasma lipids. Our study showed that there was statistically significance difference between different ways of treatments among cases as regards lipid parameter (total cholesterol, triglyceride and LDL). The mean total cholesterol was higher in patients receiving oral hypoglycemic drugs versus those receiving insulin. The mean triglyceride level was higher in patients receiving oral hypoglycemic drugs versus those receiving insulin and the mean LDL was higher in diabetic patients receiving oral hypoglycemic drugs versus those receiving insulin. On the other hand there is no statistically significance difference as regards HDL-C level between patients on oral hypo glyceemic drugs and those on insulin.

Our results were in agreement with Habib and colleagues [14] who stated that insulin treated type 2 diabetics had significantly better lipid profiles (TC, TG, LDL-C and HDL-C) compared to those patients on oral hypoglycemic agents, this study showed that Serum TC and TG levels were significantly lower in insulin group as compared with sulphonylurea. In sulphonylurea and metformin treated group, serum levels of TC, TG, LDL-C and LDL-C/HDL-C were significantly elevated, meanwhile, HDL-C levels were significantly decreased compared with insulin therapy group.

Our study showed that that majority of newly diagnosed cases show increase in total

cholesterol level (52%), triglyceride (65.7%), and LDL (59.8%) but only 17.6% of them show low level of HDL. Weerathna and colleagues [15] found that The most prevalent type of dyslipidaemia in this study was raised LDL followed by hypertriglyceridemia Prevalence of low HDL was comparatively low and seen in just 18% of the sample.

Our study showed that that there is statistically significance difference between newly diagnosed cases and the control group as regards lipid parameters (total cholesterol, LDL, and HDL) level. On the other hand there is no statistically significance difference as regards the triglyceride level. Suchitra and colleagues [16] stated that newly diagnosed diabetic patients had significantly high levels of TG compared to control group, and significantly high level of VLDL compared to control group. Whereas there was no significant change in the TC, LDL and HDL- C levels in the patients when compared to control group.

Our study showed that there is statistically significance difference between urban and rural residence as regards lipid parameters (total cholesterol, triglyceride, and LDL) the mean total cholesterol, TG, LDL was higher in diabetic patients living in urban areas versus those living in rural areas. On the other hand there is no statistically significance difference as regards the HDL level.

Our results agrees with Agrawal and colleagues [17] who performed multiple regression analysis showing independent association of diabetes with TC, TG HDL, VLDL and non-HDL levels . The higher levels of TC/HDL, TG/HDL, LDL/HDL, non-HDL/HDL, AI, and lower levels of HDL in their study population were associated significantly and independently with both diabetes and urbanization. Regarding the gender, this study included 209 males, 191 females, we found that the mean TC in males was lower than mean TC in females, and the difference was statistically non significant (p-value >0.05), the mean TGs in males was higher than mean TG in females, and the difference was statistically non significant, the mean LDL in males was lower than mean LDL in females ,and the difference was statistically non significant and the mean HDL in males was higher than mean HDL in females and the difference was statistically significant.

Ebrahim, et al in 2010 [18] stated that, in addition to diabetes-associated increased atherogenic

lipid risk factors, urbanization showed independent effect over increased lipid risk factors in diabetes. Urbanization leads to unhealthy changes in life style, thus adversely affecting metabolic changes leading to a two-fold increase in diabetes risk in urbanized areas of India than rural India due to industrial development and lifestyle changes.

Their study, owing to the independent association of diabetes and urbanization with AD, would direct us and others for further large prospective studies in determining the contribution of diet, exercise, education, occupation, physical activity, and lifestyle patterns to the increased atherogenic lipid risk factors with urbanization.

Our results were in agreement with Rajput and colleagues [19] who showed that the mean TC in males was lower than mean TC in females, and the difference was statistically non significant, the mean TG in males was lower than mean TG in females, and the difference was statistically non significant, and the mean HDL in males was higher than mean HDL in females, and the difference was statistically significant. but our results disagree with Rajput and colleagues regarding LDL as their results showed that the mean LDL in males was higher than mean LDL in females.

7. CONCLUSIONS

This study concluded that serum levels of total cholesterol and LDL-C are elevated, HDL levels are lowered in Egyptian diabetics compared to non diabetics and concluded that there was association between increased BMI and the prevalence of diabetes, also concluded that there was positive relation between HbA1C and lipid profile (TC, TG, LDL) among diabetics. Also the results revealed that there was no relation between disease duration, lipid profile in Egyptian type2 DM. By comparing diabetic patients on insulin and those on oral hypoglycemic drugs as regards the lipid parameters, we found that insulin treated type2 diabetics had significantly better lipid profiles compared with those patients on oral hypoglycemic agents.

This study showed that serum HDL-C level was found to be significantly low in female diabetics otherwise there was no significant difference in lipid profile pattern was found in between male and female diabetic patients. This study showed

that there was independent association between diabetes and urbanization with atherogenic dyslipidemia. This study showed that there was statistically significance difference with p-value <0.05 between newly diagnosed cases and controls as regards lipid profile (total cholesterol, LDH and HDL) level with high mean of total cholesterol, LDL, low mean of HDL among newly diagnosed cases.

CONSENT

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

ETHICAL APPROVAL

All authors hereby declare that all experiments have been examined and approved by the appropriate ethics committee and have therefore been performed in accordance with the ethical standards laid down in the 1964 Declaration of Helsinki.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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