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RELATIONSHIP BETWEEN HBA1C AND LIPID PROFILE IN TYPE 2 DIABETES MELLITUS PATIENTS ATTENDING AL-NU'MAN TEACHING HOSPITAL, BAGHDAD, 2022

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Abstract: Background: Diabetes mellitus (DM) is a long-lasting metabolic condition characterised by consistently high levels of glucose in the blood. In 2015, the International Diabetes Federation reported that almost 415 million persons aged 20 to 79 had diabetes mellitus. Diabetes mellitus (DM) is emerging as a significant worldwide public health challenge, with projections indicating that the number of affected individuals will increase by an additional 200 million by the year 2040. This study aimed to examine the correlation between HbA1c levels and the lipid profile in patients with type 2 diabetes (T2DM) at Al-Nu'man Teaching Hospital in Baghdad, Iraq, in 2022.

Methods: A cross-sectional investigation of the connection between glycemic control and lipid profile in T2DM patients was led at the diabetic short-term center at Al-Nu'man Showing Medical Clinic from first September 2021, to 30th of Walk 2022. This study included 112 grown-up patients who had been determined to have T2DM. Patients' socio-segment factors and anthropometric estimations were determined. Blood tests were gathered, and plasma was utilized for estimating the glucose level. An auto-analyzer (Roche Modular P-800, Roche Diagnostics, Germany) was used to measure the HbA1c, FPG, and lipid profile levels. The mean and standard deviation of the quantitative data were reported as the mean and standard deviation for comparison purposes. For the correlation between two quantitative variables, the Pearson correlation was calculated. A p-esteem <0.05 was viewed as measurably critical.

Results: 75.9% of people had high HbA1c levels. Patients with high HbA1c levels had significantly higher levels of TG and low-density lipoproteins (LDL), but there was no significant difference in the levels of high-density lipoproteins (HDL). Male patients had significantly higher TG and LDL levels than female patients did. Triglyceride and LDL levels were significantly correlated with HbA1c levels.

Conclusions: The study came to the conclusion that HbA1c level and lipid profile were correlated in diabetes patients. This may suggest that glycemic control and managing dyslipidemia are important for reducing the risk of cardiovascular disease in T2DM patients. As a result, type 2 diabetes dyslipidemia can be predicted using HbA1c.

Key words: Type 2 Diabetes Mellitus, HbA1c, Lipid Profile, Dyslipidemia.

Introduction

The prevalence of diabetes in Iraq has experienced a significant increase, rising from 3.4% in 1996 to more than 20% in recent years, primarily as a result of changes in lifestyle. Iraq is ranked eighth in terms of the prevalence of diabetes. The prevalence of complications associated with type 2 diabetes is contributing to the growing worldwide burden of the disease, with 366 million individuals affected in 2011 and an estimated 552 million projected by 2030[1,2].

The proliferation of sedentary lifestyles and the assimilation of Western dietary patterns, characterised by a high intake of refined carbohydrates and fat, are fueling a rise in the prevalence of individuals suffering from diabetes that is associated with obesity [3]. Diabetes, which is the prevailing non-communicable ailment in Iraq, is progressively affecting the rates of illness likelihood of hypertension, atherosclerosis, and dyslipidemia [4].

The American Diabetes Association recommends a glycated hemoglobin (HbA1c) level of 6.5% for diabetes diagnosis, with pre-diabetic patients having HbA1c levels between 5.7% and 6.4%. HbA1c is useful for small intra-individual variability, average plasma glucose, and fasting-free assessment, but with caution due to lower test sensitivity [5,6].

DM2 is the fifth most common disease in the elderly, after osteoarthritis, high blood pressure, cataracts, and cardiovascular diseases. At age 75, 20% suffer from it, and 44% of diabetics are over 65 years old. (8) In the province of Camagüey, there is a high number of patients with DM2 whose prevalence should continue to increase [7,8]. It is a challenge to achieve adequate glycemic control and reduce micro- and macrovascular complications, as well as improve quality of life, in addition to saving resources due to hospital admissions in diabetic patients. In this context, the present investigation was carried out to characterize the results of the analysis of glycated hemoglobin (HbA1c) in patients over 40 years of age with type 2 diabetes mellitus [9,10].

Type 2 diabetes mellitus (T2DM), an increasingly prevalent global health concern, originates from an in equilibrium in insulin levels and sensitivity, predominantly triggered by adiposity and the ageing process. It currently ranks as the ninth most common cause of mortality globally.

The American Diabetes Association suggests using HbA1c concentration as an alternative to glucose tolerance testing for diagnosing diabetes and prediabetes. This is because HbA1c concentration can forecast the risk of developing these conditions and also provides a measure of long-term glycemic management [11].

Dyslipidemic profiles, which refer to abnormal lipid levels, are autonomous risk factors for the development of type 2 diabetes, manifesting prior to the onset of the disease. Dyslipidemia can lead to impaired functioning and viability of pancreatic beta-cells. The relationship between HbA1c, dyslipidemias, and other risk factors remains uncertain. Timely detection of dyslipidemia can help mitigate the risk of cardiovascular disease in people with type 2 diabetes mellitus. [12]

This study was designed to investigate the relationship between HbA1c and the lipid profile among diabetic patients in Al-Nu'man Teaching Hospital in Bagdad, Iraq.

PATIENTS AND METHODS

Study Design and setting

A cross-sectional study of the relationship between glycemic control and lipid profile in T2DM patients was conducted at the diabetic outpatient clinic at Al-Nu'man Teaching Hospital from 30th September 2021, to 30th of March 2022.

Study Population:

The trial comprised 112 adult patients (aged ≥18 years) who had received a diagnosis of T2DM and provided consent to participate. Patients diagnosed with Type 2 diabetes mellitus were chosen based on the criteria set by the American Diabetes Association in 2019. The following values are diagnostic of Type 2 DM according to these criteria: HbA1C ≥6.5%, FPG ≥126 mg/dl (7.0 mmol/l), 2-hours plasma glucose ≥200 mg/dl (11.1 mmol/l) during an oral glucose tolerance test (OGTT), or random plasma glucose ≥200 mg/dl (11.1 mmol/l) (11).

This study excluded patients who declined to participate, had type 1 diabetes, experienced cardiovascular disease (CVD), had thyroid disorders, renal problems, or other endocrinopathies. Additionally, individuals with secondary dyslipidemia caused by factors such as pregnancy or specific medications (such as diuretics, corticosteroids, androgens, and beta blockers), as well as those who were already taking lipid-lowering agents, were also excluded.

Data Collection Tools:

This study used a questionnaire administered by an interviewer. The poll information was gathered through up close and personal meetings with the review patients, and it included socio-segment and clinical factors (age, orientation, comorbidity, family and medication history, smoking history, liquor history, and span of sickness). All patients' anthropometric estimations (weight, level, and BMI) and pulse were determined. Plasma was used to measure the level of glucose in the blood, and samples of the blood were taken between 9:00 and 11:00 AM (during the 12–14 h fast). An auto-analyzer (Roche Modular P-800, Roche Diagnostics, Germany) was used to measure the HbA1c, FPG, and lipid profile levels (s. TG, HDL, LDL, and VLDL). Also evaluated were the complete blood count, blood urea, serum creatinine, serum albumin, and general urine examination.

We classified the participants' glycemic control as either poor (HbA1c greater than 7%) or good (HbA1c less than 7%). Typical worth in diabetic patients of s. cholesterol (< 150 mg/dl), s. TG (< 150 mg/dl), LDL (< 100 mg/dl) on the off chance that the patient had no gamble factors or (< 70 mg/dl) in the event that the patient had risk factors like hypertension or ischemic coronary illness, HDL (> 40 mg/dl) in men and (> 50 mg/dl) in ladies, VLDL (< 50 mg/dl) [12].

The data was computed using SPSS version 25. The data were confirmed to follow a normal distribution using a Shapiro-Wilk test. Hence, the Student's t-test was employed for comparison, and quantitative data were expressed as the mean and standard deviation. The Pearson correlation coefficient was computed to measure the correlation between two quantitative variables, along with its associated t-test, to assess the statistical significance of the correlation. The correlation coefficient (r) can be positive (indicating a direct correlation) or negative (indicating an inverse correlation). When the value of r is less than 0.3, there is no correlation. A value between 0.3 and less than 0.5 indicates a weak correlation, while a value between 0.5 and less than 0.7 suggests a moderate correlation. A number more than 0.7 indicates a high correlation. A P-value below 0.05 was deemed statistically significant. A P-value below 0.05 was deemed statistically significant.

RESULTS

This study included a total of 112 adult patients with T2DM. The age range of study patients was 41 to 79 years, with a mean of 55.34 ± 6.36 years. More than half of the studied patients were found in the age group

of 50 – 59 years 61 (54.5%). Regarding gender, there were 59 females (52.7%) and 53 males (47.3%). The calculated BMI had a mean of 32.11 ± 6.36 kg/m², and most patients were overweight 79 (70.5%). The most common duration of disease was 5 – 9 years in 69 patients (61.6%). Out of 112 patients, 47 (41.9%) were hypertensive, while a family history of diabetes was recorded among 13 patients (11.6%). In this study, a high HbA1c level (≥ 7%) was detected in more than three-quarters of 85 patients (75.9%), while the remaining 27 patients (24.1%) had normal levels of HbA1c (< 7%). As illustrated in (Table 1).

Table 1: Baseline characteristics and HbA1c level of study patients

Patients' characteristics	No. (n= 112)	Percentage (%)
Age group (Years		
40 – 49	12	10.7
50 – 59	61	54.5
≥ 60	39	34.8
Gender		
Male	53	47.3
Female	59	52.7
BMI (kg/m²)		
Normal	8	7.1
Overweight	79	70.5
Obese	15	13.4
Duration of disease		
< 5	11	9.8
5 - 9	69	61.6
≥ 10	32	28.6
Hypertension		
Yes	47	41.9
No	65	58.1
Family History		
Yes	13	11.6
No	99	88.4
HbA1c %		
≥ 7	85	75.9
< 7	27	24.1

The comparison of lipid profile according to HbA1c levels revealed that the mean levels of triglycerides and LDL were significantly higher in patients who had high HbA1c levels when compared to those with normal HbA1c levels (179.33 mg/dl vs 146.21 mg/dl, P= 0.026 and 118.24 mg/dl vs 91.22 mg/dl, P= 0.001, respectively). There was no significant difference in the mean levels of HDL between the HbA1c levels. As shown in (Table 2).

Table 2: Comparison of lipid profile according to HbA1c levels

Lipid profile	**HbA1c levels %**		**P- Value**
	High-level Mean ± SD	**Normal level Mean ± SD**	
Triglyceride (mg/dl)	179.33 ± 72.45	146.21 ± 57.71	**0.026**
LDL (mg/dl)	118.24 ± 41.22	91.22 ± 28.23	**0.001**
HDL (mg/dl)	41.26 ± 12.23	43. 22 ± 11.34	**0.206**

* Significant difference of two means using Student t-test at 0.05 level.

Among male patients, the comparison of lipid profiles according to HbA1c levels showed a statistically significant difference in the mean levels of triglycerides. The mean triglyceride level was significantly higher in the male patients with high levels of HbA1c compared to those with normal HbA1c levels (183.72 mg/dl vs 138.37 mg/dl, P= 0.001). The mean LDL level was not significantly different according to the HbA1c levels. As illustrated in (Table 3).

Table 3: Comparison of lipid profile according to HbA1c level in male patients

Lipid profile	**HbA1c levels % (Male)**		**P- Value**
	High-level Mean ± SD	**Normal level Mean ± SD**	
Triglyceride (mg/dl)	183.72 ± 62.12	138.37 ± 61.24	**0.001**
LDL (mg/dl)	109.11 ± 39.34	99.43 ± 26.25	**0.139**

* Significant difference of two means using Student t-test at 0.05 level.

In the female patients, the comparison of lipid profile according to HbA1c levels showed that the mean LDL level was significantly higher in the female patients with high HbA1c levels than in female patients who had normal HbA1c levels (132.21 mg/dl vs. 84.97 mg/dl, P= 0.001) while the mean triglyceride level was not significantly different according to the HbA1c levels. As in (Table 4).

Table 4: Comparison of lipid profile according to HbA1c level in female patients

Lipid profile	HbA1c levels % (Female)		P- Value
	High-level Mean ± SD	Normal level Mean ± SD	
Triglyceride (mg/dl)	174.79 ± 87.82	159.83 ± 70.89	**0.304**
LDL (mg/dl)	132.21 ± 40.15	84.97 ± 29.88	**0.001**

* Significant difference of two means using Student t-test at 0.05 level.

In the Pearson correlation analysis, this study found a significant moderate positive correlation between HbA1c and triglyceride levels (r= 0.512, P= 0.003). On the other hand, there is a significant weak positive correlation between HbA1c and LDL levels (r= 0.432, P= 0.029). As illustrated in (Table 3.5).

Table 3.5: Correlations of HbA1c level with triglycerides and LDL levels

Parameters	Triglyceride (mg/dl)			
	Correlation	P- Value	Correlation	P- Value
HbA1c %	**0.512**	**0.003**	**0.432**	**0.029**

*Correlation is significant at the 0.05 level.

DISCUSSION

HbA1c levels could be employed as a possible biomarker for recognizing diabetes patients at risk of cardiovascular diseases and could be used as a guide for treating patients (13). In the present study, 85 patients (75.9%) had a high HbA1c level. Lower figure was reported from a local study in 2012 (14), in which 11% of the enrolled patients had HbA1c of ≤ 6%, 14% had a level of 7 – 8%, and 75% were with a level of > 8%. Another different result was reported from a study in 2019, which found that 90 patients (43.69%) were with HbA1c levels <7%, and 116 (56.31%) had HbA1c levels >7% (10). The differences in the rates of HbA1c levels among different countries might be attributed to the sociodemographic factors among studies population, sample size, and racial and nutritional factors.

This study found that the mean levels of TG and LDL were significantly higher in the patients who had a high HbA1c level when compared with patients who had normal levels of HbA1c, while there was no significant difference in the mean HDL levels according to the levels of HbA1c. Similar figures were reported

from the Nepali study in 2015 (15), the Pakistani study in 2016 (16), the Indonesian study in 2019 (17), and the Indian study in 2022 (6). Also, a Bangladeshi study in 2019 found a significantly higher mean levels of TG and LDL-C but differed in that significantly lower mean HDL levels were detected in diabetes patients (18). Different finding was reported from a study implemented in 2019, in which only the mean levels of TG were significantly higher in patients with HbA1c ≥ 7% than that in those with HbA1c < 7%, while there was no significant difference in the mean levels of LDL and HDL (10). The discrepancies observed in the above studies might be attributed to the different sample sizes enrolled in each study, nutritional habitual, history of co-morbid disease, types of drugs used, and lifestyles. The high levels of HbA1c and altered lipid profile in diabetic patients are considered as very risk factors for severe complications. Hence, improving glycemic control can decrease the risk of various complications in diabetic subjects (19). According to the Diabetes Complications and Control Trial (DCCT), HbA1c is the gold standard of glycemic control, and the level of HbA1c value ≤7.0% was said to be appropriate for reducing the risk of cardiovascular complications (20).

This study found that the mean levels of TG was significantly higher in male patients with HbA1c levels of ≥ 7%, while the mean level of LDL was not significantly different between HbA1c levels. Among female patients, the mean LDL levels was significantly higher in patients with HbA1c ≥ 7% when compared to those with normal HbA1c levels, and no significant difference was found in the mean levels of TG. Our finding agrees with Saudi and Pakistani studies, which found that diabetic females had significantly higher LDL levels (10, 16). Different findings were reported from a study conducted in

2017 and found that LDL, HDL, and TG were non-significantly increased in diabetic females (21). The difference in lipid parameters among diabetic patients could be due to the differences in BMIs and ages between the participants in each study as well as the length of time since diagnosis with DM. Further, this difference might be attributed to the sample size enrolled in each study and the influence of sex hormones on the distribution of body fat that causes altered lipoprotein levels.

In the study, a clear trend of DM2 was observed in people aged between 50 and 69 years, which coincides with population aging and the changes associated with the deterioration of pancreatic function, a situation that predominates more in women than in men regarding sex and age, however since the sex that most predominated in their research was male with 52%

states that HbA1c exhibited a direct correlation with the elevation of cholesterol, triglycerides, and low-density lipoprotein in patients with poor glycemic control, results that are also corroborated in the study. The research does not coincide with the results of Hamdan et al. (12) since no significant correlation of HbA1c with cholesterol, and LDLc is shown, nor with the results of Torres et al. (10) and Gross (13) in which elevated cholesterol and triglyceride levels corresponded to euglycemic patients. As expressed by Jordan D et al. (14), high-density lipoproteins (HDL) stimulate insulin secretion, inhibit beta cell apoptosis, and can also increase glucose absorption in skeletal muscle; on the contrary, the increase of BMI and atherogenic lipids in type 2 diabetes adds metabolic stress that interferes with HDL production, exacerbating pancreatic cell dysfunction and insulin resistance. Therefore, decreased HDL levels may worsen glycemic control and accelerate progression to type 2 diabetes.

Our results showed a statistically significant positive correlations between HbA1c and TG and LDL. These results are inconsistent with a study conducted in Saudi Arabia that found a significant correlation of HbA1c with TG, but there were no significant correlations with LDL and HDL. Different findings were reported from an Indian study in 2017 and a Turkish study in 2014; both studies had results displaying a non-significant positive correlation between serum levels of TG LDL with HbA1c and a significant negative

correlation to HDL (8, 22). Discrepancies observed in the above-mentioned studies could be potentially attributed to the sample size enrolled in each study, type of DM, duration of the disease, a regimen of the treatment each patient depends on, lifestyle of the participants, as dietary style, healthy food, exercise, and the presence of other comorbidities. Dyslipidemia can occur secondary to insulin resistance or factors in close relation to insulin resistance, such as adiposity. Increased free fatty acid flux secondary to insulin resistance and increased proinflammatory adipocytes and cytokines from enlarged adipose tissue may be the underlying determinants of this interrelationship. However, some studies hypothesize that dyslipidemia could be a significant contributing factor to the pathogenesis of type 2 diabetes mellitus (23).

CONCLUSION

This study found that nearly three quarters of the studied patients (75.9%) had HbA1c levels >7 %. TG and LDL were significantly higher among uncontrolled diabetic patients, while HDL was not significantly different according to the HbA1c levels. It is being proposed that HbA1c can be used as an important marker to predict dyslipidemia in diabetic patients in addition to glycemic control. Awareness of physicians and diabetic patients about blood sugar control and the deleterious consequences of dyslipidemia can play a pivotal role in controlling and avoiding the grave consequences of this complication for patients with diabetes.

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