



# The Relationship between Some Biochemical Parameters and Type 2 Diabetes Mellitus among Iraqi Patients

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**Abstract:** Type 2 diabetes (T2D) is a metabolic disorder that develops as different cell groups become resistant to insulin action on peripheral tissues. Eventually, the pancreas is unable to produce sufficient insulin to overcome this resistance resulting in insulin deficiency. This study included 120 blood samples divided into two groups, sixty from patients with T2DM recruited from the private clinic and sixty from normal healthy controls. All subjects underwent full history taking; thorough clinical examination; routine laboratory investigations including fasting blood sugar, hemoglobinA1c, total cholesterol, triglycerides, high-density lipoprotein-cholesterol, and low-density lipoprotein-cholesterol. The levels of serum glucose, total cholesterol, triglycerides, very low density lipoprotein and low density lipoprotein, showed significant increase in type II diabetes mellitus patients as compared to control group whereas the levels of high density lipoprotein showed no significant in patients with type II diabetes mellitus comparison to control subjects (  $P > 0.01$  ).

**Key words:** Type two diabetes, FBS, HbA1C.

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## Introduction

Diabetes is a disease that is defined by a chronic state of hyperglycemia and that occurs when the pancreas does not produce enough insulin or when the body cannot effectively use the insulin it produces. Uncontrolled diabetes causes hyperglycemia, or an increase in blood sugar, which over time causes major damage to the body's systems, particularly the neurons and blood vessels (1). The type 2 diabetes mellitus (T2DM) is represents a group of polygenic metabolic and endocrine disorders with various genetics and environmental influences that affects the capacity of the body to produce or use insulin resulting in hyperglycemia,

which may lead to variable complication (2). It has become one of the foremost chronic non-communicable diseases distressing the health of people worldwide (3). The global prevalence is increasing at a dreadful rate, making it the most dreaded silent epidemic of the twenty-first century. According to the International Diabetes Federation, 451 million people suffered from diabetes in 2017, and this is projected to reach 693 million by 2045(4). There were 1.411.500 cases of diabetes in Iraq in 2017 total adult population (5).

To investigated the role of chemical parameters with type two diabetes Mellitus with Iraqi Patients.

## Subjects and methods

### Subjects

This study was carried out in the private's laboratories throughout the period from 1 November 2021 until the end of July 2022. This study included 120 blood samples equally divided into two groups, patients with T2DM and normal healthy controls. The age of patients and normal healthy controls was ranged between 25 to 70 years. Age, BMI, fasting blood glucose, glycated hemoglobin and lipid profiles were evaluated in specimen of T2DM patients and normal healthy controls. Exclusion Criteria of T2DM were: 1. any subjects diagnosed with T1DM, who are on insulin therapy. 2. Pregnant women, patients with renal disease, liver disease, thyroid disorders or other endocrine or chronic diseases and Alcoholism.

### Methods

Every participant has been interviewed and asked to answer information including age, family history, weight, height, and duration of disease.

Blood samples were collected from gel tube and EDTA for biochemical examinations study. The serum was used for the estimation of glucose.

Glucose level has been evaluated according to the method of (6), the reagents used were provided by (Biotek, Spain). The Allan method was used to assay cholesterol, and the reagents were provided by (AGAPPE, Switzerland). Serum triglycerides were determined according to (7), the used reagents were supplied by (AGAPPE, Switzerland). According to (8) high-density lipoprotein (HDL) was assessed, the reagents used were provided by (AGAPPE, Switzerland). The method developed by(9). was used to measure very low-density lipoprotein (VLDL) and low-density lipoprotein (LDL). Blood collected by EDTA tube used to estimation of HbA1C, by used NycoCard, Norway.

### Results

Sixty Iraqi T2DM patient were selected for this study with the age being ranged from (25-70) years. In the present study the age was classified into three groups (<40-year, 40-50 year and >50) Data listed in table (1). The results of the age variable showed that there were significant differences between the age and type 2 DM patients for all the parameter (FBS, HbA1c, BMI, Total cholesterol, Triglyceride, LDL, HDL, and VLDL).

Table (1): Age as a risk factor in T2DM patients

Parameters	Age groups			LSD value
	<40 yr.	40-50 yr.	>50 yr.	
BMI (kg/m <sup>2</sup> )	28.04 ±0.82	28.45 ±1.06	29.90 ±0.67	2.364
FBS	221.22 ±17.04	250.92 ±12.71*	260.86 ±22.41***	48.21
HbA1C	8.29 ±0.22*	9.39 ±0.51**	11.02 ±0.42**	1.495
Cholesterol (mg/dl)	207.44 ±8.47	209.85 ±17.17**	204.90 ±12.20***	37.795
Triglyceride (mg/dl)	191.50 ±16.12	244.21 ±30.41 **	272.33 ±23.19***	69.62
HDL (mg/dl)	41.04 ±1.86	40.23 ±2.99	40.33 ±1.94	6.475
LDL (mg/dl)	137.93 ±7.78	144.63 ±14.70	133.99 ±9.63	31.211
+VLDL (mg/dl)	38.25 ±3.21	48.83 ±6.05 *	54.79 ±4.55***	13.755
* (P≤0.05) ** (P< 0.01) , *** (P<0.001)				

Body mass index was measured for all T2DM patients and the apparently healthy controls during the period of

study Figure (1) showed that there is no significant difference between BMI in type-II diabetes patients and apparently

healthy controls. The mean average of BMI in both T2DM patients and apparently health controls were ( $28.69 \pm 0.47$ ) and ( $26.55 \pm 0.46$ ) respectively, which means that all cases under study have the normal body weight and not obese. Fasting blood glucose was measured in serum of all T2DM patients and controls. In this study, the results show that fasting blood glucose significantly ( $p < 0.001$ ) increased in patients with T2DM in comparing with its levels in normal healthy controls as shown in Figure (2). The FBG in T2DM patients' group is ( $247.00 \pm 9.63$ ) in comparison with ( $82.10 \pm 1.12$ ) in healthy controls group. The levels of HbA1c were measured for both diabetic patients and healthy controls. The results showed in Figure (3) the mean average of glycated hemoglobin increased significantly ( $P > 0.0001$ ) from ( $4.99 \pm 0.05$ ) in serum specimens of seemingly healthy controls to ( $10.89 \pm 0.29$ ) in serum specimens of T2DM patients group. Cholesterol result show the mean level value in diabetic patients ( $206.90 \pm 7.30$ ) was significantly ( $P < 0.0001$ ) higher than the mean serum of control group ( $125.02 \pm 2.57$ ) as shown in figure (4). The level of TGs in

serum specimen of type-II diabetes patients and apparently healthy controls was determined. Results showed that triglycerides level in diabetic patients was significantly increased ( $P < 0.0001$ ) in comparison with its level in healthy controls, where the mean average of TGs in serum specimen of T2DM patients' group was ( $241.05 \pm 14.18$ ) compared with ( $110.65 \pm 3.58$ ) in healthy controls group as shown in figure (5). Results of high-density lipoprotein showed in figure (6) that there is no significant difference in serum mean level of HDL between T2DM patients ( $40.52 \pm 1.25$ ) and healthy controls ( $40.56 \pm 0.99$ ). LDL-Cholesterol mean value in diabetic patients ( $137.83 \pm 6.06$ ) was statistically significant ( $p < 0.0001$ ) higher than the mean value of control group ( $61.55 \pm 2.73$ ) as shown in figure (7). Very Low-Density Lipoprotein (VLDL) level was measured in serum specimen of T2DM patients and controls. The results showed that the mean level of VLDL significantly increased ( $P < 0.0001$ ), from ( $48.34 \pm 2.82$ ) in T2DM specimen in comparison with the mean level in healthy controls ( $22.17 \pm 0.72$ ) as shown in figure (8).

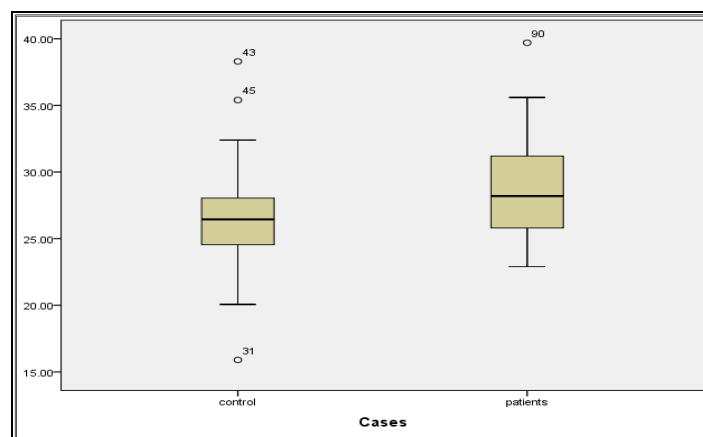


Figure (1): Comparison between control and patients groups in BMI

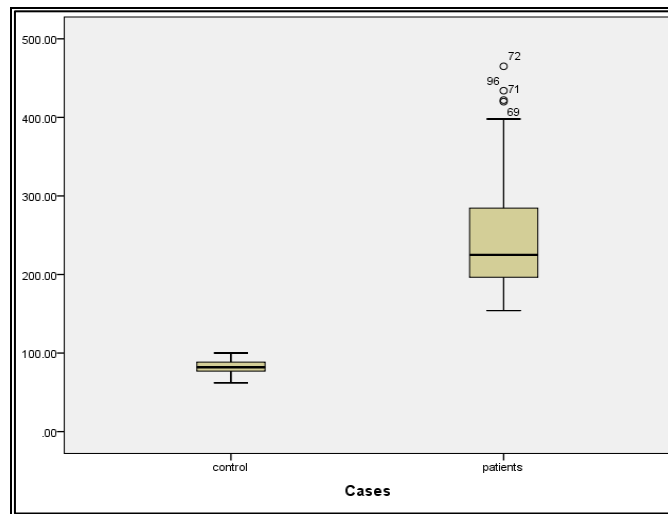


Figure (2): Comparison between control and patients groups in fasting blood sugar.

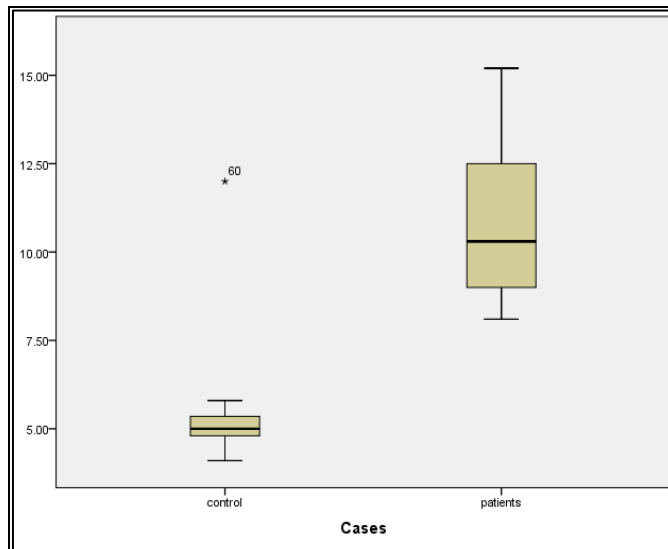


Figure (3): Comparison between control and patients groups in HbA1C.

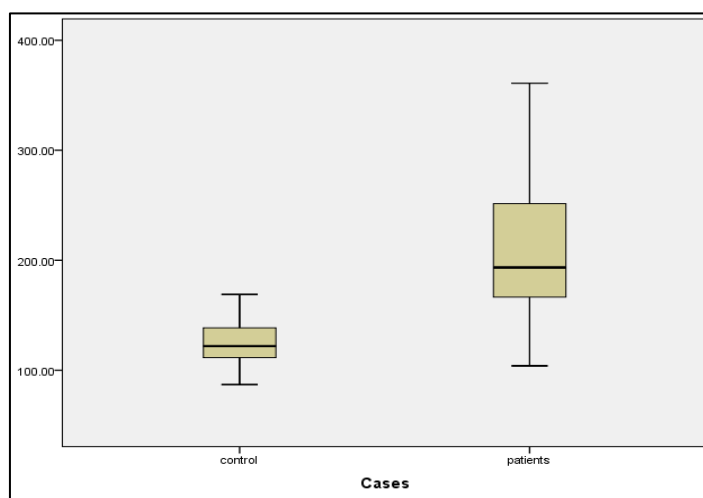


Figure (4): Comparison between control and patients groups in cholesterol.

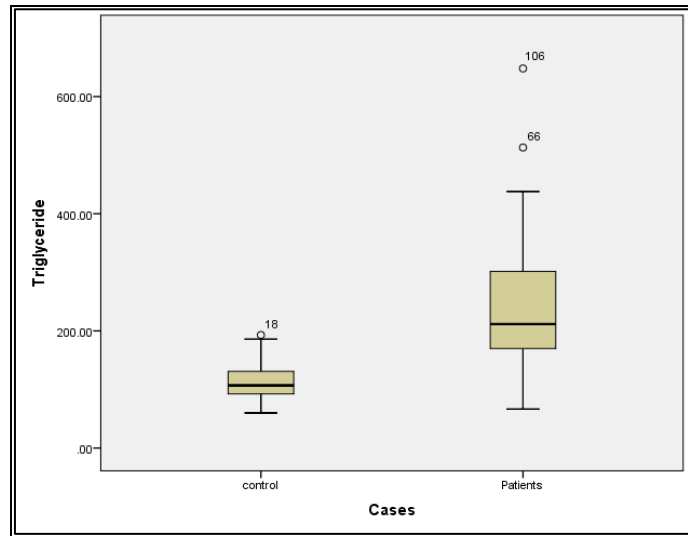


Figure (5): Comparison between control and patients groups in triglyceride.

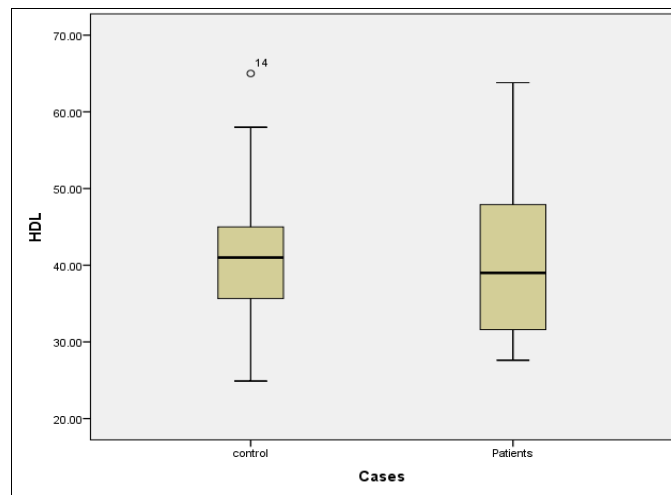


Figure (6): Comparison between control and patients groups in HDL.

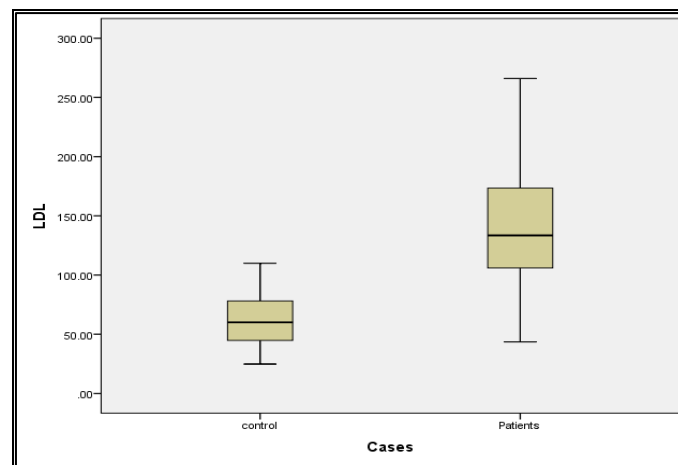


Figure (7): Comparison between control and patients groups in LDL.

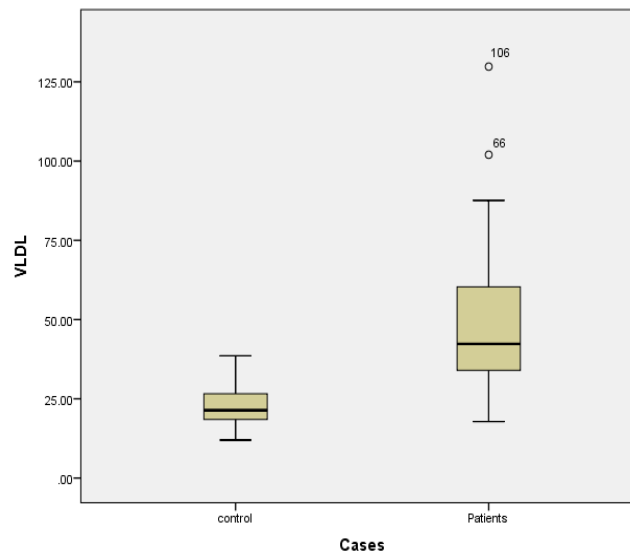


Figure (8): Comparison between control and patients groups in VLDL.

### Discussion

The primary energy source that the cells utilize is glucose. However, without insulin, glucose cannot enter the cell. An adequate quantity of insulin is created by a pancreas that is operating adequately to transport glucose into cells. Little to no insulin is created by a defective pancreas, or the bodily cells may not respond to the insulin that is produced. As a result, glucose accumulates in the blood, its concentration rises, and diabetes mellitus results (10). The prevalence of T2DM rises with population age, especially in developing countries, where the highest proportion of diabetics is found in those aged 45 to 64, whereas in developed countries, the highest number is found in those aged 65 and beyond. These distinctions are primarily due to variances in the population composition of developed and developing countries. Moreover, the result in this study showed that there is no significant difference between BMI in type-II diabetes patients and apparently healthy controls. Obesity is classified as body mass index (BMI)  $\geq 30$  kg/m<sup>2</sup>, and is a known predictor of

T2DM, the incremental association of BMI category on the risk of T2DM is strong for people with a higher BMI relative to people with a lower BMI (11).

The study's findings revealed a significant increase of glucose levels in T2DM patients compared to controls. This condition, which typically develops around the age of 40, may be caused by weak  $\beta$ -cells, little insulin synthesis and/or function, and rising insulin resistance. These results are in accordance with the study characterized by (12) who observed that serum glucose concentration were significantly higher in T2DM patients than normal healthy controls. According to (13), glycated hemoglobin (HbA1c) was considered to be standard for care for testing and control diabetes, specifically the type 2 diabetes. Non-diabetes HbA1c levels are normally between 4.0 and 5.6 percent. HbA1c values in pre-diabetes range from 5.7 percent to 6.4 percent, while people with HbA1c levels of 6.4 percent or greater have diabetes (14). The results of this study showed high significant increase in total HbA1C in diabetes patients when

compared with healthy control. These results correspond with those that achieved (15) who stated that HbA1c is increased in diabetics.

The result show that Cholesterol was significantly ( $P < 0.0001$ ) higher in diabetic patients than of control group. This increase may be due to an increase in the plasma concentration of VLDL and LDL, which may be due to the increase in hepatic production of VLDL or decrease in the removal of VLDL and LDL from the circulation, Cholesterol level in blood is based on other risk factors such as age, gender, family history, smoking, high blood pressure, physical inactivity, obesity and diabetes, total cholesterol normal range should be lower than 200 mg/dl (16). Results showed that triglycerides level in diabetic patients was significantly increased ( $P < 0.0001$ ) in comparison with its level in healthy controls, triglyceride levels should be under 135 mg/dl in the normal range. The measurement of triglyceride (TG) levels is thought to be helpful in the diagnosis of diabetes mellitus in addition to pancreatitis, heart disease, and other medical conditions. Triglyceride level was the most important risk factor for diabetes mellitus, followed by family history, BMI, and age (17). Moreover, high density lipoproteins (HDL) level was found to be no significant in diabetic patients when compared with controls group. These results disagree with other study achieved by (18) that high triglyceride levels and low HDL cholesterol levels are associated with type 2 diabetes, and that the link between high triglycerides and low HDL cholesterol levels reflects a physiological process, and explains the low levels of HDL cholesterol in patients with type 2 diabetes as its

demonstrated by (19). On the other hand, LDL-Cholesterol was significantly increased in diabetic patients when compared with controls ( $p < 0.0001$ ). Long-term insulin insufficiency may be associated with a decreased amount of LDL receptor because insulin increases the number of LDL receptors in diabetes patients. This causes a rise in LDL particles in diabetes mellitus, which raises levels of LDL cholesterol (20). Very low-density lipoproteins (VLDL) level was found to be high significant in diabetic patients when compared with controls group. Insulin resistance, in which the skeletal-muscle system drives the conversion of energy from eaten glucose to enhance liver triglyceride production, resulted in higher VLDL levels. As a result, atherogenic TG-rich lipoprotein units, such as VLDL, will be produced (21).

### Conclusion

The biochemical parameters FBS, HbA1C, Cholesterol, Triglyceride, HDL, LDL and VLDL have a strong association with the diagnosis of diabetes.

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