# Comparative Study Of Albumin, Globulin, Lipidprofile, And Ai Between Diabetic Patients And Healthy Participants

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**Abstract**

Diabetes mellitusis known as diabetes, is a metabolic disorder marked by elevated blood sugar concentrations, whileinsulin is the hormone that transfers sugar from the bloodinto the body's cells, where it can be stored or utilized for energy, so that when we have this condition, the body either doesn't producesufficient amount of insulin or didn't utilize the insulin it does make adequately. Albumin is a family of globular proteins, a number of blood transport proteins are evolutionarily related in the albumin family,globulins are also a group of proteins within the blood. They are produced by the liver and the immune system, wherever albumin makes up more than half of the total protein within the blood, and globulins make up the remainder, whilelipid profileis a pattern of lipids in the blood. A lipid profile usually includes the levels of total cholesterol (TC), high-density lipoprotein (HDL) cholesterol, triglycerides (TG), and the calculated low-density lipoprotein (LDL)cholesterolfurthermore,atherogenic index (AI) (LDL/HDL) can be strong markers for predicting the risk of atherosclerosis and coronary heart disease, The study's goal is to determine the levels of albumin, globulin, TC, TG, HDL-C, LDL-C and AI values in diabetic and healthy individuals, then compares with each other.Consequently in this study, we foundthe levels of albumin (4.24 ± 0.72 to 3.63 ± 0.64 (g/dL) with percentage-14.39%), globulin (3.09 ± 0.63 to 3.31 ± 0.86 (g/dL) with percentage 6.64%), TC (178.90 ± 17.66 to 190.45 ± 17.43 (mg/dL) with percentage 5.32%), TG (155.85 ± 17.06 to 169.15 ± 14.66 (mg/dL) with percentage 8.53%), HDL (49.15 ± 9.35 to 44.68 ± 6.84 (mg/dL) with percentage-9.09%), LDL (96.70 ± 19.56 to 111.95 ± 16.17 (mg/dL) with percentage 15.77%) and AI (2.08 ± 0.73 to 2.56 ± 0.54 with percentage 23.08%) for healthy and diabetic participants respectively, accordinglythis is evidence that the levels of globulin, TC, TG, LDLand AI valuesin diabetic patients higher than healthy participants,but the levels of albumin and HDL in diabetic patients lower than healthy participants, due to the negative effects of diabetes on the heart, blood vessels and other body parts.

**Key words:** Diabetes, Albumin, Globulin, Lipid profile, Insulin, AI,and Glucose.

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**Introduction**

**Diabetes mellitus** (DM) have an elevated blood sugar concentration,the major source of energy is blood glucose, which can be taken from food, whileinsulin results in elevated glucose absorption from the blood to the body's cells. The pancreas may either not producing an adequate amount or no insulin at all, or the body can't use it in the right way, in this caseglucose stays in the blood and doesn't enter the body's cells, accordinglyelevated concentration of glucose may cause health problems. In the meantime no definitive treatment for this disorder, but patients can manage it and stay healthy with some medications [1]. Being hungry, increased thirst, weight loss, frequency, eye problems, fatigue are among indicators of diabetes [2].

There are three forms of diabetes:

- ❖ Type 1 diabetes is more commonly occurring in children but can occur at any age stage, whereverinsulin injections are essential to control blood sugar concentrations when the body can't produce enough amount or no insulin at all.
- ❖ Type 2 diabetes is more commonly occurring among adults which accounts for about 90% of cases,in this condition, the body can't use insulin in the right way.
- ❖ Gestational diabetes is occurring among pregnant women and may cause harmful effects to both mother and her baby [3].

Besides diabetes is caused by the following factors:

The fundamental disease mechanism in type1 ( insulin-dependent ) diabetes appears to be a T cell–mediated autoimmune response targeting beta cells [4].While the body develops resistance to insulin in type 2 ( non-insulin-dependent) diabetes, and the body can't use it in a proper way. This will lead to making the pancreas produce insulin in larger amounts so thatthis could damage the pancreatic cells, andthe pancreas may eventually be unable to produce any insulin [5].In gestational diabetes, the placental hormones maydon't allow the body togoodcontrolof blood sugar during pregnancy [6].Diabetes can cause a lot of problems, such as diabetic ketoacidosis (DKA), non-ketotic hyperosmolar coma,cardiac problems, kidneyproblems, vision problems are severe problems occurring with time [7].Diabetes is a common public health problem with the absence of optimal control of this condition. Persistent hyperglycemia or uncontrolled diabetes has the potential to cause serious complications [8]

**Albumin** is a family of globular proteins, the most common of which are the serum albumins. The albumin family of proteins are all water-soluble, moderately soluble in concentrated salt solutions, and heat denaturable. Albumins are a type of protein present in blood plasma that is not glycosylated like other blood proteins. Albuminoids are substances that contain albumins. The albumin family includes serum albumin, alpha-fetoprotein, vitamin D-binding protein, and afamin, all of which are blood transport proteins [9 – 11].Glycation of both albumin and hemoglobin occurs at lower amounts of albumin in blood, according to the researchers' tests. Other proteins, such as hemoglobin, are exposed to glucose and their

glycation increases as albumin levels drop or become saturated with bound glucose. As a result, albumin and glycated albumin levels can be used to predict the start of diabetes [12]. 3.4 to 5.4 g/dL (34 to 54 g/L) is the normal range. The normal value ranges may change somewhat between laboratories. Some laboratories examine different samples or use different measures [13].

**Globulins** are a type of proteins found in the bloodstream. They are produced by liver and the immune system,half of the total proteins in the blood is albumin while the remainder is globulin. Immunoglobulins, enzymes, carrier proteins, and complement are all examples of globulins, which have numerous roles. Alpha 1 globulins (mostly alpha-1 antitrypsin), Alpha 2 globulins (Alpha 2 macroglobulin, Haptoglobin), Beta globulins (Transferrin, Complement components C3, C4, C5), and Gamma globulins (primarily immunoglobulins (antibodies)) are the four types of globulins [14].There was a graded elevation in gamma globulin concentrations, with the greater concentration in those who later developed type 2 diabetes [15].The reference range of globulin is around 2.0-3.9 g/dL or 20-39 g/L. Differences in equipment, procedures, and substances employed cause some lab-to-lab variability. Globulin concentrations in the normal range often indicate a healthy balance of carrier proteins, enzymes, and antibodies, all of which are essential for numerous biological functions. It's also probable that there's no viral infection or inflammatory or immunological disease present [16].

**Lipid profile**is a pattern of lipids in the blood. Total cholesterol (TC), high-density lipoprotein (HDL) cholesterol, triglycerides (TG), and estimated low-density lipoprotein (LDL) cholesterol are often included in a lipid profile [17]. High total cholesterol (TC), high triglycerides (TG), low high density lipoprotein cholesterol (HDL-C), and elevated amounts of small dense LDL particles define lipid abnormalities in diabetic individuals, referred to as "diabetic dyslipidemia." The concentrations of LDL-C may be moderately elevated or normal.Lipid abnormalities are frequent in patients with T2DM and prediabetes [18, 19], although the pattern of various lipids might alter depending on ethnicity, socioeconomic status, and health-care access [20, 21]. According to a recent meta-analysis, abnormal concentrations of the mentioned lipid parameters, reflect, to some degree, the risk of type 2 diabetes [22]. Furthermore, compared to the two lipid parameters measured independently, investigations in patients with T2DM have revealed an increased association between CAD and high TG and low HDL-C combined [23, 24]. These lipid profile values can be quantified in one of two ways: milligrams per deciliter (mg/dL) or millimoles per liter (mmol/L) wherever the following values are considered normal in non-fasting samples: ≥5 mmol/L (190 mg/dL) total cholesterol, ≥3 mmol/L (115 mg/dL) LDL cholesterol, ≤1 mmol/L (40 mg/dL) HDL cholesterol, ≥2 mmol/L (175 mg/dL) triglycerides [25].

**Atherogenic index (AI)** (LDL/HDL) and the coronary risk index (CRI) (TC/HDL) can both be useful tools for predicting the risk of atherosclerosis and coronary heart disease, as well as revealing the presence of LDL or TAG in the blood of patients [26].The changes in serum lipid profile; elevation inTC, TG, and LDL-C; and reduction in HDL-C are key factors in cardiovascular disease progression. The high prevalence and severity of cardiovascular diseases require new

screening tools for better evaluation.Non communicable diseases (NCDs), such as cardiovascular diseases (CVDs), diabetes, cancers, and chronic respiratory diseases, are typically found in developed countries due to the predominantly sedentary lifestyle and cause 63% or more deaths in the world. CVD is one of the most common NCDs, accounting for one-third of all fatalities globally due to increased risk factors [27]. Dyslipidemia, diabetes mellitus, hypertension (HTN), a greater body mass index (BMI), a higher waist-to-hip ratio, or poor physical fitness might all contribute to the increased cardiovascular risk in the global population [28]. The most important risk factor and predictor for CVD, acute myocardial infarction (MI), and stroke is the plasma lipid profile [29].Dyslipidemia in T2DM is characterized by high level of total cholesterol (TC), low density lipoprotein (LDL-C), triglyceride (TG) with low level of (HDL-C) [30]. The early detection of lipid abnormalities with their treatment can reduce the risk of atherogenic cardiovascular and cerebrovascular disorders in T2DM patients [31]. Atherosclerotic coronary artery disease and different form of cardiovascular disease (CVA) are the principle causing of morbidity and mortality in T2DM, that alterations in lipid profile lead to atherosclerosis in T2DM [32]. The definition of atherogenic index of plasma AIP is used logaritham(log) of the ratio of plasma concentration of TG/HDL. Which was correlated with size of HDL and LDL molecules [33].2.5 normal range of (LDL/HDL) atherogenic index.

**Subjects and Methods**

A study conducted in the private laboratories of the city of Nasiriya onfortydiabetic patients and control group consists of forty healthy participants, half of them are male and the other half are female,theirages more than 40 years, except for patients who are overweight and have kidney problems,blood was drawn from them, the levels ofalbumin, globulin, TC, TG, HDL-C, LDL-C, were measured and analyzed statistically.

**Results and Discussion**

From the Table below we foundthe levels of albumin (4.24 ± 0.72 to 3.63 ± 0.64(g/dL) with percentage -14.39%), globulin (3.09 ± 0.63 to 3.31 ± 0.86 (g/dL) with percentage 6.64%), TC (178.90 ± 17.66 to 190.45 ± 17.43 (mg/dL) with percentage 5.32%), TG (155.85 ± 17.06 to 169.15 ± 14.66 (mg/dL) with percentage 8.53%), HDL (49.15 ± 9.35 to 44.68 ± 6.84 (mg/dL) with percentage -9.09%), LDL (96.70 ± 19.56 to 111.95 ± 16.17 (mg/dL) with percentage 15.77%) and AI (2.08 ± 0.73 to 2.56 ± 0.54 with percentage 23.08%) for healthy and diabetic participants respectively, accordinglythis is evidence that the levels of globulin, TC, TG, LDL and AI values in diabetic patients higher than healthy participants, but the levels of albumin and HDL in diabetic patients lower than healthy participants, that is clear in Figure (1),due to the negative effects of diabetes on the heart, blood vessels and other body parts, the relation between albumin and other parameters displayed in Figures (2 – 7).According to a study, a highly significant alteration that was characterized by highly significant decrease in albumin concentration and highly significant increase in globulins concentration were observed in diabetic patients comparing to control group [34].However, in diabetic patients, plasma albumin concentrations have been shown to have an inverse relationship with HbA1c levels, indicating that a large number of

individuals with lower plasma albumin concentrations have poorly managed diabetes [35]. The fact that poorly managed type 2 diabetes has been linked to a further reduction in insulin production and secretion by the pancreatic β-cell might explain this inverse relationship [36, 37].

Globulin concentrations elevated (P<0.50) from 1.68 ± 0.29 (g/dL) in controls to 1.74 ± 0.57 (g/dL) in cases [38]. Similarly, gamma globulin concentrations were higher in those with more American Indian heritage (P<0.004, after adjusting for age, sex, and BMI) and in people with a family history of type 2 diabetes (P<0.04). Higher gamma globulin concentrations predicted risk of diabetes wherever a 1 S.D. difference in gamma globulin was linked with a 20% increased occurrence in those who were normal glucose. Tolerant at baseline (the ratio of hazard rate is 1.20 [CI 1.11-1.30]; P<0.0001) and remained as a significant predictor of diabetes in univariate analysis [15].When compared to control participants, alpha-1 and alpha-2 globulins were significantly higher in diabetic patients with retinopathy, diabetic patients without complications, and non-diabetic patients with retinopathy. In diabetic patients with retinopathy, beta globulin levels were substantially higher than in non-diabetic patients with retinopathy, diabetic patients without complications, and control individuals [39].

Similarly, Bhowmik and his colleagues discovered dangerously high levels of dyslipidemia, particularly high TG and low HDL-C; more than 90% of individuals with T2DM had low HDL-C levels, and 64% had high TG levels. In addition, the findings revealed a significant link between serum lipids and T2DM and prediabetes. High TC, high TG, and low HDL-C all showed significant linear trends for glucose tolerance status. In addition, the most significant relationship with type 2 diabetes and prediabetes was shown when elevated TG concentrations were combined with reduced HDL-C concentrations. Participants with T2DM and prediabetes, on the other hand, had higher levels of high TC, high TG, and low HDL-C [40].In addition, patients with elevated TG and low HDL-C concentrations had 12.75 and 4.89 times the risk of developing diabetes and prediabetes, respectively [40]. High TC, high TG, low HDL cholesterol, and elevated concentrations of LDL cholesterol are often the features of diabetic dyslipidemia [19].

According to a research, AIP is used clinically to predict Type 2 Diabetes Mellitus with a greater risk of complications, which is linked to lipid profiles and BMI [41]. Furthermore, measurement of atherogenic indices, particularly the atherogenic index of plasma, provides significant information regarding future risk of abnormal cardiac events in diabetic patients with at least one kind of dyslipidemia. As a result, it might be a more accurate marker and predictor of increased CAD risk in T2DM [42]. In T2DM patients, a higher AIP value on admission was independently and significantly linked to adverse cardiovascular outcomes [43].

**Table: levelsof albumin, globulin, TC, TG, HDL, LDL and AI values with percentage of increase or decrease for all parameters**

| Parameters | Mean ± S.D For Healthy individuals | Mean ± S.D For Diabetic patients | Percentage of increase | Percentage of decrease |
|---|---|---|---|---|

| | | | | |
|---|---|---|---|---|
| Albumin (g/dL) | 4.24 ± 0.72 | 3.63±0.64 | ---- | 14.39% |
| Globulin (g/dL) | 3.09 ± 0.63 | 3.31±0.86 | 6.64% | ---- |
| TC (mg/dL) | 178.90 ± 17.66 | 190.45±17.43 | 5.32% | ---- |
| TG (mg/dL) | 155.85 ± 17.06 | 169.15±14.66 | 8.53% | ---- |
| HDL (mg/dL) | 49.15 ±9.35 | 44.68±6.84 | ---- | 9.09% |
| LDL (mg/dL) | 96.70 ±19.56 | 111.95±16.17 | 15.77% | ---- |
| AI | 2.08 ±0.73 | 2.56±0.54 | 23.08% | ---- |

❖ Each value in the table reflects the mean ± Standard deviation.
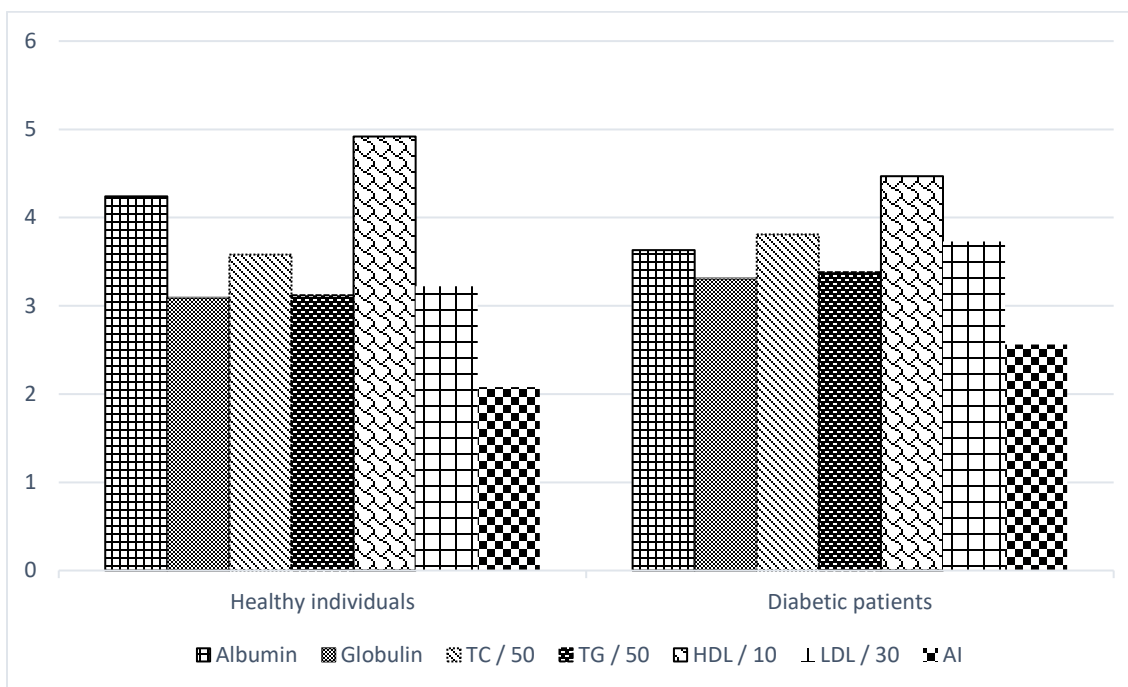


**Figure (1): levelsof albumin (g/dL), globulin (g/dL), TC (mg/dL), TG (mg/dL), HDL (mg/dL), LDL (mg/dL) and AI values for all parameters**
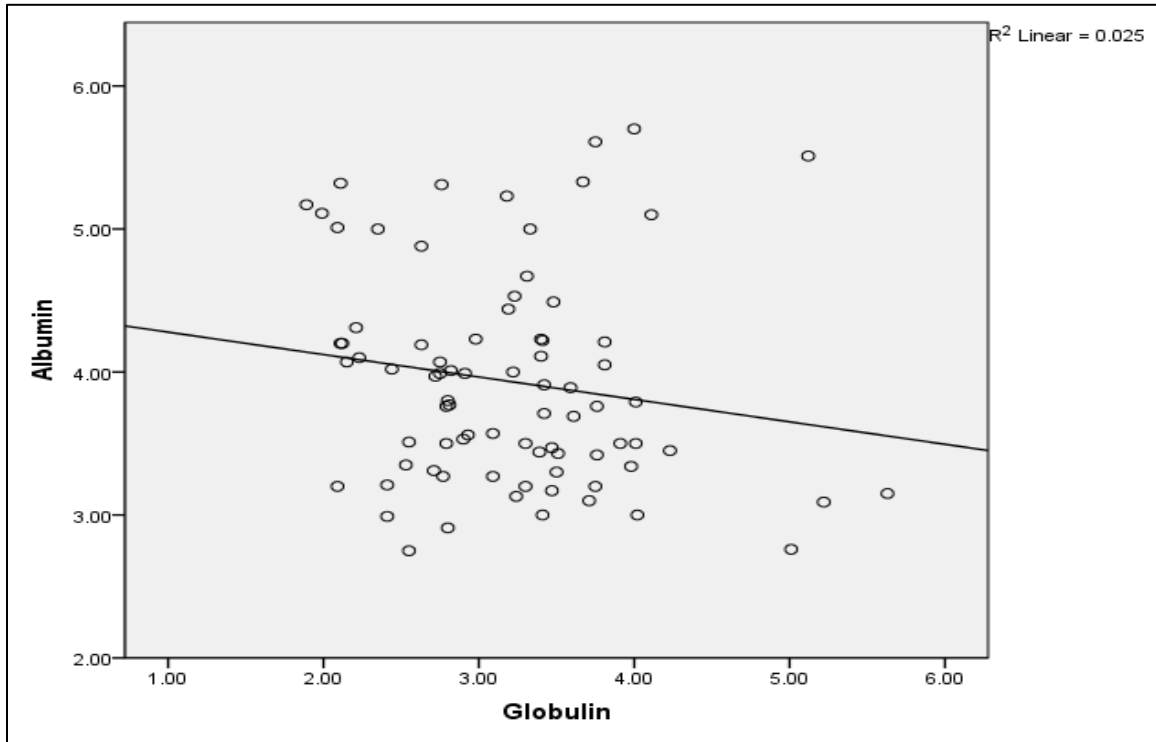
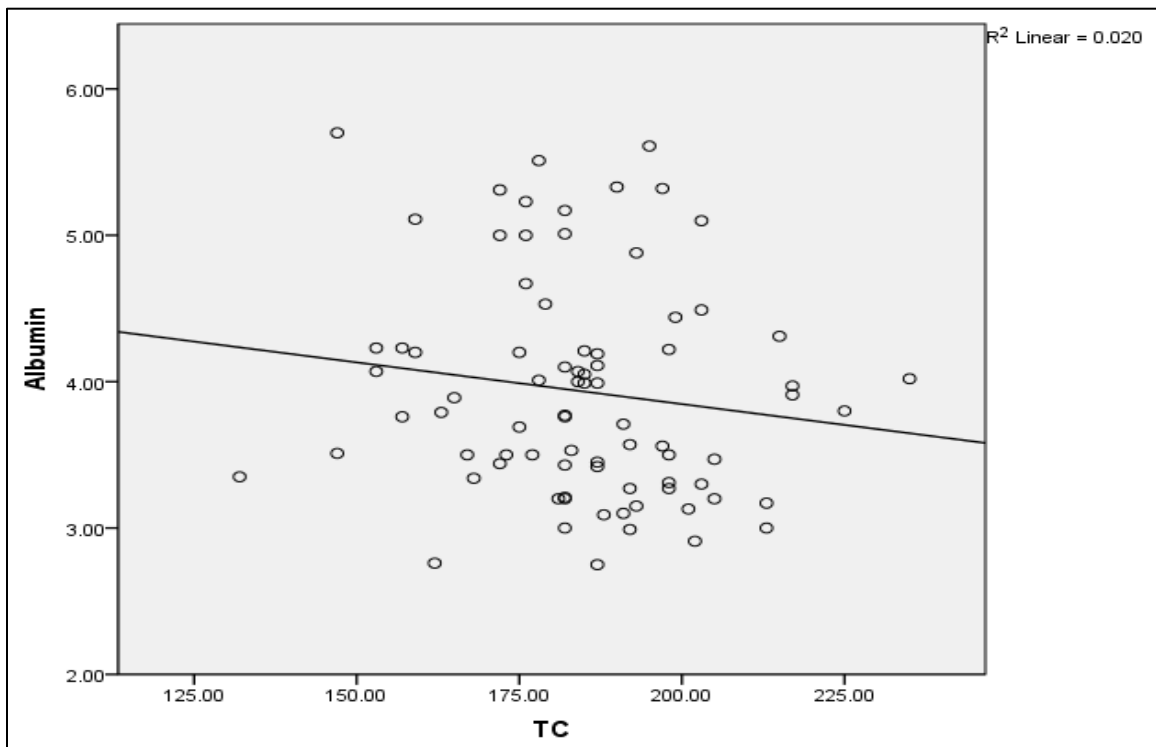**Figure (2) Correlation between Albumin (g/dL) and Globulin (g/dL).**



**Figure (3) Correlation between Albumin (g/dL) and TC (mg/dL).**
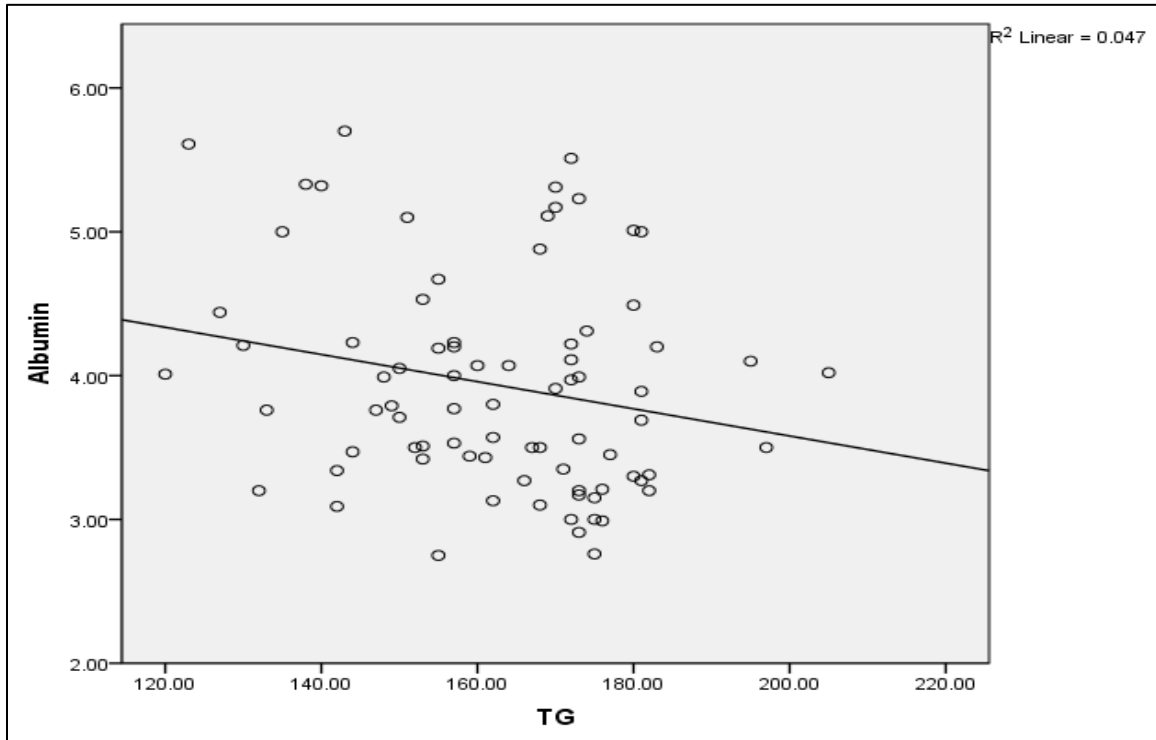
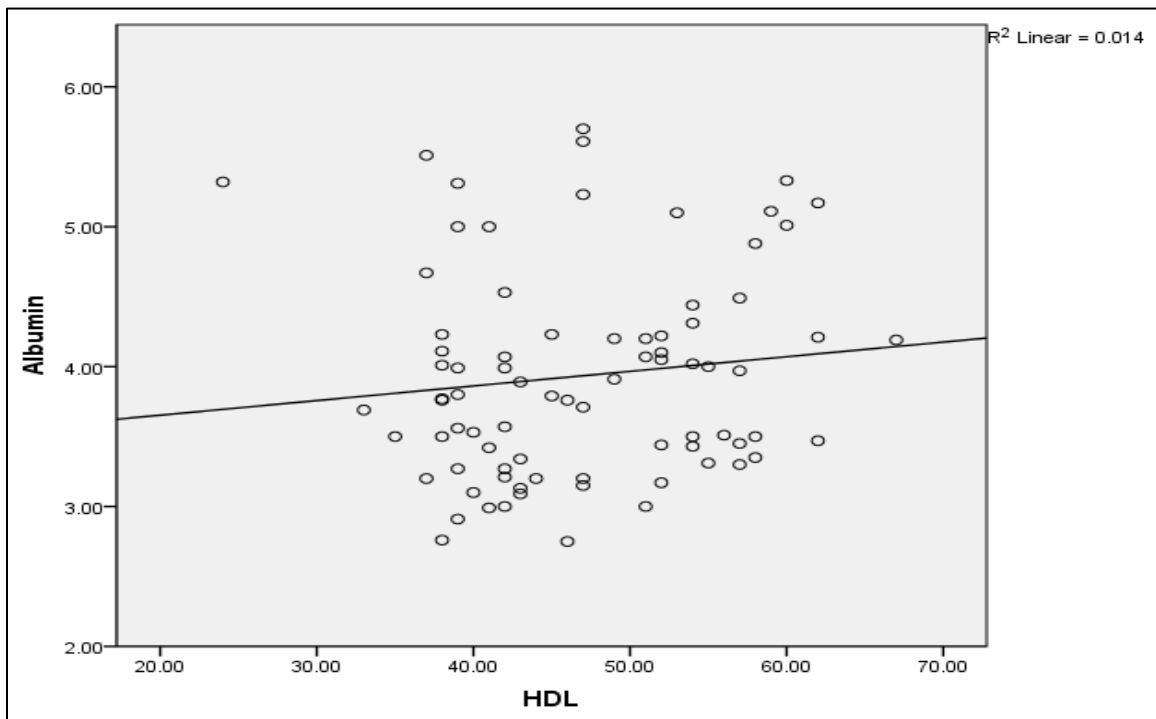**Figure (4) Correlation between Albumin (g/dL) and TG (mg/dL).**


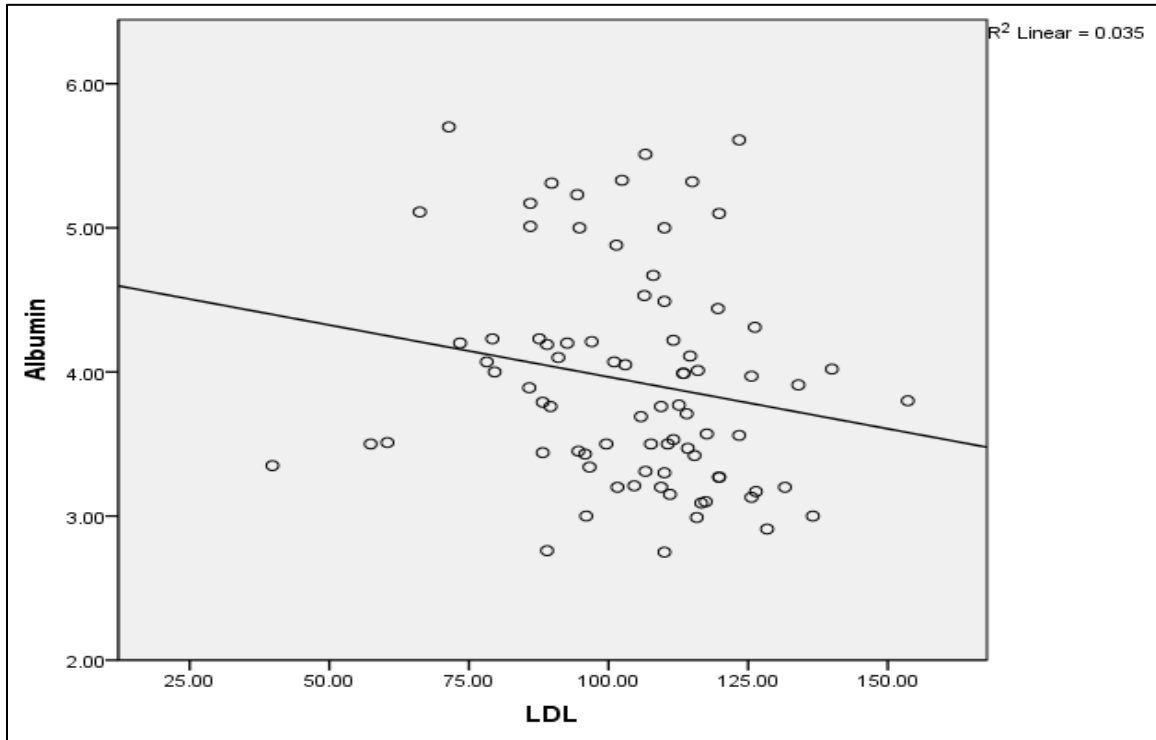
**Figure (5) Correlation between Albumin (g/dL) and HDL (mg/dL).**

**Figure (6) Correlation between Albumin (g/dL) and LDL (mg/dL).**
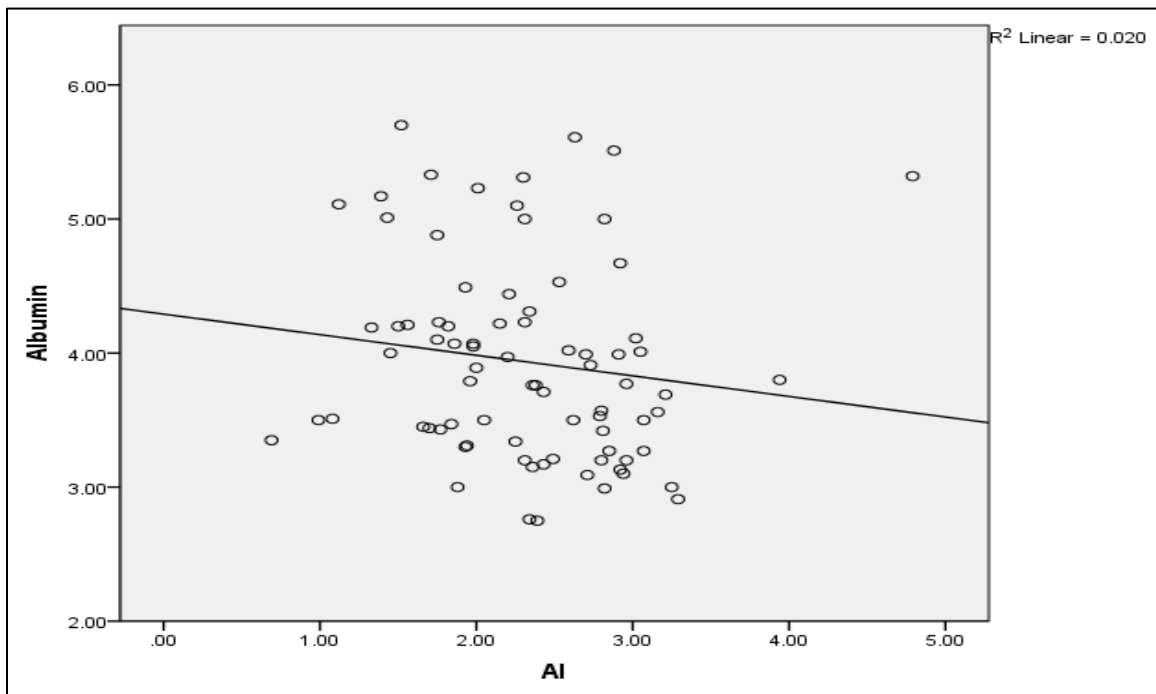


**Figure (7) Correlation between Albumin (g/dL) and AI values.**

**Conclusions**

globulin, TC, TG, LDL-C levels AND AI values are high in diabetic patients, whilelow levels of albumin and HDL-C compared with healthy participants, due to the negative effects of diabetes on the heart, blood vesselsand other body parts.

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