# Correlation of Total Cholesterol and Glucose in Serum of Iraqi Patients with Atherosclerosis and Diabetes Mellitus Type 2

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## ABSTRACT

Cholesterol is a fatty substance (lipid) classified as a waxy steroid of fat. It is absorbed by the intestine into blood stream and is packaged inside a protein coat a chylomicron. Blood glucose is a simple monosaccharide absorbed directly into the blood stream during digestion. The level of blood glucose normally represents a balance between the inflow of glucose into blood and it is uptake by the tissue. Atherosclerosis is a general term for a number of different medical conditions that affect the heart, this is occurs when the blood supply to a part of heart is interrupted, must commonly due to plaque, is build up in the coronary arteries consist of lipid cholesterol and calcium. It causes a damage of potential disease of heart muscle due to thickening and hardening of arteries. Diabetes mellitus is a disorder in which the level of blood glucose is persistently elevated above the normal range due to decrease secretion of insulin. The main objective of this study is to determine the concentrations of total cholesterol and glucose into blood serum of Iraq patients with atherosclerosis and diabetes mellitus type 2. This study included 60 specimens of patients with atherosclerosis and 60 patients with type 2 diabetes mellitus; their age range was 45-65 years. These patients were then matched by age and sex to 30 healthy individuals. Results revealed that there was highly significantly increased in the mean value of total cholesterol and glucose concentrations in patients of

atherosclerosis (p<0.001) and diabetes mellitus (p<0.001) as compared with healthy individuals.

**Key ward:** Total Cholesterol, Glucose, Atherosclerosis and Diabetes Mellitus type 2.

علاقة الكولستيرول الكلي والكلوكوز في مصل المرضى العراقيين المصابين بتصلب الشرايين و مرض البول السكري من النوع 2

**الخلاصة**

الكولستيرول مادة شحمية (دهنية) تصنف كسترويدات شمعية للشحوم. تمتص الدهون بواسطة الأمعاء الى مجرى الدم وتغلف بالبروتين كما في البروتين الدهني الجايلومايكرون. كلوكوز الدم سكر أحادي بسيط يمتص مباشرة الى مجرى الدم خلال عملية الهضم. مستويات سكر الدم تمثل طبيعيا التوازن بين تدفق الكلوكوز الى مجرى الدم و أمتصاصه من قبل النسيج. تصلب الشرايين مصطلح عام لعدد من الحالات الطبية المختلفة والتي تؤثر بالقلب وهذا يحدث عندما ينقطع تجهيز الدم الى جزء من القلب وغالبا ما يحدث بسبب بقعة تبنى من الدهون في الشرايين التاجية. تتكون من دهون الكولستيرول والكالسيوم وتسبب هذه البقعة أو اللطخة تلف لعضلة القلب لأزدياد سمك الشريان وتصلبه. البول السكري أضطراب يحدث عندما تكون مستويات الكلوكوز مرتفعة بمقاومة أكثر من المستوى الطبيعي بسبب قلة أفراز الأنسولين. الهدف الرئيسي من الدراسة هو تحديد تراكيز الكولستيرول الكلي والكلوكوز في مصل المرضى العراقيين المصابين بتصلب الشرايين والبول السكري. شملت أو تضمنت هذه الدراسة على عينة 60 من المرضى المصابين بتصلب الشرايين و60 من المرضى المصابين بالبول السكري تتراوح أعمارهم من 45-65سنة. تم أخذ 30 من الأفراد الأصحاء مطابقين بالعمر والجنس لهؤلاء المرضى. أظهرت النتائج بان هناك زيادة معنوية عالية مؤثرة في القيمة المتوسطة لتراكيز الكولستيرول الكلي (p<0.001) والكلوكوز (p<0.001) في مرضى تصلب الشرايين والبول السكري عند مقارنتهم بالأفراد الأصحاء.

**الكلمات الدالة**: الكولستيرول الكلي، الكلوكوز، تصلب الشرايين و البول السكري من النوع 2.

## INTRODUCTION

Cholesterol is lipid or fatty substance and the precursor of all steroids hormone in the body, bile acid, and vitamin D. It's an essential structural component of mammalian cell membranes and is required to establish proper membrane permeability and fluidity. High levels of cholesterol in the blood have been linked to damage to arteries and cardiovascular disease.[1] According to the lipid hypothesis, abnormal cholesterol levels (hypercholesterolemia) that is, higher concentrations of LDL-C and lower concentrations of functional HDL -C are strongly associated with cardiovascular disease, because these promote atheroma development in arteries (atherosclerosis). This disease process leads to myocardial infarction (heart attack), stroke, and peripheral vascular disease. Since higher blood LDL-C, especially higher LDL-C particle concentrations and smaller LDL particle size, contribute to this process more than the cholesterol content of the HDL-C particles, LDL-C particles are often termed "bad cholesterol" because they have been linked to atheroma formation [2].

**Glucose** is a simple monosaccharide found in plants. It is one of the three dietary monosaccharides, along with fructose and galactose that are absorbed directly

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into the bloodstream during digestion[3]. Two factors increase blood glucose, the absorption of glucose from the intestine and it is production in liver, either from stored (glycogen) or from non carbohydrates source gluconeogenesis.   Higher than usual  glucose  levels  may  be  a  sign  of prediabetes or diabetes  mellitus[4], hyperglycemia [4].
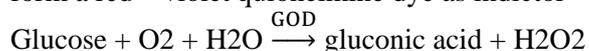
**Atherosclerosis** is a condition characterized by thickens of artery wall as a result of theaccumulation     of     fatty     materials     such     as cholesterol, this syndrome affecting arterial blood vessels, and it's a chronic inflammatory
response   in   the   walls   of   arteries,   caused   largely   by   the   accumulation of macrophage white  blood  cells and  promoted  by low-density  lipoproteins (LDL, plasma proteins that carry cholesterol and triglycerides) without adequate removal of fats    and    cholesterol    from    the    macrophages    by    functional high-density lipoproteins(HDL) [5]. Also atherosclerosis is commonly referred to as a hardening or furring of the arteries and it's caused by the formation of multiple plaques within the arteries[6], these atherosclerotic lesions, or atherosclerotic plaques are separated into two broad categories: Stable and unstable.[7]
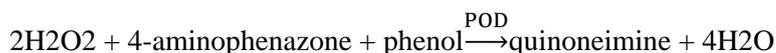
**Diabetes mellitus**, or simply **diabetes**, is a group of metabolic diseases in which a person has high blood sugar, due to deficiency of insulin, or because cells do not respond to the insulin that is produced.[8] This high blood sugar produces the classical symptoms of  polyuria, polydipsia, and polyphagia. Type 2  DM results  from insulin resistance, a condition in which cells fail to use insulin properly, unadequate secretion of insulin, sometimes combined with an absolute insulin deficiency. In the early stage of type 2, the predominant abnormality is reduced insulin sensitivity. At this stage, hyperglycemia  can  be  reversed  by  a  variety  of  measures  and medications that improve insulin sensitivity or reduce glucose production by the liver [9].

**Patients & Methods:** The prospective study comprised 60 Iraqi patients fulfilling the American Heart Association (AHA)/American College of Cardiology Foundation (ACCF) guidelines for the diagnosis of atherosclerosis[10], and 60 patients with type 2 diabetes mellitus according to the European Association for the Study of Diabetes (EASD) and the American Diabetes Association (ADA) [11], their age range was 45-65 years. These patients were then matched by age and sex to 30 healthy individuals. Blood  samples  were  taken  from  individuals  in  both  groups  for  estimating total cholesterol and glucose levels. Laboratory investigation which include: Hemoglobin (Hb), Erythrocyte sedimentation rate (ESR) was done in Laboratory Teaching center of Baghdad Hospital.

Determination of Cholesterol: Kit from fortress diagnostics limited company (United Kingdom) was used to determine total cholesterol. Cholesterol is present in serum as cholesterol esters and free cholesterol. The cholesterol esters present in serum are hydrolysed by cholesterol esterase and the cholesterol is then measured by oxidizing  with  cholesterol  oxidase  to  form  hydrogen  peroxide.  The  hydrogen peroxide in turn reacts with phenol and 4-aminoantipyrine present to form the red quinoneimine dye. The intensity of the dye formed is directly proportional to the level of cholesterol present in the sample [12].

Determination of Glucose: Kit from Randox Laboratories limited company (United  Kingdom)  was  used  to  determine  glucose.  Glucose  is  determined  after enzymatic  oxidation  in  the  presence  of  glucose  oxidase.  The  hydrogen  peroxide formed reacts, under catalysis of peroxidase, with phenol and 4-aminophenazone to form a red – violet quioneimine dye as indictor[13].

$$\text{Glucose} + O_2 + H_2O \xrightarrow{\text{GOD}} \text{gluconic acid} + H_2O_2$$

$$2H2O2 + 4\text{-aminophenazone} + phenol \xrightarrow{POD} quinoneimine + 4H2O$$

Total cholesterol and glucose levels in serum of patients with atherosclerosis and type (2) diabetes mellitus were estimated with colorimetric method

**Statistical analysis**

Descriptive statistics for all data of each set were expressed as a mean ± SD. and compared using independent sample (t) test $p<0.05$ were considered statistically significant. The overall productive values for the results in studied groups were performed according to program of office xp.

Results: Table (1 and 2) show a total of 120 subjects 60 were suffering from atherosclerosis and 60 of type (2) diabetes mellitus they were compared with 30 healthy subjects.

The mean values of glucose levels in serum of patients with atherosclerosis were significantly higher as compared to healthy control group ($P < 0.001$), also the mean values of type (2) diabetes mellitus levels were significantly higher as compared to healthy control group ($P < 0.001$), as shown in table 3 and 4. By using a correlation analysis, there was a positive relationship found between total cholesterol and glucose levels in patients with atherosclerosis ($r = 0.341$) as shown in Figure (1). Also there was a positive relationship ($r=0.534$) found between total cholesterol and glucose levels in patients with type (2) diabetes as shown in Figure (2).

**Discussion:** inflammation is important in all phases of heart disease including the early initiation of atherosclerosis plaque within the arteries, as well as the acute rupturing of this plaque, that result in heart attack of all two often sudden death. The present study showed a significant increase in serum glucose concentration of patients with atherosclerosis as compared with healthy control and this agree with a study that blood glucose may affect the development of artheriosclerosis by impairing endothelial function[14], and elevated glucose increases the risk for coronary artery disease (CAD) [15]. Hyperglycemia can damage both the kidney and the arterial wall through deposition of advanced glycation end products, generation of reactive oxygen species[16]. In this study there is a significant increase in total cholesterol concentration in patients with type (2) diabetes mellitus as shown in a study that people with type 2 diabetes have dangerously high levels of LDL "bad" cholesterol and triglycerides that circulate in the blood stream, these elevated levels are associated with an increased risk of cardiovascular disease[17], also agree with a study that type 2 diabetes is associated with a marked increased risk of cardiovascular disease (CVD) [18]. Another study showed that adults with diabetes have elevated triglycerides, low levels of HDL cholesterol, and increased presence of small, dense LDL particles[19], and have a two to four times higher risk of experiencing cardiovascular events than adults without diabetes[20,21] . There is appositive correlation between glucose  and total cholesterol concentrations in both atherosclerosis and type (2) diabetes mellitus patients and this due to that long chain of fatty acid inhibit enzymes of  the control points in glycolysis which lead to increase of  glucose concentration, and in another hand elevated glucose provide an energy as adenosine triphosphate (ATP) which inhibit the metabolism of cholesterol[22] .

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**Table (1) Characteristics of atherosclerosis patients and controls.**

| Parameters | Patients with atherosclerosis (N = 60) Mean ± SEM | Healthy Control (N= 30) Mean ± SEM | P-value | Sig. |
|---|---|---|---|---|
| Age (y) | 56.86± 2.54 | 58.32 ± 2.76 | 0.45 | NS |
| BMI (kg/m2) | 27.32 ± 0.51 | 26.31 ± 0.45 | 0.30 | NS |

**Table (2) Characteristics of type (2) diabetes mellitus patients and controls**

| Parameters | Patients with type(2) diabetes mellitus (N = 60) Mean ± SEM | Healthy Control (N= 30) Mean ± SEM | P-value | Sig. |
|---|---|---|---|---|
| Age (y) | 59.43± 2.23 | 58.32 ± 2.76 | 0.47 | NS |
| BMI (kg/m2) | 27.45± 0.75 | 26.31 ± 0.45 | 0.33 | NS |

Values are the (mean ± SD), BMI=body mass index, NS=not significant, and N=number of samples.

**Table (3) Serum glucose levels (mean ± SD) in patients with atherosclerosis (N=60) and controls (N=30).**

| Parameters | Patients with atherosclerosis (N = 60) Mean ± SEM | Healthy Control (N= 30) Mean ± SEM | P-value | Sig. |
|---|---|---|---|---|
| Glucose (mg/dl) | 204.65± 5.54 | 91.09 ± 3.66 | 0.001 | HS |
| Total cholesterol (mg/dl) | 320± 4.46 | 158.89 ± 3.54 | 0.001 | HS |

**Table (4) Serum Total cholesterol levels (mean ± SD) in patients with type (2) diabetes mellitus (N=60) and controls (N=30).**

| Parameters | Patients with type(2) diabetes mellitus (N = 60) Mean ± SEM | Healthy Control (N= 30) Mean ± SEM | P-value | Sig. |
|---|---|---|---|---|
| Total cholesterol (mg/dl) | 247.03± 5.88 | 158.89 ± 3.54 | 0.001 | HS |
| Glucose (mg/dl) | 291.78±3.67 | 91.09 ± 3.66 | 0.001 | HS |
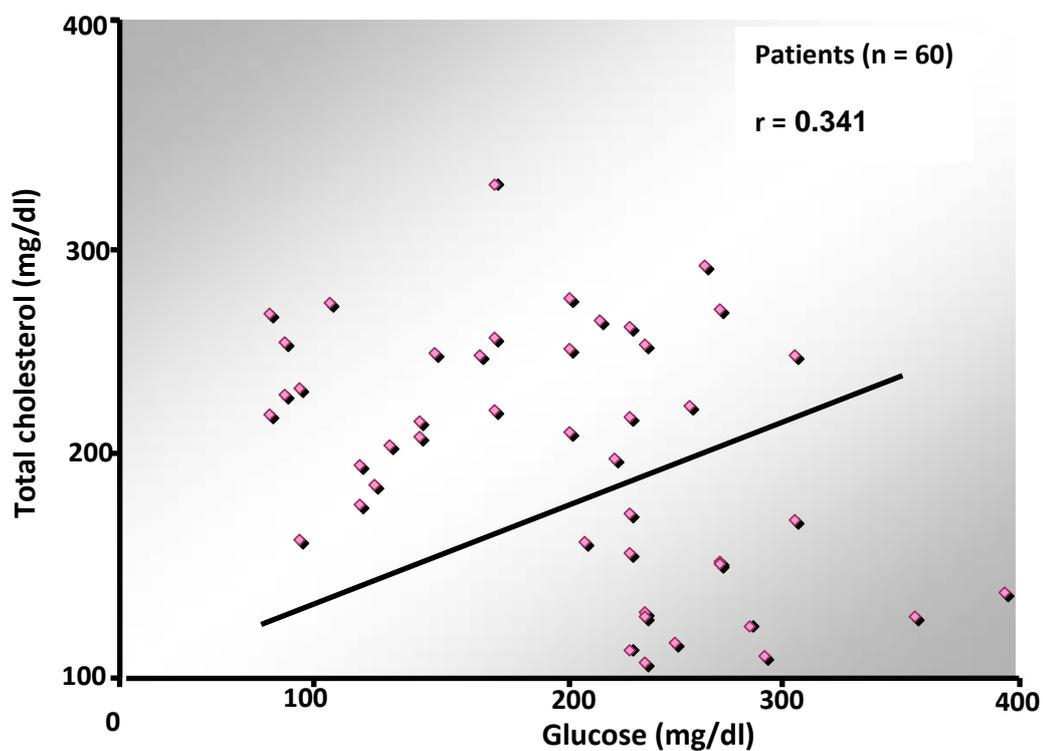


**Figure (1) Correlation between total cholesterol and glucose in patients with atherosclerosis.**

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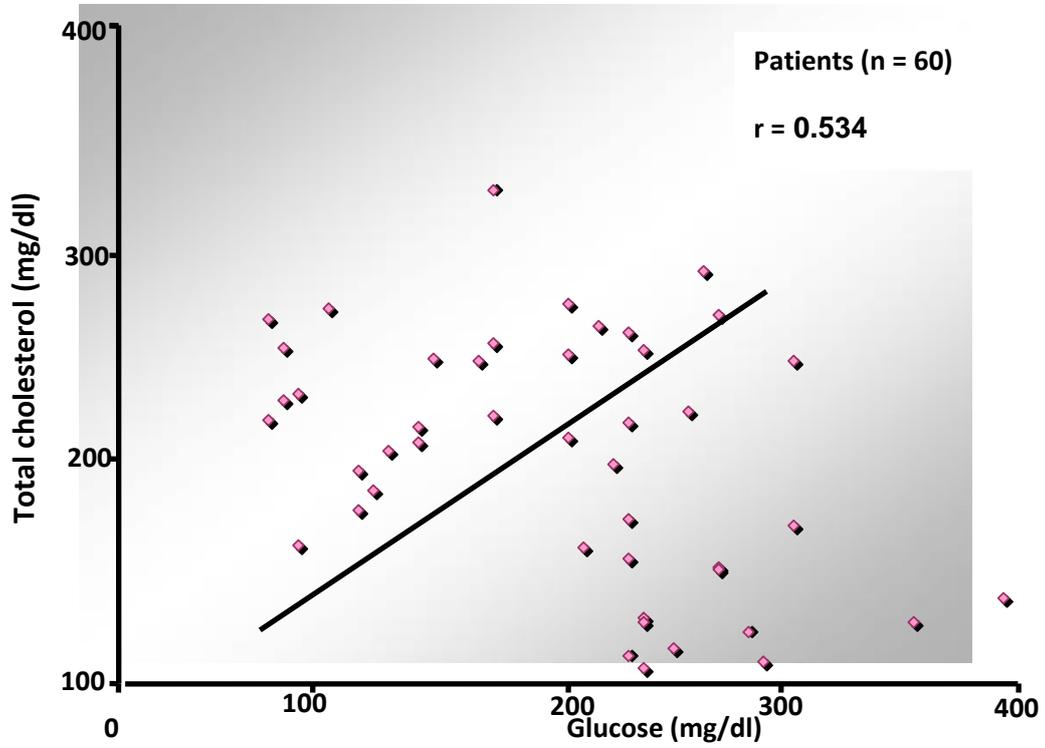and Diabetes Mellitus Type 2



**Figure (2) Correlation between total cholesterol and glucose in patients
with type (2) diabetes mellitus.**