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## **Toxoplasma Infection Alters Lipid Profiles Challenging Cardiovascular Norms**

### *Infeksi Toksoplasma Mengubah Profil Lipid yang Menantang Norma Kardiovaskular*

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#### **Abstract**

This study conducted at Baquba Teaching Hospital from January to April 2024, investigated the lipid profiles of 75 participants (50 patients with Toxoplasma and 25 controls) aged between 50 and 60 years. Existing research suggests a potential link between Toxoplasma infection and alterations in lipid metabolism; however, specific effects on different lipid fractions are not well-understood. This study aimed to explore the association between Toxoplasma infection and changes in lipid profiles, particularly focusing on whether infection status correlates with variations in high-density lipoprotein (HDL) levels. Venous blood samples were collected pre-breakfast and processed to obtain serum, which was analyzed for lipid profiles. The findings indicated that lipid levels generally increased in Toxoplasma patients compared to controls, except for a decrease in HDL levels. These results suggest that Toxoplasma infection could influence lipid metabolism, potentially impacting cardiovascular risk. Further research is needed to understand the mechanisms underlying these changes and their clinical implications.

#### **Highlights:**

- Toxoplasma infection is linked to significant changes in lipid profiles.
- The study identifies a unique decrease in HDL levels among infected individuals.
- Implications suggest potential cardiovascular risks associated with Toxoplasma.

**Keywords:** Toxoplasma, Lipid Metabolism, Cardiovascular Risk, HDL Decrease

Published date: 2024-06-07 00:00:00

## Introduction

The protozoan parasite infection One of the most prevalent parasite infections in humans and other warm-blooded animals is *Toxoplasma gondii*. It can be found all throughout the world, from Australia to Alaska. Approximately one-third of the human race has encountered this parasite [1]. Most adults are not very ill from it, but in congenitally infected children, blindness and mental retardation can occur; in individuals infected after birth, blindness can occur; and in immunocompromised individuals, the disease can be fatal. The two main risk factors for *T. gondii* infection are eating or drinking anything contaminated with oocysts and consuming raw or undercooked animal products.

### 1. *Toxoplasma Gondii* and Lipid Profile

*Toxoplasma gondii*, a member of the Apicomplexa eukaryotes, is the source of toxoplasmosis, an infection. Toxoplasmosis is a common disease that affects warm-blooded animals and humans alike. The economy and public health are both seriously threatened by this protozoan parasites [2]. Because *T. gondii* infections can result in a variety of clinical outcomes, include abortions, mental impairment, hydrocephalus, retinochoroiditis, and even death and With potentially fatal encephalitis in AIDS patients receiving organ transplants and immunosuppressive medication, they nevertheless represent a major risk to public health [3], [4]. According to estimates, *T. gondii* infections impact between 30% and 65% of the world's population [5]. Human seroprevalence of *T. gondii* infections rises with age, but it is lower in colder climates and does not differ much between genders [6]. In Iraq, attention to Toxoplasmosis has disease recently sharply increased as a result of multiple investigations [7], [8]. Many researchers have been interested in the role that serum biochemical parameters play in human infections with certain parasites. These measures comprise total protein, total globulin, total albumin, (LDL) high-density lipoprotein, (VLDL) very-low density lipoprotein, (LDL) low-density lipoprotein, triglycerides, and cholesterol levels [9]. Studies conducted in vitro showed that these parasites may proliferate in lipid, rich, serum-free medium [10]. Assessing the levels of specific biochemical markers in individuals who test positive or negative for *Toxoplasma* is the goal of this study.

## Methods

### A. Standard Kits

Kit Name	Company	Origin
TOTAL CHOLESTEROL	CROMATEST(LINEAR)	Spain
HDL-CHOLESTEROL	CROMATEST(LINEAR)	Spain
LDL_ CHOLESTEROL	CROMATEST(LINEAR)	Spain
VLDL_ CHOLESTEROL	CROMATEST(LINEAR)	Spain
TRI GLYCERIDE	CROMATEST(LINEAR)	Spain
BLOOD GLUCOSE	SIGMA	USA

**Table 1.** *The used kits*

### B. Equipment and Tools

Equipment	Company	Origin
CENTRIFUGE	HERAEUS-CHRISTGMBH	GERMANY
EPPENDORF TUBE	AFICO-DISP	JORDEN
MICROPIPETTE	GILSON	FRANCE
MULTI-CHANNEL MICROPIPETTE	GILSON	FRANCE
DEEP-FREEZE	GORENJE	SERBIA
SEMI-AUTO ANALYSER	MINDRAY	MALIZIA
INCUBATION	WTEBINDER	GERMANY
GELTUBE	XINLE	CHINA
TIPS	AFICO-DISP	JORDEN
VACUUM EDTA TUBES	AFICO-DISP	JORDEN
DISPOSABLE SYRINGES	A.D MEDICAL DEVICE	UAE
COBAS INTEGRA 400 PLUS	ROCHI	GERMANY

**Table 2.** *Instruments with their company and the origin*

## C. Study Design

The study is designed on 75 person (50patients and 25 control ) with Toxoplasma at range (50-60 y ) between January 2024 and April 2024 in the (central care unit) of the Baquba Teaching Hospital (B.T.H), the total number inthis study include conservatives 40 men and35 women .

The patients groups include :

1. Gender (30 male and 20 female)
2. Age of patients groups (50-60 years)

## D. Blood Sample Collection

Blood is taken from each participant early in the morning, before to breakfast. Venous blood samples ranging from 10 to 15 milliliters were obtained from both patients and controls, and the samples were stored in a gel tube at room temperature for fifteen minutes (anticoagulant not included). After that, the serum was split into four aliquots by centrifugation at 3000 xg for fifteen minutes, and it was refrigerated at -20 °C until it was needed for a biochemical analysis.

### 1. Determinations of Human Choleisterols

#### a. Principle

The following is the reaction strategy for the enzymatic technique as described by Allain et al. :

Cholesterols esters → Cholesterols+free fattyacids

cholesterols + O<sub>2</sub> → Cholesten 4 one<sub>3</sub>+H<sub>2</sub>O<sub>2</sub>

2H<sub>2</sub>O<sub>2</sub> + Phenols + PAP → Quienoneimine (pink) + 4 H<sub>2</sub>O

#### b. Reagent Preparations

Remove the aluminum cap with a non-sharp instrument. Quickly fill vial R1 with the contents of vial R2. Gently stir until fully dissolved. Vial R3: Ready used .

#### c . Assay Procedoure

##### 1) Manaus Methods

Keep the reagent and the samples on room temperatures.

Reagents	1000 uL
Blank, Standard, Control orspecimen	10 uL
Blend. Allow to stand for five minutes at 37°Celsius or ten minutes at room temperatureS.At 500 nm (480-520), note absorbances in relation to the reagent blanks.For one hour, the color remains consistent.	

**Table 3. The reagent and the samples on room temperatures**

- a) User validation is required for performances involving manual procedures.
- b) Applications for Kenza and other applications are available upon request.

### 2. Determinations of Human LDL-Cholesterols

#### a. Principe

Low-density lipoproteins (LDL) are specifically precipitated by polyvinyl sulfate in whole serum, which is the basis for the separation procedure used in this technique, Centrifugation is used to settle the precipitant, and the clear supernata is then tested for residual cholesterol from the remaining lipoproteins (VLDL+ HDL). Calculating LDL-cholesterol involves deducting the sample's total cholesterol from the supernatant cholesterol fractions.

#### b. Reagents Preparations



Until the date of expiration indicated on the label, all of the kit chemicals remain stable. During use, keep the vials tightly closed, shielded from light, and free from contaminations.

## c. Procedures

### 1) Precipitating

a. Samples and reagents should be brought on room temperatures.

b. Pipette in centrifuge tubes that have been labeled

Samples or Standards	0.2 mL
Precipitations Reagent	0.1 mL
Ratio = Samples / Reagent = 1/0.5 Dil.factors = 1.5	

**Table 4.**

c. Vortex, then let rest at room temperature for ten minutes.

d. You can centrifuge for two minutes at 12,000 rpm or for ten minutes at 6000 rpm.

e. For the purpose of measuring cholesterol, removed of aliquot from the supernatant.

### 2) Calorimetry

a. Allow the kit's and the cholesterol MR's components to come to room temperatures.

b. Set up two sets of tests so that the total cholesterol in the sample and the cholesterol that is still in the supernatant may be measured simultaneously. Observe the insert's directions for total cholesterol.

c. Pipette into tubes with labels

TUBES	Blank	Samples Supernats	Standards Supernats
Monoreagent	1.0mL	1.0mL	1.0mL
Supernats	~	50µL	~
Standard	~	~	50µL

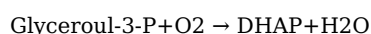
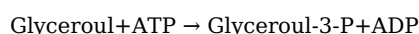
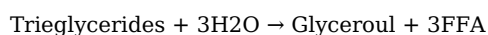
**Table 5. Pipette into tubes with labels**

Under light protection from light, the color remains constant for at least half an hour

## 3. Determinations of Human Triglycerides MR

### a. Principle

The foundation of method 1,2 is the enzymatic breakdown of serum or plasma triglyceride by lipoprotein lipase (LPL), which yields glycerol and free fatty acids (FFA). Adenosine triphosphate (ATP) phosphorylates glycerol in the presence of glycerol kinase (GK), resulting in the formation of glycerol-3-phosphate (G-3-P) and adenosine diphosphate (ADP). Glycerol phosphate Oxidase (GPO) oxidizes G-3-P to produce hydrogen peroxide and dihydroxyacetone phosphate (DHAP). When 4-aminoantipyrene (4-AA) and phenol are coupled with hydrogen peroxide (H<sub>2</sub>O<sub>2</sub>) under the action of peroxidase (POD), a red chromogen is created that is proportionate to the amount of triglycerides present in the sample.



### b. Reagents Preparations

Both the Standards and the Monoreagents are prepared for usage.

### c. Procedures

1) Let the samples and reagents come on room temperature.

2) Pipette into tubes that have been labeled

TUBES	Biank	Samples	CAL. Standards
R1.Monoureagent	1,0mL	1,0mL	1,0mL
Samples	~	10L	~
CAL.Standards	~	~	10L

**Table 6.**

3) Stir, then leave the tubes for either five minutes at 37°C or fifteen minutes on room temperature (16-25°C).

4) After calibrating the samples and standards on 500 nm, compares their absorbance (A) with the reagent blank.

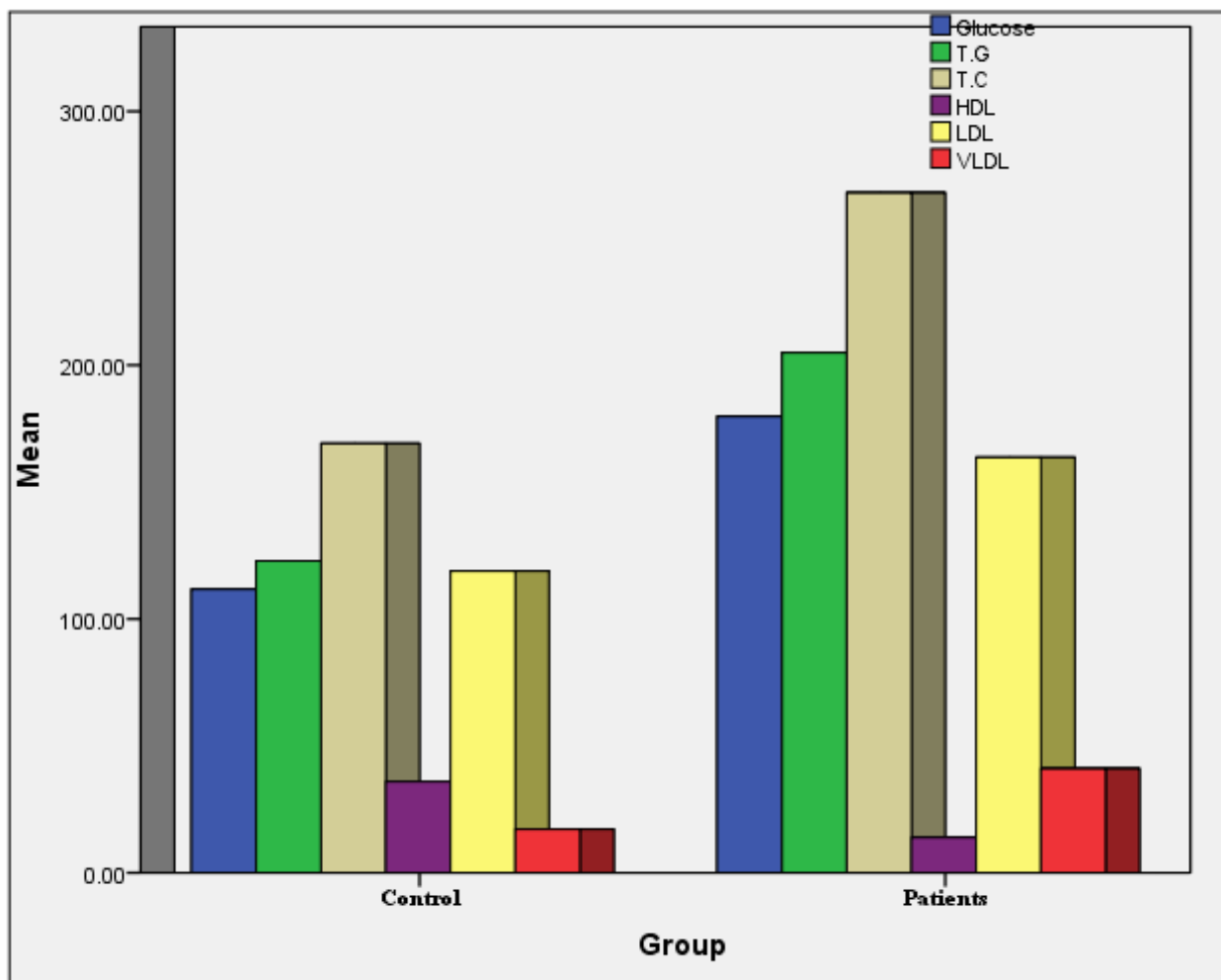
## Result and Discussion

### A. Lipid Profiles and Glucose Biomarkers Among Study Groups

Patients with toxoplasmosis exhibited significantly higher mean levels across multiple parameters compared to healthy controls. Specifically, inpatient with toxoplasmosis, the mean levels for glucose were  $179.74 \pm 14.33$  mg/dL, compared to  $111.68 \pm 8.68$  mg/dL in healthy controls ( $P = 0.001$ ). Triglycerides (TG) levels were  $204.88 \pm 33.92$  mg/dL in patients and  $122.88 \pm 29.14$  mg/dL in controls ( $P \sim 0.001$ ). Total cholesterol (Total Ch) levels showed a mean of  $267.90 \pm 20.66$  mg/dL in patient and  $169.08 \pm 17.63$  mg/dL in control ( $P = 0.001$ ). High-Density Lipoprotein (HDL) level was significantly lower in patient ( $13.92 \pm 3.87$  mg/dL) compared to controls ( $35.96 \pm 3.01$  mg/dL) ( $P \sim 0.001$ ). (LDL) Low-Density Lipoprotein levels were higher in patients ( $163.60 \pm 17.98$  mg/dL) compared to controls ( $118.84 \pm 5.49$  mg/dL) ( $P = 0.001$ ). Very Low-Density Lipoprotein (VLDL) levels were higher in patients ( $40.98 \pm 6.78$  mg/dL) compared to controls ( $17.12 \pm 3.81$  mg/dL) ( $P = 0.001$ ). These findings highlight the significant metabolic and lipid profile alterations associated with toxoplasmosis, as detailed in Figure 1.

<u>S.t.s</u>	<u>Case</u>	<u>N.</u>	<u>Me an</u>	<u>Std.Devei</u> <u>ation</u>	<u>Std.Error</u> <u>Mean</u>	<u>P</u> <u>valoue</u>
Glucose	Patients	50	179.7400	14.32966	2.02652	0.001
	Control	25	111.6800	8.68293	1.73659	
T.G	Patients	50	204.8800	33.91504	4.79631	0.001
	Control	25	122.8800	29.13520	5.82704	
Total.Ch	Patients	50	267.9000	20.66274	2.92215	0.001
	Control	25	169.0800	17.62555	3.52511	
HDL	Patients	50	13.9200	3.86950	.54723	0.001
	Control	25	35.9600	3.00666	.60133	
LDL	Patients	50	163.6000	17.97845	2.54254	0.001
	Control	25	118.8400	5.48999	1.09800	
VLDL	Patients	50	40.9760	6.78301	.95926	0.001
	Control	25	17.1200	3.81139	.76228	
<u>P valoue</u> < 0.05				<u>* <i>Indepenedent-sample Ttest</i></u>		
<u>* <i>Valoues are expresse</i></u> <u>d</u> <u>as mean ±stundard</u> <u>error(SE)</u>						

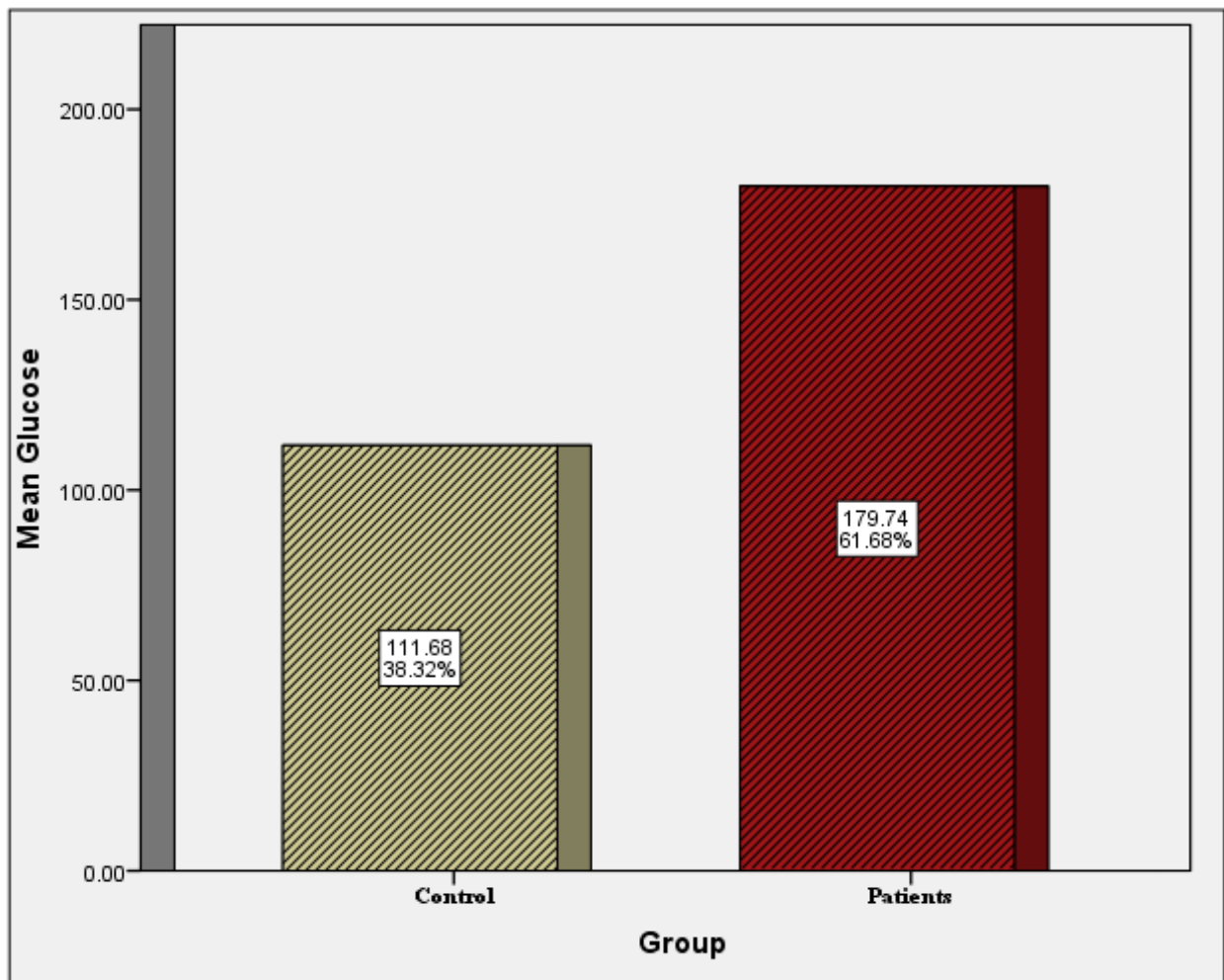
**Figure 1. Comparative Analysis of Laboratory Test Results in Patients with Toxoplasmosis and healthy Controls**



**Figure 2. Lipid Profiles and Glucose values for control and patient group**

## B. Blood Glucose

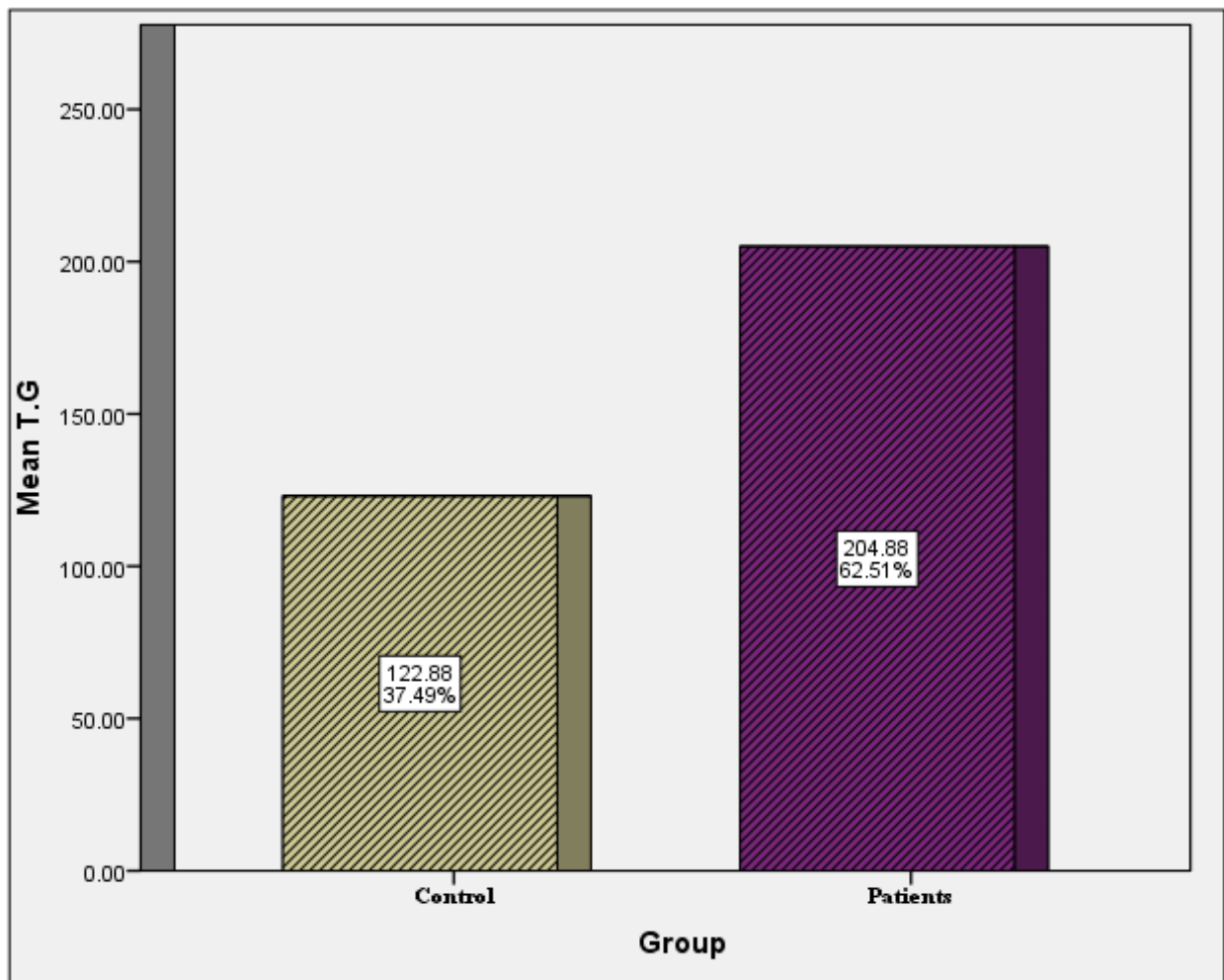
For glucose levels, patients with toxoplasmosis (N=50) had a mean of 179.74 mg/dL, compared to 111.68 mg /dLin healthy contruols (N=25) (P ~ 0.001). The findings were in agreement with Anastasia Poznyaket al. (2020),[11]



**Figure 3. Glucose values for control and patient group**

### C. Triglycerides (T.G.)

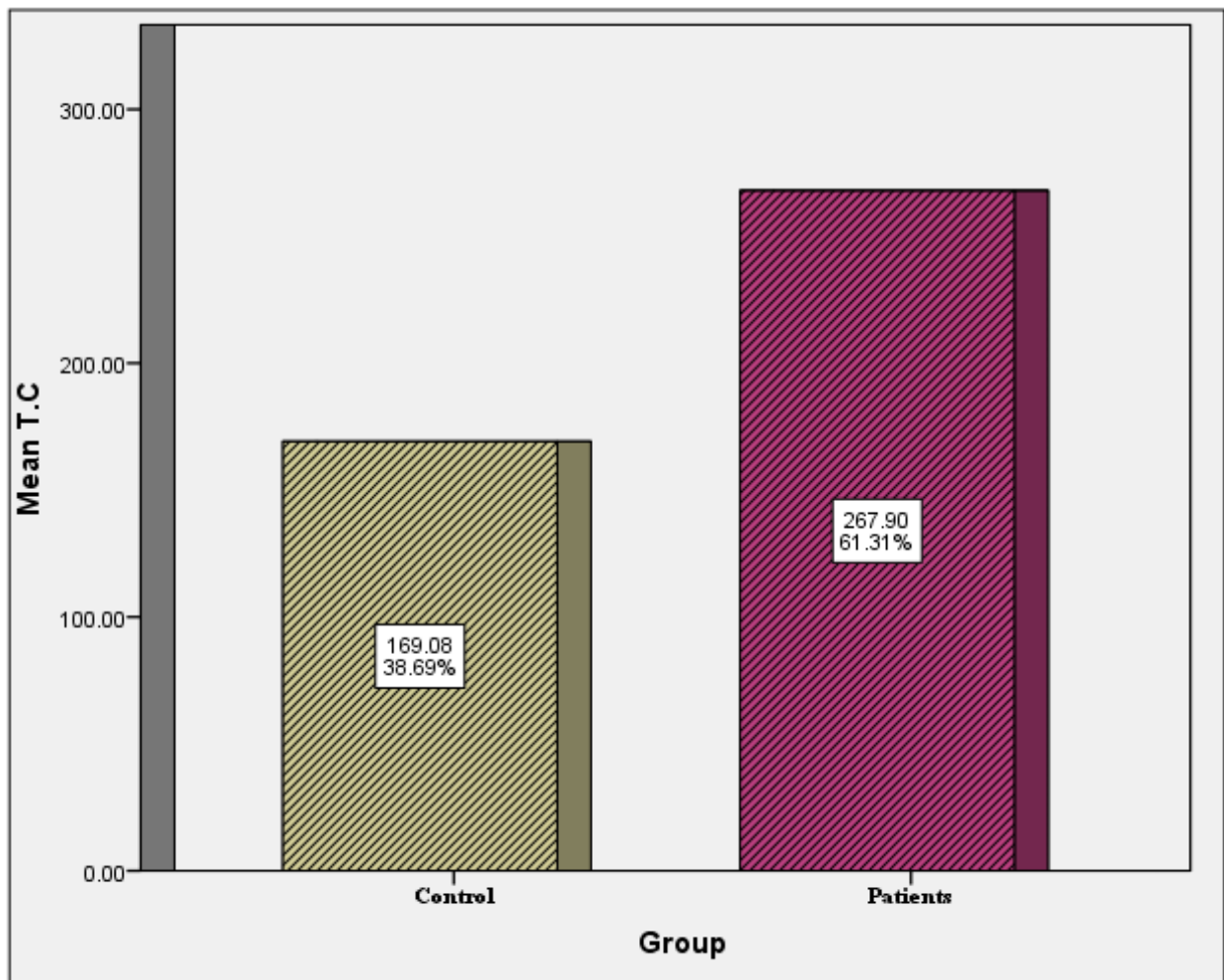
Triglycerides (T.G.) levels were significantly higher in patients (mean = 204.88 mg/dL) compared to controls (mean = 122.88 mg/dL) ( $P = 0.001$ ). This outcome agreed with that of Lambertini C.et al. [12] were seen to be rising in T.G.'s serum.



**Figure 4.** *Triglycerides values for control and patient group*

#### D. Total C holesterol s (T C)

Total cholesterol (TC) levels were also higher in patients (mean = 267.90 mg/dL) compared to controls (mean = 169.08 mg/dL) ( $P = 0.001$ ) This outcome was in agreement with Maha Radhi Abeass, et al. were seen rising in the total cholesterol serum sample.

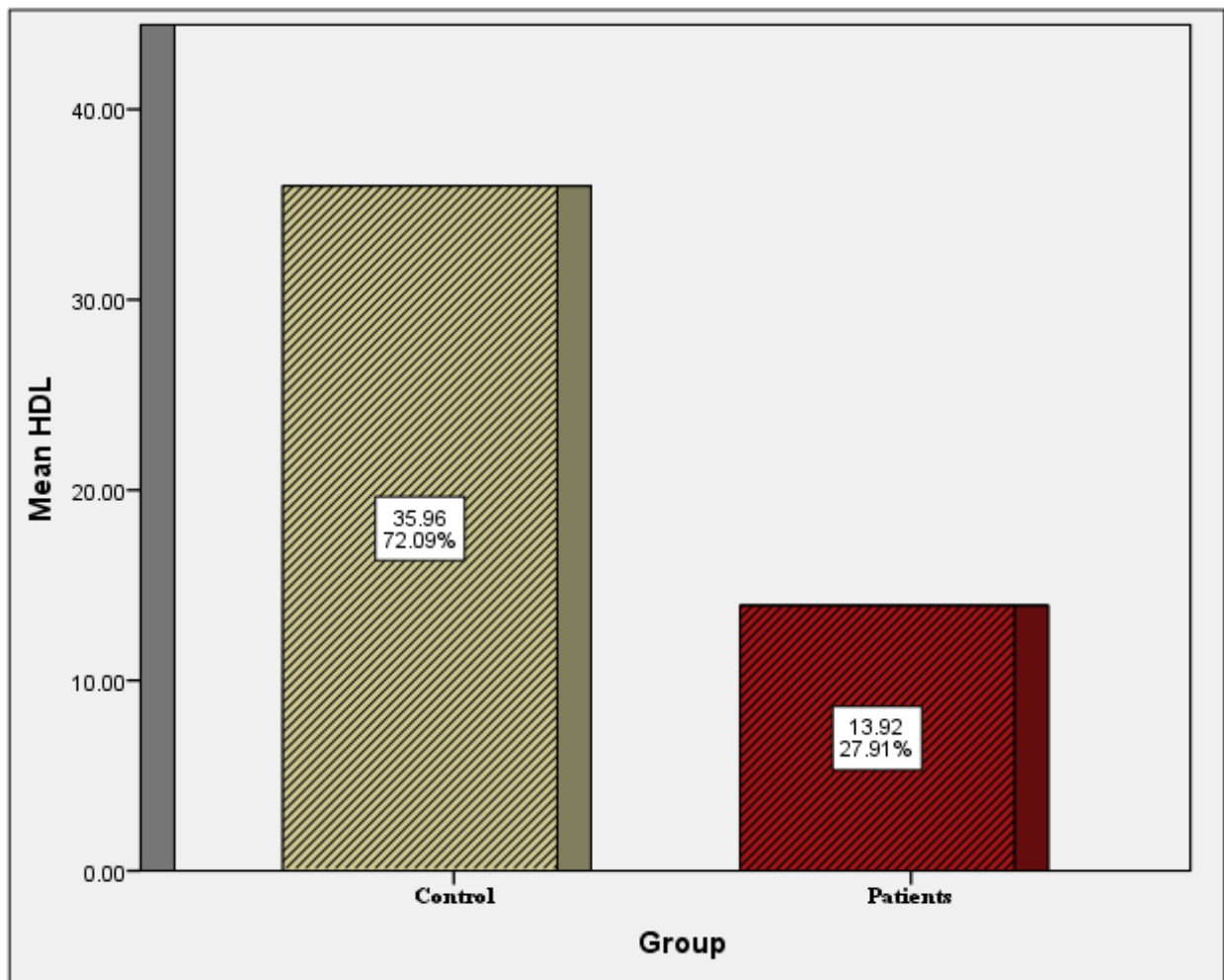


**Figure 5. Total cholesterol values for control and patient group**

### E. High Denesity Lipouprotein (HDL)

Patients had significantly lower levels of High-Denesity Lipouprotein (HDL) (mean~13.92 mg/dL) than controls (mean~35.96 mg/dL) ( $P \sim 0.001$ ). This outcome was in agreement with Maha Radhi Abeass, et al. [12] were found to be declining in the HDL cholesterol serum level.



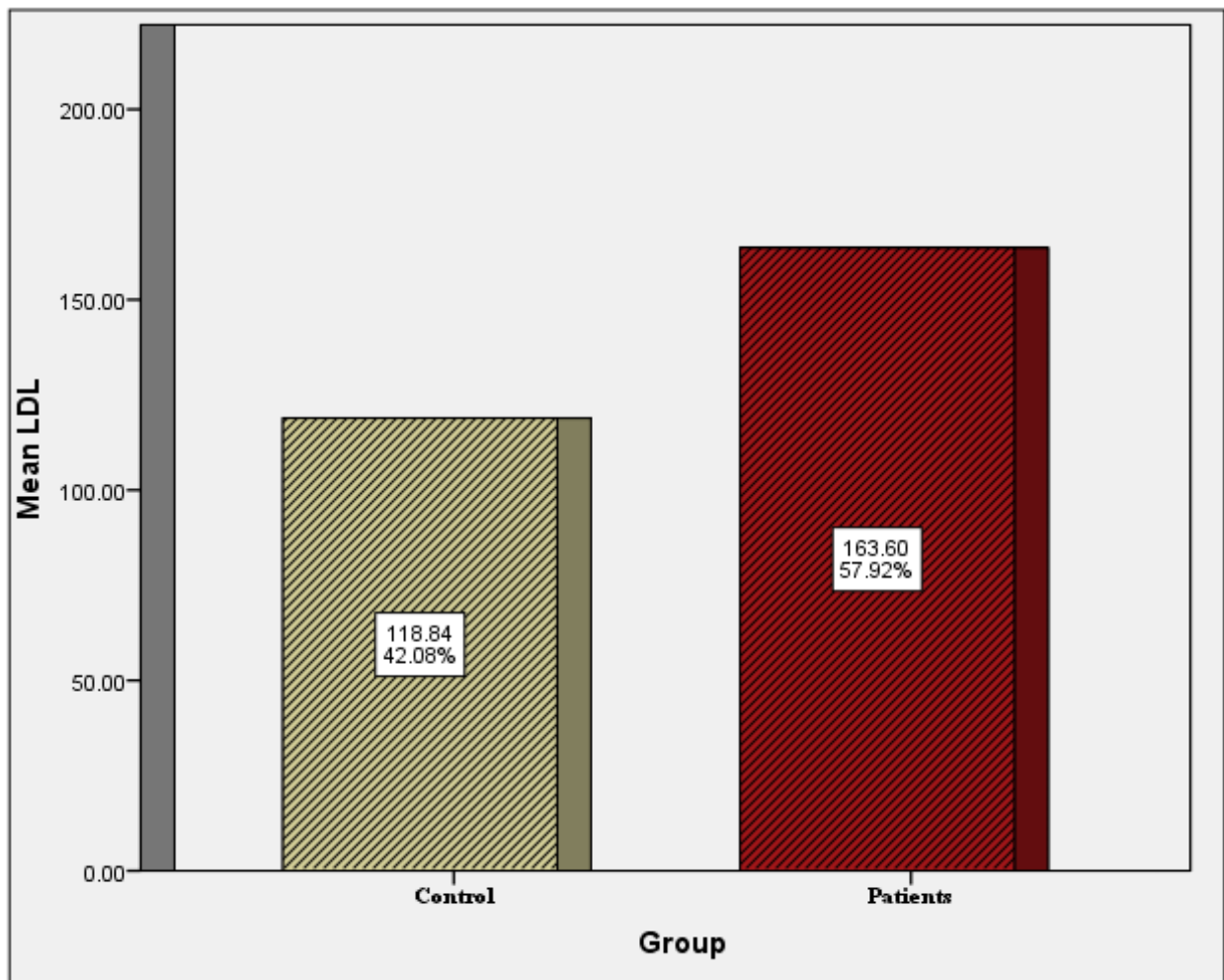


**Figure 6.** HDL cholesterol values for control and patient group

## F. Low Denesity Lipouprotein (LDL)

Patients had greater mean levels of low-denesity lipouprotein (LDL) (163.60 mg/dL) than controls (mean = 118.84 mg/dL) ( $P = 0.001$ ). This outcome was consistent with Lambertini C.,et al. [13] were shown to be rising in the LDL serum.

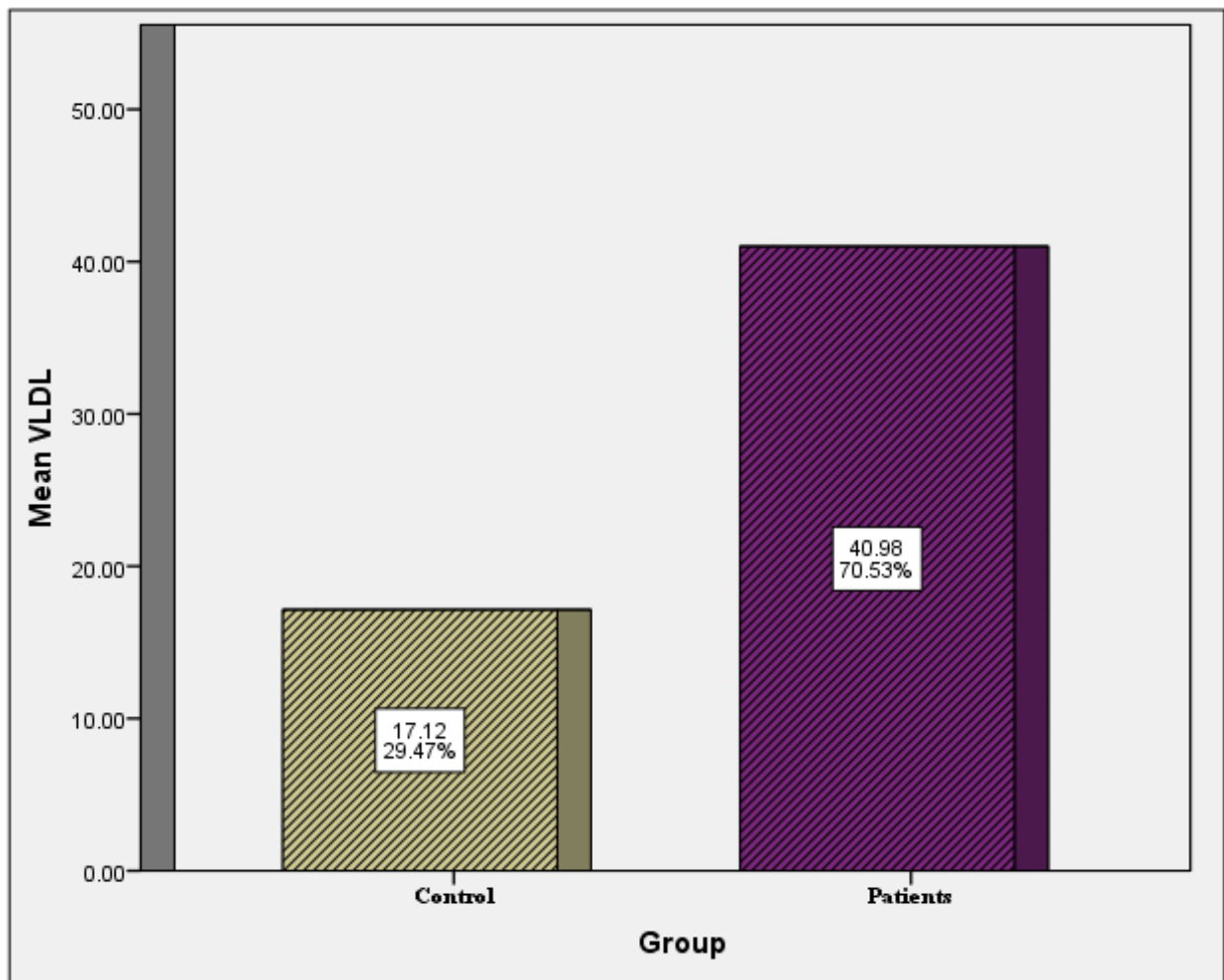




**Figure 7. LDL cholesterol values for control and patient group**

### G. Very Low Denesity Lipouproteib (V.LDL)

Very,Low-Denesity Lipouprotein (V.LDL) level was higherin patients (meun~40.976mg/ dL) comepared to control (meun~17.12mg/ dL) (P~0.001). This outcome was consistent with Lambertini [14] were shown to be rising in the VLDL serum.



**Figure 8.** VLDL cholesterol values for control and patient group

## Conclusion

1. The results observed increasing in (Glucose ) values with Toxoplasma Patients.
2. Increasing of Lipid profile ( Total cholesterol , LDL cholesterol , T.G and VLDL ) with Toxoplasma Patients.
3. The HDL cholesterol decreases with cases Toxoplasma Patients.

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