

# Insulin and Glucagon Hormone Levels in Women with Diabetes and Toxoplasmosis in Tikrit: A Comparative Study of Co-infection and Control Groups

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## Abstract

The current study included measuring the level of the hormone insulin and some other hormonal variables for 210 samples of women who were referred to the outpatient clinics for a period from October 2021 to March 2022. A group with diabetes and toxoplasmosis, a group with diabetes, and a control group. The results of the statistical analysis demonstrated that there was no significant difference in insulin hormone levels between women with toxoplasmosis and the control group ( $9.42 \pm 3.38$ ). However, a significant decrease in insulin levels was observed in diabetic women ( $3.14 \pm 1.33$ ) and in those co-infected with toxoplasmosis and diabetes ( $3.905 \pm 1.51$ ) as compared to the control group, at a significant level of  $P \geq 0.05$ , and when studying the concentration of glucagon hormone, The insulin hormone levels of women with toxoplasmosis were not substantially different from those of women in the control group, according to the statistical analysis, although only the group infected with toxoplasmosis, diabetes, and diabetes mellitus showed a significant rise, which amounted to ( $104.00 \pm 22.10$ ,  $89.33 \pm 24.10$ ) respectively compared to the control group ( $68.35 \pm 13.46$ ) at the level of significance  $\leq 0.05$ .

**Keywords:** *Toxoplasmosis, insulin hormone, glucagon hormone, diabetes., hormonal variables, women, outpatient clinics, diabetes, insulin levels, glucagon hormone, co-infected, concentration, significant difference, control group comparison, significance level.*

## INTRODUCTION

Toxoplasmosis is an infectious disease resulting from the invasion of the protozoan parasite *Toxoplasma gondii*, which can lead to various health complications. which must live inside of human cells in order to survive. Cats are the definitive hosts, although many different kinds of animals and birds act as intermediate hosts (Saeed and Al-Aubaidi, 2020; Mahfouz et al., 2019). Approximately one-third of the global population is infected with toxoplasmosis, as reported by Robert-Gangneux et al. (2017), highlighting the

widespread prevalence of this parasitic infection. making it one of the most widespread parasite infections. Pregnant women and others with impaired immune systems are particularly vulnerable to this infection (Opsteegh et al., 2019). Field animals, warm-blooded animals, poultry, and wild birds can all contract this parasite; humans are not immune, either. It is an obligatory intracellular parasite, meaning it can only reproduce inside of infected cells, regardless of whether or not those cells are healthy (Alaraji et al., 2019; Al-Ghezy, 2017).

Pregnant women can contract congenital toxoplasmosis since that is when the *Toxoplasma gondii* parasite is most commonly transmitted. Miscarriage and fetal mortality can occur as a result of an infection, which can cause immunological alterations in IgM and IgG levels, fetal abnormalities, and changes in placental tissue (Aldabagh et al., 2018; Young et al., 2018).

As stated by the World Health Organization (2019), diabetes mellitus (DM) represents a group of metabolic disorders characterized by the presence of elevated blood glucose levels, also known as hyperglycemia. These diseases develop when insulin produced by the body is not used properly. Diabetes mellitus refers to a condition characterized by hyperglycemia and other metabolic abnormalities that persist over time (ADA, 2019). Diabetes may be broken down into several subtypes, However, the three most prevalent forms of diabetes include Type 1 diabetes, Type 2 diabetes, and gestational diabetes, as outlined by Opara & Sam (2019).

Gestational diabetes is a form of diabetes characterized by the development of, or the diagnosis of, Glucose intolerance or glucose resistance is particularly prevalent during pregnancy (Saki et al., 2016; Shirbazou et al., 2013). Individuals with diabetes have an increased susceptibility to opportunistic parasitic infections due to their compromised immune systems.

Parasitic infections are common in people with diabetes who have compromised immune systems, according to previous research (Khattab et al., 2019). Toxoplasmosis has been identified as a common parasitic infection among diabetic patients (Li et al., 2018; Kankova et al., 2015), exhibiting a notable association between the two conditions. This

research set out to learn how toxoplasmosis infection affected levels of the hormones insulin and glucagon.

### Materials and Methods:

1. Sample Collection: Venous blood samples with a volume of 5ml were collected from female participants across all study groups using syringes. The samples were subsequently placed into test tubes containing gel and allowed to rest at room temperature (25°C) for a duration of 10 minutes. Following this, the samples underwent centrifugation at a rate of 3,000 revolutions per minute for 5 minutes, facilitating the separation of blood serum. The separated serum was then extracted utilizing a micropipette and transferred to small Eppendorf tubes for further analysis.

2. Hormone Concentration Estimation: The concentrations of insulin and glucagon hormones were determined using the Sandwich-ELISA test kit provided by the American company Biotec. This kit employs the Sandwich-ELISA method for accurate measurement.

3. Statistical Analysis: The collected data were subjected to statistical analysis utilizing Minitab software, with the application of analysis of variance (ANOVA). Duncan's multiple range test was employed to compare the arithmetic means of the coefficients, and a significance level of  $p \leq 0.05$  was considered statistically relevant, as per Al-Rawi (2000).

### Results and discussion:

The results of the insulin and glucagon concentrations in blood serum are shown in Table 1. Thirty healthy volunteers served as a control group, while 60 women with toxoplasmosis, diabetes, or both diseases were also sampled. No statistically significant

differences were observed in insulin levels when comparing women with toxoplasmosis to those without the infection., as well as the control group. At the 0.05 P level, women with diabetes alone or toxoplasmosis with diabetes had substantially lower rates (3.14 1.33 and 3.905 1.51, respectively) than the control group (8.55 2.43). This can happen because the pancreas isn't secreting enough insulin or because the body isn't making adequate utilization of the insulin that is produced (ADA, 2019).

These findings are consistent with Khalaf's (2021) findings, as well as those of Dyer et al.

(2016) and Airahi Yusuf (2017), who demonstrated that high glucose levels stimulate beta cells to generate more insulin, raising blood glucose and insulin levels. This increase reduces the ability of insulin receptors to bind to insulin. Diabetes is a metabolic condition with numerous recognized causes, including insufficient pancreatic insulin production, insulin resistance in the blood, and decreased insulin cellular response, Nonetheless, these findings are in contrast to the results reported by Majidiani et al. (2016) and Harker et al. (2015), indicating a discrepancy in the outcomes of these studies..

**Table (1): The level of the hormone insulin in blood serum of women under study.**

hormone	Groups	No.	Mean $\pm$ S.D Pg/ml
insulin	control	30	2.43 $\pm$ 8.55a
	Infected with <i>toxoplasma</i>	60	9.42 $\pm$ 3.38a
	Diabetes mellitus	60	1.33 $\pm$ 3.14b
	Toxo + Diabetes mellitus	60	1.51 $\pm$ 3.905b

The serum glucagon concentrations of The characteristics of the women included in the study are presented in Table 2. No statistically significant differences were observed between the groups under investigation. the toxoplasmosis group (66.33 14.11) and the control group (104.22 22.10), but the concentration of glucagon was significantly higher in the group of women with toxoplasmosis and diabetes than in the sugar group only (89.33 24.10), at the 0.05P. level of significance. Using your memory to help each other out with blood sugar regulation. In a 2015 study (Sandoral and D'Alessio), These findings corroborated he results align with the

findings reported by Ceriello et al. (2016), Ghadge et al. (2016), and Khalaf et al. (2015), suggesting consistency across these studies. who all found that higher wages were associated with greater job satisfaction. Consistent with the result of Beljic and his group (2016) hese studies, including those by Ceriello et al. (2016), Ghadge et al. (2016), and Khalaf et al. (2015), demonstrated a decrease in glucagon levels among diabetic patients. This reduction in glucagon levels can be attributed to the stimulation of new glucose production and the process of glycogenolysis, which consequently elevates the concentrations of circulating plasma glucose.

**Table (2): The level of the hormone glucagon in the blood serum of the women under study**

hormone	Groups	No.	Mean $\pm$ S.D Pg/ml
Glucagon Pg/ml	control	30	13.46 $\pm$ 68.35 c
	Infected with <i>toxoplasma</i>	60	14.11 $\pm$ 66.33 C
	Diabetes mellitus	60	24.10 $\pm$ 89.33 B
	Toxo + Diabetes mellitus	60	22.10 $\pm$ 104.00 A

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