

**How to Cite:**

Hassoon, M. R., Rasheed, Q. A., & Jebur, M. S. (2022). Roles of some functional hormones among pregnant women infected with toxoplasmosis. *International Journal of Health Sciences*, 6(S5), 9837–9844. <https://doi.org/10.53730/ijhs.v6nS5.12088>

## **Roles of some functional hormones among pregnant women infected with toxoplasmosis**

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**Abstract**---Toxoplasmosis represents one of the most widespread zoonosis caused by *T. gondii* parasite, an intracellular protozoan with a worldwide distribution. This disease infects all warm-blooded animals, including humans. The current study aimed to detect the role of some functional hormones among pregnant women suffering from *Toxoplasma gondii*. The study was carried out during the period from October 2021 to first February 2022 on (200) pregnant women who attended to various governmental hospitals in Maysan province of Iraq with their ages ranged from (19-35) years. Venous blood samples were collected from all pregnant women enrolled in this study. The results showed that of the total (200) pregnant women, 97(48.50%) had positive IgG antibodies to toxoplasmosis, while 103(51.50%) had negative IgG antibodies to toxoplasmosis. The results also exhibited that of the total (200) pregnant women, 11(5.50%) had positive IgM antibodies to toxoplasmosis, while 189(94.50%) had negative IgM antibodies to toxoplasmosis. In patients with IgG positive antibodies, the mean luteinizing hormone (LH) level was (2.69 ±0.33), and in patients with IgG negative antibodies, the mean LH level was (2.23 ±0.24), while in patients with IgG positive antibodies, the mean follicular stimulating hormone (FSH) level was (5.48 ±1.35), and in patients with IgG negative antibodies, the mean (FSH) level was (9.09 ±5.86), whereas it was shown that in patients with IgG positive antibodies, the mean total progesterone level was (29.69 ±3.95), and

in patients with IgG negative antibodies, the mean progesterone level was (32.05 ±3.89). Results of present study concluded that there was no significant difference was shown between the number and percentage of IgG+ and IgG- toxoplasma patients, while a highly significant difference was shown between the number and percentage of IgM+ and IgM- toxoplasma patients. In addition no significant difference was shown between the number and percentage of IgG+ and IgG- toxoplasma patients in relation to LH, FSH and progesterone hormones. A highly significant difference was shown between the number and percentage of IgM+ and IgM- toxoplasma patients in relation to LH hormone, while no significant difference was observed between the number and percentage of IgM+ and IgM- toxoplasma patients in relation to FSH and progesterone hormone levels.

**Keywords**---Toxoplasmosis, LH, FSH, Progesterone, Pregnant women.

## Introduction

*Toxoplasma gondii*, an obligate intracellular protozoan parasite with noteworthy zoonotic importance, causes toxoplasmosis in humans and warm-blooded animals [1]. Toxoplasmosis is a significant public health problem worldwide and qualifies as a One Health disease due to it significantly affects the health and well-being of humans, domestic animals, wildlife, livestock and ecosystems [2,3]. So toxoplasma is estimated as globally roughly one third of the human population has latent *T. gondii* infections, with considerable regional variations in prevalence [4]. *T. gondii* associated abortions in sheep are generally attributed to recent oocyst exposure, and control measures are focused on biosecurity procedures and vaccines where available [5].

Consumption of uncooked meat and fish containing bradyzoites are routes for toxoplasmosis. Also water, milk, and vegetables contaminated with oocysts and transfusion and transplantation of blood and organs, respectively, harboring tachyzoites from patients infected are the major sources of *T. gondii* infection in humans [6]. Cats as a final host, play an important role in spreading *T. gondii* infection. Therefore, poor hygienic management of farms, climate, presence of cats in farms, consuming raw or uncooked meat and vegetables, and inter-current diseases may act as potential risk factors influencing toxoplasmosis [7].

The parasite is transmitted mainly through many routes such as intake of undercooked meat infected with tissue cysts, drinking the water or consumption of unwashed vegetables infected with oocysts, and infection from mother to fetus [8]. LH has an important evolutionary function as it acts on both male and female gonads (testes or ovaries). It plays key roles in biological processes such as sex steroid synthesis (for both sexes) and the critical reproductive mechanism of ovulation in females [9].

Endocrine system plays an imperative role in the management of the human reproductive cycle. LH along with the two other gonadotropin hormones, follicle-stimulating hormone (FSH) and human chorionic gonadotropin (hCG), are

essential for the regulation of sexual and reproductive functioning [10]. Progesterone also influences the production of inflammatory mediators, such as human T-cells within the uterine cavity. Thus, a loss of progesterone leads to an increase in myometrial contractility coupled with a decrease in fighting off immunologic threats, ultimately leading to a higher risk of miscarriage and early delivery of the fetus [11].

## Materials and Methods

The study was carried out during the period from October 2021 to February 2022 on (200) pregnant women who attended to various governmental hospitals in Maysan province of Iraq with their ages ranged from (19-35) years. Venous blood samples were collected from all pregnant women enrolled in this study. Blood samples were put in plane tubes for 15 minutes to clot, then centrifuged for 10 minutes at 3000 rpm to obtain serum. The following tests were done for the pregnant infected women: Toxoplasma IgG antibodies, Toxoplasma IgM antibodies, serum LH, FSH and progesterone. The cobas E 411 system analyzer was used to estimate serum LH, FSH and progesterone levels, while serum toxoplasma IgG and IgM levels were detected by Cobase 801 system analyzer.

## Statistical Analysis

The Statistical Analysis System (SAS, 2012) program was used to detect the effect of different factors on the study parameters. T-test (Analysis of Variation-ANOVA) was used to compare between means. Chi-square test was used to compare between percentages and (0.05 and 0.01) probability values were used to estimate the correlation coefficient between the variables in this study.

## Results

This study included (200) pregnant women infected with toxoplasmosis. The results showed that (97) of them were infected with toxoplasmosis, while (103) of them were not infected (controls).

Table (1): Distribution of Toxoplasmosis results according to IgG+ and IgG- in the study samples

Toxoplasmosis (IgG)	No	Percentage (%)
IgG + (Patients)	97	48.50 %
IgG - (Control)	103	51.50 %
Total	200	100%
P-value	---	0.671 NS
NS: Non-Significant		

Results in table (1) showed that of the total (200) pregnant women, 97(48.50%) had positive IgG antibodies to toxoplasmosis, while 103(51.50%) had negative IgG antibodies to toxoplasmosis, with a non-significant difference ( $p=0.671$ ).

Table (2): Distribution of Toxoplasmosis results according to IgM+ and IgM- in the study sample

Toxoplasmosis (IgG)	No	Percentage (%)
IgM +	11	5.50 %
IgM -	189	94.50 %
Total	200	100%
P-value	---	0.0001
** (P≤0.01).		

Results listed in table (2) showed that of the total (200) pregnant women, 11(5.50%) had positive IgM antibodies to toxoplasmosis, while 189(94.50%) had negative IgM antibodies to toxoplasmosis, with a highly significant difference ( $p=0.0001$ ).

Table (3): Comparison between IgG+ (Patients) and IgG- (Control) groups/ Toxoplasmosis in relation to mean LH, FSH and Progesterone levels

Group	Mean ± SE		
	LH ( )	FSH ( )	Progesterone ( )
IgG + (Patients)	2.69 ±0.33	5.48 ±1.35	29.69 ±3.95
IgG - (Control)	2.23 ±0.24	9.09 ±5.86	32.05 ±3.89
T-test	0.805 NS	6.206 NS	10.945 NS
P-value	0.258	0.559	0.671
NS: Non-Significant.			

As shown in table (3), in patients with IgG positive antibodies, the mean LH level was (2.69 ±0.33), and in patients with IgG negative antibodies, the mean LH level was (2.23 ±0.24), with a non-significant difference ( $p=0.258$ ), while it was shown in table (3) that in patients with IgG positive antibodies, the mean FSH level was (5.48 ±1.35), and in patients with IgG negative antibodies, the mean FSH level was (9.09 ±5.86), with a non-significant difference ( $p= 0.559$ ), whereas it was shown that in patients with IgG positive antibodies, the mean total progesterone level was (29.69 ±3.95), and in patients with IgG negative antibodies, the mean progesterone level was (32.05 ±3.89), with a non-significant difference ( $p= 0.671$ ).

Table (4): Comparison between IgM+ and IgM-groups/ Toxoplasmosis in relation to mean LH, FSH and Progesterone levels

Group	Mean ± SE		
	LH ( )	FSH ( )	Progesterone ( )
IgM +	0.667 ±0.26	14.93 ±8.25	17.61 ±7.02
IgM -	2.56 ±0.21	6.90 ±3.22	31.68 ±2.89
T-test	1.766 *	26.763 NS	23.993 NS
P-value	0.0072	0.468	0.276
** (P≤0.01), NS: Non-Significant.			

As shown in table (4), in patients with IgM positive antibodies, the mean LH level was ( $0.667 \pm 0.26$ ), and in patients with IgM negative antibodies, the mean LH level was ( $2.56 \pm 0.21$ ), with a highly significant difference ( $p=0.0072$ ), while it was shown in table (4) that in patients with IgM positive antibodies, the mean FSH level was ( $14.93 \pm 8.25$ ), and in patients with IgM negative antibodies, the mean FSH level was ( $6.90 \pm 3.22$ ), with a non-significant difference ( $p= 0.468$ ), whereas it was shown that in patients with IgM positive antibodies, the mean total progesterone level was ( $17.61 \pm 7.02$ ), and in patients with IgM negative antibodies, the mean progesterone level was ( $31.68 \pm 2.89$ ), with a non-significant difference ( $p= 0.276$ ).

## Discussion

*Toxoplasma gondii* is an important obligate intracellular coccidian that infects virtually all warm-blooded mammals and birds. It has been documented that the pathogen affects approximately 30% of the world human population [12]. The infection of pregnant women results in miscarriage or congenital infection that causes hydrocephalus, blindness, fetal death, neurological damage/intracranial calcification and retinochoroiditis [13]. Hence, early serological screening for toxoplasmosis in pregnant women is imperative [12].

Toxoplasmosis affects women in different countries of the Arab world. Local reports concluded that in Iraq, it has been reported an infection rate with toxoplasmosis of 34.7% among pregnant women in Baghdad [14]. Women infected with *Toxoplasma* before conception with rare exception do not transmit the infection to their fetuses, while women infected with *Toxoplasma* after conception (during pregnancy) may transmit the infection across the placenta to their fetuses [15].

In the current study, the results showed that the number and percentage of pregnant women with toxoplasmosis who had positive IgG-toxoplasma antibodies was higher than the number and percentage of pregnant women with toxoplasmosis who had positive IgM-toxoplasma antibodies. The clinical diagnosis of toxoplasmosis includes serological tests detecting *T. gondii* IgG and IgM antibodies. The IgG antibody test is used to detect acute or chronic phases, while the IgM antibody test is used to confirm acute phases [16].

As the infection is usually asymptomatic in pregnant women, toxoplasmosis detection and screening during pregnancy rely on serological techniques. Although detection of both *T. gondii*-specific IgM and IgG in a single serum sample must suggest an acute infection, a past infection cannot be excluded either because *T. gondii*-specific IgM antibodies can persist for months or years after infection [17]. Results of current study was agreed with an Indian study, that revealed the seroprevalence of toxoplasma IgG and IgM among Indian pregnant women was 45% and 3.3% respectively [18], and also agreed with a study which showed that among Turkish pregnant women, the seropositive toxoplasma IgG and IgM was 60.4% and 3.0% respectively [19].

The high level of anti-*T. gondii* IgG levels in toxoplasma patients might be explained by the declining of cell-mediated and humoral immune response in

chronically infected patients due to subsequent reactivation of latent infection [20]. However, these results disagreed with the findings of [21] in Kut province of Iraq, who found a higher rate of toxoplasma IgM antibodies among pregnant women than IgG on using the ELISA technique. The main problem in diagnosis among pregnant women is long-term antibody IgM, but *T. gondii*-specific antibody (IgM) does not necessarily indicate acute infection [22]. In many cases, laboratory diagnosis of latent and acute *T. gondii* is based on detecting *T. gondii*-specific IgM and IgG antibodies [23].

The determination of the hormone levels in our study among pregnant women infected with toxoplasmosis indicated that there were non-significant differences in the levels of LH, FSH and Progesterone hormones among IgG +ve infected women when compared with IgG -ve infected women. The results of LH hormone in the present study were consistent with the findings of the study performed by [24], who found that there is no significant difference in LH hormone level between the groups under the study in pregnant infected women with toxoplasmosis.

In addition, the findings of the current study concerning the pregnant infected women correlate with the finding of Rui Y *et al.* who showed no obvious changes in LH hormone in mice infected with *T.gondii* [25]. These results were also similar to the results obtained by Al Warid SH *et al.* who found that *Toxoplasma* infection may not lead to an increase in LH in pregnant infected women [26]. That is because during pregnancy the FSH and LH levels suppressed by the high concentration of estrogen and progesterone and become undetectable during pregnancy [27].

Concerning FSH hormone results, the findings of the current study disagreed with those recorded by [26] who reported high level of FSH hormone in pregnant women infected with *T.gondii* due to the correlation of some sex hormones with the immune response; like high concentration of sex hormones correlate with low immune response, which might lead to increase susceptibility to parasitic infections. The result of progesterone hormone of recent study revealed non-significant variation  $P > 0.05$  between the study group in pregnant infected women, also [26] found no significant difference in progesterone levels among infected pregnant women. These results agreed with [28,29].

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