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Toxoplasma gondii Seropositivity in Chemotherapy- Treated Cancer Patients in Sulaimani Province, Iraq

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ABSTRACT:

Toxoplasma gondii (*T. gondii*) is a widespread intracellular parasite that infects humans and other warm-blooded animals. While usually harmless in heathy people, it can cause serious illness in those with weakened immune system. Cancer patients undergoing chemotherapy are especially at risk due to immune suppression and increase their susceptibility to infections like toxoplasmosis. A case- control study with 110 blood samples collected at Hiwa hospital, Sulaimani from cancer patients undergoing chemotherapy (n=76), and normal individual as controls from Sulaimani public health laboratory (n=34). Serum was separated and stored at (- 40˚C). Anti-*T. gondii* antibodies (IgG & IgM) were detected using the Roch Cobas® e411 automated electrochemiluminescence immunoassay.

A total of 110 individuals were evaluated, *T. gondii* IgG- antibodies were detected in (42.7%), with higher seropositivity among cancer patients (46.1%) compared to control group (35.3%) (p= 0.292). IgM- antibodies were found only in (5.9%) controls and absent in cancer patients. Among IgG- positive cancer patients, 46.8% had Solid organ tumors, (44.0%) Hematological malignancy, and (50.0%) lymphoma, with no significant difference (p=0.755). Age was a significant predictor of IgG positivity (p= 0.018, OR= 1.034), while gender showed no- association.

Although the prevalence of *T. gondii* was not significantly higher in cancer patients, the relatively high seropositivity (46.1%) is clinically important, as latent infection may reactivate during chemotherapy and cause severe outcomes, So, screening for Toxoplasmosis should receive significant attention for these patients.

Keywords: *Toxoplasma gondii*, Cancer, Chemotherapy, Cobas, IgG, and IgM antibodies.

1 INTRODUCTION

Cancer remains a leading cause of death worldwide and represents a growing public health concern, particularly in low and middle- income countries [1]. Patients undergoing chemotherapy often experience compromised immune function due to the cytotoxic effects of treatment, which weakens their ability to fight off infections [2]. This immunosuppressive state makes cancer patients more susceptible to opportunistic pathogens, including parasitic infections such as *T. gondii* [3, 4].

T. gondii is an obligatory intracellular protozoan parasite that infects one third of the global population [4, 5]. The parasite can be transmitted through ingestion of undercooked meat, contaminated food or water, blood transfusion, organ transplantation, from infected mother to her fetus (Vertical transmission) [6, 7], or by direct contact with cat feces, when felines are definitive host for *T. gondii* [8].

In immunocompetent individuals, infection with *T. gondii* is typically asymptomatic or mild[5, 7], in contrast, during pregnancy, due to immune modulation transplacental transmission in the first trimester has the greatest risk to the fetus, leading to complications such as, hydro-cephalitis, intracerebral calcifications, retinochoroiditis, mental disorders, blindness, and pneumonia [9]. however, in immunocompromised populations, such as those with HIV/AIDS, organ transplant recipients, or cancer patients receiving chemotherapy, the parasite may reactivate, and cause severe and even

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fatal complications [10, 11]. Reactivation in cancer patients may lead to toxoplasmic encephalitis, pneumonitis, or myocarditis [7, 10, 12]. Moreover, these diseases often developed without clinical symptoms, making early detection and diagnosis difficult [3, 10].

Several factors have been associated with an increased risk of Toxoplasmosis in cancer patients, including older age, sex, type and stage of malignancy, environmental exposure, dietary habitat, contact with cats and place of residence [11, 13]. Serological

tests for *T. gondii* specific IgG and IgM antibodies a reliable and cost-effective methods for detection of both acute and chronic infections [14].

Despite the global burden of toxoplasmosis, there is a lack of data regarding its prevalence in cancer patients in Iraq, particularly in Sulaimani providence. Assessing *T. gondii* seroprevalence in this high- risk group is important for improving diagnosis, prevention, and treatment decisions. This study aims to investigate the seroprevalence of *T. gondii* in cancer patients undergoing chemotherapy and compared with the normal individual that participates as a control.

2 METHODOLOGY

A case-control study with cross section design was conducted in Sulaimani province, Kurdistan region from January to June 2025. A total of 110 venous blood samples were collected, including 76 samples from cancer patients undergoing chemotherapy at Hiwa hospital (31 male and 45 female, aged between 1-79 years), and 34 samples from normal individuals visiting the Sulaimani public health laboratory (19 males and 15 females, aged between 22-75 years). Socio- demographic questionnaire was completed by each participance that included sex, age, residence, contact with cat, and types of cancer (for patients).
From each individual 3ml of blood sample were collected in a serum separated tube(without anticoagulants), allowed to clot at room temperature, then centrifuged at 3000rpm for 5 minutes, the serum was collected into 2 Eppendorf tubes. Cobas® e411 analyzer (Roch diagnostics, Germany) was used for the serological detection of Anti- *T. gondii* IgG and IgM antibodies, based on electrochemiluminescence immunoassay (ECLIA) principles.

2.1 STATISTICAL ANALYSIS

The statistical evaluation was carried out utilizing IBM SPSS Statistics software, Version 27. Descriptive statistics were calculated for all variables, displaying categorical data as frequencies and percentages. Group comparisons were made using Pearson's Chi-square test (or Fisher's Exact Test when appropriate) for categorical variables, such as differences in gender and seroprevalence. A one-way Analysis of Variance (ANOVA) was used to assess antibody levels across various cancer type subgroups, with a post hoc Bonferroni test applied for pairwise comparisons. A p-value of less than 0.05 was deemed statistically significant for all analyses.

3 RESULTS

A total of 110 participants were enrolled in this study, including 76 cancer patients undergoing chemotherapy (69.1%) and 34 normal individuals as a control (30.9%). The age distribution of cancer patients varied from <20 to 79 years, with a mean age of 51.30 ± 16.13 years. This is comparable to the age range observed in healthy individuals, which was 22 to 75 years, with a mean age of 46.56 ± 14.89 years. Cancer patients include 33 (43.4) males and 43 (56.6) females, while the control group include 19 (55.9%) males and 15 (44.1%) females (**Table 1)**.

Table 1. Distribution of Disease status, Age groups, and Gender among all participants.

Variable	Category	Frequency	Percentage (%)
Disease Status	Cases	76	69.1
	Controls	34	30.9
Age Groups	< 20 years	6	5.5
	20–40 years	20	18.2
	40–60 years	53	48.2
	> 60 years	31	28.2
Gender	Case male	33	43.4
	Case female	43	56.6
	Controle male	19	55.9
	Control female	15	44.1

Seropositivity of *T. gondii* IgG and IgM antibodies

Regarding *Toxoplasma* IgG antibodies, 47 (42.7%) serum samples evaluated positively, including 35 (46.1%) from cancer patients (n=76) and 12 (35.3%) from controls (n=34), while 63 (57.3%) were negative. However, the difference

between cancer patients and control group was not statistically significant (p= 292) **(Table 2).** IgM antibodies were not detected in any cases, while only 2 (5.9%) control participants tested positive for IgM.

Table 2. *T. gondii* IgG Seroprevalence by Group

IgG Status	Cases (n=76)	Controls (n=34)	Total (n=110)	*p*-value
Positive	35 (46.1%)	12 (35.3%)	47 (42.7%)	0.292
Negative	41 (53.9%)	22 (64.7%)	63 (57.3%)	

Among the 35 (46.1%) IgG-seropositive cancer patients, 16 were male and 19 were female, (p= 0.8), while in control group of the 12(35.3%) IgG- seropositive, 6 were male and 6 were female (p= 0.7). However, this difference was not statistically significant **(Table 3).**

Table 3. Distribution of the Anit- *T. gondii* IgG antibodies Among (Cases & Controls) Groups According to the Gender.

Sample	Gender	IgG groups Negative. Frequency (%)	IgG groups Positive. Frequency (%)	P value
Case	Male	17 (41.50%)	16 (45.70%)	0.8
	Female	24 (58.50%)	19 (54.30%)	
Control	Male	13 (59.10%)	6 (50.00%)	
	Female	9 (40.90%)	6 (50.00%)	0.7

The cancer group (n=76) included 47 (61.8%) cases of Solid organ malignancy, 25 (32.9%) cases of Hematological malignancy and 4 (5.3%) cases of lymphoma. This distribution difference was statistically significant (p= <0.001)**.** And about the IgG seropositivity within cancer group, 22 (46.8%) IgG-positive cases were associated with Solid tumors, 11 (44.0%) with Hematological malignancy and 2 (50.0%) with Lymphoma, and this distribution was also not statistically significant (p= 0.755) **(Table 4)**.

Table 4. Relation of anti-*Toxoplasma* antibodies (IgG and IgM) to Cancer types.

Anti-Toxoplasma antibodies	**Normal (n=34)**	**Solid tumor (n=47)**	**Hematologic malignancy (n=25)**	**Lymphoma (n=4)**	**p value**	**OR***	**95% CI**
	30.9%	**61.8%**	**32.9%**	**5.3%**			
IgG Positive, No. (%)	12 (35.3%)	22 (46.8%)	11 (44.0%)	2 (50.0%)	0.755	1.57	0.68–3.61
IgG Negative, No. (%)	22 (64.7%)	25 (53.2%)	14 (56.0%)	2 (50.0%)			
IgM Positive, No. (%)	2 (5.9%)	0 (0.0%)	0 (0.0%)	0 (0.0%)	0.208	0.085	0.004–1.82
IgM Negative, No. (%)	32 (94.1%)	47 (100.0%)	25 (100.0%)	4 (100.0%)			

4 DISCUSSION

Intact immune system has a critical role in controlling any parasitic infection. In many instances, immuno-compromised individuals, including cancer patients, are at risk of acquiring opportunistic infections such as toxoplasmosis. [3]

In the present study, the total *T. gondii* IgG seroprevalence was (42.7%) among the participants studied, indicating that sizable

proportion had been previously exposed to the parasite. Cancer patients undergoing chemotherapy demonstrated a higher IgG

positivity (46.1%) compared to controls (35.3%), although the difference was not statistically significant (p= 0.292). Interestingly, IgM antibodies were only detected in 2 (5.9%) control participants. This finding is consistent with biological expectation that chemotherapy induces immunosuppression can promote reactivation of latent infection.[15] The absence of statistical significance may be due to limited sample size, diverse cancer types, or because the infection is already common in Sulaimani population. [16]

When compared with previously published studies, the seroprevalence reported in this study was higher than that reported in Saudi Arabia (IgG - 29.9%, IgM - 0.7%) [17] and from Basrah (IgG - 31%, IgM – 0.8%) [18]. But close to that reported in Yemen (42.12%) [19]. Conversely, in Egypt higher seroprevalence rate of toxoplasmosis in cancer patients (67% for IgG, 15% for IgM) was reported [20]. This variation may reflect differences in geographical factors, sample size, socioeconomic conditions, dietary habitat, and immune status of patients.[16, 21]

The study observed that patients with lymphoma exhibited the highest IgG seropositivity, followed by those with solid tumors and hematologic malignancies (50.0%, 46.8% and 44.0% respectively), though, the differences were not statistically significant (p= 0.755). This contrasts with a study from Basrah, where breast cancer patients showed the highest IgG seropositivity (35%), and lymphoma patients the lowest (13%) [18]**.** Moreover, two studies from Egypt reported higher IgG seropositivity in patients with hematologic malignancies compared to those with solid tumors (85% vs.77% and 40% vs. 26.7%, respectively). [3, 20] Collectively, these findings suggest that exposure to *T. gondii* is common across different malignancy types, and that the risk is associated with the immunosuppressive state induced by the disease and its treatment rather than with a specific type of cancer.

In the present study, age to be a statistically significant predictor of IgG seropositivity (OR = 1.034, 95% CI: 1.006–1.063, p = 0.018), with each additional year of age increasing the odds of exposure by 3.4%. This finding matches with other studies from Egypt and Basrah showing higher Toxoplasmosis prevalence in older age groups, [18, 20] this may be due to weak immune system and exposure to infection with age. [18]

The overall prevalence of toxoplasmosis in current study was higher in females (41.30%) than males (32.90%) with non-significant statistics (p= 0.974). This finding partially agrees with a group of studies in another countries; Based on two investigations in Egypt, the overall IgG seropositivity in female was higher than in males (52.2% vs. 47.8% and 59.6% vs. 40.4%, respectively) [3, 20]**.** In Basrah, females were 92.5%, male were 7.5%. [18] In Jordan, the seropositivity in males and females were (42.3 % and 38 %, respectively) in cancer patients, and there was no statistical difference [22]**.** These results may be related to the higher exposure of females to indoor activities involving raw or undercooked meat, unwashed fruits or vegetables, farming practices, and closer contact with cats and other animals during daily cleaning activities [3, 18]**.** However, none of participants had direct contact with cats.

Overall, these findings show that Toxoplasmosis is an important opportunistic infection in cancer patients, particularly those undergoing chemotherapy and is primarily associated with weakened immunity and environmental factors rather than gender or specific cancer types. Based on these results, this study recommends the use of the Cobas test for routine toxoplasmosis screening in cancer patients to increase awareness and reduce associated mortality rates.

CONCLUSION

This study shows that *T. gondii* infection is a common risk in cancer patients, especially those undergoing chemotherapy, with age being a crucial factor. While there are no significant differences by gender or cancer types, the findings highlight the value of screening and protective strategies to protect immunocompromised patients.

ETHICAL APPROVAL

Ethical approval for this study was granted by the Ethical Committee of the College of Medicine, University of Sulaimani (321, 13/10/2024). Informed consent was obtained from each participant prior to enrollment, and their data remained confidential throughout the study.

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CONFLICTS OF INTEREST

The author declares no conflict of interest.

REFERENCES

[1] S. Kaur, P. Mayanglambam, D. Bajwan, and N. Thakur, "Chemotherapy and its adverse effects-A systematic review," *International Journal of Nursing Education and Research,* vol. 10, no. 4, pp. 399-402, 2022.

[2] R. Da Silva and T. Casella, "Healthcare-associated infections in patients who are immunosuppressed due to chemotherapy treatment: a narrative review," *The Journal of Infection in Developing Countries,* vol. 16, no. 12, pp. 1784-1795, 2022.

[3] M. I. Ali, W. M. Abd El Wahab, D. A. Hamdy, and A. Hassan, "Toxoplasma gondii in cancer patients receiving chemotherapy: seroprevalence and interferon gamma level," *Journal of parasitic diseases,* vol. 43, no. 3, pp. 464-471, 2019.

[4] E. S. Al-Malki, "Toxoplasmosis: stages of the protozoan life cycle and risk assessment in humans and animals for an enhanced awareness and an improved socio-economic status," *Saudi Journal of Biological Sciences,* vol. 28, no. 1, pp. 962-969, 2021.

[5] M. J. Gharavi, M. Roozbehani, and Z. Mandeh, "Detection of anti-Toxoplasma gondii antibodies in chronic myeloid leukemia and acute myeloid leukemia patients," *Veterinary world,* vol. 10, no. 9, p. 1063, 2017.

[6] L. T. Y. Lazar, M. S. J. Al-Ammash, and K. S. Abass, "Toxoplasma gondii: life cycle, pathogenesis, immune response: a review," *Plant Archives,* vol. 21, no. 1, pp. 1057-1059, 2021.

[7] S. K. Agordzo *et al.*, "Seroprevalence, risk factors and impact of Toxoplasma gondii infection on haematological parameters in the Ashanti region of Ghana: a cross-sectional study," *AAS Open Research,* vol. 2, p. 166, 2020.

[8] J. Layton *et al.*, "Clinical spectrum, radiological findings, and outcomes of severe toxoplasmosis in immunocompetent hosts: a systematic review," *Pathogens,* vol. 12, no. 4, p. 543, 2023.

[9] A. H. Hassen, M. S. Ali, and A. M. Ekhnafer, "Effect of Toxoplasma gondii Infection on Haematological and liver function parameters among abortive women in El-Beida City," *Publisher Full Text,* 2019.

[10] K. J. Pittman and L. J. Knoll, "Long-term relationships: the complicated interplay between the host and the developmental stages of Toxoplasma gondii during acute and chronic infections," *Microbiology and molecular biology reviews,* vol. 79, no. 4, pp. 387-401, 2015.

[11] S. Hussein and A.-L. Molan, "Prevalence of Toxoplasma gondii Infection in Hemodialysis Patients with Chronic Renal Failure and Risk Factors in Diyala Province, Iraq," *Malaysian Journal of Medicine & Health Sciences,* vol. 15, no. 1, 2019.

[12] B. Abdolkarimi, H. Mahmmodvand, N. Beyranvand, N. Naderi, and B. Amidi, "Seroprevalence and risk of Toxoplasma gondii reactivation in pediatric patients with hematological malignancies undergoing chemotherapy: A case-control study," *Archive of Oncology,* no. 00, pp. 6-6, 2025.

[13] T. M. Balcha, B. I. Aga, D. D. Disasa, and G. Berhanu, "Public health and economic significance of toxoplasmosis," *Am-Euras J Sci Res,* vol. 15, pp. 112-121, 2020.

[14] E. Innes, "A brief history and overview of Toxoplasma gondii," *Zoonoses and public health,* vol. 57, no. 1, pp. 1-7, 2010.

[15] I. A. Al-Tameemi, B. H. Abdullah, and S. J. Raisan, "Seroprevalence of Toxoplasma gondii among cancer patients in Basrah province/Iraq," *World Journal of Pharmaceutical Research,* vol. 8, no. 1, pp. 193-199, 2018.

[16] L. O. Mohammed *et al.*, "Seroprevalence of anti-Toxoplasma gondii antibodies among patients with cancer at Hiwa Cancer Hospital in Sulaimani City, Kurdistan Region, Iraq," *Iranian Journal of Parasitology,* vol. 18, no. 4, p. 526, 2023.

[17] A. Imam, F. G. Al-Anzi, M. A. Al-Ghasham, M. A. Al-Suraikh, A. O. Al-Yahya, and Z. Rasheed, "Serologic evidence of Toxoplasma gondii infection among cancer patients. A prospective study from Qassim region, Saudi Arabia," *Saudi medical journal,* vol. 38, no. 3, p. 319, 2017.

[18] A.-D. E. Shams and A. H. H. Awad, "Seroprevalence of Toxoplasma Gondii in immunocompromised cancer patients in Basrah Provence, Southern Iraq," *Basrah Researches Sciences,* vol. 48, no. 2, pp. 57-64, 2022.

[19] M. A. Al-Taj and H. A. H. Alkobati, "SEROPREVALENCE OF TOXOPLASMA GONDII AMONG CANCER PATIENTS IN AL-AMAL CENTER FOR TREATMENT OF CANCER PATIENTS IN TAIZ CITY, YEMEN," *Electronic Journal of University of Aden for Basic and Applied Sciences,* vol. 5, no. 3, pp. 254-262, 2024.

[20] E. F. Fadel, H. A. EL Hady, A. M. Ahmed, and M. E. M. Tolba, "Current Trend of Toxoplasmosis in Cancer Patients, Sohag University Hospitals, Sohag, Egypt," *Sohag Medical Journal,* vol. 28, no. 1., pp. 8-17, 2024.

[21] S.-M. Hashemi *et al.*, "Serological and molecular evaluation of toxoplasmosis in patient undergoing chemotherapy for malignancies in southeast of Iran," *Gene Reports,* vol. 23, p. 101163, 2021.

[22] N. S. Hijjawi *et al.*, "Seroprevalence of Toxoplasma gondii in Cancer Patients Admitted to Hospitals of the Royal Medical Services in Jordan," *Jordan Journal of Biological Sciences,* vol. 11, no. 5, 2018.