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## Toxoplasmosis Seroprevalence among Hemodialysis Patients: A Case-Control Study

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### ABSTRACT

**Objectives:** *Toxoplasma gondii* (*T. gondii*) is a zoonotic and opportunistic protozoan, accountable for infecting about a third of the world's population. It has serious effects on immunocompromised individuals. Patients receiving hemodialysis are more vulnerable to toxoplasmosis due to their impaired immunity. Investigating the prevalence of anti-*T. gondii* antibodies (IgG and IgM) in hemodialysis patients compared to a control group was the purpose of this case-control study. **Methods:** Using the conventional enzyme-linked immunosorbent assay (ELISA) method, anti-*T. gondii* (IgG and IgM) antibodies were assessed in 82 patients undergoing hemodialysis and 50 control individuals. Besides, collecting data regarding possible risk factors for infection. **Results:** In 57.31% (47/82) of the cases in the hemodialysis group and 22% (11/50) of participants in the control group, the anti-*T.gondii* IgG antibody was found. Even though, 2.43% (2/82) of the hemodialysis group proved seropositive for the anti-*T. gondii* IgM antibodies and no positive cases were detected in the control group. Regarding anti-*T. gondii* IgG antibody, there is a highly statistically significant difference ( $P=0.000$ ) between both groups. Besides, a significant correlation between cats' contact and undercooked meat consumption and positive anti-*T. gondii* IgG antibodies in both hemodialysis and control groups. **Conclusion:** Hemodialysis patients had a higher seroprevalence of anti-*T. gondii* IgG antibody than controls ( $P=0.000$ ) indicating their vulnerability. Thus, it is imperative to establish strategies for *T. gondii* infection prevention and control in hemodialysis patients and to plan for routine screening for toxoplasmosis among those patients.

### INTRODUCTION

*Toxoplasma gondii* (*T. gondii*) is an obligate blood protozoan that causes toxoplasmosis. Due to its broad distribution, *T. gondii* infects a significant proportion of the population of the world (Wesołowski *et al.*, 2023). There are several methods for humans to get infected with *T. gondii* including consuming food or drink contaminated by cat oocysts, which are found in garbage or soil, consuming raw or undercooked meat having tissue cysts and by blood transfusion (Elmore *et al.*, 2010). Asymptomatic infections affect between 80% and 90% of people, including adults and children, with healthy immune systems. When symptoms develop, isolated cervical or occipital lymphadenopathy is the most common clinical presentation, often with a mild, brief influenza-like illness (Rauwolf *et al.*, 2021). The infection normally resolves on its own and is not harmful (De La Mata Navazo *et al.*, 2022).

In individuals who have impaired immune systems, toxoplasmosis may trigger severe and sometimes fatal symptoms (Lima and Lodoen, 2019).

Toxoplasmosis is a concern for those with compromised immune systems like patients with hemodialysis. Pneumonitis, meningoencephalitis, chorioretinitis, myocarditis, or disseminated toxoplasmosis involving several organs are just a few of the ways the infection might present itself (Adekunle *et al.*, 2021). It has been demonstrated that hemodialysis patients are immunocompromised, mostly as a result of immune response dysfunctions implicating the complement system, phagocytosis, and chemotaxis (Kato *et al.*, 2008). In patients complaining of chronic kidney disease or at the end stage of renal disease, polymorphonuclear leukocyte dysfunction occurs due to the presence of uremic toxins at high levels (Kato *et al.*, 2008). Toxoplasmosis may emerge from the reactivation of prior infections or the acquisition of new infections during hemodialysis (Hamidi *et al.*, 2015). Consequently, these patients are more prone to opportunistic microbes, especially *T.gondii* (Foroutan *et al.*, 2018). Infectious diseases are considered the second cause of death in patients undergoing hemodialysis for end-stage kidney disease (Taghipour *et al.*, 2020). The sequences of *T.gondii* infection can be detected by serological investigation as in the primary infection: IgM appears, IgG levels increase, and then consequent stability of IgG level. Reactivation is known by two phases: an increase in IgG levels and consequent stability of those levels. This current case-control study was carried out to evaluate the seroprevalence of toxoplasmosis and potential risk variables related to *T.gondii* infection in hemodialysis patients in comparison to a control group.

## MATERIALS AND METHODS

### Participants and Sample Collection:

This case-control study was carried out on 132 participants, 82 patients undergoing hemodialysis for more than 6 months, with ages  $\geq 18$  years from the Mansoura Hospital, Egypt from July to September 2023. Additionally, 50 healthy volunteers without any renal disease who matched the hemodialysis patients in age, gender, and region were included as a control group. An informed consent was received from each participant before the study. The demographics and potential risk factors related to *T.gondii* infection were collected from participants including gender, residence, cat contact, raw/undercooked meat consumption, and milk and dairy products consumption. Five milliliters of venous blood were drawn from each participant who was eligible for the study and the samples were subsequently sent to the laboratory. After being separated by centrifugation at  $1700\times g$  for about 5 min., the sera were stored at  $-20\text{ }^{\circ}\text{C}$  until further investigation.

### Serological Assessments:

Anti-IgG and IgM antibodies against *T.gondii* have been investigated in serum samples using enzyme-linked immunosorbent assay (ELISA) kits ((IMMUNOSPEC, CA, USA) as per the instructions of the manufacturer.

### Statistical Analysis:

SPSS version 21 was utilized for conducting the Chi-square test (SPSS Inc., Chicago, IL, USA). Additionally, to evaluate the likely correlation between the relevant risk variables and seropositivity of *T.gondii* infection we employed Univariate Logistic Regression Analysis. The significance level was decided to be  $P < 0.05$ .

## RESULTS

The estimated overall seropositivity for *T.gondii* infection was 43.93% (58/132) and 1.51% (2/132) for anti-*T.gondii* IgG and anti-*T.gondii* IgM antibodies for the case and control groups, respectively. Of them, 57.31% (47/82) of the hemodialysis group and 22% (11/50) of the control group

had anti-*T. gondii* IgG antibodies, whereas 2.43% (2/82) and 0% (0/50) of these groups had anti-*T. gondii* IgM antibodies. Results revealed that hemodialysis patients had a significantly greater likelihood than healthy volunteers of being seropositive for anti-*T. gondii* IgG antibodies against *T. gondii* infection as shown in Table (1).

There was no statistically significant variation regarding gender and *T. gondii* seropositivity in case and control

groups. Moreover, no difference between both groups in regard to the anti-*T. gondii* IgG antibodies and the residence.

As shown in Table (2), we identified the *T. gondii* infection potential risk factors. The prevalence of *T. gondii* infection in hemodialysis individuals was significantly correlated with contact with cats ( $P=0.000$ ) and raw or under-cooked meat consumption ( $P=0.026$ ).

**Table 1.** Seroprevalence of anti-*T.gondii* IgG and anti-*T.gondii* IgM antibodies between hemodialysis and control groups.

	Hemodialysis group (n=82)	Control group (n=50)	Total (n=132)	Statistical analysis	
	Number (%)			X <sup>2</sup> test	P value
<b>Seroprevalence of Anti-Toxoplasma IgG</b>	47 (57.31%)	11 (22%)	58 (43.93%)	15.728	0.000**
<b>Seroprevalence of Anti-Toxoplasma IgM</b>	2 (2.43%)	0 (0%)	2 (2.43%)	1.238	0.526

n: number of the participants; \*\* indicates a highly significant correlation ( $P < 0.001$ ).

**Table 2.** The association between *T. gondii* infection seropositivity and sociodemographics and potential risk factors.

	Hemodialysis group Anti- <i>T. gondii</i> IgG seropositivity		OR (95% CI)	X <sup>2</sup> -test	P value
	Number	Percent			
<b>Gender</b>					
male	26	59.5%	(0.655-0.673)	0.366	0.656
Female	21	40.5%			
<b>Residence</b>					
Urban	21	50%	(1.000-1.000)	0.10	1.000
Rural	21	50%			
<b>Contact with cats</b>					
Yes	32	76.2%	(0.000-0.000)	13.240	0.000**
No	10	23.8%			
<b>Consumption of under-cooked meat</b>					
Yes	30	71.4%	(0.022-0.028)	5.459	0.026**
No	12	28.6%			
<b>Consumption of milk or milk product</b>					
Yes	23	54.8%	(0.822-0.837)	0.054	0.825
No	19	54.2%			

\*\* denotes a highly significant correlation ( $P < 0.001$ ); OR odds ratio; CI confidence interval

### DISCUSSION

Despite being one of the most widespread infectious diseases in the world,

toxoplasmosis usually displays nonspecific or no symptoms. However, in immunocompromised individuals, it leads

to significant clinical illness (Shehata *et al.*, 2019). Globally, increasing chronic renal failure has been highlighted as a significant public health issue. An estimate of the prevalence of chronic renal failure worldwide is 13.4% (Lv and Zhang, 2019). Hemodialysis patients are regarded as immunocompromised because of immune response dysfunctions. As a result, these patients are more prone to *T.gondii* and other opportunistic infections. Recognizing and carefully monitoring *T.gondii* seropositivity in these patient populations is crucial (Foroutan *et al.*, 2018).

In accordance with both IgG and IgM evaluation, the *T. gondii* seropositivity in our study in hemodialysis patients (57.31%) was higher than the control subjects (22%). This prevalence is greater than what Sharaf *et al.* (2021) reported, who found that 22% of hemodialysis patients in Cairo, Egypt had *T. gondii* seropositivity and that of Moawad *et al.* (2022) who reported a seroprevalence of (23%) between children receiving hemodialysis at Zagazig University Pediatrics Hospital, Egypt. Nevertheless, our findings were less than Hamza *et al.* (2015) findings that reported (61.7%) of *T. gondii* positivity in adult hemodialysis individuals in Alexandria Governorate, Egypt. Likewise, it is less than the percentage reported in different countries (76.5%) in Turkey (Ocak *et al.*, 2005) and (76.8%) in Iran (Mahmoudi and Rahmati, 2020).

According to our results, (2.43%) of the hemodialysis patients were having anti-*T. gondii* IgM antibodies. These results coincide with those of Shehata *et al.* (2019) and Sharaf *et al.* (2021), who reported that the prevalence was 2.5% and 3.3%, respectively, in adult and pediatric hemodialysis patients. On the other hand, hemodialysis patients in other studies (Fallahizadeh *et al.*, 2018; Hussein and Molan, 2019) didn't demonstrate any anti-*T. gondii* IgM antibodies.

Concerning anti-*T.gondii* IgG seropositivity, our research revealed a statistically significant difference in both

the hemodialysis group and the control group. This finding corresponds with that of Nahnoush *et al.* (2016), who found a significant association between the control group and hemodialysis patients' seropositivity for toxoplasmosis in the Cairo governorate. Also, Salem *et al.* (2023) reported anti-*T. gondii* IgG antibodies were significantly higher in hemodialysis individuals than controls in Mansoura, Egypt. Another study that was conducted in Turkey reported that there was a significant correlation between anti-*T. gondii* IgG ( $p<0.01$ ) between cases with chronic renal failure and control individuals (Yürektürk *et al.*, 2022). However, Moawad *et al.* (2022) found no statistically significant correlation between pediatric hemodialysis and control groups at Zagazig University Hospital, Egypt.

There were no statistically significant differences in *T. gondii* seropositivity among male and female patients. The same applies to individuals in both urban and rural areas. This is in accordance with other studies that found no correlation between gender and residence area and the rate of *T. gondii* infections (Jones *et al.*, 2006; Hussein and Molan, 2019) Other research, however, found a correlation (Mostafavi *et al.*, 2011). This variation in results may be explained by the different sampling techniques used in each study besides, the variation of the studied population lifestyle.

Cats' contact is, in fact, a risk cause for toxoplasmosis, according to our study findings there was a statistically significant association between contact with cats and toxoplasmosis. Consumption of undercooked meat is also another significant risk factor as (55.3%) of seropositive participants reported contact with cats. The results matched those of two previous studies (Rostami *et al.*, 2016; Arefkhaha *et al.*, 2019). On the other hand, regarding cat contact, recent research found no statistically significant variation between *T. gondii* seropositive and

seronegative participants (Sharaf *et al.*, 2021).

**Conclusion:**

As a consequence of our study, patients undergoing hemodialysis had a higher prevalence of *T. gondii* infection than healthy individuals. Given the immunocompromised status of these patients and the potential for severe and worsening consequences with a poor prognosis, we advocate routine screening for *T. gondii* infection as an integral component of the regular clinical care of hemodialysis patients. It is additionally recommended educational initiatives that could ultimately reduce the cost of healthcare from the infection.

**Declarations:**

**Ethical Approval:** None

**Conflict interests:** None

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**Availability of Data and Materials:** All datasets analysed and described during the present study are available from the corresponding author upon reasonable request.

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