



The Seroprevalence of *Toxoplasma gondii* and Associated Risk Factors Among Type 1 Diabetes Mellitus Patients in Abadan, Southwest Iran

Shahrzad Soltani ¹, Sanaz Tavakoli ², Mohamad Sabaghan ³, Mehdi Sagha Kahvaz ¹, Marzieh Pashmforosh ^{3,*} and Masoud Foroutan ^{1,**}

¹Department of Medical Parasitology, Faculty of Medicine, Abadan University of Medical Sciences, Abadan, Iran

²Department of Parasitology and Mycology, School of Medicine, Isfahan University of Medical Sciences, Isfahan, Iran

³Behbahan Faculty of Medical Sciences, Behbahan, Iran

*Corresponding author: Behbahan Faculty of Medical Sciences, Behbahan, Iran. Email: marzie_pf@yahoo.com

**Corresponding author: Department of Medical Parasitology, Faculty of Medicine, Abadan University of Medical Sciences, Abadan, Iran. Email: m.foroutan@abadanums.ac.ir

Received 2021 July 11; Accepted 2022 February 23.

Keywords: Abadan, Seroprevalence, Diabetes Mellitus, Iran, *Toxoplasma gondii*

Dear Editor,

Toxoplasma gondii is an obligate intracellular parasite capable of infecting warm-blooded animals, specially in humans and domestic animals (1). Infection with *T. gondii* in healthy individuals is often mild, while in immunocompromised patients causes a serious disease (2). Type 1 diabetes mellitus (T1DM) is an autoimmune disease, in which insufficient or no insulin is produced (3). In fact, the exact causes of T1DM are still controversial; however, it is apparent that environmental and genetic factors, as well as infectious agents are involved (3, 4). According to evidence, infection with *T. gondii* is more common in diabetic patients (5). Therefore, this study aimed to determine the seroprevalence rate of *T. gondii* infection in T1DM patients and its associated risk factors in Abadan, southwest Iran.

In this cross-section study, we included 41 patients with T1DM referred to Taleghani hospital in Abadan from December 2019 to March 2020. Written informed consent was obtained from all participants, and a questionnaire including demographic information was filled out, as earlier described (6, 7). To evaluate IgG antibody against *T. gondii* infection, 5 mL of blood sample was collected from each subject. The samples were centrifuged at 1700 × g for four minutes and then stored at -20°C until use. To detect IgG antibodies against *T. gondii* infection, we used commercial ELISA kit (Torch-IgG-Trinity Biotech Company) based on the manufacturer's guideline, as previously performed (7, 8). Data were analyzed by SPSS software (version 21), and the P value less than 0.05 was considered as statistically significant.

Overall, the seroprevalence of *T. gondii* infection in

T1DM subjects was 68.29% (28 out of 41). The demographic characteristics and risk factors related to seroprevalence of *T. gondii* in T1DM patients was presented in Table 1. Out of 41 patients with T1DM (24 female vs. 17 male), 16 female participants (66.66%) and 12 male patients (70.58%) had IgG antibody against *T. gondii*. No statistically significant difference was observed between T1DM and *T. gondii* infection according to gender (P = 0.79). In terms of residence, 20 (66.66%) patients living in urban areas and eight (72.72%) patients living in rural areas were positive for IgG antibody. Among the risk factors, there was only statistically significant association between IgG seroprevalence and contact with cat (P = 0.009) (Table 1).

In general, previous reports have shown that toxoplasmosis develops susceptibility to DM, and diabetic patients are more sensitive to be infected with *T. gondii* (5, 9). This study aimed to evaluate anti-*T. gondii* IgG antibodies among T1DM patients using ELISA method. The results of the present study demonstrated that 28 subjects (68.29%) were seropositive. In accordance with our results, Soltani et al. reported that the seroprevalence of *T. gondii* infection in T1DM patients was 69.4% in Khorramshahr, southwest Iran (6). In addition, Nassief Beshay et al. reported 86.37% seropositivity rate of anti-*T. gondii* IgG among T1DM patients (10). The probable risk factors of *T. gondii* infection in all participants were assessed in the current study. According to the results, there was only a statistically significant difference between contact with cats and IgG seroprevalence. This study confirmed some previous reports highlighting the importance of cats in acquiring *T. gondii* infection (6, 7, 11).

In conclusion, the present study revealed a relatively

Table 1. Demographic Characteristics and Risk Factors Related to Seroprevalence of *Toxoplasma gondii* in Type 1 Diabetes Mellitus Patients in Abadan

Characteristic	Type 1 DM (N= 41)		P-Value
	No. Tested	IgG Positive, No. (%)	
Age			0.914
0 - 10	7	4 (57.14)	
11 - 20	10	7 (70.00)	
21 - 30	13	9 (69.23)	
31 - 40	11	8 (72.72)	
Gender			0.79
Female	24	16 (66.66)	
Male	17	12 (70.58)	
Residence			0.513
Urban	30	20 (66.66)	
Rural	11	8 (72.72)	
Education level			0.378
Diploma or lower	29	21 (72.41)	
University degree	12	7 (58.33)	
Contact with cat			0.009
Yes	25	21 (84.00)	
No	16	7 (43.75)	
Source of drinking water			0.501
Unpurified water	8	6 (75.00)	
Purified water	33	22 (66.66)	
Consumption of raw/ undercooked meat			0.581
Yes	12	8 (66.66)	
No	29	20 (68.96)	
Total	41	28 (68.29)	

high seroprevalence of *T. gondii* infection among T1DM patients in Abadan, southwest Iran. Since the T1DM patients are among susceptible groups to acquire toxoplasmosis, they should be examined regularly for *T. gondii* to avoid severe infection. In addition, preventive programs, improving the knowledge of T1DM patients about infection with *T. gondii*, as well as effective control efforts must be performed.

Acknowledgments

The authors sincerely appreciate all personnel of Taleghani hospital in Abadan for their kind cooperation. We are very grateful to Mrs. Fatemeh Maghsoudi (Abadan University of Medical Sciences, Abadan, Iran) for her helpful consultation and comments on the manuscript.

Footnotes

Authors' Contribution: SS, MF, and ST conceived, designed, and drafted the manuscript; MS, MSK, and MP involved in data acquisition; SS and MF involved in statistical analysis; MF critically revised the text. All authors read and approved the final version of the manuscript.

Conflict of Interests: The authors declare that there is no conflict of interest.

Data Reproducibility: The datasets used and/or analyzed during the current study are available from the corresponding author on reasonable request.

Ethical Approval: This study received the approval from the Behbahan Faculty of Medical Sciences Ethical Committee (IR.BHN.REC.1399.008). Link: ethics.research.ac.ir/EthicsProposalView.php?id=130106.

Funding/Support: This study was financially supported

by the Behbahan Faculty of Medical Sciences, Behbahan, Iran (Grant No. 98114).

Informed Consent: All subjects participated in the study voluntarily. Written informed consent was obtained from adult individuals and the parents or guardians of subjects less than 18 years old.

References

- Dubey JP. The history of *Toxoplasma gondii*—the first 100 years. *J Eukaryot Microbiol.* 2008;**55**(6):467–75. [PubMed ID: 19120791]. <https://doi.org/10.1111/j.1550-7408.2008.00345.x>.
- Wang ZD, Liu HH, Ma ZX, Ma HY, Li ZY, Yang ZB, et al. *Toxoplasma gondii* Infection in Immunocompromised Patients: A Systematic Review and Meta-Analysis. *Front Microbiol.* 2017;**8**:389. [PubMed ID: 28337191]. [PubMed Central ID: PMC5343064]. <https://doi.org/10.3389/fmicb.2017.00389>.
- Canivell S, Gomis R. Diagnosis and classification of autoimmune diabetes mellitus. *Autoimmun Rev.* 2014;**13**(4-5):403–7. [PubMed ID: 24424179]. <https://doi.org/10.1016/j.autrev.2014.01.020>.
- Krause I, Anaya JM, Fraser A, Barzilai O, Ram M, Abad V, et al. Anti-infectious antibodies and autoimmune-associated autoantibodies in patients with type I diabetes mellitus and their close family members. *Ann N Y Acad Sci.* 2009;**1173**:633–9. [PubMed ID: 19758209]. <https://doi.org/10.1111/j.1749-6632.2009.04619.x>.
- Majidiani H, Dalvand S, Daryani A, Galvan-Ramirez ML, Foroutan-Rad M. Is chronic toxoplasmosis a risk factor for diabetes mellitus? A systematic review and meta-analysis of case-control studies. *Braz J Infect Dis.* 2016;**20**(6):605–9. [PubMed ID: 27768900]. <https://doi.org/10.1016/j.bjid.2016.09.002>.
- Soltani S, Tavakoli S, Sabaghan M, Kahvaz MS, Pashmforosh M, Foroutan M. The Probable Association between Chronic *Toxoplasma gondii* Infection and Type 1 and Type 2 Diabetes Mellitus: A Case-Control Study. *Interdiscip Perspect Infect Dis.* 2021;**2021**:2508780. [PubMed ID: 34122541]. [PubMed Central ID: PMC8169249]. <https://doi.org/10.1155/2021/2508780>.
- Soltani S, Kahvaz MS, Soltani S, Maghsoudi F, Foroutan M. Sero-prevalence and associated risk factors of *Toxoplasma gondii* infection in patients undergoing hemodialysis and healthy group. *BMC Res Notes.* 2020;**13**(1):551. [PubMed ID: 33287882]. [PubMed Central ID: PMC7720589]. <https://doi.org/10.1186/s13104-020-05396-5>.
- Soltani S, Ghaffari AD, Kahvaz MS, Sabaghan M, Pashmforosh M, Foroutan M. Detection of Anti-*Toxoplasma gondii* IgG and IgM Antibodies and Associated Risk Factors during Pregnancy in Southwest Iran. *Infect Dis Obstet Gynecol.* 2021;**2021**:5547667. [PubMed ID: 34135564]. [PubMed Central ID: PMC8175175]. <https://doi.org/10.1155/2021/5547667>.
- Molan A, Nosaka K, Hunter M, Wang W. The association between *Toxoplasma gondii* and type 2 diabetes mellitus: a systematic review and meta-analysis of human case-control studies. *Bull Natl Res Cent.* 2020;**44**(1). <https://doi.org/10.1186/s42269-019-0256-x>.
- Nassief Beshay EV, El-Refai SA, Helwa MA, Atia AF, Dawoud MM. *Toxoplasma gondii* as a possible causative pathogen of type-1 diabetes mellitus: Evidence from case-control and experimental studies. *Exp Parasitol.* 2018;**188**:93–101. [PubMed ID: 29627328]. <https://doi.org/10.1016/j.exppara.2018.04.007>.
- Dubey JP, Cerqueira-Cezar CK, Murata FHA, Kwok OCH, Yang YR, Su C. All about toxoplasmosis in cats: the last decade. *Vet Parasitol.* 2020;**283**:109145. [PubMed ID: 32645556]. <https://doi.org/10.1016/j.vetpar.2020.109145>.