



***Toxoplasma Gondii* Seropositivity Among Schizophrenia Patients, And Risk Assessment.**

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KEYWORDS

Toxoplasmosis;
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ABSTRACT:

Introduction: Toxoplasmosis is a zoonotic disease caused by the parasite *Toxoplasma gondii*, a protozoan that crosses the blood-brain barrier to reach the central nervous system. Numerous case-control epidemiological studies show a higher prevalence of *T. gondii* infestation in individuals with various psychiatric and behavioral disorders, including schizophrenia.

Objectives: The objective of this study is to demonstrate the links between schizophrenia and *T. gondii* infestation, to establish the prevalence of toxoplasmosis in schizophrenic patients, and to compare the prevalence and contributing factors with the results of our laboratory and those in the literature.

Methods: 46 blood samples were collected from patients with schizophrenia in our hospital, accompanied by a questionnaire on risk factors for toxoplasmosis (residence, education level, meat consumption, contact with cats, hygiene). Anti-toxoplasma IgG and IgM levels were measured using the ABBOT Architect analyzer.

Results: The study shows that the seroprevalence of toxoplasmosis in schizophrenic subjects is 60.9%. A significant relationship between age and toxoplasma seroprevalence ($P = 0.038$) has been found. However, we did not find a link between other factors and toxoplasma seroprevalence among schizophrenia patients.

Conclusions: The prevalence of toxoplasmosis is significant (60.9%) compared to the rate recorded in the general population, suggesting that brain cysts from a primary toxoplasma infection could be influencing psychiatric pathology/disorders.

1. Introduction

A recent study conducted on brain disorders worldwide shows that this type of disorder increases from approximately 2.4 billion in 1990 to 4 billion in 2021, an increase of 65%, with an estimated 450 to 500 million

people living with mental disorders worldwide (1). Among these diseases, schizophrenia is one of the concerns of several researchers. Another study found that 23.6 million people were affected by schizophrenia in 2019, an increase of 65.85% compared to 1990 (2). Since



the 1950s, suspicions have persisted regarding a potential link between schizophrenia and infection with the protozoan parasite *Toxoplasma gondii*. Two notable events initially captured the attention of the psychiatric community regarding toxoplasmosis: the disease triggered by infection with the parasite, and the transient symptoms of acute toxoplasmosis sometimes reflect the clinical presentation of paranoid schizophrenia. Numerous studies have also identified a high seroprevalence of toxoplasmosis among individuals placed in mental health institutions compared with their counterparts in control populations. It was not until the beginning of the 21st century that various independent research teams revealed information about potential mechanisms linking the *Toxoplasma* parasite to schizophrenia (3). Toxoplasmosis, induced by the protozoan parasite *Toxoplasma gondii*, is the most common infectious disease worldwide, affecting one third of the world's population (4). The ability of *T. gondii* to infect the brain and central nervous system leads to the parasite's association with human neuropsychiatric disorders. In rodents, infection has been observed to alter behavior (5).

2. Objectives

recent research suggests that *T. gondii* infection can reduce predator fear in rodents (6), increase exploratory behavior, and alter predator behavior (7). This raises the question: how does this parasite influence the brain and behavior of its hosts? and what is the link between *T. gondii* and schizophrenia? The research we are conducting here is part of an epidemiological study on this parasitic infection, the aim of which is to assess the seroprevalence of toxoplasmosis in people with schizophrenia and to identify the risk factors linked to contamination.

3. Methods

The present study was conducted to establish the prevalence of toxoplasmosis in schizophrenic patients hospitalized in the psychiatry department of the Abdelkader Hassani University Hospital. The analyses were carried out in the central laboratory of the university hospital, within the parasitology and mycology service. A total of 46 patients aged 23 to 65 years were included. A specially designed information sheet was used to collect various epidemiological data in order to compare

them with the literature. Anamnesis is performed for the 46 schizophrenic patients, clinical interviews with the patients allow to fill out a form that included a section for the patient's personal information and another section for known risk factors for toxoplasmosis, such as the consumption of well or undercooked meat, as well as the presence or absence of animals in the family environment and the duration of schizophrenia.

After blood collection from the antecubital fossa vein, testing is performed on serum or plasma samples collected with heparin sodium anticoagulant. After centrifugation at 3000 rpm for 3 minutes, serum can be used on site or collected and stored in a closed tube for later use. Samples should be thoroughly homogenized after thawing and before testing.

The analyses were performed using an ARCHITECT i1000 SR analyzer, which is an automated system that operates using the chemiluminescence immunoassay (CMIA) technique.

The purpose of the Toxo IgG/Toxo IgM test is the quantitative (IgG) and qualitative (IgM) determination of antibodies and anti-*Toxoplasma gondii* in human serum and plasma using microparticle chemiluminescence immunoassay (CMIA) technology with flexible test protocols, called Chemiflex. This test is performed using the Architect Toxo IgG/Toxo IgM kit (ABBOTT). The reading is done after the end of the operation on the microcomputer connected to the machine. The results of the toxoplasmic serology are interpreted according to the simultaneous values of the IgG and IgM antibodies. The interpretation of the results on the machine is done in reference to table 1.

Table: 1 interpretation values of the results

	Values	Interpretation
IgG	< 1.6 UI/ml	Negative
	1.6 < IgG < 3.0 UI/ml	Uncertain
	≥ 3.0 UI/ml	Positive
IgM	< 0.83 UI/ml	Negative
	0.83 < IgM < 1.00 UI/ml	Uncertain
	≥ 1.00 UI/ml	Positive



Statistical analysis

Statistical analysis was performed using SPSS 14, a p-value of < 0.05 was considered statistically significant.

4. Results and discussion

The objective of our study was to determine the prevalence of toxoplasmosis in schizophrenic patients hospitalized in the psychiatry department of Abdelkader Hassani University Hospital, and to explore potential associations between positive serology for *Toxoplasma gondii* and specific patient characteristics. Results of comparison of various parameters of schizophrenia with serological status against *T. gondii* are presented in Table 2.

We observed that the rate of individuals seropositive for *T. gondii* among patients with schizophrenia was statistically higher, reaching 60.9%.

Our results suggest that *Toxoplasma gondii* infection increases the risk of developing schizophrenia, which is

consistent with previous studies by other researchers; In Tunisia, (8) found higher seropositivity for *T. gondii* in schizophrenic patients (74.8%) than in controls (53.8%). In Iran, (9) found that the seropositivity rate in patients with schizophrenia (67.7%) was significantly higher than in the control group (37.1%). Another study conducted in Turkey on patients with schizophrenia, the results of this study show that the seropositivity rate of anti-Toxoplasma IgG antibodies in patients with schizophrenia (66%) was significantly higher than healthy volunteers (10).

The study of the distribution of schizophrenic patients according to serological status and sex showed that 85.7% of seropositive schizophrenic people were male.

Since most of our schizophrenic patients are male and according to the World Health Organization, 2016 schizophrenia affects more males than females, with a sex ratio of 6 to 1.

Table : 2 : Analyse de la séroprévalence des IgM et IgG anti-*T. gondii* par ARCHITECT i1000_{SR} chez les patients schizophrènes hospitalisés au service de psychiatrie du CHU Abdelkader Hassani.

	Seropositive	Seronegative	total	Percentage % of seropositive	Prevalence	P
Gender						
Male	24	16	40	85.7	60.00%	0.577
Female	4	2	6	14.3	66.70%	
Total	28	18	46	100	60.90%	
Age						
<30	3	8	11	10.5	27.30%	0.038
[30-40[	7	4	11	25	63.60%	
[40-50[	10	5	15	35.7	66.70%	
50 and +	8	1	9	28.6	88.90%	
Total	28	18	46	100	60.90%	
Habitat						
Rural	18	13	31	64.3	58.10%	0.575
Urban	10	5	15	35.7	66.70%	
Total	28	18	46	100	60.90%	



Education level							
Primary	14	6	20	50	70.00%	0.128	
Middle Secondary	4	7	11	14.3	36.40%		
University							
Total	4	4	8	14.3	50.00%		
	6	1	7	21.4	85.70%		
	28	18	46	100	60.90%		
Profession							
Not Active	15	13	28	53.6	53.60%	0.206	
Active	13	5	18	46.4	72.20%		
Total	28	18	46	100	60.9		
Meat							
Medium cooked	8	7	15	28.6	53.30%	0.466	
Well done	20	11	31	71.4	64.50%		
total	28	18	46	100	60.90%		
Eating outside home							
No	16	7	23	57.1	69.60%	0.227	
Yes	12	11	23	42.9	52.20%		
Total	28	18	46	100	60.90%		
Animal contact							
Absence	15	6	21	53.6	71.40%	0.179	
Presence	13	12	25	46.4	52.00%		
Total	28	18	46	100	60.90%		
Duration of schizophrenia							
<10 years						0.476	
[10-20[	7	7	14	25	50%	



[20-30[	5	5	10	17.9	50%
[30-40[	11	4	15	39.3	73.30%
Total	5	2	7	17.9	71.40%
	28	18	46	100	60.90%

In addition, another study reported that a sex ratio of three males to one female infected before the age of 15. It is suggested that this is attributed to the likelihood that men engage in more social activities, potentially exposing them to various sources of infection, unlike women who tend to stay at home, thus minimizing their risk of environmental contamination (11).

In our study, no association was found between toxoplasma seropositivity in schizophrenic patients and gender ($P = 0.577$), the same observation was revealed by other studies (8, 12).

The results of our study on the distribution of schizophrenics according to serological status and age group show that a large proportion of our schizophrenic patients are older, with the most affected age group being between 40 and 50 years, representing 35.7%. In contrast to our results, another author (12) found that the incidence of *T. gondii* in schizophrenic patients is higher in those less than 38 years of age compared to those over 38 years of age.

We observe a highly significant association between toxoplasma seropositivity and age group with a ($P = 0.038$). Thus, older people seem to be more susceptible to toxoplasma infection. This correlation can be explained by the fact that older people have weakened immunity, which can contribute to infection, as well as by a deterioration in hygiene conditions that facilitate contamination by this parasite. Similarly, a study conducted in China reported a significant association between *T. gondii* seroprevalence and bipolar depression in the age range of 41–77 years (13).

The results of this study on the distribution of schizophrenic individuals according to serological status and region, revealed that the majority of our schizophrenic patients resided in rural areas, 64.3% of the total. This is attributed to the poor hygiene conditions of these populations, which is consistent with a study conducted in Ireland that found a high rate of Toxoplasma infection in individuals from rural areas

(14). Our study did not find any significant correlation between toxoplasma seropositivity and habitat with a p-value of 0.575. Our results are similar to those found by another researcher (15) who indicate that the p-value between toxoplasma seropositivity and habitat is 0.39.

Some studies on antibodies to *T. gondii* have also indicated their higher prevalence in individuals from rural areas (11).

We observed that when analyzing the distribution of schizophrenic individuals according to serological status and educational level, a notable toxoplasma seropositivity rate of 50% was observed in schizophrenic patients with primary education level. We hypothesize that the educational level of these patients influences their immune status. It is possible that their lack of complete knowledge about hygiene practices and preventive measures contributes to their susceptibility to this parasitic infection. Despite this observation, our results did not reveal any significant correlation between toxoplasma seropositivity and educational level in schizophrenic patients ($P = 0.128$), which is consistent with other findings (8).

Regarding occupation, we found that the majority of schizophrenic patients who are unemployed have a high rate of toxoplasma seropositivity, with a percentage of 53.6%. This could be explained by the fact that this group could be more predisposed to engage in gardening activities because they have more availability.

We did not find a significant association between toxoplasma seropositivity in schizophrenic patients and occupation, with a p-value of 0.206, in accordance with other studies (12)

We observed that the majority of schizophrenic patients did not dine at restaurants, with a rate of 57.1%. This could be due to poor food hygiene practices, such as eating unwashed fruit and vegetables or drinking contaminated drinking water, and inadequate hand hygiene, including handling contaminated raw meat or



using utensils and cutting boards that have come into contact with contaminated food.

A study conducted in Tunisia also revealed that the high infection rates observed in the Tunisian population were attributed to hand hygiene and eating habits, such as the consumption of poorly washed vegetables (8).

The study of the distribution of schizophrenics according to serological status and method of cooking meat, shows a rate of toxoplasma seropositivity of 71.4% in schizophrenic patients who reported consuming well-cooked meat. However, our analysis did not reveal a significant association between toxoplasma seropositivity and meat cooking methods, with a p-value of 0.466. This could be attributed to the widespread culinary practice of consuming well-cooked meat in our region, as well as the common household practice of freezing meat, which renders *T. gondii* cysts non-infectious after freezing for at least 3 days at -12 degrees Celsius.

In contrast to our study, Eshili et al. (2016) (8) report a significant risk factor between seropositivity and consumption of undercooked meat.

However, our study did not find a significant correlation between toxoplasma seropositivity and meat cooking methods, consistent with the results of (12)

Regarding the relationship between the presence of animals in the environment of schizophrenic individuals, we observed that 53.6% of seropositive schizophrenic patients with anti-toxoplasma antibodies had no contact with animals, while 46.4% of them had had contact with animals. This could be explained by the fact that animals are not commonly kept in our region, which is mainly focused on livestock and agriculture.

In contrast, in a study of 165 parents of individuals with schizophrenia and bipolar disorder, 51% reported having owned a cat during pregnancy or during the first 10 years of the affected person's life (11). In a separate study, the mothers of 264 individuals diagnosed with schizophrenia or bipolar affective disorder. The study found that while childhood dog ownership was slightly lower among people with schizophrenia, cat ownership was significantly more common among people with mental illness, with rates of 53% versus 42% (16). In another study of 262 people with schizophrenia, it was reported

that 52% of them had owned a cat between birth and age 13 (9).

The results of the correlation study between the distribution of schizophrenic patients according to serological status and the duration of schizophrenia, show a percentage of 39.3% of schizophrenic people are seropositive between 20 and 30 years, with a prevalence of 73.3%. This increased prevalence can be attributed to a greater susceptibility to toxoplasmosis due to poor hygiene habits as patients age. Our results did not indicate a significant association between the patient's infection status and the duration of the disease ($P = 0.476$). This result is consistent with literature (17).

Conclusion:

Toxoplasmosis is a neuroencephalotropic parasitic disease that appears to be associated with a number of neuropsychiatric symptoms, including schizophrenia. The data obtained during this work allowed us to estimate the seroprevalence of toxoplasmosis in schizophrenics and to identify the risk factors associated with contamination.

Based on the results obtained from the 46 schizophrenic individuals concerning the search for anti-toxoplasma IgG and IgM levels, we found that 60.9% of schizophrenics are immune.

Among the risk factors identified, we found that the age group had a high prevalence (88.9%) and a very significant relationship with toxoplasma seroprevalence in our serie ($P = 0.038$).

Since there is currently no vaccine against this disease, it appears that better monitoring of risk factors, coupled with active screening for seroprevalence, is necessary in psychiatric population.

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