



HEALTH SCIENCES

Clinico-epidemiological and sociodemographic profile of HIV/AIDS patients who are co-infected with *Toxoplasma gondii* in the border region of Brazil

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Abstract: The present study assessed clinico-epidemiological and sociodemographic characteristics and risk factors for human immunodeficiency virus (HIV) in patients who were co-infected with *T. gondii* in the border region of Brazil. HIV-positive patients who were attended by the Expert Assistance Service in Foz do Iguaçu city were assessed using a questionnaire and medical records. Of the 332 patients with HIV/autoimmune deficiency syndrome (AIDS) who were evaluated, 111 had serology for toxoplasmosis, which could be attributed to the location of the city (i.e., border region) and tourism that encourages the intense flow of people. Toxoplasmosis infection was prevalent among patients who were 18-60 years old, had education up to the 4th grade of elementary school, ate raw vegetables from home, handled soil without gloves, drank untreated water, and allowed street cats to enter their homes. These findings contribute to assessments of the toxoplasmosis profile of HIV/AIDS patients who have a high rate of toxoplasmosis. The results may contribute to improving public health, especially in border regions with characteristics that are similar to this study. Effective measures need to be implemented to control morbidity and mortality that are associated with HIV/AIDS and toxoplasmosis in the evaluated population.

Key words: HIV, Immunocompromised host, Neurotoxoplasmosis, *Toxoplasma gondii*, Toxoplasmosis.

INTRODUCTION

Acquired immunodeficiency syndrome (AIDS) is a serious disease that is caused by the human immunodeficiency virus (HIV) retrovirus. This syndrome is one of the largest public health issues both in Brazil and abroad (Ferreira et al. 2015). It is defined by a quantitative and qualitative decrease in T-lymphocyte (mainly CD4 cell) counts. This decrease affects immune system function and subsequently affects the health of infected individuals (Coelho et al. 2016, Martins et al. 2015).

From an epidemiological perspective, more than 1.8 million adults worldwide were infected

with HIV in 2017, and approximately 940,000 died of AIDS-related causes (United Nations Programme on HIV/AIDS 2018). According to the Ministry of Health of Brazil, HIV infects one person every 15 min. Additionally, approximately 40,000 new AIDS cases were recorded annually in the last 5 years in Brazil. The most affected population is youngsters (Ministério da Saúde 2018).

Dysfunction of the immune system that is caused by HIV infection makes the individual vulnerable to opportunistic diseases. Among such opportunistic diseases that affect the central nervous system, toxoplasmosis that is

caused by the protozoan *T. gondii* is the most frequent. Consequently, neurotoxoplasmosis is the most common focal brain injury (Galisteu et al. 2015). Toxoplasmosis and HIV/AIDS are major global public health concerns because of the risk of reinfection by *T. gondii*, which can affect chronically immunosuppressed individuals (Martins et al. 2015). Despite prophylactic and effective treatments for toxoplasmosis reactivation, reports have revealed that this disease spectrum persistently affects immunosuppressed patients (Kodym et al. 2015, Basavaraju 2016, Chapuis et al. 2016). A Brazilian study assessed HIV/AIDS co-infection and found that neurotoxoplasmosis was the second most common comorbid opportunistic infection, with a frequency of 11.2% (Ferreira et al. 2015).

Neurotoxoplasmosis clinically manifests as a subacute disease that causes focal cerebral dysfunction or focal dysfunction combined with symptoms of diffuse encephalitis (Veronesi & Focaccia 2015). Manifestations of this disease depend on the location on the body and number of lesions. The most common symptoms include focal motor deficits, hemiparesis, ataxia, sensory disorders, speech disorders, severe headache, seizures, mental confusion, lethargy, and visual alterations (Veronesi & Focaccia 2015).

Cultural eating habits are the main causes of *T. gondii* infection, with differences among countries or even among regions within the same country (Dhombres et al. 2017). HIV/AIDS infection has a heterogeneous distribution (Mombelli et al. 2015). An increase in the epidemic in the Brazil, particularly in border regions, has been seen (Mombelli et al. 2015), the contributing factors of which are migratory movements by people who seek better living conditions and job opportunities, product importation and exportation, and tourism. This situation is particularly evident along the convergent borders of Brazil, Paraguay, and

Argentina (Cavatorta et al. 2017). Medium-sized municipalities along the Brazilian border region, such as Uruguaiana (Rio Grande do Sul) and Foz do Iguaçu (Paraná), have seen a higher incidence of AIDS relative to the national average (Datasus 2018). The municipality of Foz do Iguaçu has become a focal point to understand the disease and its effects on human health. The particularities of this region should be considered when formulating public policies to address this public health concern. Therefore, the present study assessed the clinico-epidemiological and sociodemographic profiles of HIV/AIDS patients who were co-infected with *T. gondii* in Foz do Iguaçu city, Parana state, and related risk factors.

MATERIALS AND METHODS

This quantitative descriptive-comparative study included patients who were attended by the Expert Assistance Service (EAS) in Foz do Iguaçu city, Paraná state, Brazil. This group was defined by the non-probabilistic convenience sampling (Ayres et al. 2003) of registered patients (approximately 2436 patients until 2019). The representativeness of the total population was ensured by a sample calculation that considered a sampling error of 5% and 95% confidence interval (Bolfarine & Bussab 2005). The final sample size was 224 patients who were attended by the SAE. However, a total of 332 patients were included to provide greater reliability of the research.

All of the participants were informed about the study and signed a Free Informed Consent Form (FICF) before the study began. The study was approved by the Human Research Ethics Committee (HREC) of UNIOESTE University (opinion no. 3.053.956) and received an Ethical Appreciation Certificate (CAAE; no. 03026218.0.0000.0107).

The medical records of HIV-seropositive patients who were attended by the EAS in Foz do Iguaçu were reviewed to obtain clinical data on HIV infection, previous diseases, most recent CD4 count, HIV viral load, antiretroviral therapy, toxoplasmosis serology based on a microparticle chemiluminescent immunoassay, and a diagnosis of neurotoxoplasmosis or other complications related to the disease.

A questionnaire that was adapted to the requirements of the study was designed to assess the epidemiological profiles of the patients and risk factors of the disease. The questionnaire included 27 objective and readily understandable questions about the following: (1) socioeconomic, demographic, and psychosocial data (sex, age, color/race, education, nationality, marital status, and family income) and (2) risk factors (awareness, guidance, and behaviors).

The study included patients of both sexes who were diagnosed with HIV/AIDS according to the protocol of the Ministry of Health of Brazil. The subjects were ≥ 18 years old, had complete medical records, and attended HIV-specialized outpatient clinics. Patients who were < 18 years old, were seen in private practice, abandoned treatment, died, or were referred to other departments were excluded from the study.

Microsoft Excel 2013 software was used to tabulate the data and perform descriptive statistics based on absolute values, percentages, and averages. Correlations between the parasitized state (i.e., dependent variable) and independent variables were assessed using Pearson's χ^2 test based on Ayres et al. (2003). All values of $p \leq 0.20$ for the variables were considered for the multivariate odds ratio (OR) analysis at a 95% confidence interval set to $\alpha < 0.05$. The analyses were performed using BioEstat 5.0 software.

RESULTS

The total sample consisted of 332 HIV/AIDS patients who were attended by the EAS in Foz do Iguaçu city, Paraná state. The EAS is a reference facility for the treatment of infectious diseases. Therefore, the present study included patients from several cities in Paraná state and regions across the border from Brazil, such as in Paraguay (74 patients lived outside Foz do Iguaçu city). The patients were divided into the following regional groups: Santa Terezinha de Itaipu city (10), São Miguel do Iguaçu city (8), Medianeira city (22), Matelândia city (5), Itaipulândia city (6), Missal city (1), Serranópolis do Iguaçu city (1), Pato Branco city (1), and Paraguay (20). With regard to place of birth, only 13 patients were not Brazilian (9 Paraguayan, 1 Lebanese, 1 Chinese, 1 Haitian, and 1 Mexican).

Of the 332 HIV/AIDS patients who were analyzed, only 111 had toxoplasmosis serology reported in their medical records. Of these 111 patients, 81 (72.9%) presented positive serology, and 27.1% presented negative serology. Data from toxoplasmosis-tested patients who were classified as indeterminate (66.6%) were not considered for the toxoplasmosis-related behavior analyses. With regard to the general characteristics of the patients, the univariate analysis revealed a statistically significant difference between age groups, level of education, and family income (Table I).

With regard to behavioral aspects that were related to oocyst infection, the univariate analysis showed that patients who ate raw vegetables from the home, manipulated soil with or without the use of gloves, and drank well or reservoir water had a higher risk of acquiring infection (Table II).

With regard to behavioral aspects that were related to cats, the univariate analysis revealed that "cats not using litter boxes and defecating

Table I. Univariate analysis of HIV/AIDS patients attended by the Expert Assistance Service of Foz do Iguacu city, Paraná state, Brazil, in 2019.

Patient profile (N = 111)	ELISA		Univariate analysis	p
	Positive (%)	Negative (%)	OR (95% CI)	
Sex				
Male	48.1	73.3	1	
Female	48.1	26.7	0.3 (0.2-0.6)	0.0016
Did not answer	3.8	0.0	—	—
Age (years)				
≥ 18 and < 30	22.2	53.3	1	
≥ 30 and < 45	38.3	30.0	0.3 (0.1-0.6)	0.0023
≥ 45 and < 60	32.1	13.3	0.1 (0.1-0.3)	0.00001
≥ 60	1.2	0.0	—	—
Did not answer	6.2	3.4	—	—
Education level				
Illiterate	16.1	0.0	—	—
4th grade of elementary school	18.5	6.7	1	
8th grade of elementary school	14.8	3.3	0.5 (0.1-2.3)	0.6157
Incomplete high school	7.4	16.6	6.2 (1.8-21.5)	0.0067
Complete high school	16.1	20.0	3.2 (1.0-9.5)	0.0616
Higher education (complete or incomplete)	25.9	53.3	5.2 (2.0-14.1)	0.0013
Did not answer	1.2	0.0	—	—
Profession				
Farmer / gardener	0.0	0.0	—	—
Freelancer	18.5	13.3	1	
Chef / butcher	3.8	13.3	4.5 (1.1-17.0)	0.0462
Private sector employee	12.3	10.0	1.1 (0.3-3.4)	0.9788
Health professional	4.9	13.3	3.6 (1.0-12.6)	0.0799
Construction worker / general service	4.9	0.0	—	—
Homemaker	12.3	13.3	1.5 (0.5-4.3)	0.6303
Domestic worker / caretaker	11.1	0.0	—	—
Retired / pensioner	8.6	0.0	—	—
Teacher	3.8	10.0	3.4 (0.8-13.5)	0.1310
Student	9.9	16.6	2.3 (0.8-7.0)	0.1818
Public agent	4.9	0.0	—	—
No profession	3.8	3.3	1.0 (0.1-5.4)	0.7046
Did not answer	1.2	6.7	9.6 (1.0-88.6)	0.0572
Family income				
Below the minimum wage	39.5	36.6	1	
Between 1 and 2 minimum wages	43.2	16.6	0.4 (0.2-0.8)	0.0256
Between 2 and 3 minimum wages	4.9	23.3	4.8 (1.6-14.0)	0.0045
Above 3 minimum wages	9.9	16.6	1.7 (0.7-4.4)	0.2929
Does not know / did not answer	2.5	6.7	3.6 (0.7-19.0)	0.1940
Aware of toxoplasmosis				
Yes	76.6	73.3	1	
No	20.9	26.7	1.3 (0.7-2.6)	0.4546
Does not remember	2.5	0.0	—	—
Received guidance about toxoplasmosis prevention				
Yes	24.7	23.3	1	
No	64.2	66.6	1.1 (0.5-2.1)	0.8659
Does not remember	11.1	10.0	0.9 (0.3-2.7)	0.8110

on the street” and “cats in the neighborhood that entered the home” were significant risk factors for acquiring infection (Table III).

With regard to the ingestion of *T. gondii* oocysts, the univariate analysis showed that avoiding raw/rare goat or sheep meat was a protective factor against acquiring toxoplasmosis (Table IV).

The multivariate analysis of level of education showed that patients who had incomplete or complete higher education were 0.2 times less likely to acquire *T. gondii* infection compared with patients who completed only up to 4th grade education (Table V). The multivariate analysis showed that patients who drank well water were 3.0 times more likely to contract toxoplasmosis than patients who did not drink well water (Table V).

Data on viral load and CD4 T-lymphocytes of HIV/AIDS patients with toxoplasmosis serology (111) and who received antiretroviral therapy are shown in Table VI.

According to the medical records, 3.31% (11/332) of the patients developed neurotoxoplasmosis at some point in life. Two of these 11 patients had congenital toxoplasmosis combined with neurotoxoplasmosis. Additionally, 3.61% (12/332) of the patients had a clinical history of ocular toxoplasmosis, four (1.20%) of whom reported primary infection during pregnancy. The medical records of 66.56% (221/332) of the patients did not show serology test results for toxoplasmosis. Patients whose medical records showed a presumptive or definitive diagnosis of toxoplasmosis (11/332) underwent specific clinical assessments. Information on CD4 T-lymphocyte counts and detectable and undetectable viral loads is shown in Table VII.

According to the medical records, 96.1% (319/332) of the patients underwent regular antiretroviral therapy, and only 13 patients (3.9%)

did not adhere to such therapy. Therefore, most of the patients received adequate treatment to suppress viral load.

DISCUSSION

HIV/AIDS patients have a high risk of acquiring toxoplasmosis. The assessments revealed positive *T. gondii* serology in most HIV/AIDS patients (72.9%) who were attended by the EAS in Foz do Iguaçu city, Paraná state. Such a high prevalence could be attributable to the location of the city in the border region and tourism that encourages the intense flow of people. The city is bordered by Ciudad Del Este (Paraguay) and Puerto Iguazu (Argentina). Tourism is the main economy in Foz do Iguaçu city, and its main tourist attractions are the Itaipu Binacional Hydroelectric Power Plant and Iguazu Falls (Conte 2018).

The seroprevalence of *T. gondii* that was found herein is similar to a previous study of HIV patients who were attended by the EAS/CTC in Ponta Grossa city (Paraná state), in which the seroprevalence of *T. gondii* was 84.6% (Fontoura et al. 2016). Studies that were performed in Natal city, Brazil (Oliveira, unpublished data), and northwestern Ethiopia (Walle et al. 2013) also reported high *T. gondii* seroprevalence (83.8% and 87.4%, respectively).

Most seroepidemiological studies that have been performed with different populations reported that people who are 18-60 years old are more likely to test positive for *T. gondii*. Anuradha and Preethi (2014) found 34.78% seropositivity in HIV patients and argued that the most affected individuals were in the age group of 31-40 years. A study in Rio Grande do Sul state, Brazil, assessed *T. gondii* IgG antibody levels and found that individuals who were > 31 years old were 3.99 times more likely to be infected (Dos Santos et al. 2015).

Table II. Univariate analysis of behaviors associated with oocyst ingestion in patients who were attended by the Expert Assistance Service of Foz do Iguazu city, Paraná state, Brazil, in 2019.

Patient Profile (N = 111)	ELISA		Univariate analysis	p
	Positive (%)	Negative (%)	OR (95% CI)	
Eats raw vegetables				
Yes	88.9	90.0	1	
No	11.1	10.0	0.9 (0.3-2.2)	0.9808
Eats raw vegetables from home				
Yes	61.7	80.0	1	
No	32.1	13.3	0.3 (0.1-0.6)	0.0024
Does not eat raw vegetables	6.2	6.7	0.9 (0.2-2.8)	0.9055
Washes hands before meals				
Yes	80.2	76.7	1	
No	9.9	10.0	1.0 (0.4-2.6)	0.8753
Sometimes	6.2	3.3	0.5 (0.1-2.1)	0.5657
Did not answer	3.7	10.0	2.5 (0.7-8.6)	0.1847
Handles soil				
Yes	64.2	50.0	1	
No	30.9	43.3	2.0 (1.0-3.2)	0.0785
Did not answer	4.9	6.7	2.0 (0.5-6.0)	0.5136
Way of handling soil				
With glove	19.7	6.7	1	
Without gloves	43.2	46.7	3.1 (1.2-8.1)	0.0290
Does not apply	30.9	43.3	4.0 (1.4-10.5)	0.0083
Did not answer	6.2	3.3	1.4 (0.2-7.3)	1.0000
Source of water				
Tap water	71.6	80.0	1	
Filtered or boiled water	14.8	6.7	0.4 (0.1-1.0)	0.1103
Mineral water	8.7	6.7	0.7 (0.2-2.0)	0.6794
Well water	1.2	3.3	3.0 (0.2-26.5)	0.7059
Did not answer	3.7	3.3	0.6 (0.1-3.1)	0.9051
Drinks / drank well water				
Yes	80.2	56.6	1	
No	12.4	36.7	4.3 (2.0-9.1)	0.0001
Does not know	7.4	6.7	1.4 (0.4-4.2)	0.7448
Drinks / drank river water				
Yes	19.8	26.6	1	
No	71.6	66.7	0.6 (0.3-1.3)	0.3538
Does not know	8.6	6.7	0.5 (0.1-2.0)	0.5099
Drinks / drank tank water				
Yes	8.7	6.7	1	
No	80.2	83.3	1.3 (0.4-4.0)	0.7753
Does not know	11.1	10.0	1.1 (0.3-4.3)	0.9112
Drinks / drank rainwater				
Yes	5.0	20.0	1	
No	83.9	73.3	0.2 (0.1-0.6)	0.0038
Does not know	11.1	6.7	0.1 (0.1-0.6)	0.0150

There were 258 new cases of HIV/AIDS in Florianópolis city, Santa Catarina state, in 2009. Young adults of reproductive age (15-49 years old) were more likely to be infected by HIV (Traebert et al. 2015). In 2016, Caxias city (Maranhão state) recorded 472 medical records of HIV/AIDS patients of both sexes within the 30- to 39-year-old age group of patients who were attended by the EAS/CTC from 1989 to August 2016 (Abreu et al. 2016).

In the present study, patients who had only 4th grade education were more likely to contract toxoplasmosis (18.5%) compared with patients with higher education ($p = 0.0067$). Patients with either incomplete or complete higher education were less likely to acquire the disease (25.9%; $p = 0.0013$). A study in El Mezquital Valley (Durango State, Mexico) supports this finding, in which individuals with no schooling had the highest *T. gondii* seroprevalence (40.2%; Alvarado-Esquivel et al. 2014). A lower level of education was also considered a risk factor for infection in studies that were performed in Pelotas city (Rio Grande do Sul state) with HIV patients who were attended by the EAS (Xavier et al. 2013). Fontoura et al. (2016) studied the seroprevalence of *T. gondii* in HIV patients in the countryside in Paraná state and identified a need for guidelines to prevent toxoplasmosis among individuals with low education and a lack of awareness about the disease.

In the present study, the multivariate analysis showed that patients with incomplete/complete higher education were 0.2 times less likely to acquire *T. gondii* infection compared with patients with only a 4th grade education ($p = 0.0125$). Foz do Iguaçu has a large number of students, particularly in the border region. The Federal University for Latin American Integration (UNILA) seeks to integrate foreign students into Latin America and is among the eight higher education institutions in Foz do Iguaçu city. It houses 184 students from Paraguay and 64 from

Argentina. Universidad Politécnica y Artística del Paraguay (UPAP) in Ciudad del Este has the largest number of medical students from cities in Brazil and Argentina, with approximately 2,000 Brazilians and 550 Argentinians, and most of these students live in Foz do Iguaçu (Conte 2018).

Most of the patients who were assessed in the present study had a low socioeconomic status (i.e., family income < 1 minimum wage or 1-3 times the minimum wage). Some studies in Brazil found correlations between positive toxoplasmosis serology and socioeconomic status (Carellos et al. 2014, Kamal et al. 2015, Rocha et al. 2015, Do Nascimento 2019). Adherence to HIV/AIDS treatment depends on the patients' income and socioeconomic status because such conditions can interfere with a patient's quality of life (Abreu et al. 2016).

Similar to studies in Ethiopia (Walle et al. 2013) and Sudan (Khalil et al. 2014), the present study found that the consumption of raw vegetables from the home was a risk factor for *T. gondii* infection ($p = 0.0024$). The study by Dos Santos et al. (2015) in southern Brazil found that the consumption of seemingly contaminated and not properly washed raw vegetables was a risk factor for the presence of *T. gondii* antibodies.

The habit of handling soil without gloves was another significant risk factor of *T. gondii* infection ($p = 0.0290$). This finding is substantiated by the study by Xavier et al. (2013), who found that contact with soil was a major risk factor for parasite infection.

With regard to water-related risks, untreated water intake increased the risk of infection. Patients who reported drinking well water had a higher risk of infection ($p = 0.0001$). The multivariate analysis confirmed that these patients were 3.0 times more likely to contract toxoplasmosis ($p = 0.0211$). Another study of HIV/AIDS patients who were infected with *T. gondii* and attended by the EAS in São Paulo city found

Table III. Univariate analysis of behaviors of patients who were attended by the Expert Assistance Service of Foz do Iguacu city, Paraná state, Brazil, in 2019.

Patient Profile (N = 111)	ELISA		Univariate analysis	p
	Positive (%)	Negative (%)	OR (95% CI)	
Has / had cats				
Yes	56.8	66.7	1	
No	43.2	33.3	0.6 (0.3-1.1)	0.1898
Places where cats stay / stayed				
Inside the house	24.7	30.0	1	
In and out of the house	30.9	33.3	0.8 (0.4-1.8)	0.8880
Does not remember	2.5	0.0	—	—
Does not have cats	41.9	36.7	0.7 (0.3-1.4)	0.4824
Cats sleep / slept on the bed				
Yes	16.1	23.3	1	
No	39.5	36.7	0.6 (0.3-1.4)	0.3961
Does not remember	1.2	0.0	—	—
Does not have cats	43.2	40.0	0.6 (0.2-1.3)	0.3591
Cats sleep / slept on chairs / couches				
Yes	25.9	36.7	1	
No	27.1	26.7	0.7 (0.3-1.4)	0.4476
Does not remember	2.5	0.0	—	—
Does not have cats	44.5	36.7	0.5 (0.3-1.1)	0.1656
Plays / played with cats				
Yes	39.5	53.3	1	
No	16.1	10.0	0.4 (0.1-1.1)	0.1322
Does not remember	2.5	0.0	—	—
Does not have cats	41.9	36.7	0.6 (0.3-1.1)	0.2102
Cat feces are / were cleaned				
Yes	11.1	20.0	1	
No	18.6	23.3	0.6 (0.2-1.7)	0.5508
Does not remember	1.2	0.0	—	—
Does not apply	69.1	56.7	0.4 (0.2-1.0)	0.0849
Cats defecate / defecated in the street				
Yes	40.7	30.0	1	
No	16.1	26.7	2.3 (1.0-5.0)	0.0533
Does not apply	43.2	43.3	1.3 (1.0-2.5)	0.4192
There are cats in the neighborhood				
Yes	91.3	86.7	1	
No	6.2	13.3	2.2 (1.0-6.2)	0.1681
Does not remember	2.5	0.0	—	—
Lets stray cats into the house				
Yes	68.0	86.7	1	
No	27.1	13.3	0.3 (0.1-1.0)	0.0128
Does not remember	4.9	0.0	—	—
Has dogs				
Yes	59.2	60.0	1	
No	38.3	40.0	1.0 (0.5-1.8)	0.9782
Did not answer	2.5	0.0	—	—

an association between tap water intake and a higher risk of infection, but no further details about water filtration were provided (Brito, unpublished data).

With regard to the presence of animals, patients who reported the presence of cats from the neighborhood who entered their homes had a higher risk of acquiring infection ($p = 0.0128$). These animals that have access to the outdoors are more exposed to the infectious form of the parasite (i.e., oocysts; Andrade et al. 2015, Souza et al. 2017).

Correlations between CD4 T-lymphocyte counts and the prevalence of toxoplasmosis have been reported in several studies. The present study found a high percentage (56.8%) of lymphocyte counts below 200 cells/mm³ in patients who developed acute *T. gondii* infection. Similar results were found in the Brazilian states of Minas Gerais (8.6%; Alves et al. 2016) and Rio Grande do Sul (9.2%; Xavier et al. 2013) and in Iran (11.1%; Daryani et al. 2011). Patients with CD4 T-lymphocyte counts below 300 cells/mm³ in the Czech Republic were more likely to suffer from reactivation (Kodym et al. 2015). CD4 T-lymphocyte counts below 200 cells/mm³ are considered one of the highest risk factors for cerebral toxoplasmosis in HIV patients (Arefkhah et al. 2018). Similar to studies in the Brazilian states of Minas Gerais (2.0%; Alves et al. 2016), Rio Grande do Sul (4.8%; Xavier et al. 2013), and Paraíba (5.2%; Soares et al. 2014), 3.31% of the patients who were assessed herein had a clinical history of neurotoxoplasmosis. This percentage is lower than findings from Iran (10%; Mohraz et al. 2011).

The occurrence of cerebral toxoplasmosis in areas with a high prevalence of HIV and toxoplasmosis is a relevant health issue for HIV patients. HIV/AIDS patients who develop ocular toxoplasmosis present extensive retinal lesions that can lead to severe visual impairments.

Retinochoroiditis is one of the main symptoms of ocular toxoplasmosis and the most common type of posterior infectious uveitis (Vasconcelos-Santos 2012). In this risk group, ocular toxoplasmosis can commonly manifest in a bilateral, extensive, or multifocal form (Fernandez et al. 2017). The present study found that ocular toxoplasmosis was the second most recurrent clinical sign of infection, which affected approximately 3.61% of the patients. Similar results were found in studies in Rio Grande do Sul state (1.6%; Xavier et al. 2013); and Recife city (5.7%; Alves et al. 2010). A study in São Paulo city found that ocular toxoplasmosis was one of the main ocular manifestations of HIV infection (Fernandez et al. 2017).

With regard to antiretroviral therapy, only a small proportion of the assessed patients did not adhere to regular antiretroviral therapy. Such irregular HIV treatment increased the risk of acute toxoplasmosis. Another study found that appropriate antiretroviral therapy can reduce the risk of infection by suppressing viral replication below detectable levels and increase CD4 T-lymphocyte counts (Mayor et al. 2011).

Although acute toxoplasmosis rates decreased after the introduction of antiretroviral therapy, the pathogenesis of this disease can become problematic for some patients who have difficulty adhering to treatment. Moreover, antiretroviral therapy is associated with side effects, drug toxicity, and the risk of viral resistance. Hence, patients may abandon treatment or use it only irregularly (Ministério da Saúde 2015).

Because of the severity and irreversibility of *T. gondii* lesions that can develop, an early diagnosis and clear distinctions between acute and chronic phases are key for appropriate intervention and risk mitigation (Xavier et al. 2013). Accordingly, awareness about the seroprevalence of *T. gondii* and its associated risk factors for HIV individuals is crucial for better understanding the dynamics of this infection and providing better prevention

Table IV. Univariate analysis of behaviors associated with *T. gondii* oocyst ingestion by patients who were attended by the Expert Assistance Service of Foz do Iguaçu city, Paraná state, Brazil, in 2019.

Patient profile (N = 111)	ELISA		Univariate analysis	p
	Positive (%)	Negative (%)	OR (95% CI)	
Eats raw / rare meat				
Yes	40.8	33.3	1	
No	59.2	66.7	1.4 (0.7-2.5)	0.3053
Eats raw / rare beef				
Yes	40.8	40.0	1	
No	4.9	10.0	2.0 (0.6-0.5)	0.3424
Does not eat raw / rare meat	54.3	50.0	1.0 (0.5-1.6)	0.9776
Eats raw / rare pork meat				
Yes	4.9	6.7	1	
No	38.3	43.3	1.0 (0.2-2.7)	0.9761
Does not eat raw / rare meat	56.8	50.0	1.0 (0.1-2.0)	0.6467
Eats raw / rare goat or sheep meat				
Yes	1.2	0.0	—	—
No	40.7	50.0	1	—
Does not eat raw / rare meat	58.1	50.0	5.1 (2.1-12.0)	0.0002
Eats raw / rare chicken				
Yes	6.2	6.7	1	
No	37.1	43.3	1.0 (0.3-3.2)	0.7692
Does not eat raw / rare meat	56.7	50.0	1.0 (0.2-2.3)	0.8484

and clinical management and treatment (Alves et al. 2016).

In conclusion, the high prevalence of toxoplasmosis in HIV/AIDS patients in the present study could be attributed to the location of the city in the border region and tourism that encourages the intense flow of people. Infection was prevalent among patients who were 18-60 years old, had education only up to the 4th grade of elementary school, ate raw vegetables from

the home, handled soil without gloves, drank untreated water, and let street cats into their homes. The present findings will contribute to public health, especially in border regions that have characteristics that are similar to the present study, indicating the need to implement effective measures to control morbidity and mortality that are associated with HIV/AIDS and toxoplasmosis in the evaluated population.

Table V. Multivariate analysis of aspects associated with *T. gondii* infection in patients who were attended by the Expert Assistance Service of Foz do Iguaçu city, Paraná state, Brazil, in 2019.

Independent variable	Odds ratio	Multivariate analysis (95% CI)	p
Age (years)			
≥ 18 and < 30	1		
≥ 30 and < 45	1.4	1.0-2.4	0.1239
≥ 45 and < 60	1.3	1.2-2.3	0.1439
Education level			
4th grade of elementary school	1		
Higher education (complete or incomplete)	0.2	0.1-0.1	0.0125
Family income			
Below the minimum wage	1		
Between 1 and 2 minimum wages	1.0	0.4-2.0	0.6464
Eats raw vegetables from home			
Yes	0.5	0.2-1.1	0.0998
No	1		
Handling soil			
With gloves	1.0	0.5-1.4	0.7521
Without gloves	1		
Drinks / drank well water			
Yes	3.0	1.1-7.0	0.0211
No	1		
Cats defecate / defecated in the street			
Yes	1.2	1.0-2.0	0.5134
No	1		
Lets stray cats into the house			
Yes	2.0	1.0-5.0	0.1599
No	1		

Table VI. Rate of *T. gondii* seropositivity and seronegativity and CD4 T-lymphocyte counts, viral load, and antiretroviral therapy in HIV patients who were attended by the Expert Assistance Service of Foz do Iguacu city, Paraná state, Brazil, in 2019.

Clinical variable	Rate		Seropositive toxoplasmosis		Seronegative toxoplasmosis	
	N	%	N	%	N	%
CD4 < 200 cells/mm ³	6	5.4	6	7.4	0	0
CD4 > 200 cells/mm ³	60	54.1	46	56.8	14	46.7
Not found	45	40.5	29	35.8	16	53.3
Detectable viral load (> 40 copies/mm³)						
Yes	25	22.5	23	28.4	2	6.7
No	83	74.8	56	69.1	27	90.0
Not found	3	2.7	2	2.5	1	3.3
Regular antiretroviral therapy						
Yes	107	96.4	77	95.1	30	100
No	4	3.6	4	4.9	0	0

Table VII. Clinical and serological features of HIV/AIDS patients with suspected or confirmed neurotoxoplasmosis in Foz do Iguacu city, Paraná state, Brazil, in 2019.

	CD4 (cells/mm ³)	IgM/IgG anti- <i>T. gondii</i> serology	Viral load (copies/mm ³)	Antiretroviral therapy
Patient 1	36	NR	284647	Regular use
Patient 2	168	NR	56	Regular use
Patient 3	473	IgM ⁻ /IgG ⁺	UND	Regular use
Patient 4	92	NR	1745	Regular use
Patient 5	303	NR	UND	Regular use
Patient 6	348	NR	UND	Regular use
Patient 7	360	NR	3296	Regular use
Patient 8	378	IgM ⁻ /IgG ⁺	533	Regular use
Patient 9	771	NR	UND	Regular use
Patient 10	196	NR	841240	Regular use
Patient 11	350	IgM ⁻ /IgG ⁺	3296	Regular use

NR, no result; UND, undetectable.

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