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Full Length Research Paper

Knowledge and practices towards toxoplasmosis among blood donors in Abidjan, Côte d'Ivoire

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Abstract

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***Toxoplasma gondii* transmission occurs mainly through consumption of contaminated food or water, from mother to fetus during pregnancy, and after reactivation of the parasite in seropositive individuals who become immunocompromised. Toxoplasmosis can also occur during blood transfusions. Considering the risk of blood donors for susceptible recipients (immunosuppressed people and pregnant women), it is important to evaluate blood donors' knowledge and identify their practices regarding toxoplasmosis to determine the associated risk factors. From January 2022 to October 2023, 1275 donors were included in this study. Their knowledge and practice data regarding toxoplasmosis were collected using a questionnaire. The survey results were statistically analyzed to determine correlations between knowledge and practices and factors such as age, sex, and education level. Most of them were men, aged approximately 38 years. Only 9.6% of them knew toxoplasmosis and its modes of transmission. 14.1% and 27.6% of them were cat owners and gardeners, respectively, this status increased the risk of parasite exposure. This study showed a low rate of knowledge about prevention; thus the importance of integrating toxoplasmosis education into blood donation programs. This measure will reduce the risk of toxoplasmosis transmission among blood donors.**

Keywords: Toxoplasmosis, Knowledge and practise, blood donors, Côte d'Ivoire.

Introduction

Toxoplasmosis is a zoonosis caused by *Toxoplasma gondii* (*T. gondii*). It is the most successful cosmopolitan protozoan, infecting up to one-third of the global human population (Robert-Gangneux and Dardé, 2012). *T. gondii* transmission occurs mainly through consumption of contaminated food or water, from mother to fetus during pregnancy, and after reactivation of the parasite in seropositive individuals who become immunocompromised (Dubey *et al.,* 2021). Although this infection is generally benign in healthy individuals, it can cause serious complications in immunocompromised individuals, pregnant women, and newborns (Štajner *et al.,*

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2022). In addition, the parasite can be transmitted through blood transfusion. Blood transfusion is crucial for many patients, but it presents infectious risks for susceptible recipients, such as immunosuppressed individuals and pregnant women (Singh and Sehgal, 2010), (Foroutan-Rad *et al.,* 2016). Therefore, prevention of toxoplasmosis is essential for transfusion safety (Dodd, 1998).

Toxoplasmosis remains a serious problem, particularly in the context of organ transplantation and blood transfusions (Wesołowski et al., 2023). Although research has already been conducted on this infection, the increase in cancer cases and the use of immunosuppressive treatments make the situation more critical today.

Foroutan-Rad*.* has estimated that approximately 33% of blood donors in the world are infected with *T. gondii*, with the African region recording the highest rate (46%) and Asia the lowest (29%) (Foroutan-Rad *et al.,* 2016). In Côte d'Ivoire, a seroprevalence of 67.42% among blood donors was found (Siransy et al., 2016).

In countries with low- or middle-income economies, such as Côte d'Ivoire, the prevalence of toxoplasmosis is often high due to specific environmental, culinary, and socioeconomic factors (Tavakoli Kareshk *et al.,* 2016). In 2004, Adou-Bryn et al. (2004) estimated the seroprevalence of *T. gondii* among women of childbearing age to be 60%. One study reported a seroprevalence of 45.2% among pregnant women at the Institute Pasteur of Côte d'Ivoire between 2006 and 2014 (Bonouman-Ira et al., 2017). However, little data are available on blood donors' knowledge and practices regarding this infection, even though their behavior may constitute dangerous risk factors for blood recipients. For these reasons, it is important to have news data on this topic (Tavakoli Kareshk et al., 2016). The aim of this study was to evaluate the knowledge of blood donors and identify their practices regarding toxoplasmosis to determine associated risk factors in order to improve awareness of toxoplasmosis with formal education about toxoplasmosis risk factors, reduce the risk of transmission of toxoplasmosis among blood donors, and formulate recommendations to reinforce transfusion safety in Côte d'Ivoire.

Materiel and methods

1) Study design and population

This cross-sectional study was conducted from January 2022 to October 2023 among blood donors at Abidjan's Centre National de Transfusion Sanguine (CNTS) and mobile blood drives in the city. The sample size was calculated using the SCHWARTZ formula: n= p(1-p) *z2/i2. (n) is the required number of donors to be sampled. (p) 48%, represent the reference prevalence of toxoplasmosis in Côte d'Ivoire, and a 95% confidence interval (Z=1.96) with an absolute precision of 3% (i). Donors had to meet the eligibility criteria for blood donation. The inclusion criteria for the study were (i) age between 18 and 65 years, (ii) good health, and (iii) weight greater than 50 kg.

2) Data Collection

The Participants who provided free and informed consent were asked to answer a structured questionnaire comprising three sections: the first was devoted to the sociodemographic characteristics of the donors, including age, sex, blood group, profession, and place of birth; the second aimed to assess their general knowledge of toxoplasmosis; and the third was designed to identify potential risk factors for contamination by examining donors' attitudes and practices, such as contact with cats, consumption of undercooked meat, consumption of unwashed raw vegetables and fruit, and gardening. All these data were selected based on the literature and after a pre-test on 30 donors to adjust the questionnaire.

3) Ethical considerations

This study was approved by the National Committee of Ethics of Life Sciences and Health of Côte d'Ivoire (N° 0004125/MSHPCMU/CNESVS-km). The study was also conducted with the approval of the General Manager of the CNTS. Participation in this study was voluntary. Individual signed informed consent was obtained from each blood donor before inclusion, both for the questionnaire and for the collection of sera. Informed consent was obtained from uninstructed donors by the investigator with the donor's authorization.

4) Statistical analysis

The survey results were reported in a database generated using Sphinx Plus^2 V5 software. Statistical analysis of the results was performed using the SPSS Statistics software, version 27. The Pearson chi-square test was used to establish the association between knowledge of toxoplasmosis and sociodemographic characteristics. Values of $p < 0.05$ being considered statistically significant, odds ratios (OR) and corresponding 95% confidence intervals (CI) were calculated to measure associations. Fisher's exact test was used for theoretical group sizes less than or equal to five.

Results

1) Socio-demographic characteristics

The sociodemographic characteristics of the blood donors included in this study are shown in Table I. The mean age of the blood donors was 38.3 years (median: 38 years; range: 18–60 years). Many donors (46.3%) were from Abidjan's southern zone (Treichville, Marcory, Koumassi,

Table I: Distribution of blood donors according to demographics characteristics.

CHARACTERISTICS		n	%
Sex			
	Male	1093	85.7
	Female	182	14.3
Age (years)			
	18-25	148	11.6
	26-35	357	28
	36-45	463	36.3
	> 45	307	24.1
ABO Rh blood group			
	A+	214	16.8
	B+	188	14.7
	AB+	32	2.5
	O+	492	38.6
	A-	13	1
	B-	17	1.3
	AB-	1	0.1
	O-	44	3.5
	I don't Know	274	21.5
Profession			
	Executive/Employee	664	52.1
	Craftsman/Dealer	389	30.5
	Retired	7	0.5
	Unemployed	8	0.6
	Housekeeper	42	3.3
	Pupil/Student	120	9.4
	Others	45	3.5

and Port-Bou ët). Most blood donors were men, managers/employees, and did not know their blood group.

2) Awareness level of blood donors regarding toxoplasmosis

In terms of information, only 9.6% of blood donors had heard toxoplasmosis. The main sources of information on this disease were healthcare personnel (53.3%) and school courses (19.7%). Most of them did not know the name and type of the toxoplasmosis microbe. Their knowledge mainly concerned risk factors and preventive measures. Among the modes of transmission, the consumption of undercooked meat (34.4%) and congenital transmission (27%) were the most common among donors. However, more than half of donors (57.4%) were unaware of the modes of contamination despite some general knowledge of the disease. Only a minority knew about the existence of treatment (Table II).

Regarding screening, 34.4% of donors said they had already been tested for toxoplasmosis, with a positivity rate of 11.9%. In addition, 36.1% of donors informed of the subject received prevention advice.

3) Donor's practices towards toxoplasmosis

The main responses of the female donors regarding toxoplasmosis practices are shown in Table III. Only 7% and 8% of them owned cats and gardened cats, respectively. 17.4% and 31.8% of them had a habit of eating undercooked vegetables and meat, respectively. In addition, 29.1% consumed raw milk and 8.3% untreated water.

Over 90% of these women always washed their hands before cooking and washed fruits and vegetables before eating them. The majority (97.8%) never wore gloves while cooking. However, 76.2% of women always washed their knives after using it to cut raw meat. Some 27.6% Of these

Table II: General knowledge about toxoplasmosis.

Questions and answers	n	%
Do you know what toxoplasmosis is?		
Yes	122	9.6
No	1153	90.4
What is your information source?		
Healthcare professional	65	53.3
Friends and family	14	11.5
Internet	5	4.1
Television	7	5.7
Books	2	1.6
School	24	17.7
Others	7	5.7
Kind of information		
Risks factors	61	50
Toxoplasmosis microbe	22	18
Screening methods	34	27.9
Preventive measure	44	36.1
Do you know the toxoplasmosis microbe name?		
Yes	22	18
No	100	82
Do Toxoplasmosis microbe is?		
Bacteria	16	72.7
Virus	4	18.2
Parasite	2	9.1
Can *Toxoplasma* infection be transmitted by consumption of raw meat?		
Yes	42	34.4
No	80	65.6
Can *Toxoplasma* infection be transmitted by consumption of contaminated food or drinks?		
Yes	14	11.5
No	108	88.5
Can *Toxoplasma* infection be transmitted by blood transfusion?		
Yes	13	10.7
No	109	89.3
Can *Toxoplasma* infection be transmitted from mother to fetus during pregnancy?		
Yes	33	27.0
No	89	73.0
Can Toxoplasmosis be treated?		
Yes	26	21.3
No	6	4.9
I don't Know	90	73.7

women always frozen meat.

The results showed that some donor practices were not adapted to prevent toxoplasmosis. Among them, 14% owned a cat and 28% gardened, two activities which increased the risk of exposure to the parasite. 30.5% Of donors cleaned their fruits and vegetables with bleach, while the majority - 77.8%, 4.3%, and 32.5%) cleaned undercooked vegetables, undercooked, and raw milk, respectively.

Regarding domestic hygiene, 71.7% of participants said they regularly cleaned their refrigerators. However, 21.2% of donors, mainly men, confessed to being unaware of these good practices, explaining that maintenance was generally carried out by their wives.

Table III: Donor's practices towards toxoplasmosis.

Questions and answers	Aware of toxoplasmosis		
	YES n (%)	NO n (%)	p value
Owning a cat			
Yes	13 (10.7%)	167 (14.5%)	0,277
No	109 (89,3%)	986 (85,5%)	
Gardening			
Yes	43 (35,2%)	309 (26,8%)	0,55
No	79 (64,8%)	844 (73,2%)	
How often do you wash fruits and vegetables			
Regularly	47 (38,5%)	342 (26,7%)	0,160
Often	75 (61,5%)	811 (70,3%)	
Eating undercooked vegetables			
Yes	89 (73%)	903 (78,3%)	0,109
No	33 (27%)	250 (26,7%)	
Eating undercooked meat			
Yes	10 (8,1%)	45 (3,9%)	0,05
No	111 (90,9%)	1082 (93,8%)	
Consumption of raw milk			
Yes	31 (25,4%)	384 (33,3%)	0,08
No	91 (74,6%)	769 (66,7%)	
Consumption of untreated water			
Yes	121 (99,2%)	1145 (99,3%)	0,597
No	1 (0,8%)	8 (0,7%)	

4) Distribution of blood donors who have heard toxoplasmosis according to demographics data

The percentage of donors who had heard of toxoplasmosis varied significantly, according to several characteristics. This percentage was significantly higher among female donors (28%) than male donors (6.5%). In addition, this percentage increases with age, particularly among donors over 45, and in the eastern zone residents of Abidjan (Cocody, Bingerville), with respective rates of 12.7% and 24.4% (p = 0.0001). Regarding professional categories, managers/employees accounted for 6.8%, but specific professions such as photographers, artists, jewellers, couriers, sportsmen, and pastry chefs had a higher percentage of 54.3% (p= 0.0001) **(Table IV).**

Discussion

In the present study, 1275 blood donors from the National Center of Blood Transfusion were included. Their sociodemographic characteristics indicated that male donors were the most represented (sex ratio: 6.01). This situation can be explained by restrictions on blood donation eligibility for pregnant, breastfeeding, or menstruating women, as well as cultural and social constraints in Africa (Alphonsine et al., 2012)**.**

The mean donor age was 38.3 (median, 38 years), with a range from 18 to 65 years. The majority of the donors were aged between 26 and 45 years. This was a young population. These data are similar to those obtained in 2020 by Lachkhem et al. in Tunisia, who found an age mean of 35 among donors, with a predominance of males(Lachkhem et al., 2020)**.**

In terms of occupation, almost half (52.1%) are managers/salaried workers. Students accounted for 9.4%, followed by professionals 30.5% and the unemployed 0.6%. These data are consistent with existing data on blood donors in Côte d'Ivoire by Liliane Siransy et al, in 2014 in Abobo (Siransy et al., 2016). However, in Colombia, one study revealed that students were the most frequent, with respective rates of 37.7% and 84.2% (Ramírez et al., 2019).

The prevalence of toxoplasmosis in Africa, specifically in Côte d'Ivoire, is high. However, data on the knowledge,

Table IV: Distribution of blood donors according to demographics data and their awareness of Toxoplasmosis

Demographics data	Aware of toxoplasmosis		p value
	YES n (%)	NO n (%)	
Sex			
Male	71 (6.5%)	1022(93.5%)	**0.0001**
Female	51 (28.0%)	131(72.0%)	
Age (years)			
18-25	7 (5.7%)	141 (95.3%)	
26-35	26 (7.3%)	331 (92.7%)	**0.015**
36-45	50 (10.8%)	413 (89.2%)	
> 45	39 (12.7%)	268 (87.3%)	
Area of residence			
Abidjan North	5 (2.7%)	183 (97.3%)	
Abidjan Sud	44 (7.5%)	546 (92.5%)	**0.0001**
Abidjan Centre	4 (5.2%)	73 (94.8%)	
Abidjan East	48 (24.4%)	148 (75.5%)	
Abidjan West	21 (9.4%)	203 (90.6%)	
Profession			
Craftsman/Dealer	14 (3.4%)	375 (96.4%)	
Executive/Employee	89 (13.4%)	575 (86.6%)	
Looking for job	1 (12.5%)	7 (87.5%)	**0.0001**
Housekeeper	3 (7.1%)	39 (92.8%)	
Pupil/Student	11 (9.2%)	109 (90.8%)	
Retired	1 (14.3%)	6 (85.7%)	
Others	3 (6.7%)	42 (93.3%)	

attitudes, and preventive behaviors related to this disease among blood donors are limited. Our study revealed that only 122 donors (9.6%) out of 1,275 had heard of toxoplasmosis, with health personnel as the main source of information. Toxoplasmosis among blood donors in Côte d'Ivoire is poorly documented. To our knowledge, no specific survey or publication has precisely assessed the level of knowledge about this disease in this population. However, the data collected can be compared with those observed in other groups of pregnant women, especially according to a review by Martini et al. in 2020. In Poland, for example, knowledge of toxoplasmosis reached 94.4% among pregnant women (Smereka et al., 2018). In Morocco, 41.3% of pregnant women have heard or read about toxoplasmosis (Ait Hamoud et al. 2021). In Egypt, the level of knowledge is like ours, with 9.9% of pregnant women having heard or read about toxoplasmosis (Abdalla et al., 2014). This difference may be due to the different cultural or sociodemographic factors in each country.

Regarding knowledge of risk factors and modes of contamination, more than half of informed donors (57.4%, or 70 out of 122) were ignorant of the modes of transmission of toxoplasmosis, despite some familiarity with the name of the disease. The most frequently mentioned modes of contamination were consumption of undercooked meat (34.4%), maternal-fetal transmission (27%), and contact with cats (13.1%).

In our study, contact with cats was identified as the only factor significantly associated with the spread of toxoplasmosis ($p = 0.01$), according to the statistical analysis using the chi-square test. This suggests that *T. gondii* infection in our population may be associated with the ingestion of parasitic oocysts present in contaminated food or water.

A study conducted in Taiwan also showed a higher seroprevalence of toxoplasmosis in cat-owning blood donors (14.7%) than in non-cat-owning donors (8.7%) (Chiang *et al.,* 2012) . In addition, 27.6% of donors practiced gardening, a potential risk factor for exposure to oocysts in the soil. Similar results were reported by Cosme Alvarado-Esquivel et al. in 2007) in Mexico, where 29.4% of participants had frequent contact with soil (Alvarado-Esquivel *et al*., 2007).

This study showed that among the donors surveyed, 77.8% consumed undercooked vegetables, 4.3% undercooked meat, 32.5% raw milk, and 0.7% untreated water. These results are in accordance with observations obtained in Taiwan (Chiang *et al.,* 2012), Tunisia (Lachkhem *et al*., 2020) and Portugal (Rodrigues *et al.,* 2020), where the consumption of raw or undercooked vegetables, fruits, and meat has been identified as an important risk factor for toxoplasmosis transmission.

Conclusion

An assessment of the knowledge, attitudes, and practices of blood donors in Abidjan revealed a low level of awareness of toxoplasmosis and risky behaviors favoring exposure.
Therefore, it is necessary to set up educational programs to make donors aware of toxoplasmosis, its risk factors, symptoms, transmission, and preventive measures. Future research will be done to determine the presence of *Toxoplasma gondii* in blood bags, so that this condition can be requested in the routine examination.

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