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Original Article

The community knowledge, awareness, and practices influencing transmission of toxoplasmosis in Mbeya District, Tanzania

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Abstract

Background: Toxoplasmosis caused by Toxoplasma gondii is an important but neglected zoonotic disease of global distribution. The study aimed at evaluating community knowledge, awareness, and practices linked to transmission and control of the disease among the residents of urban and peri-urban areas of Mbeya District, Tanzania.

Methods: A cross-section study was conducted from January 2022 to March 2022 in the Mbeya district. A semi-structured questionnaire was self-administered to gather information on social demographic characteristics, knowledge, and risk behaviors related to toxoplasma infection, chi squire was employed to test the difference where p-value < 0.05 was considered statistically significant.

Results: A total of 100 respondents were recruited. The majority (38.0%) of the respondents were aged 26 - 35 years and (49.0%) had attained primary education. The average mean age was 35.6 (+ 11.5 SD), 57% were male while 43.0% were female. Only 22 percent of the respondents were aware of toxoplasmosis and among them, 10 percent were aware of the clinical manifestations of the disease and 20 percent knew the mode of the disease transmission. Identified risk practices include lack of deworming in cats (81.0%), outdoor cats management (60.0%), disposal of cats' faces in gardens (36.0%), use of cats in controlling rodents (41.0%), and not wearing gloves during gardening (77.0%). Children are noted to be at the highest risk of contracting the disease as they are greatly involved in caring for cats. (49.0%). The knowledge of the disease was found to be associated with sex (males) p value= of 0.041, occupation (medical employees) p-value =0.002, and high level of education of the respondents' p value =0.000.\.

Conclusion: The study revealed a low level of knowledge of the participants and practiced risky behaviors for disease transmission. Thus, we recommend to relevant authorities to offer education to the community concerning Toxoplasmosis.

Keywords: Protozoan, rodents, cats, neglected diseases, Mbeya, Tanzania

Background

Toxoplasmosis is a zoonotic protozoan disease caused by a parasite called Toxoplasma gondii. The parasite infects all warm-blooded animals affecting one-third of the global population [1, 2]. The disease is transmitted to humans via either vertical or horizontal pathways. The horizontal pathway involves the ingestion of oocysts in contaminated water, soil, or food with the feces of a definitive feline host. Also, ingestion of intracellular cysts in undercooked meat of an intermediate host such as rodents [3, 4]. On the other hand, the vertical pathway is observed in an infected pregnant mother who transfers the pathogen to her fetus through the placenta which may consequently result in miscarriage, fetal death, and neurological and/or ocular disorders to the fetus [5, 6]. Furthermore, T. gondii infection could also occur as a result of a blood transfusion or an organ donation from an infected donor [7]. Toxoplasmosis may cause retinochoroiditis and central nervous system lesions [8] that are presented as encephalitis [9]. The clinical manifestations are more pronounced in immunocompromised individuals [10, 11, 12].

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The global spatial orientation of this disease reveals it to be more prevalent in tropical countries with warm, humid climates compared to arid or colder countries. Local variation of the prevalence of this disease is influenced by variations in social practices such as eating habits, sanitation, keeping petty animals, and hygiene practices as well as variations in host immune status among individuals in a particular population [10, 13]. Human toxoplasmosis in particular is most prevalent in Western and Eastern parts of the African continent while the southern part of the continents has the lowest prevalence.

The status of the disease in humans in Tanzania has been reported to range from 4 to 60.0% in the past 30 years [14, 15, 16]. The disease caused 188 deaths in the country during ten years (2006-2015), the figure might be a gross underestimation of the burden as many cases might have gone undiagnosed.

The highest case mortality rate per 100 000 population was noted in the southern part of the country [17]. Despite that, the disease does not receive due attention due to limited epidemiological information. The community risk factors influencing the acquisition and transmission of the disease remained unknown in the country's southern part despite the reported higher case mortality rates. This phenomenon demands the assessment of community knowledge, awareness, and practices that are likely to influence the disease dynamics in the area. This study therefore aimed to assess community knowledge, awareness, and practices to establish the risk factors which may influence the epidemiology of the disease in the study community. The findings will be useful in planning and designing proper disease prevention, and control strategies in the country.

Methods

Study area

The study was conducted in urban and peri-urban areas of Mbeya district from January 2022 to March 2022. The district is located in the Southwest highlands of Tanzania and it lies along the crossings of latitude and longitude of 8054' south of Equator, 330 27'east of Greenwich Meridian respectively. The district is bordered by Mbarali, Ileje, Rungwe, and Mbozi districts on the northern, southern, eastern, and western sides, respectively [18]. Mbeya district's population is approximately 385279 people [19].

The district is administratively divided into 36 wards. The major economic activities in the district include business, agriculture, and livestock keeping as well as small and large-scale industrial production [19]. The climate is generally mild-warm and temperate. The annual average temperature is 7°C to 22 °C while the average rainfall is around 2068 mm per year [20]. Four Periurban wards (Igawilo, Mwansekwa, Itende, and Iziwa) and four urban wards (Ruanda, Iyela, Mabatini, and Maendeleo) were selected to make a total of 8 surveyed wards in the district (Fig 1).

Study design and setting

A cross-sectional study was conducted to assess socio-demographic characteristics, knowledge, awareness, and practices influencing the epidemiology of toxoplasmosis. The study was conducted in the Mbeya district from January 2022 to March 2022.

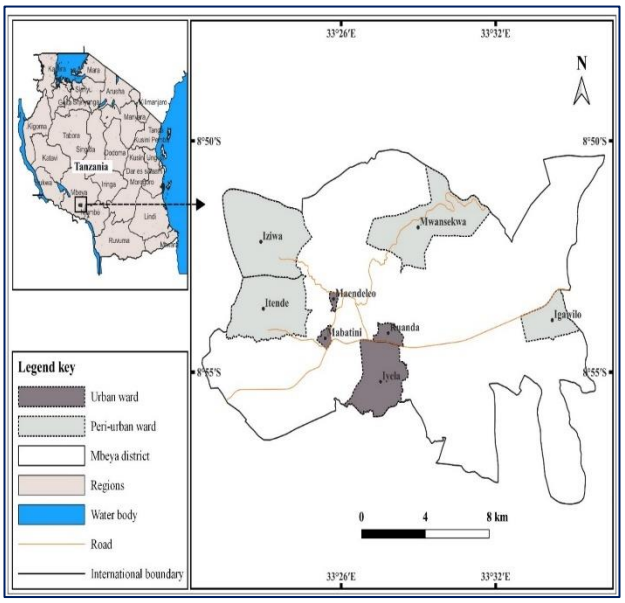

Figure 1: Map of Mbeya district showing surveyed wards
Source: GIS 3.28.0 "Firenze" visited on (10/11/2022)

Inclusion and exclusion criteria

Three inclusion criteria were observed in the selection of the study population. The first criterion was age, where all participants had to be 18 years old and above. The second was the location, where all study participants had to be permanent residents in urban and peri-urban wards of the study area. The last criterion was affiliation to a household or storage facility that was recruited in the trapping of the rodents and cats to achieve a complementary objective of the study. On the other hand, exclusion criteria were age below 18 years old, not being a permanent resident of the study area, and unwillingness to participate in the study.

Sample size

The formula n= [Z2 P (1-P)]/ d 2 was used to calculate the sample size for the survey based on the previously known prevalence of the disease [16]. Where, n = Sample size; Z = Statistic for the degree of confidence (1.96 at the confidence level of 95.0%); P = Expected prevalence (13.0%) [16]; d = Precision (5.0%). The computation results in: n=1.96x1.96x0.13 (1-0.13)/0.05x0.05=173. A total of 173 respondents from the eight selected wards were required to participate in the questionnaire data survey. However, the study recruited 100 participants due to inclusion criteria and exclusion.

Study tool

A semi-structured questionnaire in the Swahili language translated from the English version was administered to the respondents. Each question was read to respondents who were unable to read the questions on their own then their responses were recorded. The questionnaire consisted of 30 questions, 25 of these questions were closed-ended while the remaining five were open-ended. The questionnaire had four major parts; demographic characteristics 5 questions, basic knowledge of toxoplasmosis 3 questions, awareness towards Toxoplasmosis 2 questions, and practices 20 questions influencing the prevalence of disease in the sampled community participants. The bulk of the questions were designed to assess practices reflecting the

role of the definitive host(cats), intermediate host (rodents), respondents' behaviors, and their influence on the acquisition and transmission of this disease in the study community.

Dependent and independent variables

Independent variables were education level, sex, marital status, occupation, age, and location while the dependent variables were Knowledge, awareness, and practices influencing transmission of the disease. Emphasis was given to the role of the intermediate and definitive hosts in spreading the disease in a household setting. The mean percentage of scores in relation to the knowledge and awareness of Toxoplasmosis in the community was interpreted where knowledge and awareness of the respondents in relation to Toxoplasmosis was considered either low or high if the mean score was less or more than 50%, respectively.

Statistical analysis

The survey data were coded and entered in Microsoft Excel spreadsheets and descriptive and analytic statistics were computed using Statistical Package for Social Science (SPSS) software version 25, IBM Corporation, Armonk, NY, USA [22]. The variables in the frequency tables and their proportions were summarized and described using descriptive statistics. The chi-square test was employed to determine statistically significant variations in awareness of the disease among categorical demographic variables. Knowledge and awareness of the respondents in relation to the disease were considered either low or high if the mean score was less or more than 50% respectively.

Results

Socio-demographic characteristics of study participants

A total of 100 participants were recruited in the study, 52.0% of these were from urban while 48.0% were peri-urban residents. The majority (38.0%) of the respondents were aged 26-35 years. Males formed a slightly bigger portion (57.0%) of the total respondents in the study population. About half (49.0%) attended primary educational level. In addition, farming appeared to be the main source of income for the respondents (Table 1).

Respondents' Knowledge and Awareness of Toxoplasmosis

The results revealed that a relatively small percentage (22.0%) of the respondents were aware of the existence of the disease while most (78.0%) of them were unaware of its existence (Figure 2).

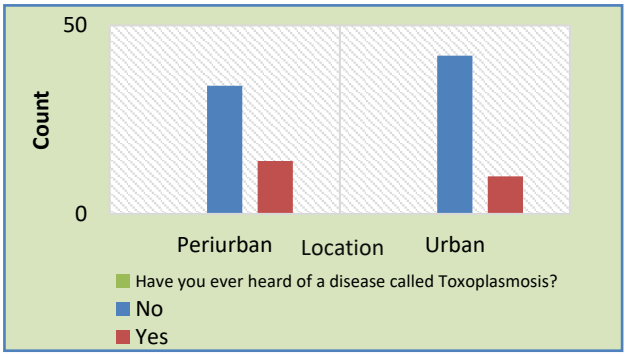

Figure 2: The distribution of responses reflecting respondents' awareness of the existence of Toxoplasmosis

Furthermore, an analysis was made of respondents who were aware of the existence of the disease to reveal the sources of that information. The results show that a substantial amount of these respondents appeared to have obtained the information from higher learning institutions, health facilities, social networks, and radio while a noticeably small portion of them obtained the information from newspapers and television (figure 3).

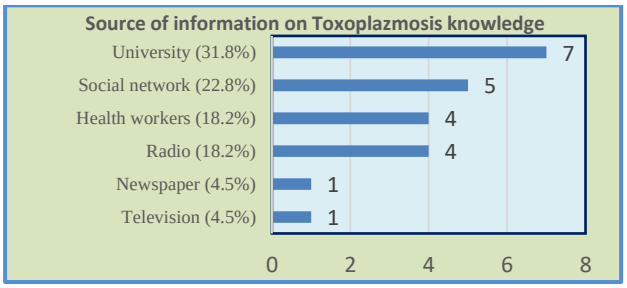

Figure 3: source of information on Toxoplasmosis knowledge

The respondent's awareness in relation to transmission of this disease was relatively low, where 80.0% of the respondents were uncertain of the mode of transmission. 20.0% was distributed to 15.0%, 4.0%, and 1.0% of the respondents who respectively thought that the disease was transmitted through consuming raw meat, contaminated food, and cat excretions. Furthermore, the awareness of respondents on other communicable diseases spread by cats or rodents was assessed where 81.0% claimed to be unaware of any communicable disease spread by these animals. On the other hand, the remaining 19.0% was distributed to 10.0%, 3.0%, 3.0%, and 3.0% of the respondents who respectively mentioned plague, leptospirosis, rabies, and worms as communicable diseases transmitted from rodents and cats while none mentioned Toxoplasmosis. In relation to respondent's knowledge of clinical manifestations of this disease, only 10% of the respondents mentioned relevant clinical manifestations while the majority (90.0%) of them were unaware (Table 2). The mean scores of 17.0% reflected that the majority of the respondents in the Mbeya district had low knowledge and awareness of Toxoplasmosis (Table 3).

Practices influencing the definitive host (Cats) in the transmission of Toxoplasmosis

The practices influencing the risk of toxoplasmosis transmission from the definitive hosts (cats) were assessed by seven questions. The results show that more than 80.0% of respondents did not deworm their cats regularly. The results also revealed a great diversity in cat feeding practices where 39.0% and 30.0% of the respondents fed their cats with milk and homemade feeds respectively. On the other hand, a relatively smaller proportion of the respondents claimed to employ other cat-feeding practices where 15.0% fed products unfit for human consumption from slaughterhouses and slabs while the remaining 17.0% claimed not to feed them at all. Factors reflecting domestic cat management were also assessed where results showed that the majority (60.0%) of the respondents didn't manage to keep their cats indoors while the remaining 37.0% and 3.0% respectively kept their cats indoors or didn't own one (Table 4).

Table 1: Socio-demographic characteristics of study participants in urban and Periurban areas of Mbeya district.

			Periurban Wards				**Urban Wards**			
VARIABLE	Categories	**Igawilo**	**Mwansekwa**	**Iziwa**	**Itende**	**Maendeleo**	**Mabatini**	**Ruanda**	**Iyela**	**Total**
Education level	None	_	6(35%)	4(23.5%)	3(17.6%)	2(11.8%)	1(5.9%)	1(5.9%)	_	17
	Primary Education	5(10.2%)	2(4.1%)	4(4.1%)	8(16.3%)	7(14.3%)	7(14.3%)	10(20.4%)	6(12.2%)	49
	Secondary Education	1(8.3%)	3(25%)	2(16.7%)	-	-	2(16.7%)	1(8.3%)	3(25%)	12
	Advanced Education	-	-	-	-	2(40%)	1(20%)	_	2(40%)	5
	Post-Secondary Education	6(35.3%)	1(5.9%)	-	1(5.9%)	2(11.8%)	2(11.8%)	1(5.9%)	2(11.8%)	17
Sex	Male	8(66.7%)	4(33.3%)	9(75%)	10(83.3%)	6(46.2%)	7(53.8%)	5(38.5%)	8(61.5%)	57
	Female	4(33.3%)	8(66.7%)	3(25%)	2(16.7%)	7(53.8%)	6(46.2%)	8(61.5%)	5(38.5%)	43
Marital status	Single	4(12.9%)	4(12.9%)	4(12.9%)	4(12.9%)	5(16.1%)	5(16.1%)	2(6.5%)	3(9.7%)	31
	Married	7(13%)	6(11.1%)	6(11.1%)	7(13%)	4(7.4%)	6(11.1%)	8(14.8%)	10(18.5%)	54
	Cohabiting	1(100%)	_	_	_	_	_	_	_	1
	Separated/Divorced	_	1(16.7%)	2(33.3%)	1(16.7%)	1(16.7%)	_	1(16.7%)	_	6
	Widow	_	1(12.5%)	_	_	3(37.5%)	2(25%)	2(25%)	_	8
Occupation	Peasant	2(5.3%)	7(18.4%)	8(21.1%)	6(15.8%)	5(13.2%)	1(2.6%)	3(7.9%)	6(15.8%)	38
	Formally Employed	1(33.3%)	_	1(33.3%)	_	_	_	1(33.3%)	_	3
	Self Employed	4(13.8%)	1(3.4%)	2(6.9%)	4(13.8%)	5(13.8%)	5(17.2%)	6(20.7%)	2(10.3%)	29
	Business	4(16%)	3(12%)	1(4%)	2(8%)	3(12%)	5(20%)	3(12%)	4(16%)	25
	Student	1(50%)	1(50%)	_	_	_	_	_	_	2
	Unemployed	1(33.3%)	-	-	-	-	2(66.7%)	-	-	3
Age	18-25	2(11.1%)	2(11.1%)	2(11.1%)	4(22.2%)	2(11.1%)	1(5.6%)	2(11.1%)	3(16.7%)	18
	26-35	3(7.9%)	7(18.2%)	3(7.9%)	5(13.2%)	4(10.5%)	8(21.1%)	2(5.3%)	6(15.8%)	38
	36-45	5(20%)	1(4%)	6(24%)	1(4%)	5(20%)	1(4%)	5(20%)	1(4%)	25
	46-55	2(16.7%)	-	1(8.3%)	2(6.7%)	1(8.3%)	1(8.3%)	2(6.7%)	3(25%)	12
	56 and above	1(14.3%)	1(14.3%)	-	-	1(14.3%)	2(28.6%)	2(28.6%)	_	7

Table 2: Awareness of clinical signs and Transmission of Toxoplasmosis

			Periurban Wards				Urban Wards		
	Igawilo	**Iziwa**	**Itende**	**Mwansekwa**	**Maendeleo**	**Mabatini**	**Ruanda**	**Iyela**	**Total**
Do you know the clinical manifestation of the disease?									
Yes	2(14.3%)	1(7.1%)	3(21.4%)	_	5(35.7%)	_	1(7.1%)	2(14.3%)	14
No	10(11.6%)	11(12.8%)	9(10.5%)	12(14%)	8(9.3%)	13(15.1%)	12(14%)	11(12.8%)	86
If yes mention									
Abortion	1(12.5%)	1(12.5%)	3(37.5%)	_	2(12.5%)	_	_	1(12.5%)	8
Eye infection	1(50%)	_	_	_	1(50%)	_	_	_	2
I don't know	10(11.1%)	11(12.2%)	9(10%)	12(13.3%)	10(11.1%)	13(14.4%)	13(14.4%)	12(13.3%)	90
How is Toxoplasmosis transmitted									
Food contamination	1(25%)	1(25%0	_	_	1(25%)	_	1(25%)	_	4
Consumption of raw meat	4(26.7%)	1(6.7%)	_	2(13.3%)	4(26.7%)	3(20%)	_	1(6.7%)	15
cat excreta	_	_	1(50%)	_	_	1(50%)	_	_	1
I don't know	9(11.3%)	11(13.8%)	12(15%)	11(13.8%)	7(8.8%)	8(10%)	11(13.8%)	11(13.8%)	80
Mention other rodent or cat -borne diseases									
Plague	2(20%)	1(10%)	1(10%)	1(10%)	2(20%)	1(10%)	1(10%)	1(10%)	10
Leptospirosis	3(100%)	_	_	_	_	_	_	_	3
Rabies	2(66.7%)	_	_	_	1(33.3%)	_	_	_	3
Worms	1(33.3%)		_	_	_	2(66.7%)		_	3
I don't know	5(6.2%)	11(13.6%)	11(13.6%)	11(13.6%)	10(12.3%)	11(13.6%)	11(13.3%)	11(13.3%)	81

Table 3: Mean score assessment of the respondents toward Toxoplasmosis knowledge

Aspect Under Assessment	Question number	Desired Response	Percentage
Awareness of Toxoplasmosis existence	6	Yes	22
Awareness of clinical manifestation of disease	8	Yes	14
Ability to mention a clinical manifestation	8	Relevant clinical sign	10
Mode of disease transmission	9	Relevant mode of transmission	20
Awareness of any other rodent/cat-borne disease	10	Common rodent/cat-borne disease	19
Total			85
Mean			17

Human sanitation and hygiene

The questionnaire also assessed factors revealing human sanitation and hygiene practices influencing transmission of the disease from definitive hosts. In relation to this, the results showed that the majority (91.0%) of the respondents didn't clean their hands after physical contact with a cat. Furthermore, children appeared to be at the highest risk of contracting the disease as the greatest percentage of respondents mentioned them to be the group that was involved in cat kennel /box cleaning as well as playing with them. In addition to this, the results also revealed a great diversity in methods employed to dispose of cat litter material where the majority (36.0%) of the respondents disposed of cat litter materials in their gardens while 21.0% and 15.0% of the respondents' mentioned farms and in designed boxes as respective disposal destination (Table 4).

Table 4: Practices Influencing the Risk of Toxoplasmosis from definitive host Cats

Statements	n	%
Do you deworm cats regularly?		
No	81.0	81.0
Yes	19.0	19.0
What do you feed your cat?		
Homemade feedstuff	30.0	30.0
Milk	39.0	39.0
Leftovers/condemned parts from slaughter slab	15.0	15.0
Do nothing	17.0	16.0
Do you keep your cat indoors or outdoors?		
Indoor	37.0	37.0
Outdoor	60.0	60.0
I don't have a cat	3.0	3.0
How do you dispose of cat litter material?		
Boxes	15.0	15.0
Garden	36.0	36.0
Farm	21.0	21.0
Pity	6.0	6.0
Garbage dump	10.0	10.0
Do nothing	12.0	12.0
Who cleans cat kennels/cat litter boxes?		
Children	49.0	49.0
Youth	30.0	30.0
Adult	21.0	21.0
Seniors	0.0	0.0
Do you wash your hands after physical contact with cats or their feces?		
No	91.0	91.0
Yes	9.0	9.0

Practices assessing the role of the intermediate host (rodent) in the transmission of Toxoplasmosis

Practices influencing the risk of Toxoplasmosis transmission from the intermediate host (rodents) in a home setting were assessed by four questions. In relation to this assessment, the results revealed that the majority (80.0%) of the respondents claimed not to consume rodents as a source of food. However, most (41.0%) of the respondents claimed to use cats to control rodents in their homes. The questionnaire also assessed methods employed in the disposal of dead rodents where results showed that the majority (55.0%) of the respondents disposed of dead rodents in land pits, followed by 19.0% and 12.0% of the respondents who respectively claimed to burn and feed dead rodents to cats. The remaining 14.0% included those who disposed of dead rodents either by consumption, throwing them in farm fields, or left unattended (Table 5).

Table 5: Practices influencing Toxoplasmosis transmission from the intermediate host (rodent)

	n	%
Do you consume rodents for food?		
No	80.0	80.0
Yes	20.0	20.0
Do you control rodents in your house?		
No	27.0	27.0
Yes	73.0	73.0
If yes, specify the method		
Rodenticides	19.0	19.0
Cats	41.0	41.0
Traps	13.0	13.0
Nothing	27.0	27.0
How do you dispose of dead rodents?		
Pity	55.0	55.0
Feeding the cats	12.0	12.0
Eating as meat	1.0	1.0
Burning	19.0	19.0
Farm	3.0	3.0
Do nothing	10.0	10.0

Practices influencing transmission of Toxoplasmosis with the exclusion of intermediate and definitive host involvement

The results revealed that the majority (65.0%) of the respondents consumed boiled water. Furthermore, the results show that 77.0%, 61.0%, and 84.0% of the respondents didn't consume raw meat, vegetables, and milk respectively. Questions linked to human hygiene in relation to the disease were also assessed where 88.0%, 96.0%, and 77.0% of the respondents, claimed to wash vegetables before consumption, wash their hands before eating, and do not wear gloves/protective gear while conducting gardening activities respectively (Table 6).

Table 6: Respondents' behaviors that may influence the risk of Toxoplasmosis Transmission

Statements	n	%
Does your household utilize boiled water for drinking?		
No	35.0	35.0
Yes	65.0	65.0
Do you directly consume raw animal meat?		
No	77.0	77.0
Yes	23.0	23.0
Do you directly consume raw vegetables for food?		
No	61.0	61.0
Yes	39.0	39.0
Do you consume unboiled milk?		
No	84.0	84.0
Yes	16.0	16.0
Do you wash vegetables before cooking them?		
No	12.0	12.0
Yes	88.0	88.0
Do you protect your hands during gardening activities?		
No	77.0	77.0
Yes	23.0	23.0
Do you clean your hand before meals?		
No	4.0	4.0
Yes	96.0	96.0

Statistically inference of variations in awareness of the disease within categorical demographic variables

The results showed a statistically significant variation in awareness of the existence of the disease within three of the socio-demographic variables assessed. The variables that showed a statistically significant variation in the awareness of the existence of this disease include education level, sex, and occupation of respondents (Table 7).

Discussion

This study reports the level of community awareness, knowledge, and practices related to Toxoplasma transmission and prevention in the Mbeya district. The study indicates a low level of knowledge about the disease. Only 17.0% were aware implying that the majority of the study respondents were not aware of Toxoplasmosis. As with other neglected diseases, the disease is not given priority in health education programs. This increases the risk of disease transmission in the community. A similar observation was also made by [16] in Dar es Salaam who found that less than 36% of study participants knew the existence of the disease. Furthermore, [23,22] respectively reported a similarly low level of awareness of the disease in Morocco (41.2%) and Kuwait (15.6%). The unawareness of the existence of this disease observed in our study is probably due to fewer regular toxoplasmosis screening programs in Tanzania compared to other common diseases like Malaria, Typhoid, and HIV AIDS. This hypothesis is in line with that provided by [24, 16] who respectively claimed that the low level of awareness of the disease is attributed to the lack of a screening program in Morocco and Tanzania. For effective prevention of the disease awareness campaign is important. This low level of knowledge and awareness (17.0%) about Toxoplasmosis among study participants furthermore, relates to their low level of education as the majority had only primary education as similarly observed in Iraq [25]. In addition, the low case mortality rate and the chronic nature of the disease have left it neglected and made it less common as evidenced by the lack of a local vernacular term to address it hence negatively affecting its popularity. In relation to this, [16,26] similarly, reported unawareness of this disease and emphasized on negative effects of the absence of a local vernacular term on its popularity. The limited awareness of the existence of this disease among community members could also be attributed to the low/lack of continuous mass health education (education campaigns) by members of the health sector towards Toxoplasmosis as among zoonotic diseases [27]. The results further revealed high-learning institutions to be the main source from which most of the respondents (32.0%) got informed of the disease through attending university education. Similarly, a scenario observed by [28]in Iran showed that the majority (55.8%) of study participants got informed of the disease in the pursuit of medical training in higher learning institutions during parasitological curriculum courses. Furthermore, similar to this study done in Dar es Salaam by [29], found that social networks, radio, and health centers were significant sources of knowledge. This emphasizes the need for more government effort in health education awareness campaigns towards the disease through different media. The results also exposed the risk of Toxoplasmosis transmission from infected definitive hosts (cats) who play a major role in local transmission of the disease with an ability to shed numerous oocysts in the environment [30]. The results revealed poor veterinary management of domesticated cats highlighted by a high percentage of respondents who never dewormed their cats but simultaneously use them for rodent control in their homes hence increasing their potential to contract and transmit the disease to humans. Outdoor management of domesticated cats and their feeding behaviors including access to rodents as intermediate hosts, in this study majority of the participants (60.0%) practiced outdoor management of the cats this can attribute the diseases transmission and hence leading to an increase in Toxoplasmosis prevalence in both human and animals in the study area similarly observed by [31]. There is a great possibility of cat feeding behaviors influence their risk of contracting the disease as reflected by the diversity of cat feeding practices such as feeding raw milk, as well as un edible offal observed in this study population. A similar finding has been reported in Britain by [32]. Local transmission of the disease in the study community could also be influenced by poor cat litter disposal and sanitary management practices employed by the majority of the community members. Such an observation occurs in line with that provided by [33] in Kenya and [34] in Thika region Kenya who reported that disposal of cat litter waste in gardens could increase the risk of acquiring Toxoplasmosis infections, particularly to farmers. Children are the ones who play, feed, and clean cat litter boxes or kennels this can risk them acquiring Toxoplasmosis and other companion zoonosis such as parasitic diseases [35, 36]. There is a great possibility of cat feeding behaviors influencing their risk of contracting the disease as reflected by the diversity of cat feeding practices such as feeding raw milk, as well as un edible offal observed in this study population.

Table 7: Association between Social demographic characteristics and Knowledge of Toxoplasmosis

Variable		**Have you heard of a disease called Toxoplasmosis**				
		No	**Yes**	**Total**	**X^2**	**p-value**
Education level	None	17(100%)	0(0.0%)	17	23	0.000*
	Primary Education	9(81.6%)	40(18.4%)	49		
	Secondary Education	2(83.3%)	10(16.7%)	12		
	Advance Education	2(60.0%)	3(40%)	5		
	Post-secondary Education (college, University)	6(35.3%)	11(64.7%)	17		
Sex	Male	39(68.4%)	18(31.6)	57	4.174	0.041*
	Female	37(86.0%)	6(14.0%)	43		
Marital status	Single	21(67.7%)	10(32.3%)	31	3.95	0.413
	Married	41(75.9%)	13(24.1%)	54		
	Cohabiting	1(100%)	0(0.0%)	1		
	Separated/Divorced	6(100%)	0(0.0%)	6		
	Widow	7(87.5%)	1(12.5%)	8		
Occupation	Peasant	36(94.7%)	2(5.3%)	38	17.551	0.002*
	Formally employed	1(33.3%)	2(66.7%)	3		
	Self Employed	16(55.2%)	13(44.8)	29		
	Business	19(76.0%)	6(24.0%)	25		
	Unemployed	3(100%)	0(0.0%)	3		
	Student	1(50.0%)	1(50.0%)	2		
Age	18-25	15(83.3%)	3(16.7)	18	4.368[a]	0.358
	26-35	25(65.8%)	13(34.2%)	38		
	36-45	21(84%)	4(16%)	25		
	46-55	10(83.3%)	2(16.7%)	12		
	56- Above	6(85%)	1(14.3%)	7		
Location	Periurban	39(81.2%)	9(18.8%)	48	0.941	0.332
	Urban	38(73.1%)	14(26.9%)	52		

A similar finding has been reported in Britain by [32]. Local transmission of the disease in the study community could also be influenced by poor cat litter disposal and sanitary management practices employed by the majority of the community members. Such an observation occurs in line with that provided by [33] in Kenya and [34] in Thika region Kenya who reported that disposal of cat litter waste in gardens could increase the risk of acquiring Toxoplasmosis infections, particularly to farmers. Children are the ones who play, feed, and clean cat litter boxes or kennels this can risk them acquiring Toxoplasmosis and other companion zoonosis such as parasitic diseases [35, 36]. The study further revealed community members practicing good hygienic behaviors hence lowering the risk of acquiring the disease. The majority of the community members reported consuming boiled water and milk as well as cooked meat and vegetables and avoided consuming rodent meat. This observation is contrary to those obtained in previous studies by [33,37], in Kenya and Mvomero respectively who found that the majority of community members were practicing risky eating habits in relation to the acquisition of the disease. However, one practice appeared to raise the risk of acquiring toxoplasmosis where 77% claimed that they don't wear gloves while conducting gardening practices as similarly observed in Al-Najaf [38]. The results revealed a statistically significant relationship between knowledge of the disease among sex, occupations, and education such an observation was similarly made in studies conducted by [39, 24] in Ethiopia and Morocco respectively. In this study, participants with higher levels of education (post-secondary education), were more knowledgeable about toxoplasmosis compared to those with lower levels. On the other hand, respondents who are formally employed especially in medical-related employment were more knowledgeable about toxoplasmosis than other occupation categories. This might be escalated by the educational background linked to their professions this is in line with reports from Dodoma by [26] and [40] In Nigeria. Nevertheless, the sex of the respondent had a significant association with knowledge of the disease. Males were more knowledgeable than females. However, [40] in Nigeria contrarily found insignificant variations in awareness of the same disease between sexes. The variation of these findings could be attributed to the difference in representative sample within the study populations as well as the occupation of the respondents and educational background.

Conclusion

The study revealed low community awareness and knowledge of the existence of Toxoplasmosis in the study area. The study also revealed some of the practices that are considered as the risk factors in local transmission of the disease from definitive, intermediate, and human hosts of the pathogen such as lack of regular deworming of cats, outdoor management of cats, poor disposal of cat's litter materials in gardens, use of cats in controlling of rodents and not wearing gloves during gardening. We recommend more efforts to educate the mass community in both rural and urban on aspects related to transmission, clinical signs, treatment, and control of the disease harnessing the
One Health Approach. Furthermore, we recommend regular animal and human screening of the disease to reveal its epidemiological patterns. Also, we recommend similar studies be done targeting health providers.

Abbreviation

NY: New York; USA: United States of America; SUA: Sokoine University of Agriculture; HIV: Human immunodeficiency virus; AIDS: Acquired immunodeficiency syndrome.

Declaration

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Availability of data and materials

Data will be available by emailing chalostell71@gmail.com

Authors' contributions

Stela. Chalo (SLC) is a primary investigator involved in data collection, analysis, interpretation, and article writing. Ernatus.M. Mkupasi (EMM), A.S.Katakweba (ASK), and Eliakunda.M. Mafie (EMM) are supervisors, both supervisors were responsible for drafting and reviewing the article.

Ethics approval and consent to participate

The study was conducted in accordance with the ethical principles of the Declaration of Helsinki (2013). Ethical clearance was obtained from the Institutional review board of the Sokoine University of Agriculture with reference number (SUA/DPRTC/R/186/20) issued on 1/12/2021. Furthermore, permission was also obtained from the Mbeya district administrative authorities to allow the conduct of research activity in all respective study sites (wards) prior to commencing the study (MCC/R.50/1/VOL.XXV/207) issued on 27/01/2022. The purpose of the study was explained to participants whose verbal consent was requested and confidentiality guaranteed before data collection.

Consent for publication

Not applicable

Competing interest

The authors declare that they have no competing interests.

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