

Research Article

Assessment of Knowledge, Attitudes, and Practices Towards Toxoplasmosis among Small Scale Farmers in Mogadishu, Somalia

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Abstract | A cross-sectional study was conducted from July 2022 to January 2023, designed to assess knowledge, attitudes, and practices about toxoplasmosis. A total of 384 participants from various districts within the Benadir region were interviewed using a structured questionnaire. The demographic profile of the participants revealed that 35.70% of respondents were from Kaxda district, and a lower portion (12.24%) from Deyniile district. The majority of respondents were females (68.8%), and individuals aged 50 years and above constituted the highest proportion (45.8%). Regarding knowledge assessment, 63.0% of participants had knowledge about toxoplasmosis, but only 11.2% were aware of its zoonotic nature, and 13.8% understood the transmission from animals to humans. Knowledge regarding the association between toxoplasmosis and abortion in humans and animals was low (24.3%). Furthermore, awareness about the treatment of toxoplasmosis in animals was limited (34.4%). In terms of attitudes, 31.25% of participants were knowledgeable about the dangers of toxoplasmosis, while the majority either lacked knowledge or showed limited concern about these matters. In terms of practices, a significant percentage of participants had direct contact with livestock without using gloves (71.9%) and consumed unwashed vegetables (30.2%). Additionally, a high percentage of participants drank untreated water or tap water (95%). These findings highlight the concerning lack of knowledge, varied attitudes, and risky practices regarding toxoplasmosis among small-scale farmers in Mogadishu, Somalia. Public education campaigns should be implemented to enhance awareness, promote positive attitudes, and encourage safe practices to prevent toxoplasmosis in this population.

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Introduction

Toxoplasma gondii is an intracellular opportunistic parasite responsible for causing the infectious disease known as toxoplasmosis (Robert-Gangneux and Dardé, 2012). This parasite exhibits a broad host range among mammals and is primarily transmitted through several routes, including the ingestion of food contaminated with oocysts from an infected feline, consumption of inadequately cooked meat harboring cysts, vertical transmission from mother to fetus during pregnancy, and contact with soil during gardening activities conducted without the use of protective gloves (Dubey *et al.*, 2012; Robert-Gangneux and Dardé, 2012; Adem and Ame, 2023). In accordance with the comprehensive assessment conducted by the Food and Agriculture Organization (FAO) and the World Health Organization (WHO), toxoplasmosis holds the rank of fourth among the twenty-four most detrimental foodborne pathogens (FAO and WHO, 2012). This infectious disease is widely prevalent across the globe, with approximately 30% of the global population estimated to be chronically infected with *Toxoplasma gondii* (Flegr *et al.*, 2014).

While the majority of individuals affected by *Toxoplasma gondii* infections do not exhibit noticeable symptoms, it is noteworthy that such infections have been linked to adverse outcomes such as fetal demise, congenital malformations, and miscarriages in pregnant women, as well as reproductive losses in animals (Robert-Gangneux and Dardé, 2012; Wong *et al.*, 2013). Furthermore, *Toxoplasma gondii* infections have the potential to induce a range of disorders, including cognitive impairments

Regarding the seroprevalence of toxoplasmosis, comprehensive investigations have demonstrated a global variation in the rates of *T. gondii* seropositivity, encompassing a broad spectrum ranging <10% to >90% (Pappas *et al.*, 2009). Remarkably, studies conducted in Africa have highlighted a significantly elevated seropositivity rate of *T. gondii* infection among pregnant women (11%–83.6%) (Alsammani, 2016).

Regrettably, the availability of information concerning the incidence of toxoplasmosis in Somalia remains limited. Nonetheless, a noteworthy study conducted in Mogadishu shed light on the serological survey

of caprine toxoplasmosis. The study reported an overall prevalence rate of 58.0%, with the highest seropositivity observed in males (61.5%) and the lowest in females (57.8%) (Afrah *et al.*, 2020). Furthermore, in the Benadir region, a comprehensive seroprevalence survey encompassing domestic animals such as camels, cattle, sheep, and goats was conducted in 2014. The findings revealed an overall prevalence rate of 15.9% (Kadle, 2014).

There is currently a significant gap in research and reports on awareness, knowledge, practices, and attitudes towards the prevention of toxoplasmosis, highlighting the need for further investigation in this area. This study aims to assess the knowledge, attitudes, and practices related to toxoplasmosis among small-scale farmers in Mogadishu, with the goal of informing targeted public health interventions.

Materials and Methods

Study area, design, period, and population

This cross-sectional study was conducted in the Benadir region of Somalia, located at latitude 2.046934 and longitude 45.318161, chosen for its high population of small-scale farmers and increased risk of zoonotic diseases like toxoplasmosis. The climatic conditions in this region range from an average low of 28.7°C to a high of 37°C annually. Benadir, being the capital city of Somalia, accommodates the largest population within the nation, estimated at approximately 2.3 million people, covering an expanse of around 96,878 km² (Mohamud *et al.*, 2020). This research was conducted over a period of 6 months, from July 2022 to January 2023. Its main objective was to assess the knowledge, attitude, and practices of small-scale farmers towards Toxoplasmosis in Mogadishu, Somalia. The study population primarily constituted the owners of small-scale farms in selected districts within the Benadir region.

Sample type

The research implemented a stratified random sampling approach to select subjects based on specific occupational risks associated with their respective roles.

Sample size

The sample size was calculated using the formula $n = Z^2 pq / d^2 = Z^2 P(1 - P) / d^2$ (Mohamud *et al.*, 2020).

(Where, n represents the sample size, Z is the standard deviate, P is the prevalence, $Q=1-p$, d =error accepted).

A confidence level of 95% ($Z = 1.96$) and a margin of error of 5% ($d = 0.05$) were used, resulting in a final sample size of 384 participants individuals, guided by this formula and insights from prior studies.

Data collection

Data collection involved the use of a meticulously designed, pretested questionnaire to assess the knowledge, attitude, and practices towards Toxoplasmosis among small-scale farmers in Mogadishu, Somalia.

Data analysis

Collected data were entered into Microsoft Excel Spreadsheet-2019 for comprehensive analysis. Subsequently, the data were analyzed, and the results were presented in terms of frequency and percentages, providing valuable insights for the research.

Results and Discussion

Frequency of respondent based on districts

Figure 1 illustrates the distribution of questionnaire respondents across various districts within the Benadir region. A total of 384 participants were interviewed for this study. The highest proportion of respondents was found in Kaxda district, accounting for 35.70% (n=137), while the lowest proportion was found in Deyniile district, with a respondent percentage of 12.24% (n=47).

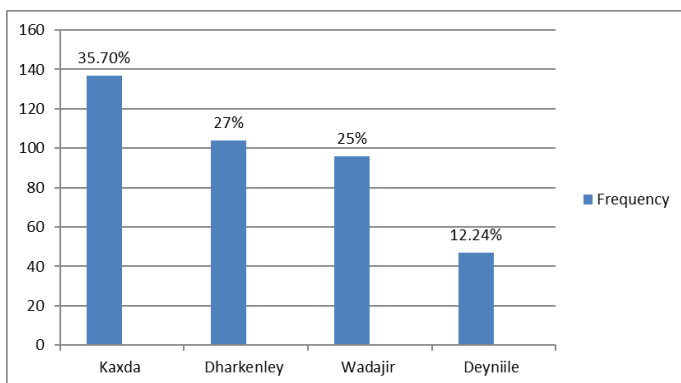


Figure 1: Frequency of participants based on districts.

Frequency of respondent based on sex

Table 1 Shows the distribution of questionnaire respondents based on sex. The data reveals that the highest percentage of respondents consisted of females, accounting for 68.8% (n=264) of the total

participants. Conversely, the percentage of male respondents was 31.3% (n=120).

Table 1: Number of participants based on age.

Age	Frequency	Percent	Cumulative percent
18-25	35	9.1	9.1
26-35	56	14.6	23.7
35-45	117	30.5	54.2
Above 50 years	175	45.8	100.0

Frequency of respondent based on Age

Table 2 illustrates the distribution of questionnaire respondents based on age. The findings indicate that the highest proportion of respondents was observed among individuals aged 50 years and above, constituting 45.8% (n=175) of the total sample. Conversely, the lowest percentage of respondents was found within the age group of 18 to 25, accounting for 9.1% (n=35).

Table 2: Number of participants based on sex.

	Frequency	Percent	Cumulative percent
Male	120	31.3	31.3
Female	264	68.8	100.0
Total sex	384	100	

Frequency of respondent based on marital status

Table 3 presents the breakdown of questionnaire respondents according to their marital status. The data indicates that the largest proportion of respondents were categorized as married, comprising 69.3% (n=266) of the overall participants. On the other hand, the smallest proportion of respondents was observed among those who identified as divorced, accounting for 15.1% (n=58).

Table 3: Number of participants based on marital status.

	Frequency	Percent	Cumulative percent
Single	60	15.6	15.6
Married	266	69.3	84.9
Divorced	15.1	15.1	100.0
Total	384	100.0	

Frequency of respondent based on knowledge assessment

Based on the assessment of knowledge, it is noteworthy that a majority of participants (63.0%; n=242) in the study area possess knowledge about the disease Toxoplasmosis. However, only a small percentage (11.2%; n=43) of individuals have been informed

about the zoonotic nature of Toxoplasmosis, while the vast majority (88.8%; n=341) remain unaware of its zoonotic potential. Similarly, a limited level of understanding is observed regarding the transmission of Toxoplasmosis from animals to humans, with only 13.8% (n=53) demonstrating knowledge in this aspect.

In terms of the association between Toxoplasmosis and abortion in both humans and animals, the study area reveals a relatively low level of awareness, as only 24.3% (n=93) of participants possess knowledge about this causal relationship. Additionally, knowledge regarding the treatment of Toxoplasmosis in animals is limited, with only 34.4% (n=132) demonstrating awareness in this regard.

However, a positive finding emerges concerning information provided by veterinarians regarding Toxoplasmosis cases in livestock. A significant majority of respondents (60.41%; n=232) report having received such information, indicating effective communication between veterinarians and livestock owners. However, the study also highlighted positive findings regarding veterinarian communication with livestock owners. A significant majority of respondents (60.41%; n= 232) reported receiving information from veterinarians regarding Toxoplasmosis cases in their livestock. Overall, the data presented in Table 4. Reflects a concerning lack of knowledge regarding Toxoplasmosis among the study participants.

Frequency of respondent based on attitudes assessment

Table 4: Knowledge regarding toxoplasmosis.

Statement	Frequency		Percent	
	Yes	No	Yes	No
Have you ever heard about the <i>Toxoplasmosis</i> ?	242	142	63.0%	37.0%
Have you heard of the <i>about zoonotic</i> disease?	43	341	11.2%	88.8%
Do you know how <i>Toxoplasmosis</i> is transmitted from animal to human?	53	331	13.8%	86.2%
Do you know <i>Toxoplasmosis</i> can cause aborus both human and Animal?	93	291	24.3%	75.9%
Do you know if there is any treatment for <i>Toxoplasmosis</i> in cows/sheep/goats?	132	252	34.4%	65.62%
Have you been told by the veterinarian that some of your sheep/goats or cows have had <i>Toxoplasmosis</i> ?	232	152	60.41%	39.59%

Table 5: Attitude regarding Toxoplasmosis.

Statement	Frequency		Percent	
	Yes	No	Yes	No
Do you know that Toxoplasmosis is dangerous?	120	264	31.25%	68.8%
Would you like to contact a veterinarian if you suspect your animal to toxoplasmosis?	384	0	100%	0%
Would you like to receive more information on brucellosis?	384	0	100%	0%

According to the respondents' attitudes, 31.25% (n=120) are knowledgeable about the dangers of toxoplasmosis, while 68.8% (n=264) of the participants either have no knowledge or do not care about such matters. All of the participants express a desire to contact a veterinarian and obtain further information regarding toxoplasmosis (Table 5).

Frequency of respondent based on practice assessment

The majority of participants, specifically 71.9% (n=276), have direct contact with their livestock without using gloves, while the remaining 28.12% (n=108) choose to wear hand gloves when handling their livestock. In terms of direct contact with cats, it was found that 21.61% (n=83) of participants have direct contact with cats. Concerning the consumption of undercooked meat, all participants ended up dying. In the case of unwashed vegetables, it was revealed that 30.2% (n=116) of participants eat their vegetables without washing them. Furthermore, the majority of participants, a staggering 95% (n=365), were found to drink untreated water or tap water. The complete details regarding the practices adopted in the study area can be found in Table 6.

A comprehensive study assessing the knowledge, attitude, and practice regarding toxoplasmosis among the high-risk population in Somalia has not yet been conducted. Educating the population about zoonotic diseases is crucial for mitigating the potential risks associated with handling livestock, and for implementing effective control measures.

Table 6: Practice regarding Toxoplasmosis.

Statement	Frequency		Percent	
	Yes	No	Yes	No
Have you been contact with livestock without gloves?	108	276	28.12%	71.9%
Have you been in direct contact with cat?	83	201	21.61%	52.34%
Do you eating undercooked meat?	0	384	0%	100%
Do you eat unwashed vegetables?	116	268	30.2%	69.8%
Do you drinking untreated water?	365	19	95.%	5%
Have you had any abortions among your livestock during the last year?	31	353	8%	92%

In our current study, we investigated the level of understanding and factual information about toxoplasmosis among farmers who have direct or indirect contact with livestock in the Benadir region of Somalia. These individuals are involved in businesses that require regular interaction with animals.

The participants in our study demonstrated an overall knowledge rate of 63.0% regarding toxoplasmosis. This contrasts with the findings of a previous study by [Ebrahimi et al. \(2015\)](#), which reported that only 15.7% of participants were aware of toxoplasmosis. However, our results align with the study conducted by [Jones et al. \(2015\)](#), where 48% of participants had heard of toxoplasmosis. Similar levels of awareness were also reported in other studies, such as [Ogunmodede et al. \(2005\)](#) in Minnesota (42%) and [Pawlowski et al. \(2001\)](#) in Poland (45%).

Toxoplasmosis is a prevalent parasitic zoonotic disease observed worldwide ([Bermúdez et al., 2009](#)). The frequency of prenatal infections associated with toxoplasmosis varies, ranging from 1 to 120 per 10,000 births. Seroprevalence rates among women of childbearing age range from 4% to 85% ([Tenter et al., 2009](#)). However, our study revealed a concerning finding, indicating that only 11.2% of participants were knowledgeable about the zoonotic nature of toxoplasmosis. This significant knowledge gap can potentially lead to adverse consequences

Regarding the association between toxoplasmosis and abortion in both humans and animals, the study area demonstrated a relatively low level of awareness, with only 24.3% (n=93) of participants having knowledge about this cause-and-effect relationship. This finding is consistent with the study conducted by [Ebrahimi et al. \(2015\)](#), which reported that 55% of participants lacked awareness of Toxoplasma-induced abortion.

In terms of the participants attitudes, a notable 31.25% (n=120) demonstrated awareness of the hazards associated with toxoplasmosis, while a significant 68.8% (n=264) either lacked knowledge or exhibited indifference towards such concerns. A majority of participants, specifically 71.9% (n=276), engaged in direct contact with livestock without using gloves, while the remaining 28.12% (n=108) chose to wear gloves when handling their animals. It was observed that 21.61% (n=83) of participants had direct contact with cats. Alarming results were obtained regarding the consumption of undercooked meat, as all participants who engaged in such practices suffered fatal outcomes. Additionally, 30.2% (n=116) of participants consumed unwashed vegetables. These findings closely resemble those of [Amin et al. \(2013\)](#), which indicated that 98.2% of participants avoided contact with cats and cat litter, 82.6% refrained from consuming undercooked and raw meat, but approximately 50% of them neglected to wash their hands after handling raw meat and vegetables. It is important to note that up to 50% of *T. gondii* infections are transmitted through the ingestion of undercooked meat, making toxoplasmosis one of the significant foodborne diseases with clinical implications for pregnant women ([Ogunmodede et al., 2005](#)).

Moreover, the high prevalence of participants, a staggering 95% (n=365), consuming untreated water or tap water raises significant concerns. This finding exceeds the results of a study conducted by [Al-Rashada et al. \(2016\)](#), which indicated that over 50% of participants consume unfiltered water. The consumption of tank water has been identified as a contributing factor to the transmission of *T. gondii* in various regions worldwide ([Breeze, 2007](#)). Oocysts, the infective form of the parasite, can remain viable for extended periods in water and exhibit resistance to freezing temperatures and moderately high water

temperatures (Dumetre *et al.*, 2008). The prevalence of untreated water consumption among the population poses a substantial risk for the transmission of toxoplasmosis, emphasizing the need for improved awareness and preventive measures regarding water safety.

Conclusions and Recommendations

The study found that among the high-risk population in the Benadir region of Somalia, there is a moderate level of knowledge regarding toxoplasmosis. However, significant gaps were identified, including a lack of awareness about the zoonotic nature of the disease and its link to abortion. Risky practices, such as direct contact with livestock without protective gloves and consuming untreated water, were also observed.

These findings underscore the urgent need for a multifaceted approach to address the issue. In addition to educational campaigns to raise awareness about the disease, practical interventions are essential. Providing gloves to livestock handlers and improving access to clean drinking water in rural areas would significantly reduce exposure risks. Collaborative efforts between veterinarians, public health officials, and livestock owners are critical to implement preventive measures, promote safer practices, and protect this vulnerable population.

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Novelty Statement

This study provides novel insights into the knowledge, attitudes, and practices related to toxoplasmosis among small-scale farmers in Mogadishu, Somalia. It highlights a lack of awareness regarding toxoplasmosis transmission and the need for improved knowledge on its association with abortion. Effective communication between veterinarians and livestock owners is a positive finding, emphasizing the importance of public education and promoting

safe practices.

Author's Contributions

HIN and MHM: Conceived and supervised the study.

MAA, AAH, and MID: Contributed to data collection.

HIN, MAJ, and MHM: Conducted statistical analysis.

AIM, MAA, AAH, and MID: Drafted the manuscript.

AIM: Finalized the manuscript, provided critical comments, and performed a comprehensive review.

All authors critically reviewed the manuscript and agreed to be accountable for its contents.

Limitations

The study encountered constraints primarily related to time and a relatively small sample size.

Conflict of interest

The authors affirm that there are no conflicts of interest associated with the publication of this article.

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