

## Seroprevalence of Toxoplasmosis in Relation to Knowledge and Practice among Pregnant Women in Burao City, Somaliland: A Cross-Sectional Study

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### Abstract

**Background:** Toxoplasmosis is a zoonotic infectious disease that can affect a variety of warm-blooded vertebrates, including humans and other warm-blooded domestic and wild animals. Antenatal statistics on this parasitic disease are thought to provide baseline data on the prevalence of *T. gondii* in pregnant women as well as for the planning and implementation of *T. gondii* diagnostic, control, and prevention programs. Therefore, this study was aimed to determine the seroprevalence of *T. gondii* infection and its risk factors among pregnant women attending Maternal, and Child Health (MCHs) on the emphasis of screening and management of pregnant women in Burao city, Somaliland.

**Objectives:** To assess toxoplasmosis seroprevalence in relation to knowledge and practice among pregnant women in Burao city, Somaliland, 2023.

**Methods:** An institutional-based cross-sectional study was conducted among all pregnant women attending Maternal Child Health (MCHs) in Burao city. A total of 418 pregnant women attending maternal child health were our study population in Burao city. A systematically random sampling method was used to select from a total of 418 pregnancy women from different maternal child health in Burao city. During this study, the data was collected by 1 nursery and 2 midwifery, and 1 supervisor supervising the data being collected who can speak the Somali language. As a part of antenatal care screening, all pregnant women were tested for *T. gondii* immunoglobulins. Data was checked for completeness, cleaned, coded, entered and collected using Kobo toolbox software (ODK), and exported to Statistical Package for Social Sciences (SPSS) version 27 for analysis to calculate the Odds Ratios (OR) and the respective 95% confidence interval for the association between the presence of *T. gondii* and potential risk factors.

**Result:** A total of 418 pregnant mothers, with an average age of  $31.7 \pm 1.191$  years, were attended to at the antenatal care clinics. The overall positivity of against *T. gondii* in the study population was 67 (16%). Only 41.6% of the respondents have heard about the disease Lack of knowledge significantly increased the risk of infection (OR=0.430, p 0.054).

**Conclusion:** This study improved knowledge of *T. gondii* infection exposure in Burao, Somaliland, as well as the relative significance of numerous risk variables, particularly a lack of understanding which is essential for the development of specific toxoplasma control strategy.

**Keywords:** *Toxoplasma gondii*; Pregnant women; Immunoglobulin; Knowledge; Risk factors

### Introduction

### Background

Toxoplasmosis is a zoonotic infectious disease that can affect a variety of warm-blooded vertebrates, including humans and other warm-blooded domestic and wild animals. *T. gondii* is an obligate single-celled, intracellular protozoan parasite that belongs to the phylum *Apicomplexa* [1]. The CDC has identified five parasitic infections as being of public health concern or belonging to the TORCH group of infectious agents, including Rubella, Cytomegalovirus, Herpes viruses, and *Treponema pallidum*, which can infect the fetus trans placentally and result in congenital abnormalities and even fetal loss in both humans and animals. This parasitic infection is one of these neglected diseases [2].

The widespread geographic distribution of toxoplasmosis is linked to a number of risk factors, including the local climate, getting in contact with cat or other pet feces, dietary choices, and where one

residence [3]. Consuming raw meat that has tissue cysts or accidentally

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eating oocysts in food, water, or soil contaminated with cat feces are two ways to become infected [4]. In high-risk groups like pregnant women and immunocompromised people (such HIV-positive patients, organ transplant recipients, and cancer patients), toxoplasmosis can result in life-threatening diseases [5]. *T. gondii* is hidden in healthy people, but if a pregnant woman is exposed, it can vertically transmit to the embryo [6,7].

An infant exposed to *T. gondii* may have congenital toxoplasmosis, which can cause blindness, spontaneous miscarriage, microcephaly, hydrocephaly, and stillbirth. Congenital infection severity and transmission rates change across trimesters. In the first trimester, infection severity is greatest and the rate of transmission is lowest; however, in the third trimester, the opposite is true [8]. Congenital toxoplasmosis can manifest clinically in a variety of ways, including death in utero, seriously ill infants, and infected but clinically well children. The clinical spectrum can range from subclinical infections that cause retinochoroiditis later in life to clinically obvious birth abnormalities such intrauterine growth retardation [9].

Serology, culture-based approaches, mouse assays, and PCR are all ways for diagnosing toxoplasmosis. When these techniques are combined, the diagnostic precision increases. IgG, IgM, and the avidity to *T. gondii* specific antibodies are commonly used in the diagnosis of toxoplasma infection in pregnant women [10].

The global seroprevalence of toxoplasmosis varies from 1% to 100% based on a number of variables, including the host's susceptibility, the environment, socioeconomic status, dietary habits, healthcare infrastructure, hygiene, and soil humidity. The far east has the lowest prevalence, at 1%, and the humid regions of South America have the highest, at over 90%. Toxoplasmosis was ranked third among the 24 most hazardous food-borne illnesses by the Food and Agriculture Organization and the World Health Organization.

Over the past three to four decades, the incidence has decreased in some areas of Eastern and Central Europe [11]. In Latin America, the Middle East, and areas of South-East Asia, there have been reports of a high prevalence of the infection among pregnant women and women who are childbearing age [12]. *T. gondii* prevalence is elevated in conjunction with HIV in Africa, especially in Sub-Saharan Africa [13]. Different prevalence rates from other African nations, such as Ghana's 92.5% and Sudan's 79.8%, were recorded [14]. Most *T. gondii*-infected expectant women have a persistent infection, whereas very few actually develop the infection. However, women who are pregnant and have an acute infection run the danger of congenitally passing the infection to the fetus [15].

In Somalia the prevalence of toxoplasmosis was (51.79%) which is slightly higher than the previous reports of 43.6% [16]. In the village, the overall prevalence of antibodies was 56%, compared to 40% in Mogadishu. Antibodies were acquired early in life in both populations at the age of 10. 44% of the children in the villages and 31% of those in Mogadishu were seropositive [17]. Despite the common practice of keeping cats as pets and the existence of stray cats, the study area's consuming drinking unpasteurized milk, transmission by oocysts, and favorable climatic conditions support the parasite's survival [18,19].

To the best of our knowledge, there is no routine serological testing for *T. gondii* infection in pregnant women. Furthermore, there is no information available about the disease's prevalence and related risk factors in the research area. Antenatal statistics on this parasitic disease are thought to provide baseline data on the prevalence of *T. gondii* in pregnant women as well as for the planning and

implementation of *T. gondii* diagnostic, control, and prevention programs. Therefore, this study was aimed to determine the seroprevalence of *T. gondii* infection and its risk factors among pregnant women attending Maternal Child Health (MCHs) on the emphasis of screening and management of pregnant women in Burao city, Somaliland.

## Significance of the study

The result of this study will firstly benefit the community in the field of study and also will play significant role for the researchers for further studies. This study will also provide sufficient and reliable information on the subject that both academic students and health workers. Health workers can benefit to take action and implement any measures that seem necessary to reduce the impact of toxoplasmosis transmission in pregnancy women. Moreover, this study will help both national and international organization to know more about the seroprevalence of toxoplasmosis in relation to knowledge attitude and practice among pregnancy women in the study area, the study will offer assistance to the researchers as standard for conducting another study.

## General objectives

To assess seroprevalence of toxoplasmosis in relation to knowledge and practice among pregnant women in Burao city, Somaliland, 2023.

## Specific objectives

To assess the seroprevalence of toxoplasmosis among pregnant women in Burao city, Somaliland, 2023.

To identify associated risk factors of toxoplasmosis towards knowledge, and practices of among pregnant women in Burao city, Somaliland, 2023.

## Study area and setting

Somaliland is located on the Southern coast of the Gulf of Aden. It has hundreds of miles of coastline along the Gulf of Aden to the North, and it borders Ethiopia to the South and West and Djibouti to the Northwest Burao is one of the cities in Somaliland and also second capital city of Somaliland is geographically divided into four major districts, in which each district contains six villages. The study was conducted from September to October, 2023.

## Study design

An institutional-based cross-sectional study was conducted among all pregnant women attending Maternal Child Health (MCHs) in Burao city, Somaliland.

## Population

**Source population:** The source population was all pregnancy women visiting maternal child health in Burao city.

**Study population:** A total of 418 pregnant women attending maternal child health were our study population in Burao city.

## Inclusion and exclusion criteria

**Inclusion criteria:** Pregnant women who had not emergency conditions and who accepted to give consent were included in the study.

**Exclusion criteria:** Pregnant women who had emergency conditions and requiring urgent intervention and who refused to give consent were not included in the study.

## Sample size determination

The size determination was done by using single population proportion formula with the following assumptions on seroprevalence of toxoplasmosis which was 45.2% in Muqdisho, Somalia with 95% confidence level CI, 5% marginal error, and 10% contingency for non-response rate [20].

Where,

$n$ =required sample size,

$Z$ =standard normal distribution value at 95% confidence interval=1.96,

$P$ =population proportion (45.2%),

$d$ =desired absolute precision (5%)

Where,

$n$ =required sample size,

$Z/2$ =1.96 for a 95% confidence interval,

$P$ =population proportion (45.2%),

$d$ =margin of error between the sample and population (5%)=0.5

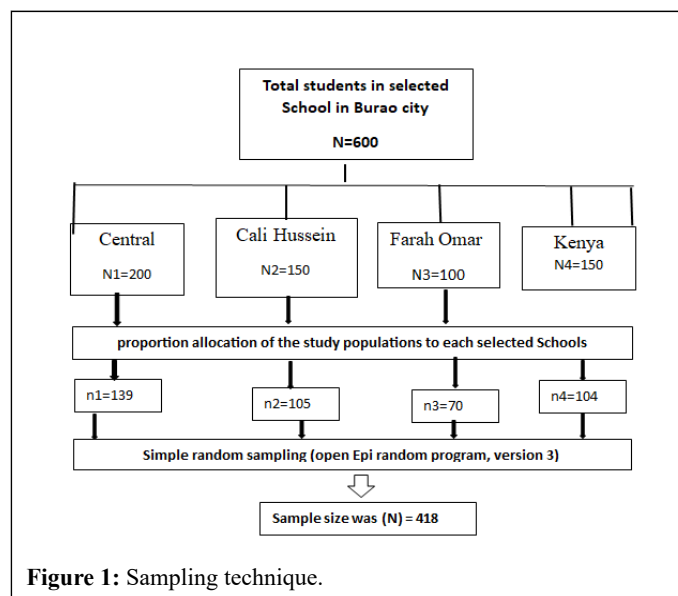
$$n = ((Z/2)^2 \times P(1-P))/d^2$$

$$n = (1.96^2 \times (0.452) \times (0.548))/0.0025 = 380$$

After adding 10% of non-respondent the final sample size will be=418

## Sampling technique

A systematically random sampling method was used to select from a total of 418 pregnancy women from different maternal child health in Burao city (Central=350, Cali Hussein=250, Farah Omar=290, Kenya=300). The primary study units (schools), and a simple random sampling method was employed to reach the secondary study units (students). The number of participants from Central, Cali Hussein, Farah Omar, and Kenya was determined using proportional allocation to size and the same procedure were applied to select the number of participants for respective levels. Then, study participants was selected from each selected maternal child health (Figure 1).



**Figure 1:** Sampling technique.

## Materials and Methods

### Data collection instrument

The data collection instrument of this study was adapted from different literature depends on the local situation and the study objectives. The structured questionnaire which consists of four parts was used to assess toxoplasmosis seroprevalence in relation to knowledge and practice among pregnant women in Burao city, Somaliland. Then the respondents were considered based on their knowledge, and preventive practice on toxoplasmosis then, data was conducted using structure questionnaire that was translated into both Af-Somali (the local language) and translated back to English by the language experts to maintain conceptual consistency.

### Data collectors and supervisors

During this study, the data was collected by 1 nursery and 2 midwifery, and 1 supervisor supervising the data being collected who can speak the Somali language. The principal investigator was regularly supervising the data collection. The data collectors were trained for two days, including the pre-test, and training was included role play, how to handle data, how to keep confidentially, and how to approach participants.

### Data collection procedure

Before data collection, two days training was given for both the data collectors and supervisors by the principal investigator. Before interviewing, the data collectors were informing the clients about the aims/purposes, risks and possible benefits of the study, the right and refusal to participate in the study. The collected information was kept confidential. Study participants who was willing and sign the voluntary consent form was interviewed. Data was collected through face-to-face interviews using a structured, and pretested questionnaire.

### Serological tests

As a part of antenatal care screening, all pregnant women were tested for *T. gondii* immunoglobulins. Architect Toxo IgG or IgM kits

(Abbott, Wiesbaden, Germany), chemiluminescent microparticle immunoassays were performed according to the manufacturer's instruction. Specimens with concentration values  $\geq 3.0$  IU/mL were considered reactive for IgG antibodies to *T. gondii*. Specimens with results  $\geq 0.60$  index were considered reactive for IgM antibodies to *T. gondii*.

## Variables

**Dependent variables:** Seroprevalence of toxoplasmosis.

**Independent variables:** The predictor variables of this study were socio-demographic factors (age, parity rate and educational status), knowledge factors (heard toxoplasmosis, under cooked meat, source of infection, soil contact, handling raw meat and effect of fetus), and practice factors (living with cat, tasted meat, eaten outside, eaten under cooked chicken).

## Operational definitions

**Contact with soil (Gardening):** Defined as person who has a direct exposure to soil while gardening or any kind of outdoor activities.

**Drinking untreated water:** Defined as a person who consumes "untreated water," e.g., water from a pipe, tap, or rain.

**Knowledge:** In this research paper, those who were responded correctly 5 or less questions (<50%) out of knowledge questions was rated as having poor knowledge while those who answered correctly 6 or more questions (60-100%) was categorized as having good knowledge.

**Practice:** Is defined as a health behavior that may promote health or prevent disease or opposite, what the individual have been doing regarding gonorrhea prevention.

**Presence of own cats at home:** Defined as a person who is the owner of at least one cat or has close contact with cats while feeding and playing in the house.

**Presence of stray cats at home:** Defined as a person having a close proximity with stray cats roaming in the house compound.

## Data quality control

The quality of data was ensured through the training of 3 data collectors and 1 supervisor on the objective of the study. After providing the training, a pre-test was conducted in 5% of the sample size in Burao city selected Materna and child health's to check the clarity of the questionnaire before the actual data collection begins.

Adjustments and corrections to the questionnaires was done based on the finding of the pretest. The data was collected by trained data collectors and supervisors. Principle investigator was checked daily the completeness of the questionnaires.

## Data analysis

Quantitative data was checked for completeness, cleaned, coded, entered and collected using Kobo toolbox software (ODK), and exported to Statistical Package for Social Sciences (SPSS) version 27 for analysis to calculate the Odds Ratios (OR) and the respective 95% confidence interval for the association between the presence of *T. gondii* and potential risk factors. We used 20–24 age group as the reference group and calculated odds ratios and p-values compared to this group. Nulliparous group was used as the reference group, and for education level we used university graduates and calculated odds ratios and p-values compared to these groups. Data were analyzed using univariate analysis. We used 5% ( $p < 0.05$ ) as a level of significance.

## Ethical considerations

The study was conducted after getting ethical clearance from Burao University, the Institutional Health Research Ethics Review Committee (IHRERC), college of medical and health sciences, and a permission letter was written to the relevant authorities. Informed, voluntary, written, and signed consent was obtained from both heads of maternal and child health's centers, and study participants. The importance of participation and the purpose of the study was discussed, code numbers were used throughout the study to keep the information confidential.

## Results

### Socio-demographic characteristics of the respondents

A total of 418 pregnant women, with a mean age of  $31.7 \pm 1.191$  years, were examined at the antenatal care clinics. Among the study population, the overall positivity rate for *T. gondii* infection was found to be 16% (67 cases). It was observed that pregnant women who tested positive for immunoglobulin M were considered to be at an increased risk of congenital infection. Among individuals aged 20 to 24, a seropositivity rate of 3.6% was detected, which subsequently experienced an upward trend in participants aged 30-34 to 35-39, but significantly declined in other age cohorts. Multiparous individuals were found to have an increased risk, although this association was not statistically significant (Table 1).

Variables	Positive	Negative	% Positive	OR (95% CI)	P-value
<b>Age</b>					
20–24	15	94	3.6	1	
25–29	14	111	3.3	1.482 (0.387-5.667)	0.566
30–34	19	68	4.5	2.636 (0.822-8458)	0.103
35–39	18	60	4.3	2.415 (1.065-5.474)	0.035
$\geq 40$	1	18	0.2	0.917 (0.517-1.628)	0.765

Parity					
Nulliparous	18	113	4.3	1	
multiparous	49	238	11.7	1.292 (0.720-2.319)	0.39
Education					
University	14	78	3.3	1	
High	16	54	3.8	0.606 (0.273-1.344)	0.218
Middle	14	80	3.3	1.026 (0.459-2.291)	0.951
Uneducated	23	139	5.5	1.085 (0.528-2.228)	0.825

**Table 1:** *T. gondii* infection with age, parity rate, and education level and the Odds Ratios (OR) with the 95% CI in 400 pregnant women in Burao, Somaliland.

### Knowledge of risk factors associated with the infection with *T. gondii* in pregnant

Only 41.6% of the respondents have heard about the disease lack of knowledge significantly increased the risk of infection (OR=0.430, p 0.054). Most of those who have heard about the disease knew the association of the infection with under cooked meat and recognize cats as a source of infection. Additionally, lack of knowledge about the risk

of effect of diseases on fetus was associated with statistically significant high-risk factor (OR=3.844, p 0.002). Half of the respondents (45.2%) were aware of the risk of handling raw meat or tasting it during cooking. Of all participants, only 39% knew the association of *T. gondii* infection with soil and unwashed vegetables and fruits. Only 38.3% of the respondents knew the risk of *T. gondii* on fetus (Table 2).

Variables	Positive	Negative	% Positive	OR (95% CI)	P-value
Heard about toxoplasmosis					
Yes	31	143	7.4	0.430 (0.182-1.016)	0.054
No	36	208	8.6		
Awareness of under cooked meat					
Yes	40	178	9.6		
No	27	173	6.5		
Awareness of cat as a source of infection					
Yes	33	146	7.9		
No	34	205	8.1		
Soil contact and washed fruit					
Yes	34	129	8.1		
No	33	222	7.9		
Handling raw meat					
Yes	37	152	8.9		
No	30	199	7.2		
Effect of diseases on fetus					
Yes	37	123	8.9	3.844 (1.667-8.881)	0.002
No	30	228	7.2		

**Table 2:** knowledge of risk factors associated with the infection with *T. gondii* in 400 pregnant women.

### Practices associated with the infection with *T. gondii* in pregnant women

Of all interviewees, 38.3% lived with cats. However, living with cats indicated no threat of the infection. Consumption of undercooked meat was reported by 14.4, 12.7, and 12.9% of sheep/goat, camel and chicken, respectively. However, only slightly higher insignificant risk was related to the consumption of undercooked sheep/goat rather than other meat types. No risk was associated with the 49.5% of the

participants who mentioned that they do taste meat during cooking. Possible contact with soil in public parks and gardening was reported by 22.2% of the respondents and increased risk of the infection was reported which was found to be related to a statistically significant higher risk of infection (OR=4.045,  $p<0.001$ ). Eating outside the home at restaurants was reported by 50.2% which was found to be related to a statistically significant higher risk of infection (OR=2.155,  $p<0.016$ ) (Table 3).

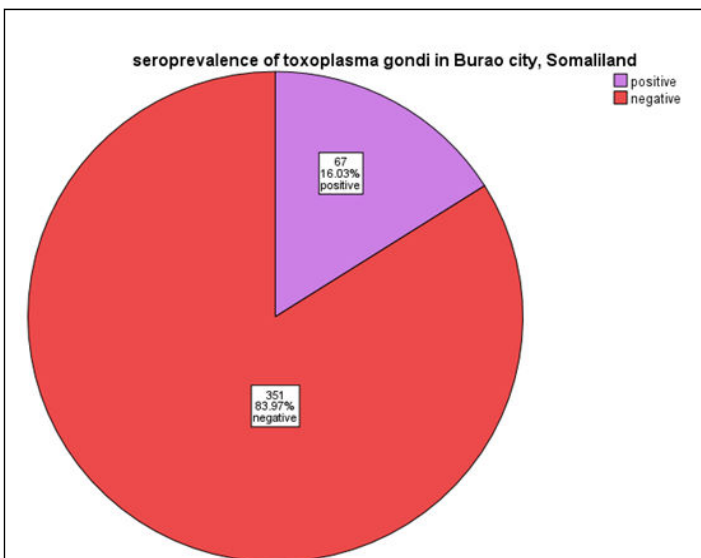
Variables	Positive	Negative	% Positive	OR (95% CI)	P-value
Living with cat					
Yes	28	132	6.7		
No	39	219	9.3		
Eaten under cooked meat (sheep/goat)					
Yes	24	36	5.7		
No	43	315	10.3		
Eaten under cooked meat (camel)					
Yes	22	31	5.3		
No	45	320	10.3		
Chicken meat					
Yes	24	30	5.7		
No	43	321	10.3		
Handling raw meat					
Yes	37	152	8.9		
No	30	199	7.2		
Tested meat during cooking					
Yes	48	159	11.5		
No	19	192	4.5		
Contact with soil					
Yes	37	56	8.9	4.045 (1.983-8.249)	<0.001
No	30	295	7.2		
Eating outside the home					
Yes	47	163	11.2	2.155 (1.152-4.034)	0.016
No	20	188	4.8		

**Table 3:** Preventive practices associated with the infection with *T. gondii* in pregnant women.

### Seroprevalence of *T. gondii* among pregnancy women

The overall seroprevalence of toxoplasma was 16.03% with 95% confidence interval (0.80-0.88) (Figure 2).





**Figure 2:** Seroprevalence of toxoplasmosis in Burao city, Somaliland, 2023.

## Discussion

We conducted a survey in order to find out the seropositivity, awareness, and practices of pregnant women in Burao, Somaliland. In the study population, 16% of people were generally positive for *T. gondii*. Although it is usually believed that between 25 and 30 percent of people worldwide have toxoplasma. Between 10% to 80%, the actual rate varies significantly between among countries. North America, South-East Asia, Northern Europe, and the Sahelian areas of Africa have all recorded low seroprevalence rates of 10–30%. Those in Central and Southern Europe have a moderate frequency of 30–50%, but those in Latin America and tropical Africa have a high prevalence. The fall in IgM antibody positivity indicated a decline in exposure to *T. gondii* through food or the environment.

According to the current study, toxoplasmosis seroprevalence was lower than study conducted in France reported the overall seroprevalence of *Toxoplasma gondii* among pregnancy women was 31.3%, study conducted in Peru reported the seroprevalence of *Toxoplasma gondii* among pregnancy women was 35.8%, systematic review and meta-analysis conducted in Iran reported the prevalence of *T. gondii* was 43% (95% Confidence Interval (CI)=38–48%) in pregnant women, study conducted in Morrocco reported seropositive rates of *T. gondii* infection reach up to 51% in pregnant women. Study conducted in Sri Lanka reported the seroprevalence *T. gondii* in the first, second and third trimesters were 30.4%, 30.6% and 26.1% respectively. Study conducted in Burkina Fasa reported the overall seroprevalence for *T. gondii* infection was 31.1%, study conducted in Hawassa University, Ethiopia reported the prevalence of toxoplasmosis was 81.8%, study conducted in Adwa Ethiopia reported the prevalence of toxoplasmosis was 35.6% and study conducted in Muqdisho, Somalia reported the overall prevalence of toxoplasmosis was 45.2%. The findings of the present investigation reveal that the prevalence of toxoplasmosis seropositivity greater than study conducted in Zambia the overall seroprevalence of the infection (IgG) was 5.87%.

Statistical analysis of the associations of age and seroprevalence indicated that seropositivity started at age of 20, increased between

participants of 30 years through 35 years of age, then slightly decreased among the subsequent age groups. However, there was no significant difference between age group associations with seroprevalence.

Seropositivity was also higher in multigravida women than in women who were expecting for the first pregnancy. There has been evidence of a higher seroprevalence of *T. gondii* infection in women who had multiple pregnancies. This may be an age associated, or less care of women with children. Lack of education was linked to a higher incidence of infections (OR=4.58). According to reports, one of the most significant socioeconomic factors linked to toxoplasmosis risk is education level.

Generally, there was a low level of awareness regarding toxoplasmosis. However, among those who were familiar with the disease, they recognized the connection between the infection and undercooked meat, as well as the role of cats as a source of infection. The lack of knowledge about toxoplasmosis was found to be a significant high-risk factor based on statistical analysis. Merely 45.2% of the participants were aware of the potential risk associated with soil contact, as well as consuming unwashed vegetables and fruits, which could lead to *T. gondii* infection. Although not statistically significant, the estimated risk of lacking this knowledge was still elevated. Furthermore, only a small number of respondents were aware of the dangers of handling or tasting raw meat while it was being cooked, which was considered to have a significantly higher risk. Shockingly, only 38.3% of the participants were aware of the risk of toxoplasmosis on the fetus.

Low level of knowledge about toxoplasmosis risk factors and practices of infectious among pregnant women have been reported worldwide including the USA and Ireland. Statistical analysis of the association of seropositivity with practice indicated that 38.3% of the interviewees lived with cats. Living with a cat did not pose any threat of infection. The consumption of undercooked meat was reported by 14.4% of sheep/goat consumers, 12.7% of camel consumers, and 12.9% of chicken consumers. However, the risk associated with consuming undercooked sheep/goat meat was only slightly higher and statistically insignificant compared to other types of meat. There was no risk observed among the 49.5% of participants who mentioned tasting meat during cooking. On the other hand, 22.2% of respondents reported possible contact with soil in public parks and gardening, which was found to be significantly associated with an increased risk of infection (OR=4.045,  $p<0.001$ ). Eating at restaurants outside the home was reported by 50.2% of participants and was also found to be significantly associated with a higher risk of infection (OR=2.155,  $p<0.016$ ). Previous studies have shown that consuming unwashed raw vegetables or fruits is associated with an increased risk of infection.

A crucial aspect of minimizing the risk of horizontal transmission of toxoplasma to humans through tissue cysts is maintaining a high level of kitchen hygiene. It is important to note that the findings of our study may not be fully representative of the population in the specific area under investigation, as our study was clinic-based. Participants may not accurately recall the risk factors relevant to the time they were infected, which could have occurred years before. It is worth mentioning that toxoplasma seropositivity might indicate previous exposure to *T. gondii* rather than an ongoing infection.

## Conclusion

The findings of this study contributed to the advancement of knowledge regarding *T. gondii* infection exposure in Burao city, Somaliland. Moreover, it highlighted the relative significance of multiple risk variables, with a particular emphasis on the lack of awareness. This understanding is vital for targeted effective strategies to control toxoplasma.

## Recommendation

Further examination is required to determine the effectiveness of health education in changing the behavior of pregnant women regarding the avoidance of maternal infection in any program aimed at preventing congenital toxoplasmosis.

## Conflict of Interest

No conflicts of interest.

## Availability of Data and Materials

All the data generated or analyzed during the current study are available from the corresponding author upon reasonable request.

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