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*Research Article*

# Prevalence of *Toxoplasma gondii* Infection in Breeders, Animals, Soil, and Cats in Baghdad, Iraq

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## About Article

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**ABSTRACT**

This research examined Toxoplasma gondii parasite infections in 2023 from a variety of male and animal populations in different parts of Baghdad. It compared the prevalence of infection with the breeders' age, educational attainment, and animal kind. The findings revealed that the infection rate was 36.90% in 84 blood samples obtained from animal breeders. Furthermore, there is a connection between age and illness. According to the case study, the biggest proportion of infections occurred among those aged 26 to 30 (66.66%). Additionally, 138 blood samples from animals—68 sheep and 70 cows—were examined, and the infection rate for parasites was found to be 41.30%. Additionally, 120 soil samples collected from various locations within the city of Baghdad showed a 32.50% infection rate with the parasite Toxoplasma gondii, and 112 stool samples collected from various locations within the same city revealed a 50% infection rate in cats. In summary, this research identifies women who are direct and indirect carriers of Toxoplasma gondii parasite infections via their spouses for certain Baghdadi animal producers.

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## 1. INTRODUCTION

The parasite Toxoplasma gondii is thought to be one of the causes of toxoplasmosis, which is a prevalent illness that affects both people and animals at all life stages worldwide. More than 40% of people worldwide are infected with Toxoplasma gondii (Mohammed & Al-Janabi, 2019). Pregnant women are at risk of contracting the parasite during pregnancy (Majeed & Abbas 2018); it can be passed from the mother to the fetus through the placenta (Wassef & Abdel-Malek, 2019), it can cause miscarriages in pregnant women, fetal malformations, or even serious disease symptoms in the fetus (Salih *et al.*, 2020), and the biggest risk is that most infected people do not exhibit any clinical symptoms at all (Abdullah & Al-Ubbyde, 2012). According to Tonouhewa *et al.* (2017), epidemiological figures on the illness's spread differ across nations; in Saudi Arabia, for example, an epidemiological survey found that 37% of pregnant women had the disorder (Wallander, 2016). Additionally, a 2008 research carried out in Qatar revealed that the greatest incidence rate, 41.2%, was seen in those under 45. (Guo *et al.*, 2016) In 1939, the researcher Machattia isolated the parasite from the loose spleen of dogs and conducted an epidemiological study explaining that the infection rate reached 45.3% using the indirect hematological agglutination test (IHAT).

## 2. LITERATURE REVIEW

A number of studies and epidemiological research documented the disease's spread in Iraq (Shallal, 2017; Al-Kappany *et al.*, 2018). According to a study by academics Al-Sanjary and Hussein (2012), the infection rate among women of reproductive age was 66.3%, with the greatest infection incidence—32.8%—occurring in the 20–24 age range. According to Saleem and Al-Samarai (2018), 'the rate at which the parasite is transferred from the mother to the fetus fluctuates over the course of pregnancy (Noori, 2021). According to research, the rate of transmission is 15% during the first three months of pregnancy, 30% during the middle three months, and 60% during the last three months (Wassef & Abdel-Malek, 2019). Pregnancy indicates that, depending on placental blood flow, the rate of parasite transmission rises as the months of pregnancy progress (Madjeed *et al.*, 2022; Saleem *et al.*, 2022).

In order to determine the association between toxoplasmosis and carriers of antibodies to cardiac lipids (anti-cardiolipin Abs) type IgM in animal breeders, their animal types, and the environment in which their animals are raised, we attempted to use ELISA to detect specific antibodies in the serum of animal breeders. In order to identify the sources of infection with this disease, researchers are also examining the effects of various factors, including age, occupation, raising animals (cats and other kinds), the degree of parasite spread among sheep and cows that come into direct contact with humans, as well as the degree of parasite spread in cat feces and soil. This research examined Toxoplasma gondii parasite infections in 2023 from a variety of male and animal populations in different parts of Baghdad. It compared the prevalence of infection with the breeders' age, educational attainment, and animal kind.

## 3. METHODOLOGY

### 3.1. Animals' data

Blood sample collection and analysis from animal breeders: the collection (82) of blood samples were taken from breeders of animals suspected of having toxoplasmosis, with ages ranging from 16 to 45 years, as indicated in table 2, during various seasons of 2023 in different parts of the Baghdad Governorate, as indicated in table 4. Simultaneously, a blood sample (4 ml) was drawn intravenously from the breeder using a sterile syringe, and the sample (blood) was put in special test tubes to sit for 10 to 30 minutes in order to record details such as the animal's age, residence, type of animal raised, and breeding method. To separate the serum, the samples are put in a centrifuge for five minutes right after extraction.

### 3.2. Collecting and examining animal blood samples

68 sheep and 70 cows, as shown in Table 3, had blood samples taken from their jugular veins at a rate of 5 milliliters each. A direct agglutination test was used to identify animals infected with the toxoplasma parasite after the serum was obtained using the previously described method (Gharban *et al.*, 2023).

### 3.3. Collect and examine cat stool samples

A total of 112 cat feces were gathered from various locations across the city of Baghdad. 5% potassium dichromate solution was put in plastic bottles with tight-fitting lids as a preservative. The bottles were then floated in a lab using zinc sulfate (331 grams of 1 milligram of sulfate salt were dissolved in a liter of distilled water) by mixing 1 gram of feces with 10 milliliters of warm water in test tubes that could be centrifuged for a few minutes. After that, the sediment was removed, and the suspended portion was ignored while the procedure of suspending it in clean water was repeated. In order to purify the precipitate, add two milliliters of zinc sulfate. The solution was poured into the tube until it reached the top, then a sliding cover was placed over it. At the same pace, another deposition procedure was carried out. After transferring the slide cover to a slide with a drop of local iodine dye, it was inspected under a microscope at two powers (10x) and (40x), observing that three smears had been formed.

### 3.4. Collecting and examining soil samples

In total, 120 soil samples were collected from different areas in a city in Baghdad and placed in plastic bottles. The above-mentioned circumvention method was used to investigate the egg sacs (Oocysts) of the Toxoplasma parasite due to the possibility of the presence of egg sacs in the soil to a large extent because the cats bury their feces in the soil, and if conditions are present the appropriate environment, including temperature and humidity, will cause to sporulate, and thus will remain resistant to environmental changes for approximately a year.

### 3.5. Serology

Specialized antibodies against the parasite Toxoplasma gondii

were found in the patient's blood using the fast test kit (Biokit S.A., Spain). When the latex agglutination test yielded positive results, the chemical 2-mercaptoethanol (2ME) was used to determine if the infection was acute or chronic. The antigen Streptolysin-O, which covers the latex granules in the latex reagent for the test, interacts with antibodies in the patient's blood to produce the ASO test (Anti-Streptolysin-O)'. This test was conducted using a kit made by the Spanish business Bio kit-SA.

### 3.6. Statistical analysis

The Fisher-Freeman-Halton test was used to determine differences between the groups after the findings were statistically examined using conventional procedures to determine the average, standard deviation, number, ratio, and percentage. At a probability threshold of 0.05 or below, the findings were deemed significant (Gharban, 2023).

## 4. RESULTS AND DISCUSSION

Table No. 1 displays the Toxoplasma parasite infection rate among breeders of animals of all kinds, ages, and regions, which is 36.90% based on 84 blood samples. The overall infection rate among animals was 41.30% of the 138 total animals. Significant variations between breeders' and animals' blood samples are also shown by the statistical analysis ($p<0.05$). When compared to the infection rates reported by Abdullah researcher (Abdullah & Al-Ubbyde, 2012) in a study on the 'prevalence of toxoplasmosis in animal breeders, which reached 43.6%, this high percentage of infections among animal breeders includes both active and latent cases of the disease. Additionally, Abdullah researcher (Abdulla, 2021) reported an infection rate of 56.6%. According to other studies, the frequency of this illness is continuously rising year after year, with a 66% infection rate in females and a 51% infection rate in men among animal breeders' patients in Mosul (Rufash & Yousif, 2018).

**Table 1.** the infection percentage of the - Toxoplasma Gondii of blood samples from breeders and all animals in the city of Baghdad.

| Sample type | No. of sample | No. of Infection | Infection % |
|---|---|---|---|
| Animal breeders | 84 | 31 | 36.90 |
| All animals | 138 | 57 | 41.30 |

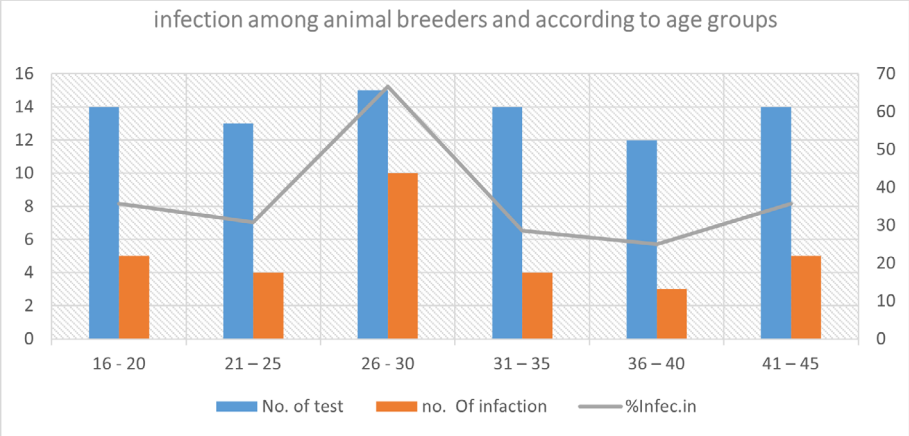


**Figure 1.** Percentage of *Toxoplasma gondii* parasite infection among animal breeders and according to age groups

According to Figure No. 1, the maximum infection rate was 66.66% in the 26–30 age group, and the lowest was 25% in the 36–40 age group. Table No. 2 illustrates the link between the infection rate and the animal breeder's age. According to the statistical analysis, there were notable age-related differences, which is in line with the findings of the Fatohi study (2018) in the Anbar governorate and the Abbas study conducted in the Babylon and Salah al-Din governorates, where the age group of 33–26 years old had the highest infection rate (43.47%). The rationale is that this age is one of the suitable times for childbirth, which increases the risk of the illness since it can result in miscarriage if the infection spreads to the fetus through the umbilical cord or in birth defects if it strikes during the final stages of pregnancy from an animal.

**Table 2.** Percentage of *Toxoplasma gondii* parasite infection among animal breeders and according to age groups.

| Age by years | No. of sample test | No. of Infection | % Infection |
|---|---|---|---|
| 16 - 20 | 14 | 5 | 35.71 |
| 21 – 25 | 13 | 4 | 30.76 |
| 26 - 30 | 15 | 10 | 66.66 |
| 31 – 35 | 14 | 4 | 28.57 |
| 36 – 40 | 12 | 3 | 25 |
| 41 – 45 | 14 | 5 | 35.71 |
| Total | 82 | 31 | |

After analyzing 138 samples from all animals, the study's findings revealed that 41.30% of the animals were infected with Toxoplasma gondii overall, as shown in Table 3. Sheep had an infection rate that was 38.57% lower than that of higher-ranking cows (44.11%). These findings are consistent with Wilson's research conducted in Tikrit (Wilson *et al.*, 2017). The prevalence of cats in pastures and breeding areas, which release egg sacs that animals consume, is the cause of the high infection rate in sheep and cows. Dubey (2010). Additionally, using feed that has been held by sheep and cow breeders contributes to the spread of illness since it has been exposed to rot and contains mycotoxins that weaken the immune system of these animals (Jawetz, 2007).

**Table 3.** Percentage of infection with *Toxoplasma Gondii* for blood samples taken from animals in the different regions of Baghdad Governorate.

| Type sample | No. of sample | No. of Infection | Infection % |
|---|---|---|---|
| Sheep | 70 | 27 | 38.57 |
| Cow | 68 | 30 | 44.11 |
| Total | 138 | 57 | 41.30 |

Additionally, Table No. 4 reveals that, after analyzing 120 soil samples from various parts of the Baghdad Governorate, the overall infection rate was 32.50%. The AL-Mashtal region had the lowest infection rate, at 11.11%, while the AL-Dora region had the highest infection rate, at 57.14%.

**Table 4.** The number of test and infected soil samples and the percentage of infection with *Toxoplasma gondii* collected from different areas in Baghdad Governorate.

| Area | No. of sample test | No. of Infection | % Infection |
|---|---|---|---|
| Al-Mashtal | 18 | 2 | 11.11 |
| AL-Kadhimiya | 20 | 4 | 20.00 |
| AL-Dora | 21 | 12 | 57.14 |
| Baghdad Al Jadeeda | 19 | 6 | 31.57 |
| AL-Ameria | 24 | 12 | 50.00 |
| Sadr City | 18 | 3 | 16.66 |
| Total | 130 | 39 | 32.50 |

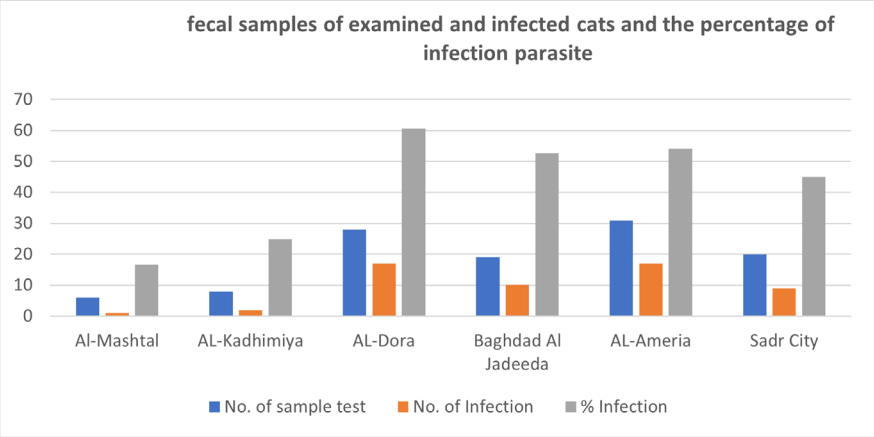


**Figure 2.** Fecal samples of examined and infected cats and the percentage of infection with the parasite *Toxoplasma gondii*

The percentage of infection in cats is displayed in Table 5 based on an analysis of 112 fecal samples from various parts of the Baghdad Governorate. The highest infection rate, 60.71%, was found in the Al-Dora area, while the lowest rate, 16.66%, was found in the Al-Mashtal area. The differences are statistically significant, with $P<0.05$. Among the animals analyzed, the overall infection rate was 50.00.

Regarding the connection between illness and animal breeders' and animals' locations, it seems that certain breeders are more prone to infection than others. This is in line with the Anbar Governorate's Al-Bayati report from 2021. This is explained by a lack of knowledge about public health regulations, a lack of interest in personal and group cleanliness, and a lack of health awareness (Al-Bayati *et al.*, 2021).

**Table 5.** The number of fecal samples of examined and infected cats and the percentage of infection with the parasite - *Toxoplasma gondii* which were collected from different areas in Baghdad Governorate.

| Area | No. of sample test | No. of Infection | % Infection |
|---|---|---|---|
| Al-Mashtal | 6 | 1 | 16.66 |
| AL-Kadhimiya | 8 | 2 | 25.00 |
| AL-Dora | 28 | 17 | 60.71 |
| Baghdad Al Jadeeda | 19 | 10 | 52.63 |
| AL-Ameria | 31 | 17 | 54.00 |
| Sadr City | 20 | 9 | 45.00 |
| Total | 112 | 56 | 50.00 |

According to a study by Saleem in an area outside of Baghdad city and a study by Sroka *et al.* (2020), there is also a higher infection rate among animal keepers in areas with less cultural awareness than in civilized areas, as well as a lack of concern in their day-to-day interactions with the sources of infection around them. Due to high infection rates in cats and other ruminants, the cause immediately affects tissues and afflicted animals'. Additionally, breeders in deserted places engage in agriculturally related occupations that need interaction with hosts. According to Alobaidy *et al.* (2022), exposure to the illness is more hazardous via egg sac parasites for animal breeders who work cleaning animal pens, cats, and ruminants as well as direct soil exposure in agriculture.

All things considered, the study found that many women keep cats in their homes, which suggests that the increase may be caused by a number of factors, including poor health, the high number of stray cats, dirt buildup, a lack of health education, and a lack of knowledge about the disease's sources of infection and efforts to prevent them. They are unaware that cats are the disease's primary source.

## CONCLUSION

This study provides crucial insights into the prevalence and epidemiology of Toxoplasma gondii infection among breeders, animals, soil, and cats in Baghdad, Iraq. The detection of the parasite in all investigated sources underscores the significant zoonotic potential and public health threat posed by T. gondii in the region. Our findings reveal considerable levels of infection in cats and soil, highlighting their central role as reservoirs and sources of environmental contamination. The notable prevalence among breeders and domestic animals further emphasizes the risk of transmission through occupational exposure and close contact with infected hosts.

The results suggest urgent need for increased awareness regarding toxoplasmosis transmission, particularly among vulnerable populations, such as breeders and immunocompromised individuals. Implementation of regular screening programs, public education campaigns, and improved hygienic practices—especially concerning animal handling and soil contact—are recommended to mitigate the spread of T. gondii. Furthermore, the study underscores the necessity for integrated One Health approaches involving veterinary, environmental, and public health sectors to monitor and control toxoplasmosis in Baghdad.

In conclusion, the widespread presence of T. gondii across multiple reservoirs in Baghdad poses a significant health concern. Continued surveillance and comprehensive intervention strategies are essential to reduce infection rates and protect the health of both humans and animals in the region.

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