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The Seroprevalence Study of Asymptomatic Toxoplasmosis in Cats and their Owners in Basrah, Iraq

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Abstract

Due to a little information about asymptomatic toxoplasmosis (A.T.) and its prevalence in cats and their owners in Basrah city. The study was established to assess the seroprevalence of toxoplasmosis and associated factors among cats and adopted households. The study's results showed that cats and their owners had high levels of A.T. The female cats are significantly more vulnerable to infection by toxoplasmosis compared to male cats. In the case of feline toxoplasmosis and age-related, the cats can be infected at any age, and the junior cats are more susceptible to having toxoplasmosis. Studying feline toxoplasmosis and its relationship to lifestyle revealed that animals raised and living outdoors had a higher infection rate. The feeding style plays a significant role in feline toxoplasmosis, and it is increased when the animals feed on 100% home leftover food. The animals that had a good veterinary health coverage are significantly less vulnerable to having A.T. The breed of animals does not affect the rate of infection. The cat owners had high levels of A.T. No significant effect on the prevalence of infection in humans regarding age and sex, indicating that all genders and ages are susceptible to infection. However, the lifestyle and the level of veterinary health knowledge of the pet owner had a significant effect. So, the A.T. represented a serious threat to animals' and humans' health. Using the routine examination supported with treatment, proper methods for management and treating animals are essential for prevention.

Keywords: Cats , Toxoplasmosis, asymptomatic , Seroprevalence.

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Introduction

An obligatory intracellular protozoan parasite, *Toxoplasma gondii*, is a member of the phylum Apicomplexa(1). It causes toxoplasmosis, a common zoonotic illness that can infect both humans and animals. Feline (both domestic and wild) hosts are the definitive hosts of this parasite, which has a complex life cycle comprising both asexual and sexual stages. All warm-blooded animals, including humans, can act as intermediate hosts(2,3)

T. gondii is a unicellular eukaryotic parasite that infects the nucleated cells of its hosts and can establish latent infections through tissue cysts, primarily in neural and muscular tissues. Its capacity to manipulate host cell functions makes it a model organism for studying host-pathogen interactions(4). Toxoplasmosis is a zoonotic disease caused by the protozoan parasite *Toxoplasma gondii* (5). This species is an Apicomplexan intracellular coccidian parasite. Various animals, including household pets like dogs, cats, and birds, and farm animals, such as pigs, cows, goats, and sheep, primarily transmit it. Found globally, it shares traits with the malaria-causing parasite. Although *T. gondii* infects much of the world's population, it seldom results in significant clinical disease. Toxoplasmosis is often asymptomatic but can become severe or even lethal during pregnancy when it impacts the fetus, newborns, and those with weakened immune systems(6). Most toxoplasmosis cases in healthy individuals are mild or subclinical, while those who are immunocompromised or affected by congenital forms of the condition face the most serious consequences and symptoms(4, 5).

T. gondii causes toxoplasmosis and has three infectious stages: tachyzoites (the rapidly dividing form), bradyzoites (the slow-dividing form found in cysts), and sporozoites (which are contained in oocysts shed by cats). Acute infections are mainly driven by Tachyzoite replication, while bradyzoites maintain chronic infections within tissue cysts(6).

In individuals with a healthy immune system, toxoplasmosis typically shows little to no symptoms or may manifest as mild flu-like signs. Conversely, the immunocompromised patients (those with AIDS or those under chemotherapy) can develop serious complications such as encephalitis, pneumonitis and myocarditis. There are severe issues associated with congenital toxoplasmosis, such as miscarriage, hydrocephalus, and intracranial calcifications, chorioretinitis(7). Toxoplasma gondii presents differently in cats, and its manifestation is influenced by the host's immune condition, as well as the presence of co-infections. While healthy cats often show subclinical symptoms, those affected may exhibit lethargy, loss of appetite, fever, diarrhoea, respiratory issues (such as dyspnea and coughing), ocular symptoms (including uveitis and chorioretinitis), and neurological problems(8).

The epidemiology of toxoplasmosis exhibits a global distribution, with seroprevalence varying widely based on dietary habits, climate, age, sex, lifestyle, and cat population. High prevalence is noted in South America, Africa, and Europe, while a lower yet still significant prevalence exists

in the United States and many parts of Asia. Recent estimates indicate that approximately one-third of the global population has been exposed to T gondii (9, 10).

Infection and transmission occur primarily through the ingestion of undercooked or raw meat containing tissue cysts, the ingestion of mature oocyst-contaminated food, water, or soil, congenital transmission (transplacental), and organ transplantation or blood transfusion (rare). Cats become infected by consuming infected prey and then shed millions of oocysts in their faces, contaminating the environment(11,12).

Toxoplasmosis imposes significant economic burdens due to its impact on public health, veterinary health, and food safety. In livestock, mainly sheep and pigs, it causes abortion and stillbirths, leading to economic losses. In humans, the cost includes medical care, long-term disability, and productivity loss. In the U.S. alone, the annual economic burden of toxoplasmosis was estimated at over $3 billion(12).

Because of a little information about asymptomatic toxoplasmosis and its prevalence in cats and their owner in Basrah city, this study was established to assess the seroprevalence of toxoplasmosis and associated factors among cats, pets, and their adopted households in Basrah city.

Material and Methods

The household cats were selected from multiple veterinary clinics in Basrah City. A total of 100 cats and 150 cat owners were to be evaluated. Basrah College of Veterinary Medicine's ethical committee approved the study. In addition to client consent, a questionnaire was completed, including signalment, gender, age, lifestyle, feeding style, and clinical signs of veterinary health care services at presentation (100 percent indoors, 100 percent outdoors, >50 percent indoors or >50 percent outdoors). A minimum of 1 mL of blood was collected from each feline and the cat's owners. For the purpose of analyzing circulating Ag (0.5 mL) in the EDTA tube, a commercial kit (VDRG® Toxoplasma Ab Rapid kit, MEDIAN Diagnostics Inc., Republic of Korea) was used. To confirm toxoplasmosis, 0.5 mL of blood from an EDTA tube was tested for anti-toxoplasma antibody. In order to test for feline toxoplasmosis Ag, serum from humans was collected, and a commercial kit (TOXO Toxoplasma Ab IgM/IgG Rapid Test Cassette (WB/S/P), Zoetis, Parsippany, New Jersey, USA) was used for the Ag test. Descriptive statistics were used to demonstrate toxoplasmosis prevalence. Prevalence results are expressed as median (range). Statistical analysis was done by using GraphPad Prism version 10 by using part from whole and one way Anova mulita comparison techniques. Multivariate logistic regression analysis was used to determine the relationships between Toxoplasmosis prevalence and the presence of multiple risk factors obtained from the questionnaire.

Results

The infection ratio of toxoplasma seropositive cases among female cats was significantly higher than the infection ratio of anti- Toxoplasma antibodies seronegative cases ($p < 0.001$), indicating

that female cats were more susceptible to infection in this study population. The majority of male cats were Toxoplasma-seronegative ($p < 0.05$), indicating a statistically significant but smaller difference than female cats, although they displayed a lower but slightly less dramatic trend. Figure 1 (A, B).

Adult (3–6 years) and mature (7–10 years) cats had the highest infection rates, with a significantly higher infection ratio of toxoplasma-seropositive cases than seronegative ($p < 0.01$ and $p < 0.05$, respectively). This could be the result of increased exposure to contaminated environments over time or a higher risk of consuming infectious agents through scavenging or hunting. On the other hand, the prevalence of Toxoplasma infection was lowest in kittens and junior cats, with a significantly higher number of Toxoplasma-negative cases than positive ones ($p < 0.001$ and $p < 0.0001$, respectively). This implies that younger cats are either less susceptible to the parasite or may be better protected due to early-life care or restricted outdoor access. Figure 2 (A,B)

Cats that lived entirely outside had a higher prevalence of Toxoplasma infection, with a greater percentage of positive cases than negative cases ($p = 0.001$). Cats that spent over 50% of their time outside showed similar patterns, with a significantly higher proportion of Toxoplasma seropositive cases than negative ones ($p < 0.05$). Nonetheless, the majority of cats who were indoors less than 50% of the time were toxoplasma seronegative (p 0.05). Cats kept indoors had the lowest infection rates. A strictly indoor lifestyle is linked to a lower risk of infection, as evidenced by the fact that Toxoplasma seronegative cases in this group significantly outnumbered toxoplasma seropositive ones ($p < 0.05$). Figure 3 (A, B).

The highest prevalence of Toxoplasma infection was found in cats that were fed only home leftovers; the number of Toxoplasma-positive cases was significantly higher than the number of negative cases ($p < 0.001$). The higher risk that occurs when household food makes up the majority of a cat's diet was highlighted by a similar trend among cats that received less than 50% of their diet from processed food, which also displayed a significant excess of positive cases ($p < 0.01$). The majority of Toxoplasma seronegative results were obtained by cats fed more than 50% processed food, but the difference was still statistically significant ($p < 0.05$). Cats fed only processed cat food had the lowest infection rates. Toxoplasma-negative cats in this group greatly outnumbered positives ($p < 0.001$), suggesting a potent protective effect of, Toxoplasma-negative cats significantly outnumbered positives ($p < 0.001$), indicating a strong protective effect of fully processed commercial diets. Figure 4(A,B)

Comparable percentages of Toxoplasma-positive and Toxoplasma-negative cases were found in both breed categories. Infection and non-infection rates were nearly equal among native breeds. Likewise, there was a small but statistically insignificant difference for foreign breeds. These findings imply that, in the sample under study, breed does not seem to be a determining factor in susceptibility to Toxoplasma infection. Figure 5 (A, B)

With a significantly higher percentage of toxoplasma-seropositive cases than negative ones ($p < 0.001$), cats without veterinary coverage had the highest prevalence of Toxoplasma infection. Cats with less than 50% or more than 50% coverage showed a similar pattern, with more Toxoplasma-positive cases than negatives ($p < 0.05$). But compared to the uncovered group, the infection rate was marginally lower. On the other hand, the infection rates were lowest among cats with full (100%) veterinary healthcare coverage. Toxoplasma-negative cases in this group were significantly more common than positive ones ($p < 0.05$), indicating that regular veterinary care is crucial for early detection, prevention, and potentially treatment or control of T. gondii infection. 6 (A,B).

Examines the connection between human age groups and the status of Toxoplasma gondii infection (Toxoplasma-positive and Toxoplasma-negative). Interestingly, the notation "ns" (not significant) next to every comparison indicates that there is no statistically significant difference between infection status and age across any of the groups. Figure 7 (A,B).

The percentages of people with and without Toxoplasma were almost the same in both sexes. This implies that among the population under study, gender does not seem to be a determining factor in the risk of contracting Toxoplasma. The results suggest that other factors, rather than biological sex alone, are probably more important in determining an individual's risk of infection. These include cat interactions, hygiene, food habits and consciousness. Figure 8 (A,B)

Individuals who tested positive for Toxoplasma were more prevalent than those who tested negative, regardless of their income level. However, the income did not have the same severity as the infection. The Toxoplasma-positive cases were significantly more numerous than the Toxoplasma-negative cases in the low-income group ($p < 0.05$). This implies that access to veterinary care, safe food handling information, and health education may be even more difficult due to financial issues, which may contribute to the risk of exposure. The same trend was observed in individuals with mid-level income: Toxoplasma-positive cases continued to outnumber negatives, with statistical significance ($p < 0.05$), albeit with a smaller difference. This could be because some people are exposed to constant environmental or lifestyle risk factors and have limited access to preventive resources. Figure 9 (A,B)

The percentage of Toxoplasma-positive individuals among participants with a lack of knowledge and skills was significantly higher than that of Toxoplasma-negative participants ($p < 0.001$), indicating that this group has the highest percentage of Toxoplasma-positive individuals. In groups with less than 50% and more than 50% knowledge, there were still more Toxoplasma-positive cases than negative ones. This was a similar but less pronounced trend that both reached statistical significance ($p < 0.05$). But people who knew everything there was to know about pet care and were good at it had the fewest infections, with a much higher number of Toxoplasma-negative cases than positives ($p < 0.05$). This means that people can avoid getting sick from zoonotic diseases by knowing how to care for their pets properly, which includes keeping the litter box clean, making sure the food is safe, and keeping parasites away. Figure 10 (A,B)

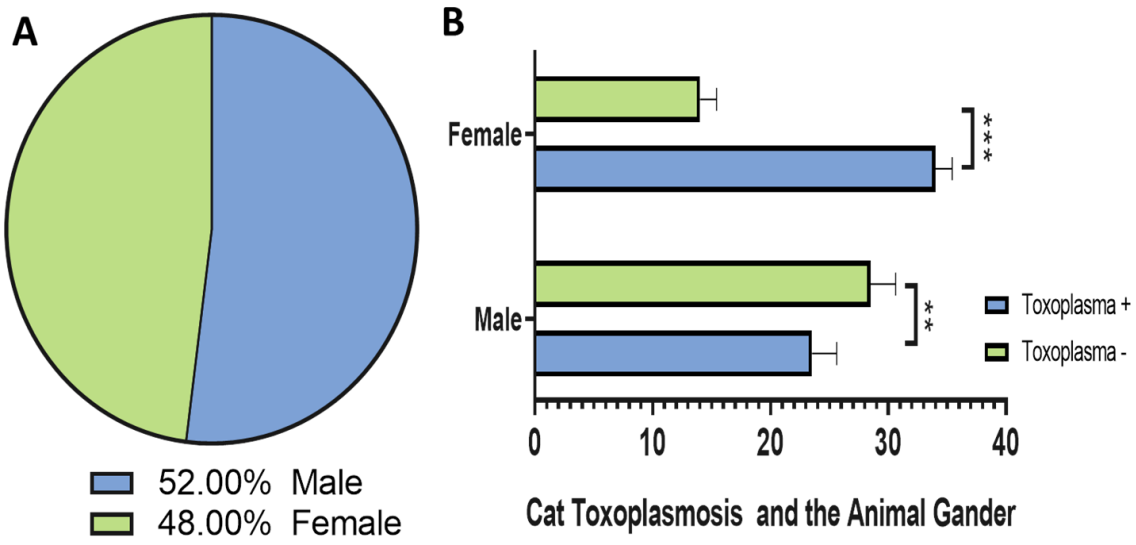

Figure 1: Feline Toxoplasmosis and Gender related : A) The percentage of Feline in the experimental and their Gender: **B)** The relation between the Infection with Toxoplasmosis and Feline Gender: **Statistics:** all the data presented in the figure show means ± standard Error Mean(SEM), calculated with GraphPad Prism version 8.01. Significance (P-value: * < 0.05, ** < 0.01, *** < 0.005, **** < 0.001) was determined by using Student's t-test.

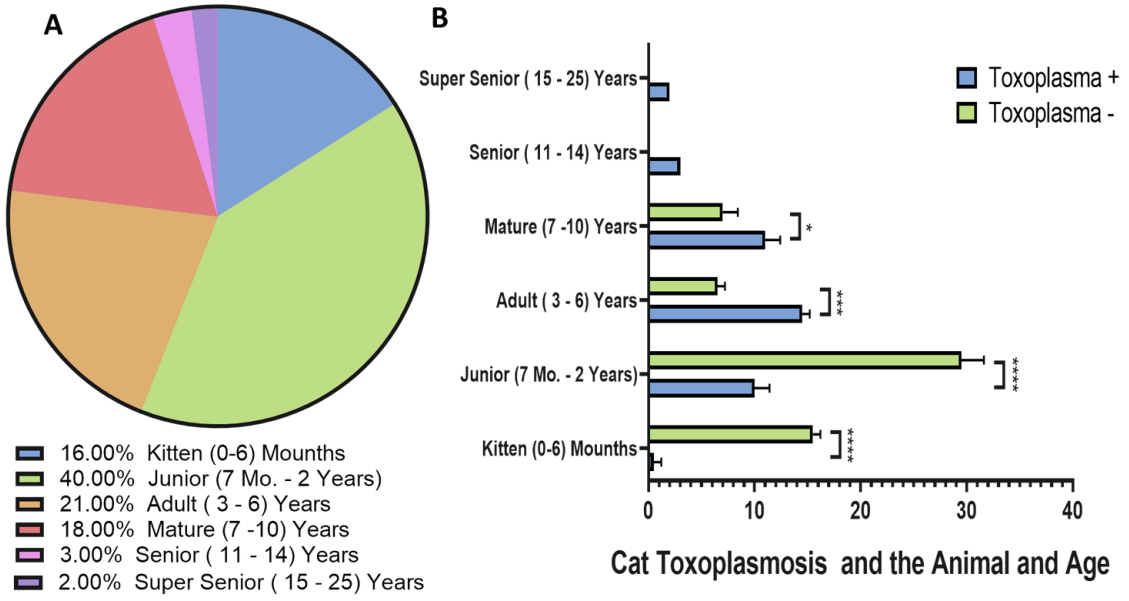

Figure 2 : Feline Toxoplasmosis and Age related: A) The Percentage of Feline in the experimental and their Age Range: **B)** The relation between the infection with Toxoplasmosis and Feline Age Range: **Statistics:** all the data presented in the figure show means ± standard Error Mean(SEM), calculated with GraphPad Prism version 8.01. Significance (P-value: * < 0.05, ** < 0.01, *** < 0.005, **** < 0.001) was determined by using Student's t-test.

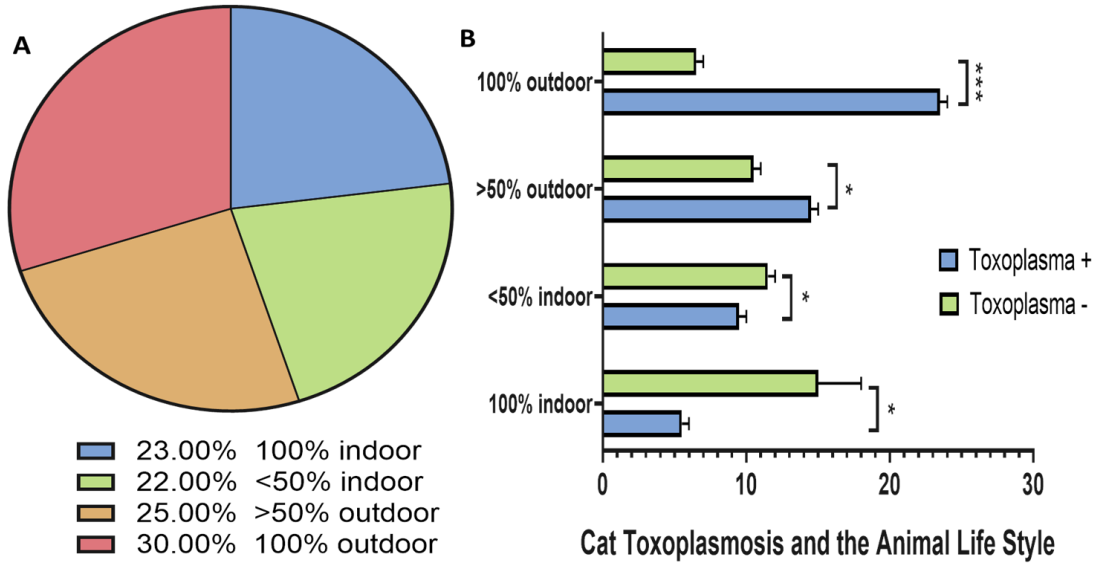

Figure 3 : Feline toxoplasmosis and the animal lifestyle: A) the percentage of animals in the experimental population that follow different lifestyles: **B)** the relation between the infection with toxoplasmosis and the animal's lifestyle: **Statistics:** all the data presented in the figure show means ± standard Error Mean(SEM), calculated with GraphPad Prism version 8.01. Significance (P-value: * < 0.05, ** < 0.01, *** < 0.005, **** < 0.001) was determined by using Student's t-test.

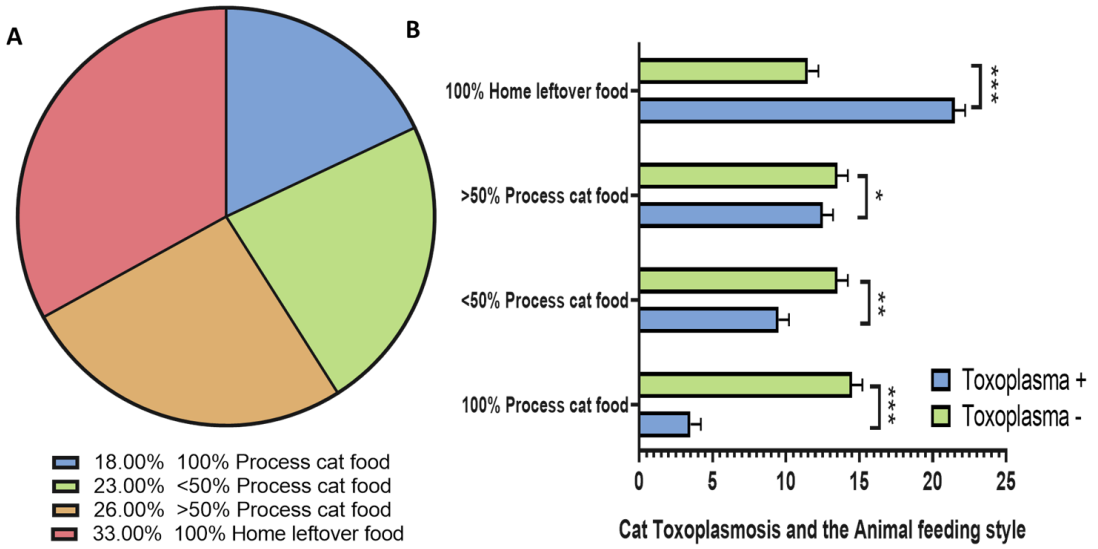

Figure 4 : Feline Toxoplasmosis and the Animal Feeding style: A) the percentage of animals in the experimental population that follow different Feeding types: **B)** the relation between the infection with toxoplasmosis and the animal's Feeding style: **Statistics:** all the data presented in the figure show means ± standard Error Mean(SEM), calculated with GraphPad Prism version 8.01. Significance (P-value: * < 0.05, ** < 0.01, *** < 0.005, **** < 0.001) was determined by using Student's t-test.

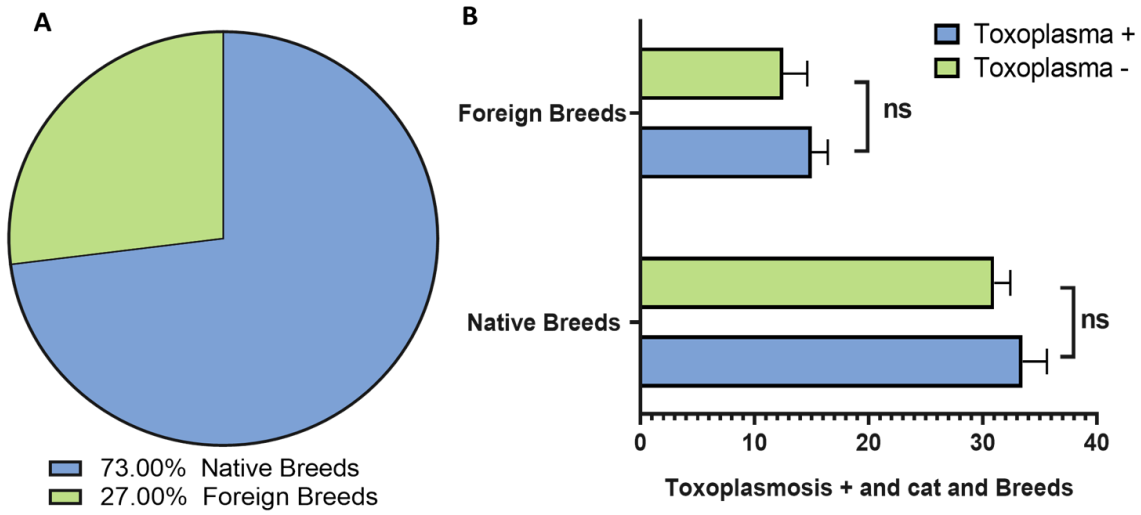

Figure 5 : Feline Toxoplasmosis and the Animal Breed: **A)** the percentage of animals and their Breed in the experimental: **B)** the relation between the infection with toxoplasmosis and the animal's Breeds: **Statistics:** all the data presented in the figure show means ± standard Error Mean(SEM), calculated with GraphPad Prism version 8.01. Significance (P-value: * < 0.05, ** < 0.01, *** < 0.005, **** < 0.001) was determined by using Student's t-test.

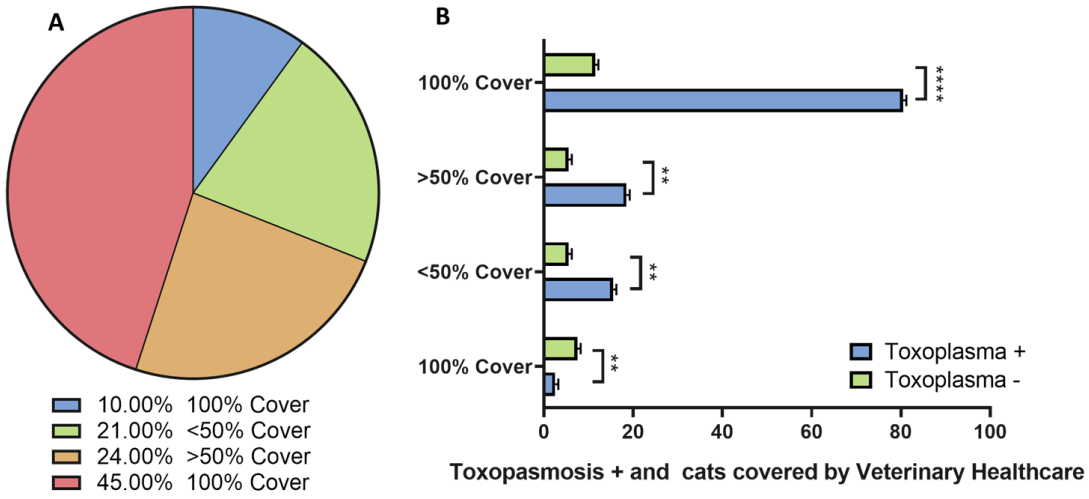

Figure 6 : Feline Toxoplasmosis and the Veterinary health care coverage: A) the percentage of animals and in the experimental and the veterinarian heath care coverage: **B)** the relation between the infection with toxoplasmosis and the Veterinary health care coverage: **statistics:** all the data presented in the figure show means ± standard Error Mean(SEM), calculated with GraphPad Prism version 8.01. Significance (P-value: * < 0.05, ** < 0.01, *** < 0.005, **** < 0.001) was determined by using Student's t-test.

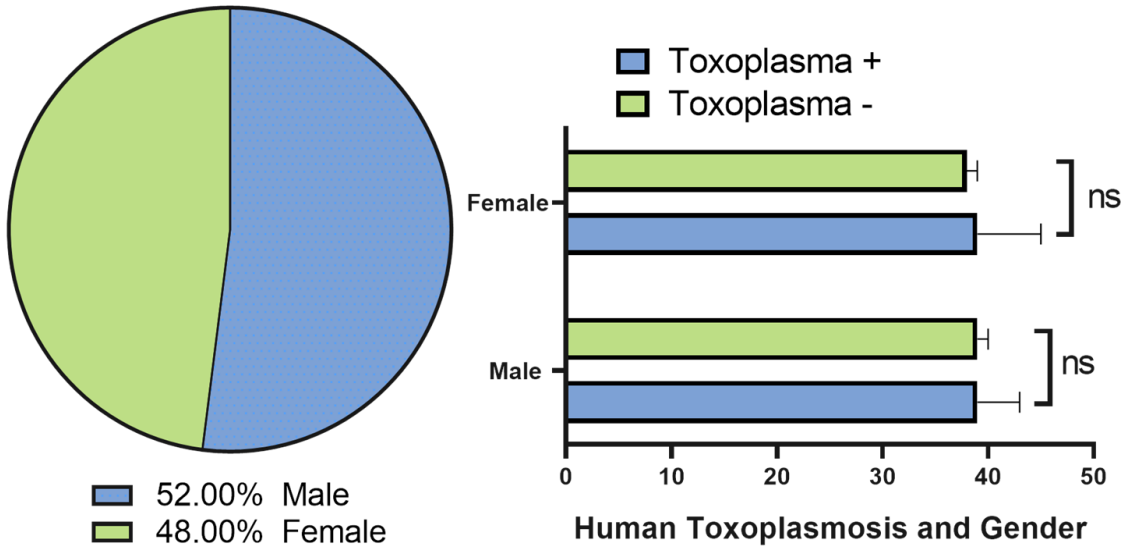

Figure 7 : Human Toxoplasmosis and Gender related A) The percentage of Human in the experimental and their Gender **B)** The relation between the Infection with Toxoplasmosis and Human Gender: **Statistics:** all the data presented in the figure show means ± standard Error Mean(SEM), calculated with GraphPad Prism version 8.01. Significance (P-value: * < 0.05, ** < 0.01, *** < 0.005, **** < 0.001) was determined by using Student's t-test.

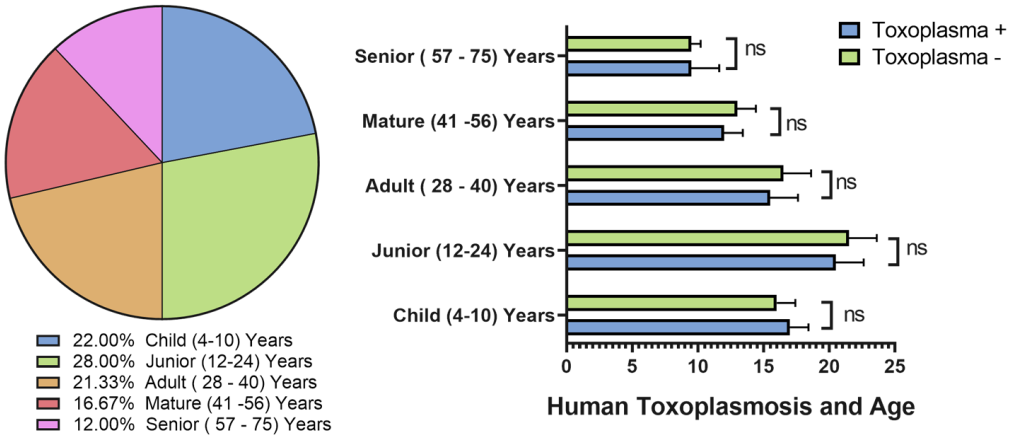

Figure 8 : Human Toxoplasmosis and Age related A) The Percentage of Humans in the experimental and their Age Range **B)** The relation between the infection with Toxoplasmosis and Human Age Range: **Statistics:** all the data presented in the figure show means ± standard Error Mean(SEM), calculated with GraphPad Prism version 8.01. Significance (P-value: * < 0.05, ** < 0.01, *** < 0.005, **** < 0.001) was determined by using Student's t-test.

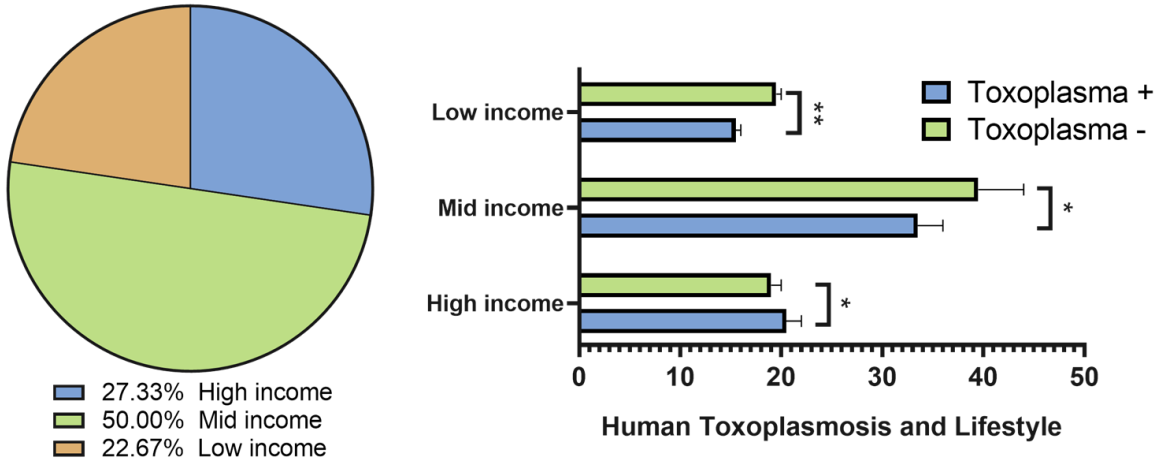

Figure 9 : Human Toxoplasmosis and Lifestyle income related : A) The Percentage of Humans in the experimental and their Income Range **B)** The Relation between the Infection with Human toxoplasmosis and Their Income Range: **Statistics:** all the data presented in the figure show means ± standard Error Mean(SEM), calculated with GraphPad Prism version 8.01. Significance (P-value: * < 0.05, ** < 0.01, *** < 0.005, **** < 0.001) was determined by using Student's t-test.

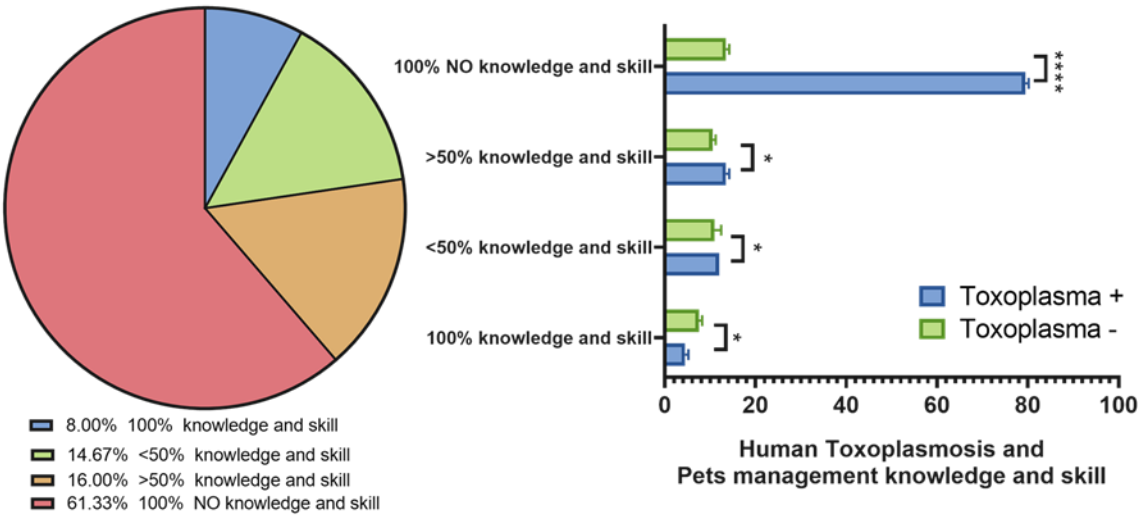

Figure 10 : Human Toxoplasmosis and Pet Management Knowledge and Skills: A) The Percentage of Humans in the experimental and their and Pet Management Knowledge and Skills **B)** The Relation between the Infection with Human toxoplasmosis and Their and Pet Management Knowledge and Skills: Statistics: all the data presented in the figure show means ± standard Error Mean(SEM), calculated with GraphPad Prism version 8.01. Significance (P-value: * < 0.05, ** < 0.01, *** < 0.005, **** < 0.001) was determined by using Student's t-test.

Discussion

Toxoplasmosis, caused by *toxoplasma gondii*, is a serious zoonotic disease with extensive global distribution. This paper has evaluated the prevalence and risk factors of feline and human diseases in Basrah. The findings revealed that the condition is multifactorial, as there were significant correlations with lifestyle, diet, veterinary care, gender, and age.

The association between outdoor activity and the rate of infection was found to be very strong. Cats that had unrestricted access to the outside world had the highest infection rates, as prior results highlight the importance of environmental exposure - via contaminated food sources or soil - as a significant risk factor(14,15). The same trends were also noted in Taiwan, whereby outdoor animals were exposed to more parasites due to their contact with vectors(13,16).

Eating raw or stale food significantly increases the risk of infection, particularly when undercooked meat is involved. On the other hand, processed commercial diets had a lower infection. These results are consistent with the biology of the parasite, as the ingestion of tissue cysts through the consumption of raw meat is a confirmed means of infection(5,7) .Cats that were not taken to the veterinarian had the highest infection rates, with those who attended the veterinarian regularly having lower prevalence rates(17). This also emphasizes the significance of regular deworming, vaccination and health surveillance in the prevention of parasites(18,19).

The highest rate of infection was observed in female cats compared to male cats, which was probably because of the reproductive activities, roaming behaviour, hormonal and immune variations. Immune-regulating cytokines such as IL-10 and IFN are also to be studied further concerning the same(20,21).

There were no notable differences between native and foreign breeds, and this claim is that genetic background is not a very crucial risk factor to infection. This agrees with the results obtained in Taiwan and other places, which suggests that environmental exposure is a stronger determinant(22)(23). The adult and mature cats (3 -10 years) and the old cats showed higher infection rates, which may be attributed to accumulation of exposure. Kittens and younger cats had much less prevalence, and senior cats had lower prevalence, most likely due to early immunity or due to lack of activity(20,24).Information, Income and Socio-Demographic Variables: In human respondents, the lack of information on pet care and toxoplasmosis prevention was highly correlated with the high infection rate ($p < 0.001$). This highlights the importance of the significance of public education in knowledge and hygiene and its role in reducing the spread of T. gondii. The participants who failed to appropriately understand the process of taking care of cats, maintaining the litter box clean, and avoiding parasites were more likely to test positive for the antibodies. Although gender and age did not show strong connections, socioeconomic position, in particular, low income, remained a significant risk factor ($p < 0.05$). This is not surprising

because what has been observed in other parts of the world is that individuals with low incomes are also more prone to zoonotic diseases, due to their inability to access medical and veterinary services and safe food(14,25) and (21).

Conclusion

The asymptomatic toxoplasmosis has a high prevalence among cats and their households in Basrah Province. Gander, Breed, Age, feeding style, and veterinary healthcare and knowledge played a critical role in the prevalence and disease distribution. The research findings reiterate and recommend the essential need to combine community-based health education with veterinary and community health programs to reduce the incidence of toxoplasmosis.

Conflict of interest

There is no need to declare a conflict of interest.

Ethical Clearance

This work is approved by The Research Ethical Committee

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دراسة انتشار الأجسام المضادة لداء المقوسات غير المصحوب بأعراض لدى القطط وأصحابها في البصرة، العراق

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الخلاصة

نظراً لقلة المعلومات المتوفرة حول داء المقوسات اللاعرضي وانتشاره بين القطط وأصحابها في مدينة البصرة، أُجريت هذه الدراسة لتقييم الانتشار المصلي لداء المقوسات والعوامل المرتبطة به بين القطط المنزلية. أظهرت نتائج الدراسة ارتفاع مستويات داء المقوسات اللاعرضي بين القطط وأصحابها. وتُعدّ القطط الإناث أكثر عرضةً للإصابة بداء المقوسات مقارنةً بالقطط الذكور. وفيما يتعلق بداء المقوسات لدى القطط وعلاقته بالعمر، يمكن أن تُصاب القطط في أي عمر، وتكون القطط الصغيرة أكثر عرضةً للإصابة. وكشفت دراسة داء المقوسات لدى القطط وعلاقته بنمط الحياة أن الحيوانات التي تُربى وتعيش في الهواء الطلق لديها معدل إصابة أعلى. ويلعب أسلوب التغذية دوراً هاماً في الإصابة بداء المقوسات لدى القطط، حيث يزداد انتشاره عندما تتغذى الحيوانات على بقايا الطعام المنزلي بنسبة 100%. أما الحيوانات التي تتمتع بتغطية صحية بيطرية جيدة فهي أقل عرضةً للإصابة بداء المقوسات اللاعرضي. لا يؤثر نوع الحيوان على معدل الإصابة. وقد لوحظ ارتفاع مستويات داء المقوسات لدى مُلّاك القطط. لم يُلاحظ أي تأثير يُذكر للعمر أو الجنس على انتشار العدوى بين البشر، مما يشير إلى أن جميع الأجناس والأعمار معرضة للإصابة. مع ذلك، كان لنمط حياة مُلّاك الحيوانات الأليفة ومستوى معرفتهم بالطب البيطري تأثير كبير. لذا، يُمثل داء المقوسات تهديدًا خطيرًا لصحة الحيوانات والبشر. يُعدّ استخدام الفحص الروتيني المصحوب بالعلاج، واتباع أساليب مناسبة لإدارة وعلاج الحيوانات، أمرًا ضروريًا للوقاية.

الكلمات المفتاحية: القطط، داء المقوسات، بدون أعراض، الانتشار المصلي.