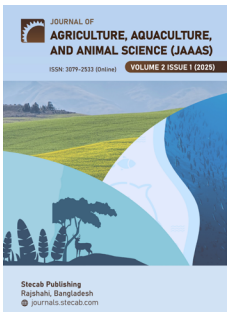

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Research Article

Incidence of Cystic Echinococcosis in Slaughtered Animals at Al-Diwaniyah City, Iraq

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About Article

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ABSTRACT

Cystic echinococcosis, is an infection caused by tapeworms of the genus Echinococcus, which infect a wide range of domestic and wild animals in addition to humans. Estimation the prevalence rate of echinococcosis among different slaughtered animals, and their organs with evaluation the association of infection to a number of risk factors (age and sex). An overall 4529 animals including buffaloes (no = 142), cattle (no = 1877), camels (no = 29), goats (no = 306), and sheep (no = 2175) slaughtered at different official and private slaughterhouses located in Al-Diwaniyah (Al-Qadisiyah, Iraq) were examined grossly to identify the presence of echinococcosis. The total prevalence rate of cystic echinococcosis was 0.93%, which differed insignificantly among study animals: buffalo (2.11%), cattle (1.17%), goats (0.33%), and sheep (0.74%), but not in camels (0%). However, buffaloes and cattle were significantly at higher risk of infection than others. In concerning to body organs, cystic echinococcosis was seen significantly in the liver but decreased significantly in the spleen and brain when compared to the lung and mesentery. Regarding age, the prevalence rate of cystic echinococcosis was significantly higher in animals aged ≥9 years old (18.75%) than in those of ≤ 1 (0.05%), 2-4 (0.24%), and 5-8 (3.7%) years old. Whilst the risks of infection were elevated significantly in infected animals aged ≥ 9 followed by 5-8 years, but reduced in those aged 2-4 and ≤ 1 year old. Although insignificant differences were recorded in the prevalence rate of cystic echinococcosis between females (1.34%) and males (0.24%), females were significantly at higher risk of infection than males. Sheep may undoubtedly play a significant part in the maintenance of the E. granulosus life cycle in the studied locations, given that cattle have a greater prevalence and risk of contracting cystic echinococcosis than other species. Thus, the safe removal of contaminated offal, particularly from sheep and cattle, would greatly lessen the spread of cysts from slaughterhouses to possible hosts in this area.

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1. INTRODUCTION

The genus Echinococcus contains tapeworms that cause cystic echinococcosis, sometimes referred to as hydatid illness or echinococcosis. These tapeworms are just a few millimeters long and infect a variety of domestic and wild animals in addition to humans (Wen *et al*., 2019; Gessese, 2020). As with other tapeworms, the life cycle requires two animals: 'any mammal, including humans, serves as an intermediate host where the worms develop cysts in different organs, and carnivores serve as the final host where the mature worms reside in the intestines (Parija & Pramodhini, 2022; Milgroom, 2023). Cysts are slow-growing, fluid-filled structures that contain larvae. They are most commonly found in the liver or lungs and function similarly to tumors, disrupting the function of the organ in which they are found. This results in poor growth, decreased milk and meat production, and organ rejection at meat inspection (Wabe *et al*., 2017; Ün *et al*., 2020; Bresson-Hadni *et al*., 2021).

2. LITERATURE REVIEW

When dogs eat fresh offal or scavenge infected carcasses with cysts, they become infected and contaminate the pasture with their feces, which re-infects the domestic animals during grazing. This is the most common cycle of E. granulosus between dogs and field animals (Zemen *et al*., 2015; Woolsey & Miller, 2021). Although they are prone to desiccation, they are well suited to live in the environment for up to a year in cold, humid circumstances and release their eggs into the environment via the feces of their host animals (Thompson, 2017). Because they are sticky, fresh eggs may cling to their hosts' fur, which helps them spread (Parija & Pramodhini, 2022). The eggs are accidentally consumed by the intermediate host when it is grazing, foraging, or drinking. In the small intestine, the eggs hatch into larvae that pierce the gut wall and travel throughout the circulatory system to different organs where they develop into cysts or metacestodes (Díaz, 2017; Chubb *et al*., 2020). Depending on the species and strain of Echinococcus, the life cycle is finished when the cysts are consumed by a carnivore definitive host. The larvae are then released from the cyst into the small intestine to mature into adult tapeworms, which release their eggs into the environment in the host animal's feces within 25 to 80 days (Al-Khalidi *et al*., 2020; Pal *et al*., 2022). Because of their inconsistent sensitivity and specificity, serological assays are not often utilized in light of the life cycle in intermediate hosts (Siles-Lucas *et al*., 2017). Thus, the gold standard for diagnosis is still the post mortem finding of cysts in various organs during meat inspection (Reinehr *et al*., 2020; Mohammad *et al*., 2022; Alvi *et al*., 2023). The current study was designed to estimate the association of infection to various slaughtered animals and their organs while evaluating the association of infection to various risk factors, as there are currently no studies available to detect the prevalence rate of echinococcosis in slaughtered animals in Al-Diwaniyah city' (Al-Qadisiyah, Iraq).

3. METHODOLOGY

3.1. Ethical approval

The current study was approved by the Scientific Committee of the College of Veterinary Medicine in the University of Wasit (Wasit, Iraq).

3.2. Study animals and samples

The present study was conducted from May to September (2024) at different official and private slaughterhouses located in Al-Diwaniyah (Al-Qadisiyah, Iraq). The cystic echinococcosis was identified in slaughtered animals and their organs based on gross examination, and information concerning age, sex, and infected organ(s) was reported as risk factor data.

3.3. Statistical analysis

One-Way ANOVA, relative risk, and Odds-ratio in GraphPad Prism version 6.0.1 (GraphPad Software Inc. USA) were used to analysis of study data at $p < 0.05$ (Gharban *et al*., 2024).

4. RESULTS AND DISCUSSION

Among total of 4529 slaughtered animals, gross examination revealed that the total prevalence rate of cystic echinococcosis was 0.93% (total number = 42); while 99.07% (total number = 4487) were negative (Figure 1).

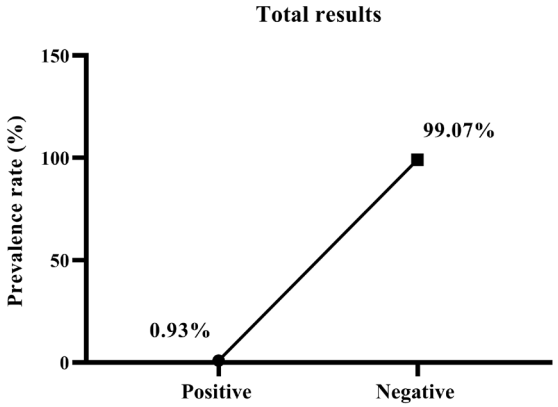

Figure 1. Prevalence rate of cystic echinococcosis among totally 4529 slaughtered animals

Although the prevalence rate of cystic echinococcosis was differed insignificantly (p-value = 0.0767; 95%CI = -0.1488 to 1.889) between study animals; buffalo [2.11% (3/142)], cattle [1.17% (22/1877)], camels [0% (0/29)], goats [0.33% (1/306)], and sheep [0.74% (16/2175)] (Figure 2), the results of relative risk and Odds ratio recorded that buffaloes (2.348 and 2.4062, respectively) and cattle (1.5478 and 1.5608, respectively) were significantly (p-value = 0.00001; 95%CI = 16.77 to 15.02; and p-value = 0.0001; 95%CI = 22.48 to 221.1, respectively) at higher risk of infection than goats (0.166 and 0.3344, respectively), sheep (0.4266 and 0.6636, respectively) and camels (0 and 0, respectively), (Figures 3, 4).

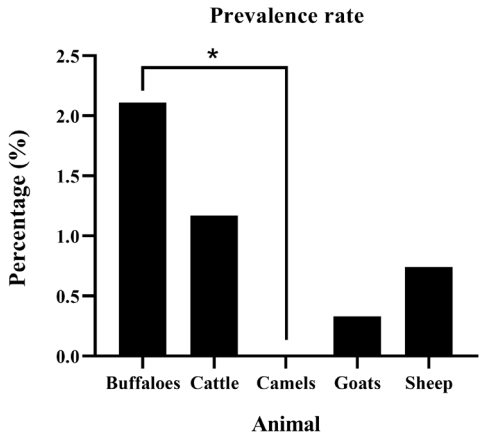

Figure 2. Prevalence rate of cystic echinococcosis in study animals

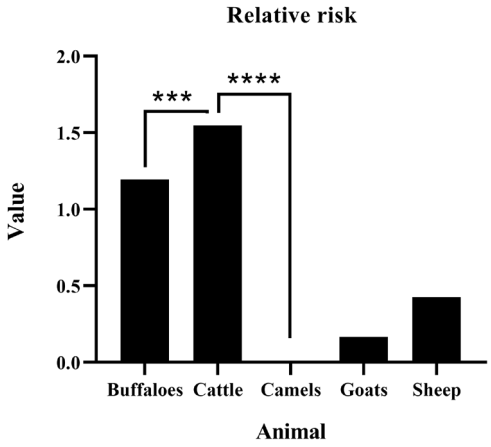

Figure 3. Values of Relative risk in positive study animals to cystic echinococcosis

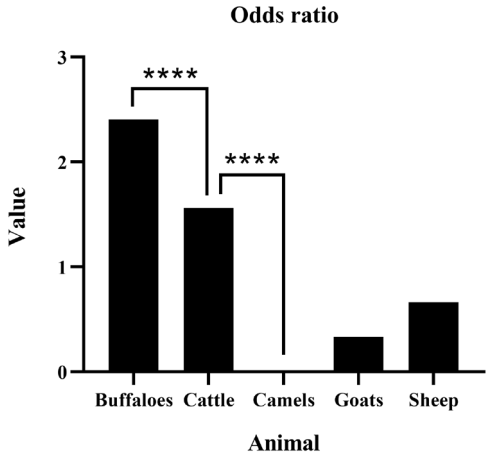

Figure 4. Values of Odds ratio in positive study animals to cystic echinococcosis

In concerning to body organs, the incidence of cystic echinococcosis among infected cases (total number = 42) was increased significantly (p-value = 0.0156; 95%CI = 11.82 to 51.82) in liver [64.29% (number = 27)] and decreased significantly in spleen and brain [2.38% (number = 1)] when compared to lung [16.67% (number = 7)] and mesentery [14.28% (number = 6)], (Figure 5).

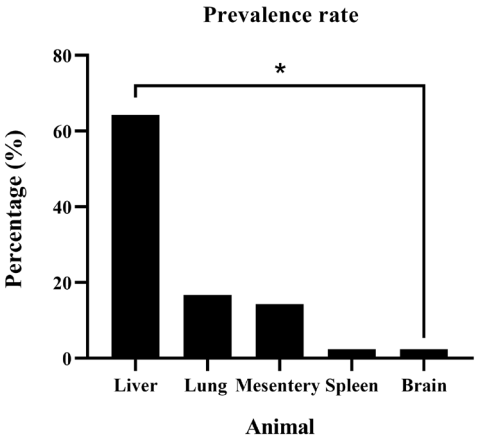

Figure 5. Prevalence rate of cystic echinococcosis in body organs of infected animals

Regarding age, the prevalence rate of cystic echinococcosis was significantly (p-value = 0.029; 95%CI = 8.429 to 19.80) higher in animals aged ≥9 years old [18.75% (18/96)] than those of ≤ 1 [0.05% (1/2227)], 2-4 [0.24% (4/1692)], and 5-8 [3.7% (19/514)] years old (Figure 6). Whilst, values of Relative risk and Odds ratio were elevated significantly (p-value = 0.0001; 95%CI = 131.6 to 310.5; and p-value = 0.0001; 95%CI = 199.7 to 446.0, respectively) in infected animals aged ≥ 9 [29.3224 and 42.3942, respectively] followed by 5-8 [6.2584 and 6.6621, respectively] years but reduced significantly in those aged 2-4 [0.1784 and 0.1745, respectively] and ≤ 1 [0.0256 and 0.0248, respectively] years old (Figures 7, 8).

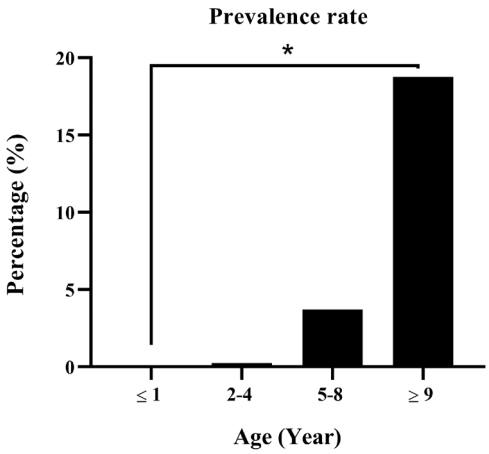

Figure 6. Prevalence rate of cystic echinococcosis among different age groups of study animals

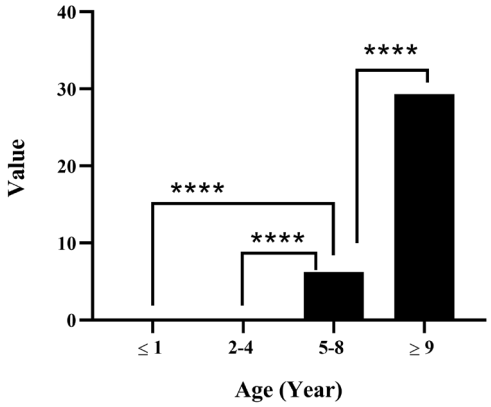

Figure 7. Values of Relative risk in different age groups of study animals

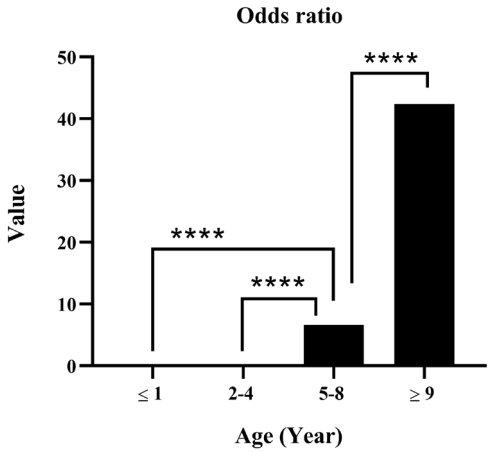

Figure 8. Values of Odds ratio in different age groups of study animals

Among positively infected animals (total number = 42), prevalence rate of cystic echinococcosis was increased significantly (p-value = 0.011; 95%CI = 10.34 to 60.34) infected animals aged ≥ 9 [42.86% (number = 18] and 5-8 [45.24% (number = 19)] years old and decreased significantly in those aged ≤ 1 year [2.38% (number = 1)] when compared to those aged 2-4 [9.52% (number =4)] years old (Figure 9).

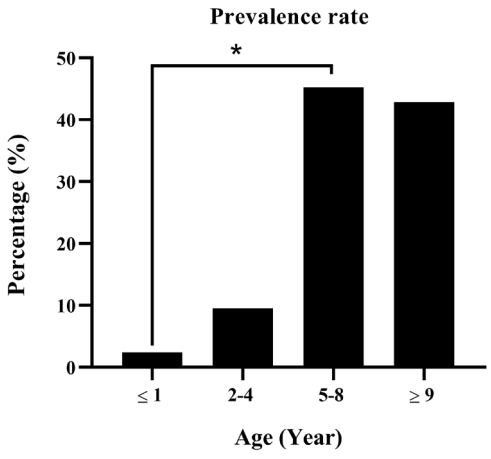

Figure 9. Prevalence rate of cystic echinococcosis among different age groups of positively infected study animals

Although insignificant differences (p-value = 0.3872; 95%CI = -6.198 to 7.778) were recorded in prevalence rate of cystic echinococcosis between females [1.34% (38/2841)] and males [0.24% (4/1688)] (Figure 10), values of relative risk and Odds ratio revealed that females (5.5832 and 5.7075, respectively) were significantly (p-value = 0.0001; 95%CI = 314.5 to 372.1; and p-value = 0.0001; 95%CI = 321.9 to 380.7, respectively) at higher risk of cystic echinococcosis infection than males (0.1791 and 0.1776, respectively), (Figures 11, 12).

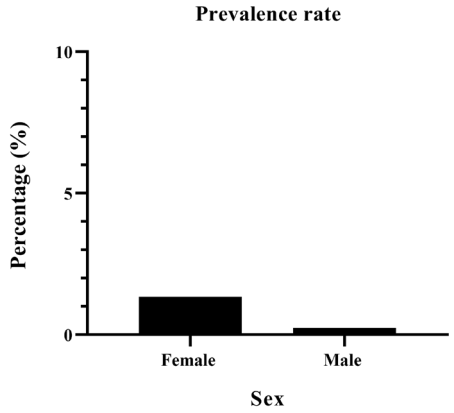

Figure 10. Prevalence rate of cystic echinococcosis among different sex groups of study animals

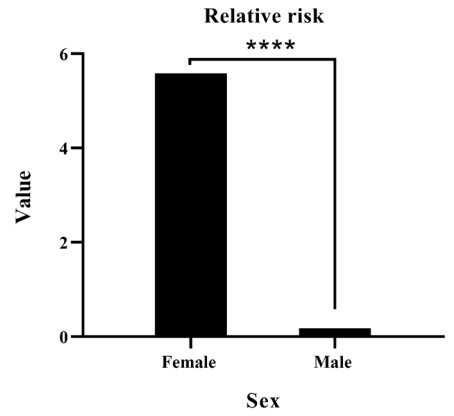

Figure 11. Values of Relative risk in different age groups of study animals

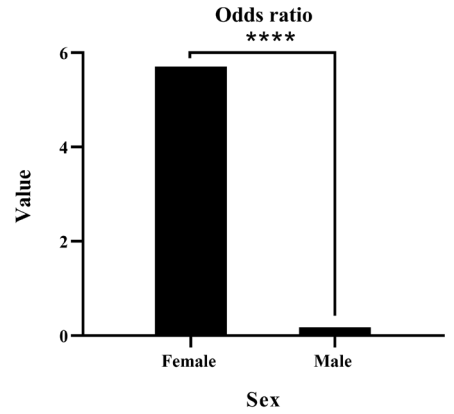

Figure 12. Values of Odds ratio in different sex groups of study animals

In relation to the distribution of cystic echinococcosis among the positive study animals, prevalence rate of infection was significantly higher (p-value = 0.0043; 95%CI = 464.3 to 564.3) in females [90.48% (38/42)] than males [9.52% (4/42)] (Figure 13).

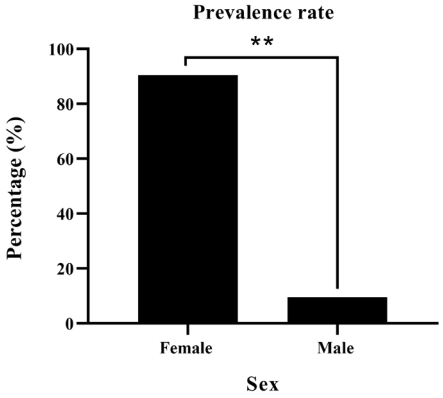

Figure 13. Prevalence rate of cystic echinococcosis among different sex groups of positively infected study animals

4.1. Discussion

The overall prevalence of cystic echinococcosis in the present research was 3.75%, with 4.68% of cattle and 0.874% of sheep—but not camels or goats, which had a 0% prevalence rate. Consistent with our results, Morocco (22.98%) and Algeria (24.8%) have higher rates of infection in cattle (Bardonnet *et al*., 2003; Azlaf & Dakkak, 2006). According to Banks *et al.* (2006), infections with cystic echinococcosis may slow the development of certain livestock species, including sheep, but not the cattle in this investigation experienced this. Geographic origin had the most impact on infection prevalence, according to the model used for cattle (Tamarozzi *et al*., 2020). In order to validate and improve the distribution and prevalence of cystic echinococcosis in cattle, this discovery led to the addition of a wider set of examination data. Although stock transfers across properties may have resulted in some errors, trace-back provided accuracy that earlier researchers were unable to get (Banks *et al*., 2006). It has been suggested that the endemic zone remains stable and has not moved much over the last 30 years, despite this greater accuracy (De Wolf, 2011). According to the results of a recent research (Jasim *et al*., 2024), the overall percentage of animals infected with cystic echinococcosis was 9.33%, with 12.29% of sheep, 8.97% of cattle, 8.26% of buffalo, and 4.08% of camels having the condition. Additionally, the scientists documented that the liver and lungs are the only organs impacted, demonstrating a considerable difference between the infection rate and the diseased organ. According to Adinehbeigi *et al.* (2013), the prevalence of cystic echinococcosis in Iran ranged from 5.1 to 74.4% in sheep, 1.7 to 20% in goats, 3.5 to 38.3% in cattle, and 11.4 to 70% in camels. Contrary to our results, the rate of infection in North African camels was higher than in sheep and cattle, indicating that camels may be the primary host for the spread of the hydatid infection and may be crucial to the local sustenance of the life cycle (Elmajdoub & Rahman, 2015). The lack of positive infection in the recent research may be explained by the fact that the camels were not killed at the slaughterhouse under a veterinarian's supervision when the villagers sought camel meat for wedding festivities. Only in a small number of abattoirs were various animals killed under a veterinarian's watch. Variations in environmental conditions, including temperature, humidity, and pasture type, may be one cause of the fluctuation in the infection rate for all killed sheep throughout the whole study locations. Additionally, these differences can be connected to the various strains of E. granulosus (Singh *et al*., 2014).

Compared to the lung, mesentery, spleen, and brain, the liver had a noticeably greater prevalence and risk of cystic echinococcosis. One of the most common and dangerous helminthic zoonotic illnesses in poor and underdeveloped nations worldwide is cystic hydatid disease. Livestock species are often more vulnerable to infection by contamination from viable E. granulosus eggs. Co-infection status was linked to anatomical location, with fewer animals afflicted by liver disease and more impacted by lung disease alone. According to Brehm and Koziol (2017), portal circulation is the main way that oncospheres infect E. granulosus, and it has a strong affinity for the liver. Because Fasciola hepatica may harm the liver in both acute and chronic infections, it may prevent E. granulosus from establishing itself in the liver (Sohair & Eman, 2009). While small cystic echinococcosis was mostly discovered in the liver when F. hepatica was absent, it was more often seen in the lungs when F. hepatica was present. Small cysts may be non-viable cysts or immature cysts that have the potential to become infertile or fertile (Stoore *et al*., 2018).

Our results demonstrated that the chance of contracting cystic echinococcosis rose dramatically with age, especially in animals ~~A~~36 months of age, and that females were more likely than males to get infected. According to several international studies, the prevalence rises with age (Adinehbeigi *et al*., 2013; Chihai *et al*., 2016; Poglayen *et al*., 2017). If the incidence does not increase further beyond the age of four, it may indicate the emergence of age-dependent immunity or, more likely, acquired resistance to super-infection. Because females in this area stay longer than men for the goal of reproduction, females are more likely than males to have greater rates of infection and mean intensity. In a similar vein, older animals are more susceptible to infection or have a longer period for cyst development than younger ones. The findings demonstrated that the older age groups had greater infection frequency and mean intensity. The analyzed animals' age-dependent rise in infection rate is consistent with findings from other researchers (Khan *et al*., 2020; Omondi, 2021; Mares *et al*., 2023). Because older animals may have been exposed to more infectious stages, this age variance may be translated into differential exposure to infection (Omadang *et al*., 2024).

According to the results of this study, there were notable variations in infection rates throughout several seasons, although only between spring and fall and between winter and summer were these variations seen. Likewise, it discovered notable variations in infection rates between fall and winter in numerous nations, as well as between spring and autumn in Saudi Arabia (Tashani *et al*., 2002; Ibrahim, 2010; Elmajdoub & Rahman, 2015).

5. CONCLUSION

Sheep may undoubtedly play a significant part in the

maintenance of the E. granulosus life cycle in the studied locations, given that cattle have a greater prevalence and risk of contracting cystic echinococcosis than other species. Thus, the safe removal of contaminated offal, particularly from sheep and cattle, would greatly lessen the spread of cysts from slaughterhouses to possible hosts in this area. Additionally, research in other fields using cutting-edge diagnostic methods like molecular tests might actively provide additional details about the location of infection in live animals in the field.

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