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## An epidemiological Study of Cystic Echinococcosis among Animals intermediated host in Thi-Qar Province, Iraq

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### Abstract

Cystic hydatid disease is a significant global health concern and a hazardous obstacle for public health and the livestock industry. The present investigation is aimed to determine the prevalence of hydatid cysts and economic losses in slaughtered animals (sheep, cattle, buffalo and camel) in Thi-Qar province, south of Iraq. This research was carried out from the beginning of February 2022 to the end of January 2023. The study focused on the prevalence of cystic echinococcosis in slaughtered animals from the central slaughterhouse of Nasiriyah city. The total cases (8847) were examined and the proportion of infection of hydatid cysts was: out of 2792 of examined sheep, 343 (12.29%) were infected, out 3209 of examined cattle, 288 (8.97%) were infected, out of 1865 of examined buffalo 154 (8.26 %) were infected and out 980 of examined camels, 40 (4.08%) were infected. Among the infected animals in the Al-Nasiriyah abattoir, sheep recorded the highest prevalence, while camel abattoir recorded the lowest prevalence among other animals intermediate hosts. The incidence of hydatid cysts has a positive proportion to the age of animals. Regarding organ involvements, the liver and lungs were the most infected organs, the liver had a higher prevalence than the lung with infection rates of 62.3 % and 37.70% respectively. Females of sheep, cattle, buffalo, and camel were statistically higher than males, and were significant differences between the

severity of infection and sex of hosts at ( $P \leq 0.05$ ). Sheep was the highest fertility with 84.26%, this attributed to the sheep strains in this region have a higher morbidity rate compared to other regions.

**Key word:** epidemiology, echinococcosis, *Echinococcus granulosus*, Thi-Qar province

## 1.Introduction

Cystic Echinococcosis (CE) is a zoonotic parasitic disease with global distribution. It is endemic in rural sheep-raising areas. In Iraq, hydatid cyst disease is hyperendemic, with high socioeconomic effects due to the infection of humans and their livestock (Benyan *et al.* 2013; Shnawa *et al.* 2021). The parasite has an indirect life cycle requiring two hosts. First is the intermediate host, in which the cysts can develop in several organs of humans and domesticated mammals such as sheep, cows, buffalo, goats, camels, and pigs. Second is the final host in which the adult worms develop in the small intestine of carnivorous animals such as dogs, and other wild canids, which pollute the soil with the infective eggs evacuated with their feces (Issa *et al.* 2022).

*Echinococcus granulosus* is a parasitic worm (Cestoda) and is the causative agent of hydatidosis or hydatid cysts disease. This is attributable to the development of the larval stage (hydatid cyst) in various human organs (Hizem *et al.* 2020). This parasite consider the most common in animal production, causing considerable economic loss in Iraq (Meerkhan 2019). The main way that humans become infected is by consuming ova of the parasite that are secreted with the faces of the definitive host and contaminated food, soil, and water. The ingested eggs hatched and released embryos in the small intestine of the intermediate hosts, which then passed through the intestinal wall and wandered through the bloodstream to various tissues, primarily the hepatic and pulmonary tissues, where they developed to give the larval stage or the hydatid cyst (Eckert & Thompson, 2017).

Although there are numerous strategies to manage the disease, it continues to be a substantial health issue that affects millions of individuals and causes economic loss worldwide. The primary objective of this research is to determine the prevalence of *E. granulosus* in animals intermediate host and its relationship to age, sex, cyst location, and fertility of cysts to achieve a better understanding of the disease.

## 2. Materials and Methods:

### 2.1: Samples Collection

During the period from the beginning of February 2022 to the end of January 2023, a survey was conducted to detect CE. The licensed Al-Nasiriyah abattoir was visited at least three times a week to

examine all slaughtered intermediate host animals (Sheep, Cattle, Buffalo, and Camel) organs and collect those infected with hydatid cysts. All isolates were collected from liver and lungs. Detection of hydatid cyst in organ made by palpation of organ's content. Superficial hydatid cysts have a clear white or pale yellow color similar to a small bubble. A pulmonary cyst is located deeply in tissue; palpation of the organ appears as the presence of a rigid content then removal of superficial organ tissues by surgical tools to ensure of cyst existence; while hepatic hydatid cysts are located superficially to the liver and taking irregular shape.

The total cases (8847) were examined distributed as: 2792 of examined sheep, 3209 of examined cattle, 1865 of examined buffalo and 980 of examined camels. The age of each animal was estimated by asking the middle man (buyer) and examining the teeth eruption and mouthing (Jenny, 2009; Jadoon 2021). The following data were recorded: determination of infected organs (lung and liver), calculation of the number of cysts in infected organs and severity of infection, and determination of the age, sex and fertility of infected samples.

## 2.2 Cyst Isolation

The samples were transported in plastic containers containing normal saline under cold conditions to the parasitology laboratory at the College of Education and Pure Science, Thi-Qar University, where each cyst underwent a preparation process. Hydatid cyst was carefully separated from the surrounding tissues, such as liver and lungs, using a scalpel and forceps. The surface of the cyst was disinfected with 70% ethanol and stored at room temperature for further examination. The percentage of prevalence of hydatid disease infection was determined according to Margolis *et al.* (1982). Infection percentage = No. of infected animals / No. of animals examined x 100. Determining the severity of infection according Tashani *et al.* (2002).

Intensity of infection = No. of cysts / No. of infected animals.

**2.2 Statistical Analysis:** Statistical analysis was performed using SPSS version 23. The results were statistically analyzed using Analysis of Variance (ANOVA), Chi-square ( $X^2$ ) to compare the percentages of the study indicators, at a level of significance  $\leq 0.05$  according to Field (2012).

## 3. Results

This study recorded the distribution of 825 confirmed cases out of 8847 examined animals harbored hydatid cysts of *E. granulosus* isolated from lung and liver. The present study included the occurrence

infection rate of hydatid cyst according to age and sex and also involved the fertility and sterility of cysts as well as the infection according to host.

In this study, the incidence of hydatid cysts was different according to age of the host. 8847 cases were examined and the total proportion of infection of hydatid cysts was 9.33% and the total severity of infection was 8.94 distributed concerning the type of animal carcasses, the infection rates were as follows: out of 2792 of sheep, 343 (12.29%) were infected. Out of 3209 cattle, 288 (8.97%) were infected out of 1865 of buffalo 154 (8.26 %) were infected. Out of 980 camels, 40 (4.08%) were infected as show in Table (1).

Table (1): Total Infection rate by hydatid cysts of infected host according to the age groups

Host	Examined	Infected	Percentage %	No. Cyst	Severity
Sheep	2792	343	12.29	2893	8.43
Cattle	3209	288	8.97	1982	6.88
Buffalo	1865	154	8.26	1133	7.36
Camel	981	40	4.08	290	7.25
<b>Total</b>	8847.00	825.00	9.33	7374.00	8.94

The statistical analysis showed that there are significant differences in infection rate with age group (  $P<0.05$ ) for sheep  $X^2= 32.0$ , cattle  $X^2=56.1$ , buffalo  $X^2=52.2$ , and camels  $X^2=28.0$ . In sheep the incidence of hydatid cysts has a positive proportion to the age of sheep; a high prevalence rate (19.52%) and the severity of infection (9.34) that observed in more than 2 years; while less prevalence rate was observed in less than one year (0.38%) with severity (3), but with significant differences ( $P<0.05$ ) as showed in Table (2) below.

Table (2): Infection rate and severity by hydatid cysts of sheep according to the age groups

Age group	examined	infected	Percentage %	No. cyst	Severity of infection
Less than one year	530.00	2.00	0.38	6.00	3.00
1-2 years	1258.00	145.00	11.53	1057.00	7.29

<b>2-3 years</b>	1004.00	196.00	19.52	1830.00	9.34
<b>Sum</b>	2792.00	343.00	12.29	2893.00	8.43

In cattle the higher prevalence rate (19.21%) with infection severity (11.26) was recorded in age more than 4 years; while the lower similar rate (2.69%) with infection severity (7.21) was recorded at less than 2 years with significant differences (  $P<0.05$ ) Table (3) below.

**Table (3):** Infection rate and severity by hydatid cysts of cattle according to the age groups

Age group	examined	infected	Percentage %	No. cyst	Severity of infection
<b>Less than two years</b>	520.00	14.00	2.69	101.00	7.21
<b>2-4 years</b>	1773.00	98.00	5.53	975.00	9.95
<b>More than 4 years</b>	916.00	176.00	19.21	1982.00	11.26
<b>Sum</b>	3209.00	288.00	8.97	3058.00	10.62

In buffalo a higher prevalence rate (15.55%) with a severity (8.28) was recorded in more than 6 years; while a lower rate (4.22%) with a severity (2.61) was recorded in less than three years with significant differences (  $P<0.05$ ) as show in Table (4).

**Table (4):** Infection rate and severity by hydatid cysts of buffalo according to the age groups

Age group	examined	infected	Percentage %	No. cyst	Severity of infection
<b>Less than 3 years</b>	427.00	18.00	4.22	47.00	2.61
<b>3-6 years</b>	930.00	57.00	6.13	432.00	7.58
<b>More than 6 years</b>	508.00	79.00	15.55	654.00	8.28
<b>Sum</b>	1865.00	154.00	8.26	1133.00	7.36

In camels the higher prevalence rate (4.15 %) with the severity of infection was (8.00) recorded in age more than 4 years; while the lower similar rates (3.78%) with a severity (3.71) recorded at less than 4 years with significant differences (  $P<0.05$ ) Table (5) below.

Table (5): Infection rate by hydatid cysts of camel according to the age groups

Age group	examined	infected	Percentage %	No. cyst	Severity of infection
<b>Less than 4 years</b>	185.00	7.00	3.78	26.00	3.71
<b>More than 4 years</b>	796.00	33.00	4.15	264.00	8.00

<b>Sum</b>	981.00	40.00	4.08	290.00	7.25
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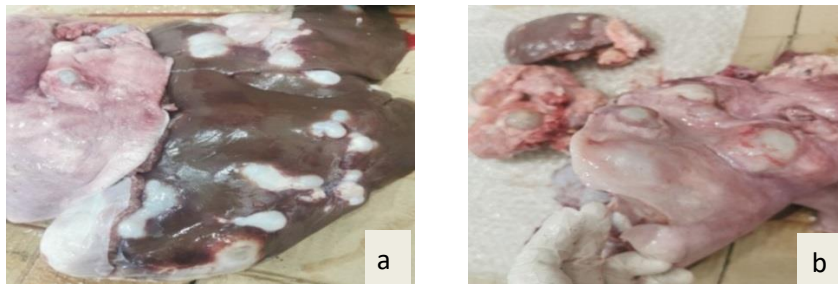


Figure (1): liver and lung infected with cysts isolated from cattle less than 4 years;  
a: liver of cattle b:lung of cattle

The study of prevalence of Hydatid cyst in hosts according to infected organ showed a significant difference between the infection rate and the infected organ in the probable rate  $p < 0.05$  in all intermediate hosts  $X^2=29$ . The liver recorded the highest rate in sheep, cattle, buffalo, and camel, 26.67%, 22.67%, 9.82% and 3.15 respectively. The lunge was recorded in sheep (14.91%), cattle (12.24%), buffalo (8.85%), and camel (1.70%) as show in Table (6).

Table (6): Prevalence of Hydatid cyst in hosts according to infected organ

Host	Liver	Percentage %	Lung	Percentage %
Sheep	220	26.67	123	14.91
Cattle	187	22.67	101	12.24
Buffalo	81	9.82	73	8.85
Camel	26	3.15	14	1.70
<b>Sum</b>	514	62.30	311	37.70

The total sex groups of the animals were: 247 males (5.76%) and 578 females (12.93%), out of them 94 males and 249 females of sheep; 77 male and 211 females of cattle; 60 males and 94 females of buffaloes; 16 males and 24 females of the camels. The statistical analysis of infection with hydatidosis according to sex revealed that females were exposed to infection more than males and were no significant differences between the rate of infection and sex of sheep, cattle, buffalo, and camel ( $P < 0.05$ ) as show in Table (7) below.

Table (7):the prevalence of infection with hydatid cysts in male and female of animals intermediate host

Host	No. of examined male	No. of infected Male	Percentage of infected male%	No. of examined female	No. of infected Female	Percentage of infected female%
sheep	1119	94	7.86	1596	249	15.6
cattle	1537	77	5.01	1662	211	12.7
buffalo	1080	60	5.56	785	94	11.97
camel	554	16	2.89	426	24	5.63
Total	4290	247	5.76	4469	578	12.93

The rate of fertility and sterility of hydatid cysts according to host revealed that sheep had the highest prevalence of fertile hydatid cysts, accounting for 84.26%, among other intermediated hosts. On the other hand, camels exhibited the lowest fertility rate, with only 37.5% of their hydatid cysts being fertile. Interestingly, camels also had the highest incidence of sterile hydatid cysts, while sheep had the lowest rate at 15.7% as show in Figure (2) below.

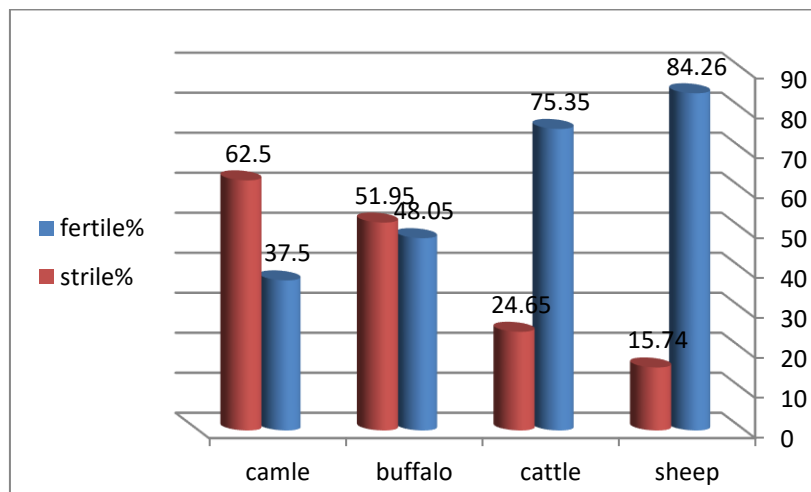


Figure 2: The prevalence of infection with hydatid of fertility and sterility rate according to host of animal

#### 4. Discussion

The total rate of infection of *E. granulosus* in sheep, cattle, buffalo and camel were 9.33%, distributed as 12.26%, 8.97%, 8.26% and 4.08% respectively. The study found that sheep and cattle had the highest infection rates, while camels had the lowest. This may be attributed to the animals' grazing habits and diet, as they are often found in pastures near definitive hosts, which increases their exposure to



contaminated vegetation and due to the constant companionship between dogs and sheep herds has resulted in an adaptation between the parasite and the host (Al-Rishawi, 2019). Sheep, the major intermediate host for *Echinococcus granulosus*, provide a reliable indicator of infection in dogs, and periodic surveillance of slaughtered sheep was a simple and inexpensive method of evaluating the effectiveness of control programs for the disease (Cabrera *et al.*, 2003; Craig *et al.*, 2007; Zhang *et al.*, 2015). Also the sheep and cattle were more prominent in the research as they were sold more often to slaughter than any other animal. The unregulated slaughter of animals (particularly during religious and national celebrations) in households, inadequate health education among farmers and butchers, and the existence of stray dogs in these area.

The relationship between age and the infected animals was significant in this study ( $P < 0.05$ ). The study observed that the all age group exposure to infection to hydatid cysts and that agree with Hanash, (2016) and Farhood, (2022). In sheep the incidence of hydatid cysts has a positive proportion to age of sheep; a high prevalence rate (19.52%) and the severity of infection was (9.34) that observed in more than 2 years that was the most infection (196 cases) were from 2-3 years. The same was found by Hanash, (2016) who recorded high prevalence in adult age groups. Also other study recorded a high prevalence in adult age in Pakistan by Mehmood *et al.*, (2020). while less prevalence rate observed significantly in less than one year was (0.38%) with severity (3.00).

In cattle the high prevalence rate (19.21%) with infection severity (11.26) was recorded in age more than 4 years and in camel the high prevalence recorded in adult age was (5 year), specified that the age of the host converted an infection determinant for many farm host species, and adult animals aging three years or older have danger more than younger animals (Marshet *et al.*, 2011) regard this to cyst persistence is generally life-long and as such cyst burden represents an on-going infection pressure over time (Kebede *et al.*, 2009). An increase of cyst abundance was observed in farm animals with the progress of age (Ibrahim, 2010). Some studies found that no significant differences were recorded between young and adult ruminants in the number of cysts and prevalence based on age (Abegaz and Mohammode, 2018) in Ethiopia. The elevated occurrence of cysts in older animals may be attributed to two factors. Firstly, as the host ages, they are exposed to the infection for a longer period of time, resulting in a greater prevalence rate. Secondly, the identification of cysts in older animals is effortless due to their larger size (Sekar and Lal, 2014, Haleem *et al.*, 2018).

A higher prevalence infection was in liver (62.30%) and the prevalence rate of lung was (37.70%).

The liver considers the most infected organ to hydatid cyst in animals and human may be because it is the first instances of the capillaries that confrontation of embryo of hydatid cyst who takes the hepatic portal route. The higher infection with hydatid cyst recorded in liver of female more than other male (Radhwan *et al.*, 2021).



The total sex groups of the animals were: 247 males and 578 females, out of them 94 males and 249 females of sheep; 77 male and 211 females of cattle; 60 males and 94 females of buffaloes; 16 males and 24 females of the camels. The highest prevalence infection rate was in female rather than male, detected a significant difference. The prevalence was 35.64% in female while in male 3.46, Similar results had been observed by Lazim, (2019) and Hajimohammadi (2022). These differences between the sex may be due to the males are raised in special sheds, as well as different types of nutrition for the purposes of fattening and benefiting from meat, unlike females raised in fields and pastures and slaughtered at late ages. Also the Females kept longer near house than males, which are typically utilized for milk production and reproductive functions, thereby increasing their exposure to infected dogs, as well as the stress of pregnancy and lactation so they are more affected than males (Haleem *et al.*, 2018).

The fertility rates computed as finding of protoscolices in aspirated cystic fluid examination of cyst fertility. Sheep was the highest fertility with 84.26% this agree with Mehmood *et al.*, (2020), followed by cattle and the lowest was camel, the highest sterile cyst was observed in camel and buffalo cysts and the lowest was in sheep, this may be due to the fact that the sheep strains in this region have a higher morbidity rate compared to other regions, and that the study region may have different strains of *Echinococcus*, resulting in a mix of these strains Gareh, (2021).

## **5. Conclusion**

Host type, gender, age, infected organ and fertility, of hydatid cysts can be considered as risk factors for *E. granulosus* epidemiology by supplying the life cycle requirements to be completed and, it is necessary to implement monitoring and control programs in sheep and dog populations to decrease the infection.

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