

EFFECT SOME FACTORS ON THE RATIOS OF INFECTIONS, FERTILITY, AND EPIDEMICAL OF HYDATID CYSTS DISEASE IN SOME INTERMEDIATE HOSTS IN THI- QAR PROVINCE / IRAQ.

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Abstract

The cestod of *Echinococcus granulosus* produces hydatid cysts, which is endemic zoonotic in Iraq. Hence the current study aimed to determine the epidemiology of hydatid cyst disease in livers, lungs, and spleens of intermediate hosts (sheep, cows, buffaloes, camels, and goats). As well as, figuring out the extent of its spread and its risk factors, in addition, the effect of gender, age, and affected organs on the fertility of hydrated cysts in intermediate hosts were that examined over a whole year from the 2nd January to December 2021 in Thi-Qar province/ Iraq .Four thousands eight hundreds and fourteen animals that were were examined and distributed as the following: 1821 sheep, 1941 cows, 463 buffaloes, 131 camels, and 455 goats. The information of hosts were collected that included; sex, age, and intensity of infections for each type of the hosts.

The results show that 396 animals were infected with hydatid cysts. The highest infection and fertility rates were in sheep with 10.8%, 85.18% respectively. In goat the lowest infection rate was detected 0.44% with 0% for the fertility percentage . Based on the infected organs, the liver recorded the highest infection, followed by the lungs. In contrast, the lungs recorded the highest rate, followed by livers. The infection and fertility rates increased with age progression., The sex effect showed that females had the highest infection rate and fertility for all intermediate hosts

The current study revealed that kind of host, gender, the infected organ, and age have significant contributors to the infection, and fertility status of hydatid cysts. Thus these characteristics can be respected as risk factors and affect the epidemiology of this illness.

Key word : *E. granulosus* , Hydatid cysts , Sterile , epidemiology, epidemical factors.

1.Introduction :

Hydatid disease is the most dangerous tapeworm infection that affects human health caused by *E. granulosus* larvae. Its poor prognosis may be due to the ineffectiveness of chemotherapy and the complications associated with surgical removal (Dybicz,2019; Khademvatan,2019).

The life cycle of this parasite is complicated, and needed two hosts for completed. The larval cysts (hydatid cysts) are found in different organs of domesticated and wild herbivores, while the

adult worm is attached to the small intestine wall of carnivores (Romig *et al.*, 2017; Thompson,2017) .

Domestic animals are one of the many intermediate host species that the larvae of this worm can infect. (Hama *et al.*, 2015). Protoscolices of fertile hydatid cysts are considered a major risks that causing infecting dogs (which represent one of the final hosts) with adult worms if eaten (Fallah *et al.*, 2021).

Hydatid cysts are divided into two types: fertile cysts and sterile cysts that do not generate protoscolices for unexplained reasons, therefore ending the parasite's life cycle. (Zhang *et al.*, 2003 ; Daryani *etal.*,2009).

The biological molecular basis and mechanisms underlying the processes the development of the fertile/sterile hydatid cysts remain poorly understood and unknown, despite the fact that numerous studies have been carried out to better understand the genetic diversity of *E. granulosus* (Paredes *et al.*, 2007; Cabrera *et al.*,2008; Wassermann *et al.*, 2016; Kinkar *et al.*, 2017; Al-Ataby,2022), no correlation has been found between the haplotype of the parasite and the sterility of hydatid cysts (Farhood *et al.*, 2022a), while Cabrera *et al.* (2008) ; Riesle *et al.* (2014) reported that the oxidative DNA damage is promoted by internal environmental variables as well as immunological factors (IgG1) may have contributed to hydatid cyst sterility. Fallah *et al.* (2021) suggested to It is likely that the host plays a key role in hydatid cyst fertility. Also Farhood *et al.* .(2022b) indicated to adverse influences of the environmental factors that might play a key role in the fertility of hydatid cysts.

Thus, this study was designed to investigate the epidemiology of hydatid cyst disease in livers, lungs, and spleens of its intermediate hosts (sheep, cows, buffaloes, camels, and goats) and to determine the risk of age, gender, and affected organ of the host on the epidemiology and fertility status of hydatid cysts.

2- Material & methods :

2.1:Samples collection :

The examination of 4814 slaughtered animals 1821 sheep, 1941 cows, 463 buffalos, 131 Camels, and 455 goats, collected 2404 hydatid cysts of livers, lungs, and spleen for 396 infected animals, whole in this year from the 2nd of January until December 2021, from Nasiriya city slaughterhouses in Thi- Qar province/ Iraq .

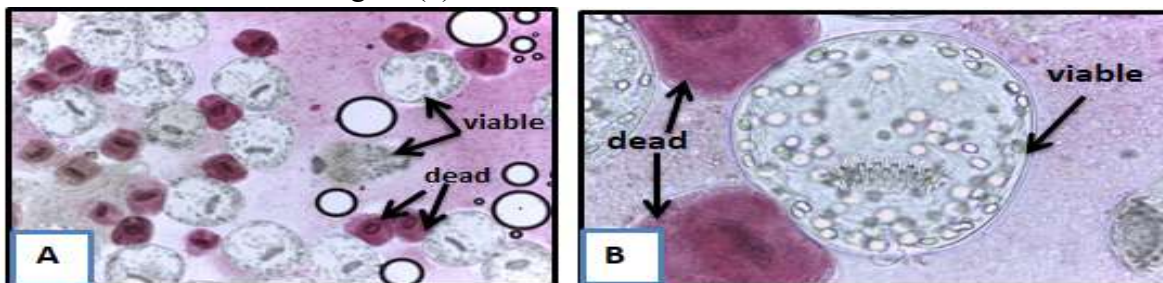
Information about the number of animals, organs infected, gender, age, and host, from intermediate hosts, were recorded.

2-2: Fertility and viability determination of hydatid cysts .

In order to determine the fertility status and viability of this parasite, cysts were processed as described by Smyth & Barrett (1980) and Macpherson (1985). Fertile cysts were identified under a light microscope (10x, and 40x magnification) ,by dropping 0.1% of aqueous eosin solution

the living protoscolices that attached to the germinal layer, or/and free in the hydatid fluid, were not stain, unlike the dead ones.

The sterility cysts were those that showed the absence of the protoscolices by microscopic observations as shown in Figure (1).



Picture :(1) Viable and dead protoscolices hydatid cyst stained with aqueous Eosin stain (A) 10x . (B) 40x .

2-3 : Determining the percentage and intensity of infection

1 -Determining the percentage of infection according Margolis *et al.* (1982).

$$\text{Infection percentage} = \frac{\text{No. of infected animals}}{\text{No. of animals examined}} \times 100.$$

2- Determining the intensity of infection according Tashani *et al.*(2002).

$$\text{Intensity of infection} = \frac{\text{No. of cysts}}{\text{No. of infected animals}}.$$

2-4: Statistical Analysis:

Statistical analysis was performed using SPSS version 23 software. The results were statistically analyzed using Analysis of Variance ANOVA, Chi-square X^2 were used for the purpose of comparing the percentages of the study indicators, at a level of significance ≤ 0.05 according to Field (2012) .

3- Result :

Table (1) Percentages and intensity of infection and fertility with hydatid cysts according age groups in intermediate hosts.

Sheep							
Age groups	No. of Exam	No. of infection	Percentages of infection (%)	No. of cysts	Intensity	Fertile	Percentages of fertility (%)
1 > year	421	0	0	0	0	0	0
1-2 year	615	46	7.48	291	6.3	278	95.53%
2 < years	785	151	19.23	1153	7.6	2952	82.57%

Total	1821	197	10.82	1444	7.32	1230	85.18%
	X² = 23.330		P ≤ 0.05			X² = 8.992	P ≤ 0.05
Cows							
2 > year	753	0	0	0	0	0	0
2-4 year	657	41	6.24	135	3.3	114	84.4%
4 < years	534	125	23.41	687	5.5	159	23.1%
Total	1944	166	8.53	822	4.95	273	33.21%
	X² = 32.600		P ≤ 0.05			X² = 74.786	P ≤ 0.05
Buffalos							
3 > year	243	1	0.41	2	2	2	100%
3-6 year	115	3	2.61	12	4	8	66.7%
6 < years	105	17	16.2	75	4.41	13	17.3%
Total	463	21	4.53	89	4.24	23	25.84
	X² = 22.115		P ≤ 0.05			X² = 147.273	P ≤ 0.05
Camels							
4 > year	49	3	2.29	4	1.33	3	75%
4 < years	82	7	5.34	10	1.43	3	30%
Total	131	10	7.63	14	1.4	6	42.86%
	X² = 3.789		P ≤ 0.05			X² = 124.812	P ≤ 0.05
Goats							
1 > year	334	0	0	0	0	0	0
1 < years	121	2	1.6	35	17.5	0	0

Total	455	2	0.44	35	17.5	0	0
	$X^2 = 4.027$		$P \leq 0.05$			$X^2 = 100$	$P \leq 0.05$
Total	4814	396		2404			

Table (1) shows 4814 animals that are intermediate hosts that were divided into different age groups were examined. 2404 hydatid cysts were isolated from the livers, lungs, and spleen of 396 infected animals. The percentage of intensity and infection in intermediate hosts increases with the age of the host, as shown in pictures (Table 1).

It was found that there were significant differences in the incidence rates between age groups at a probability level of $P \leq 0.05$ for sheep $X^2 = 23.330$, cows $X^2 = 32.600$ and buffalo $X^2 = 22.115$, and no significant differences were detected $P > 0.05$ in camels $X^2 = 3.78$ and goats $X^2 = 4.027$. The highest rates and intensity of infection were recorded in sheep among these intermediate hosts.



Picture (2). Liver sheep infection in (HC), 2 > years.



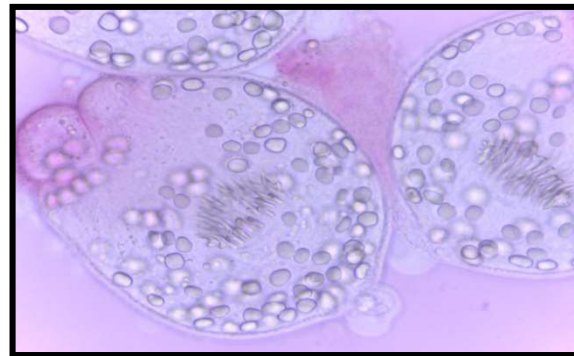
Picture (3). Liver Goat infection in (HC), 1 > years.



Picture 4). (HC) calcified in liver's cow . camel.



Picture (5). (HC) sterile in lung's



Picture (6). Protoscolices isolate from lung's sheep. Picture (7). Protoscolices isolate from lung's cow

The statistical analysis also recorded significant differences between the percentages of fertile and sterile hydatid cysts and age group in all intermediate hosts at the probability level of $P \leq 0.05$, $X^2 = 8.992$, $X^2 = 74.786$, $X^2 = 147,273$, $X^2 = 124.812$ and $X^2 = 100$ for sheep, cows, buffalo, camels, and goats, respectively. In general, the sterility was directly proportional to the increase in age, thus the older ages recorded high rates in the proportions of sterile cysts in all hosts (Figure 1).

While the fertility hydatid cysts according to infected organ, the results of the statistical analysis showed significant differences between the percentages of fertile and sterile hydatid cysts in intermediate hosts $P \leq 0.05$, $X^2 = 25.229$ for cows, $X^2 = 25.229$ for buffalo, $X^2 = 29.009$ for camels, and $X^2 = 100$ for goats. However, no significant difference was found in sheep. In sight of infected organs, significant differences in fertility status were seen in all intermediate hosts, $X^2 = 2.829$, $P \leq 0.05$ (Figure 2).

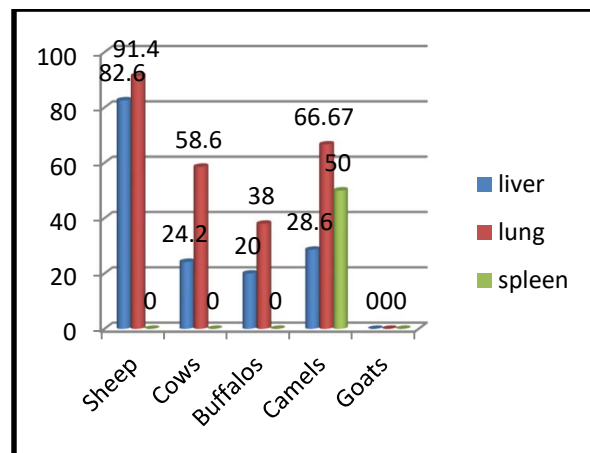
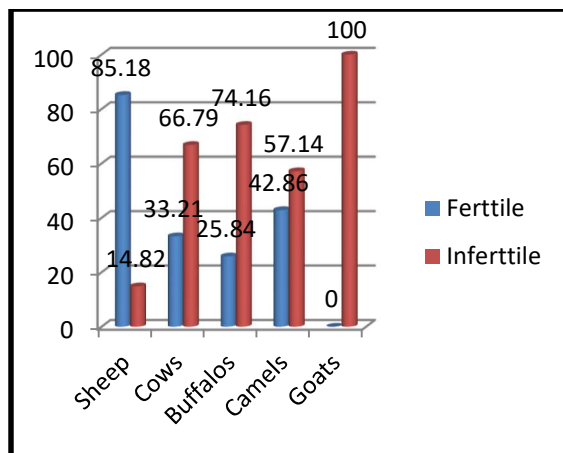


Fig.(1) Percentages of fertility hydatid cysts according to age group

Fig.(2) Percentages of fertility hydatid cysts according to infected organ

intermediate host .

organs.

The infection rates in organs among all intermediate hosts showed significant variations $P \leq 0.05$; in $X^2 = 1996.00$, $X^2 = 2000.0$, $X^2 = 2000.0$, and $X^2 = 500.0$ for livers and lungs, (common infection) and spleen, respectively. The highest rate of infection was recorded in the liver of sheep, cattle, buffalo and camels, 10.82%, 8.53%, 4.53% ,2.29% respectively (Figure 3) .

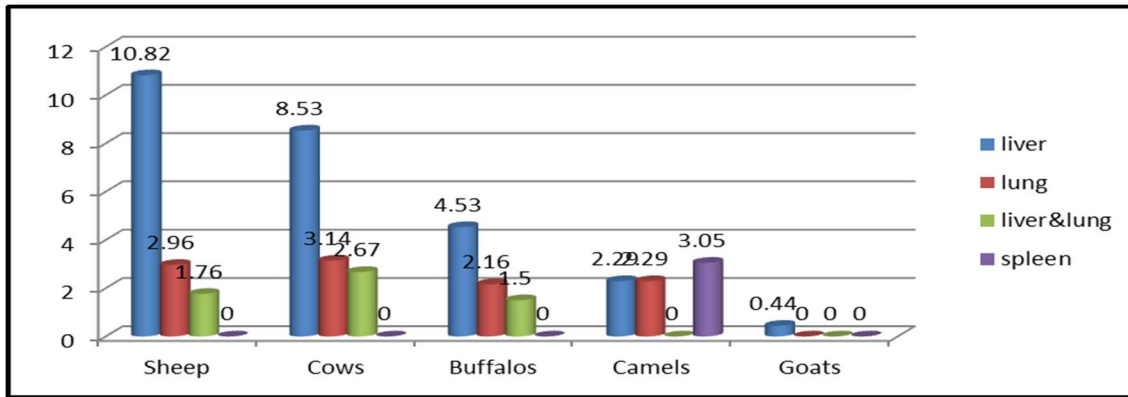


Fig. (3).Percentage of infection with hydatid cysts according to the affected organ in the intermediate host .

The gender of intermediate hosts revealed a significant effect $P \leq 0.05$ on the infection rates. $X^2 = 14.483$, $X^2 = 9.681$, $X^2 = 13.315$ and $X^2 = 11.966$ for sheep, cows, buffalo, and camels respectively, as the highest percentage was recorded in females, as female sheep, cows, buffaloes, camels and goats recorded 19%, 15.5%, 15.2, 16.33 and 1.42% . In exception for goats that showed a non -significant difference in both genders (Figure 4-1) .

Also there were significant differences between fertility and host gender in all intermediate hosts $P \leq 0.05$, $X^2 = 8.028$, $X^2 = 18.843$, $X^2 = 8.395$ and $X^2 = 17,053$ for sheep, cows, buffalo and camels, respectively. Similarly, the goat was not showed a significant difference in fertile cyst between genders. The highest percentage was recorded in females, of sheep, cows, buffalo and camels (Figure 4-2).

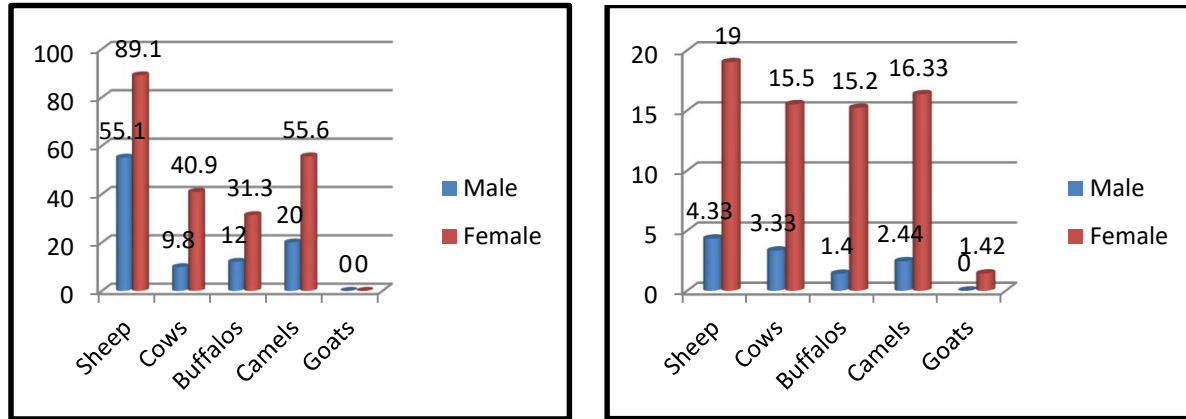


Fig. (4-1).Percentage between the fertility & gender. Fig. (4-2).Percentage between the infection & gender .

4- Discussion :

The current findings showed that sheep infection rate was 10.82%, cows 8.53%, camels 7.63%, buffalo 4.53%, and the lowest infection rate was in goats 0.44%. Sheep recorded the highest infection and fertility rate of hydatid cysts isolated from their livers and lungs compared to the other intermediate hosts. This may be due to the adaptation between the parasite and the host (sheep) due to the constant companionship of dogs to herds of sheep (Al-Rishawi, 2019). The low of infection and low fertility in goats and may be due to the feeding behavior of goats, which is different from other hosts, as they feed on the upper limbs of plants .

in case of the intensity of infection the highest intensity of infections was recorded in goats 17.5, and the lowest intensity of infections was recorded in camels, which was 1.4. This observation may be due to the nature and place of feeding the animal, or its proximity to dogs, and its sharing of grazing areas or barns increases the chances of infection .

Also, observed the infection, intensity and the sterility of hydatid cysts increase with the age (a positive relationship) in all intermediate hosts, except for camels and goats that did not exhibit a remarkable difference in infection rate, this may be due to the low in number of isolated cysts from them. The reason for the increasing in the rate and intensity of infection in older animals may be due to the long period of exposure to parasite eggs compared to younger animals. As well as the animals' immunity decreases with age (Himonas *et al.*, 1987), also it might be the innate susceptibility to infection varies according to age (Rickard & Williams, 1982). The increased sterility of isolated hydatid cysts from the older intermediate hosts may be due to its exposure to long periods of accumulation of environmental pollutants such as heavy metals that cause one of the factors of sterility of hydatid cysts (Farhood *et al.*, 2022b).

As for the fertility of hydatid cysts among the intermediate hosts, the current study recorded different percentages among them, and the difference may be due to the difference in the

intermediate hosts in the innate resistance to infection (Torres & Wisnivesky, 1978; Yong *et al.*, 1984). In addition to the differences in the range of adaptations between the parasite and the host (Al-Rishawi, 2019).

The highest fertility rate was found in hydatid cysts that were isolated from the lungs of the intermediate hosts compared with cysts isolated from livers and spleen, that may attributed to the organ effect on the fertility of the cysts (Getachew *et al.* 2012), or that lungs provide the most suitable habitat for hydatid cyst growth, (Andersen *et al.* 1997).

While the differences in percentage of infection & fertility between both genders, may be due to the high levels of sex hormones such as the testosterone hormone, in males in comparison with females, that can be clarified by explained the ability of androgen hormones to reduce the incidence of hydatid cysts, This hormones especially testosterone has the ability to destroy the parasite *Echinococcus granulosus* through the mechanism of direct toxic effect or through inhibition of the respiratory chain (Fantappie *et al.* 1999 ; Hamamci *et al.* 2004). Al-Tamah (2011) explained the mechanism of testosterone in killing the parasite's protoscolices by binding the hormone to the receptor sites in the parasite.

5 - Conclusion :

Fertility, host type, gender, age and infected organ of hydatid cysts can be considered as risk factors for *E. granulosus* epidemiology by supplying the life cycle requirements to be completed.

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