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Epidemiological study of hydatidosis in the dromedaries (*Camelus dromedarius*) of different regions of IranMoghaddas Elham<sup>1\*</sup>, Borji Hassan<sup>1</sup>, Naghibi Aboul Ghasem<sup>1</sup>, Razmi Gholamreza<sup>1</sup>, Shayan Parviz<sup>2</sup><sup>1</sup>Department of Pathobiology, School of Veterinary Medicine, Ferdowsi University of Mashhad, Iran<sup>2</sup>Department of Parasitology, School of Veterinary Medicine, Teharn University, Tehran, Iran

## PEER REVIEW

## Peer reviewer

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## Comments

Because hydatidosis is an important zoonotic disease as mentioned above, this research is a valuable research work. The results of this study show that hydatidosis control strategies in the last year's such as education of farmers and destroying offal containing hydatid cysts, deworming domestic dogs and control of homeless feral dog was not effective for decreasing of hydatidosis in camels in Iran.

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## ABSTRACT

**Objective:** To determine the prevalence of hydatidosis in dromedaries.

**Methods:** 438 dromedaries were examined in five regions of Iran from 20 March, 2010 to 19 March, 2011. The relationship between host age and the mean number of hydatid cysts, and prevalence and fertility rates was analyzed using chi-square test.

**Results:** One hundred and thirty five out of 438 (30.82%) camels harboured hydatid cysts of *Echinococcus granulosus*. Number of cysts was 700 with 72.5% lung cyst. The highest rate of infection was that 54 (40%) of camels was found in the Khorasan Razavi region (in the north-east part of Iran) while the lowest 6 (4.4%) of camels was found in Semnan province. Infection was higher in >15 years age group. The most commonly infected organs were lungs (72.5%) followed by liver (12.6%). Both liver and lungs together constituted 14.8% of infection. A comparison found that hydatid cysts of liver had a higher fertility rate (32.57%) than that of lung (19%); while most of cysts of lung were calcified (24.42%). The mean number of protoscoleces per mL in the lung fertile cysts was higher than that of liver cysts. Fertile or sterile might be due to the different species or genotypes. The mean number of cysts in infected liver and lungs was 1–5 cysts. The intensity of infection increased with age.

**Conclusions:** The results of current study can make a background data for implementing hydatid control programs and warrant the importance of camel in public health.

## KEYWORDS

*Camelus dromedaries*, Hydatidosis, Iran, Prevalence

## 1. Introduction

Iran with an area of 1648195 square kilometers and having a variety of climate is one of the important regions of the livestock industry in the Middle East. The population of camels in Iran was 154000 in 2008 and they were distributed in 22 of the 31 provinces. Of the total camel population, 69.7% (107350) is distributed in the eastern half of Iran including Khorasan Razavi, South Khorasan, Semnan, Sistan–Baluchestan and Yazd, where is mainly hot and arid or semiarid[1]. Because of its physiological attributes, the camel is the most suitable

domestic mammal for use in these climatic extremes. Free grazing pattern of the camels with their common grazing regions and water resources with other animals, shepherds and villagers makes the infected camels a potential source of infection to canidae and from they to human. G6 genotype was reported from Iranian patients[2].

One of the diseases that are not apparent to farmers, but are of notable economic and public health importance is hydatidosis. Hydatidosis is one of the most significant zoonoses all around the world[3]. In Iran, high prevalence of parasite have been reported in different animals including

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**Table 1**

The prevalence (%) of hydatid cysts in camels in five regions of Iran in 2010–2011.

Regions	No. examined	No. infected (prevalence) (%)	Lung hydatid prevalence (%)	Liver hydatid prevalence (%)	Lung–liver hydatid prevalence (%)
Khorasan Razavi	136	54 (40.40)	62.0%	18.0%	20%
Yazd	80	25 (31.20)	62.5%	12.5%	25%
South Khorasan	120	32 (26.60)	75.0%	15.0%	10%
Semnan	27	6 (22.20)	79.0%	10.0%	11%
Sistan and Blouchestan	75	18 (24.00)	84.0%	12.0%	4%
Total	438	135 (30.82)	72.5%	13.5%	14%

sheep, goats, cattle, and camels as intermediate hosts as well as dog and other canids as definitive hosts[2,4,5]. There are few data about prevalence of hydatidosis in dromedary from Middle East countries including Iran[6,7]. Nonetheless, information on epidemiology of hydatidosis in the dromedaries in different regions of Iran is very limited.

Therefore, the main objective of the present study was to determine the prevalence and characterization of hydatidosis in camels of different regions of Iran and to analyze the association between the prevalence rates with epidemiological factor.

## 2. Materials and methods

### 2.1. Sampling

The study was performed in five main regions where camels are mainly harboured (Figure 1). From each region, an abattoir where camels were slaughtered was selected. These abattoirs were visited from 20 March, 2010 to 19 March, 2011. At each visit, Liver and Lung of slaughtered camels were carefully checked for the presence of hydatid cysts. Host age based on dentition formula and the number of cysts on each organ was also recorded.



**Figure 1.** Map of Iran, showing the geographical locations where *Echinococcus granulosus* samples were collected from camels.

### 2.2. Parasitological examination

The cyst fluid was aspirated from each infected organ using a sterile syringe, and 0.3 mL of each sample of cyst fluid were examined for the counts of protoscoleces using Mac–master slide. Those cysts which had protoscoleces were considered fertile. Cysts with fluid only and without protoscoleces were considered sterile, and all hard cysts were classified as calcified.

### 2.3. Data analysis

Data were analyzed by SPSS software package, version 16. The relationship between host age and the mean number of hydatid cysts, and prevalence and fertility rates was analyzed using chi–square test.  $P \leq 0.05$  was considered significant.

## 3. Results

Out of 438 dromedaries examined from five regions, 135 (30.82%) were found to be infected with hydatid cysts (Table 1). Number of all of cysts from five province was 700 (300 cysts from Razavi Province, 125 cysts from Yazd, 160 cysts from South Khorasan, 30 cysts from Semnan, and 85 cysts from Sistan Baluchestan). The prevalence of hydatidosis in Khorasan Razavi (in the north–east part of Iran) was significantly higher than that in other regions ( $P < 0.05$ ). Host age (only in 300 camels) and prevalence were correlated in the camels as shown in Table 2. Age–prevalence (only in 300 camels) profiles showed that 10.0% of camels less than 3 years old had hydatid cyst, which rose to 48.0% in camels aged 15 years or older (Table 2).

**Table 2**

The prevalence (%) and site of infection of Iranian camels with cystic echinococcosis, relative to host age in 300 camels.

Host age (years)	No. examined	Lung only (%)	Liver only (%)	Lung + Liver (%)
<3	60	10.0%	7.0%	8.0%
3–7	60	16.5%	7.0%	11.5%
7–10	60	19.0%	10.0%	12.0%
10–15	60	20.0%	12.5%	35.0%
>15	60	27.0%	13.7%	48.0%

### 3.1. Analysis of location in dependence of the intensity of infection

Lungs were the most commonly infected organs. Overall, 72.5% of infected camels harboured cysts in the lungs alone, while only 12.6% having cysts in the liver and 14.8% having cysts in both liver and lungs (Table 1). Lung infections were significantly more common than those in the liver ( $P < 0.05$ ). Table 2 shows the location of cysts relative to age groups (only 300 camels).

### 3.2. Cyst fertility

A total of 361 (51.5%) of the 700 cysts were fertile. Of the remaining infected camels, 151 (21.5%) had sterile and 188 (26.8%) had calcified cysts. The proportion of fertile cysts in the liver was higher [228 (32.57%)] than that in the lung [133 (19%)].

**Table 3**

Characterization of hydatid cysts in Lung of camels from five regions of Iran in 2010–2011

City	Size of cyst (mean)	Mean Volume liquid of cyst (mL)	Number of protoscolex/cc (mean)	Calcified cysts (%)	Steriled cysts (%)	Fertile cyst (%)
Khorasan Razavi	3.42 cm	26.90	153	40.0	12.0	48.0
Yazd	2.30 cm	20.00	233	62.0	9.0	29.0
South Khorasan	2.50 cm	10.00	53	77.5	13.0	9.5
Semnan	9.50 cm	15.80	120	27.0	10.0	63.0
Sistan and Blouchestan	5.80 cm	23.70	206	39.0	12.0	49.0
Total	4.70 cm	19.28	153	49.0	11.2	39.7

Only 6.42% of the lung infections were sterile and 24.42% were calcified; meanwhile, 15.14% of liver infections were sterile and the rest 2.42% calcified (Table 3). The mean number of protoscolexes per mL in the lung fertile cysts (153) was higher than that of liver cysts (77).

### 3.3. Intensity of infection

Most of infected camels (73%) harboured 1–5 cysts each, 21.75% had 6–10 cysts, 3.65% had 11–20 and 2.1% had >20 cysts each (Table 4).

**Table 4**

The intensity of infection of liver and lung of camels with hydatid cysts in five regions of Iran in 2010–2011.

Site	1–5 cysts	6–10 cysts	11–20 cysts	>20 cysts
Lung	53%	38.0%	5.5%	3.5%
Liver	93%	5.5%	1.8%	0.7%

## 4. Discussion

Data on the prevalence of hydatidosis in camels and other intermediate hosts provide a reliable indicator of the extent of local environmental contamination with eggs from carnivores. In Iran, according to a few previous studies, the prevalence of cystic echinococcosis of camels has previously been reported to be 64%, 42.8%, 40.86%, 8.84% and 13.2% in Tehran, south of Iran, Shiraz, North of Khorasan and Khorasan Razavi respectively[2]. In the present study, 30.82% of slaughtered camels in different regions of Iran were found to be infected with hydatid cysts. The prevalence of *Echinococcus granulosus* infection recorded in the present study, in the slaughtered dromedaries, was, in general, the same as what previously reported from other regions of Iran[2]. Results of this study show that cystic echinococcosis control strategies in the last year's such as education of farmers and destroying offal containing hydatid cysts, deworming domestic dogs and control of homeless feral dog were not effective for decreasing of hydatidosis in camels because of local environmental contamination with eggs from wildlife carnivores. It is to be investigated that which animals amongst wildlife play a role in the area. The infection rate in camels from Khorasan Razavi province in north–east of Iran was significantly higher than those from other regions. The prevalence of *Echinococcus granulosus* infection in the camels of Khorasan Razavi is also higher than that previously reported over the 6–year study period[7]. Differences in prevalence of hydatidosis are not clear, but may be because of Mashhad, the capital of Khorasan Razavi, is a tourist area with high demand for meat. Therefore, slaughtered camels are from different locations

within and outside the district. Some camels may have come to Iran from neighboring countries such as Pakistan and Afghanistan, where cystic echinococcosis has been reported, for example 77.5% in camels in Pakistan. Other reasons like difference in environmental conditions that are conducive for the perpetuation of the parasite, plenty of infected definitive hosts and nature of the pasture may contribute to this variation.

The prevalence of echinococcosis is known to be dependent on the age of the potential host. The prevalence rate in infected camels over 15 years old during this survey was almost 3.5 times more than that observed in camels aged less than 3 years. An increase in the infection rate of camels with age had already been noted in other region of Iran and other country. Although camels are the intermediate hosts, the present survey showed that the cysts in camels did not or seldom develop before the age of 3. Therefore, the differences in slaughtering age could explain that the younger camels, which are not infected by *Echinococcus granulosus*, do not enter the camel–dog parasite life cycle, whereas the older camels could be implied in this cycle.

In the Iranian camels, the lungs were the most commonly infected organs (72.5%). This agrees with data from Libya, Africa and Ethiopia[8–10]. In the present study, while most of camels (73%) were lightly infected (1–5 cysts per animal), only 2.1% of them harbored heavy infections (>20 cysts per animal). The volume liquid of cyst (mL) found in infected camels did vary from region to region in Iran, but these differences were not significant.

The fertility of cysts is an important factor that can influence the transmission of *Echinococcus granulosus*. Depending on the geographical situation, the nature of infected hosts and the sites of infection, cysts may have different fertility rates. The present work shows that most of infections (51.57%) in camels were fertile, and data on cyst fertility were similar to those previously recorded by Rokni[2] from different region of Iran and by other workers elsewhere[11,12]. On an organ basis, the highest fertility rates were seen in the liver, rather than the lung, these being the two most commonly infected organs. These results are in conflict with other findings[8,11]. Results presented here show the mean number protoscolexes per mL in the lung fertile cysts (153) was higher than that of liver cysts (77).

So far, molecular studies strongly suggest that Iranian camels are infected by the “camel” and “sheep” strains, which contribute to the reservoir of human disease[13,14]. Moreover, the G3 genotype was recently found in Iranian camels[15,16]. The high prevalence of hydatidosis in camels and the occurrence of different strains in camels indicate much potential for the transmission of *Echinococcus*

*granulosus* in Iran. In some areas of Iran, people are used to consume camel meat which has good quality and is economically cheaper in comparison to sheep and equal to beef. Recent changes in human feeding behaviour and shifting toward camel slaughtering for providing meat could cause camels to become an actual source of *Echinococcus granulosus* infection in these communities. It should be noted that proper meat hygiene and sanitary conditions will not increase the risk. Hydatidosis is the risk for dogs, and maybe eggs on the skin of camels is the risk for humans or both. As there are many reports of human hydatid cases from different region of Iran<sup>[2]</sup>, the results of current study can make a background data for implementing hydatid control programs and warrant the importance of camel in public health.

### Conflict of interest statement

We declare that we have no conflict of interest.

### Acknowledgements

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### Comments

#### Background

Hydatidosis is a serious zoonotic disease In Iran and other parts of the world. It can impose economic losses on to livestock industry. Also hydatidosis is an important and serious disease in humans. Livestock like camels can serve as intermediate host of *Echinococcus granulosus*, and dogs and other canids are definitive hosts of this parasite. Information on epidemiology of hydatidosis in the dromedaries can help health care authorities and camels owners for designing appropriate control programs.

#### Research frontiers

This research presents new data about prevalence, cyst fertility and predilection sites of hydatidosis in dromedary camels in Iran.

#### Related reports

There have been a few reports about the prevalence rate of hydatidosis in camels in Iran and other countries.

#### Innovations and breakthroughs

Study on cyst fertility and infected organs are the novelties of this work.

#### Applications

Information on epidemiology of hydatidosis in the dromedaries can help health care authorities and camels owners for designing appropriate control programs.

#### Peer review

Because hydatidosis is an important zoonotic disease as

mentioned above, this research is a valuable research work. The results of this study show that hydatidosis control strategies in the last year's such as education of farmers and destroying offal containing hydatid cysts, deworming domestic dogs and control of homeless feral dog was not effective for decreasing of hydatidosis in camels in Iran.

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