



Original article

Assessment of prevalence of hydatidosis in slaughtered Sawakny sheep in Riyadh city, Saudi Arabia

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ABSTRACT

Hydatidosis, or echinococcosis, is a serious medical and veterinary problem in many countries, particularly those with rural communities where there is a greater contact between dogs and domestic animals. Domestic livestock act as intermediate hosts which are the main reservoir for the disease in humans. It is therefore very important to estimate the prevalence of hydatid cysts in slaughtered animals since it can be transmitted to humans through dogs, which act as the final host for the disease. From this point of view, the present study was suggested to determine the prevalence of hydatidosis in Sawakny sheep slaughtered in Riyadh city, Saudi Arabia. During the course of the study 12,569 Sawakny sheep were inspected for hydatidosis infection. An overall prevalence of 1.06% was detected among the examined sheep, with the highest prevalence occurring in winter (1.38%) and lowest prevalence in summer (0.67%). Sheep aged 6–12 months had a higher rate of infection than older animals, and males were the predominant carriers of infection (97.7%) compared to females (2.3%). The liver was the most infected organ (79.1%), followed by the lungs (14.6%), while concurrent infections of both the liver and the lungs occurred in 6% of cases. The fertility and viability rates of hydatid cysts in the liver (70.1% and 85.1% respectively) were higher than that in any other organs. In conclusion, it is evident that fertile cysts in slaughtered sheep could have an important role in the continuation of hydatid cyst transmission to humans through dogs. Considerable effort should be devoted to controlling the transmission of cysts from abattoirs by the secure disposal of infected offal. In addition, plans are required for further epidemiological studies and control programs.

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1. Introduction

Echinococcosis (hydatidosis) is one of the common zoonotic and severe clinical forms of disease caused by the larval (metacestode) and adult stages of cestodes of the genus *Echinococcus* and the family *Taeniidae* (Eckert and Deplazes, 2004). The normal life cycle of *Echinococcus* species requires two mammalian hosts; adult worms inhabit the small intestine of canids as definitive hosts, while larval stages or the hydatid cyst occur in herbivorous intermediate hosts

and, occasionally, in humans (Thompson and McManus, 2002). Since Echinococcosis is an important zoonosis, the identification of the incidence and prevalence of infection in various intermediate hosts is essential for determining the significance of each animal species in the maintenance of the parasite life cycle and, subsequently, in the spread of the disease (Cadavid Restrepo et al., 2016). Infections with hydatid cysts in intermediate hosts (goat, sheep, cattle, camels, etc.) are normally asymptomatic, and there are usually no dependable methods for the routine diagnosis of the infection in living animals except in a few cases where cysts have been distinguished by ultrasonography (Eckert and Deplazes, 2004; Hayajneh et al., 2014). Accordingly, the most reliable demonstrative technique is cyst detection during meat investigation or at post mortem inspection and, therefore, the slaughter house is the best place to survey hydatidosis in livestock. From this perspective, we provide here a survey undertaken in Riyadh city, Saudi Arabia, to determine the spread of hydatidosis in food animals, especially Sawakny sheep.

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2. Materials and methods

This work was conducted on Sawakny sheep slaughtered in slaughter houses in the city of Riyadh in the central region of Saudi Arabia. A total of 12,569 Sawakny sheep were examined for cystic hydatidosis over the course of one year from November 2015 to October 2016. Data including age, sex and site of infection were recorded for each animal. Slaughtered sheep were examined at the slaughterhouse by visual inspection and palpation for hydatid cysts in visceral organs including the liver, lungs, spleen, heart and kidneys according to guidelines recommended by WHO/FAO/UNEP (1994). Infected organs were transferred to the Parasitology Laboratory, Zoology Department, College of Science, King Saud University, and all cysts in each organ were measured and examined for fertility and viability of protoscolices. Fertility was detected by the examination of cyst content for the presence of protoscolices. Cysts with no protoscolices were considered infertile cysts. The viability of the protoscolices was assessed using 0.1% aqueous solution of eosin staining; unstained protoscolices were considered as viable while stained protoscolices were considered as non-viable (Fig. 1) (Moazeni and Nazer, 2010).

3. Statistical analysis

Statistical significance differences were assessed with a one-way ANOVA using a statistical package program (Sigma Plot version 11.0). Data are presented as mean \pm standard deviation from the mean (SD) and $P \leq 0.005$ was considered significant.

4. Results

The results showed that the infection prevailed throughout the year with an overall prevalence of 1.06% (134/12,569). The highest prevalence was recorded in winter (1.38%: 42/3009) followed by spring (1.15%: 36/3100) and autumn (1.08%: 33/3069), while the lowest prevalence was reported in summer (0.67%: 23/3391). Statistically, however, the prevalence of infection was not significantly different between the seasons ($P = 0.139$) (Table 1, Fig. 2).

The prevalence of hydatidosis did differ significantly by sheep sex though, with males dominating the incidences of infection (97.7%: 131/134) compared to females (2.3%: 3/134) ($P < 0.001$) (Fig. 3).

The results also showed that infection differed according to the sheep's age, with the highest prevalence in sheep aged 6–12 months (58.2%: 78/134) followed by sheep aged 13–24 months (30.6%: 41/134) while the lowest prevalence was

Table 1

Seasonal prevalence of hydatidosis in Sawakny sheep slaughtered in Riyadh city.

Season	Examined no.	Infected no.	Prevalence of infection (%)
Winter	3009	42	1.38
Spring	3100	36	1.15
Summer	3391	23	0.67
Autumn	3069	33	1.08
Total	12,569	134	1.06

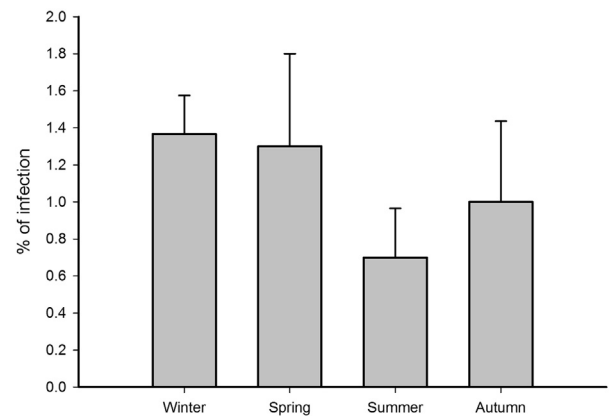


Fig. 2. Mean seasonal prevalence (% \pm SD) of hydatid cyst in slaughtered sheep.

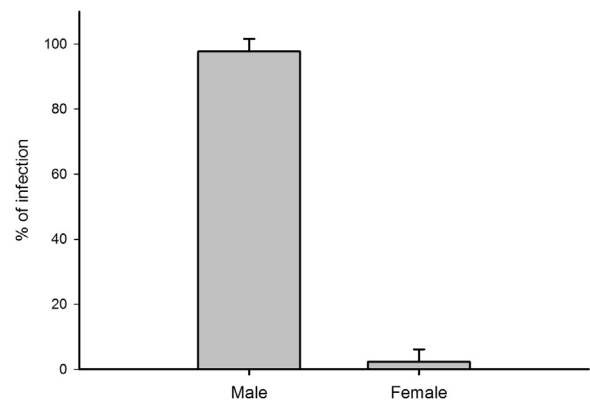


Fig. 3. Mean prevalence (% \pm SD) of hydatid cyst per sex of slaughtered sheep.

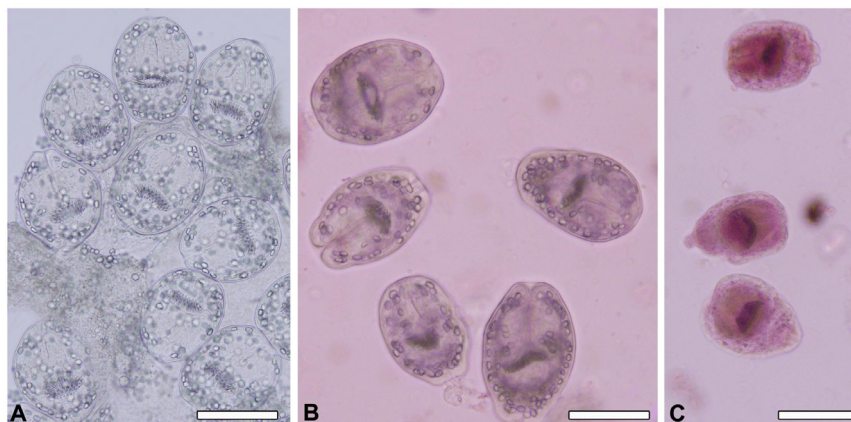


Fig. 1. Representative photomicrographs for viability test; (A) viable non-stained protoscolices, (B) viable protoscolices after staining with 0.1% eosin, (C) dead protoscolices after staining with 0.1% eosin. Scale-bar = 100 μ m.

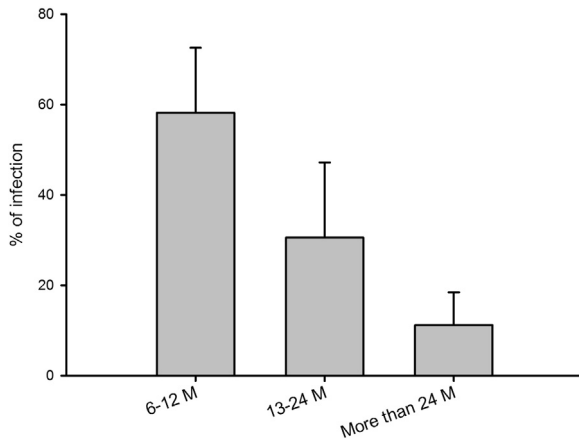


Fig. 4. Mean prevalence (% \pm SD) of hydatid cyst according to the age of slaughtered sheep.

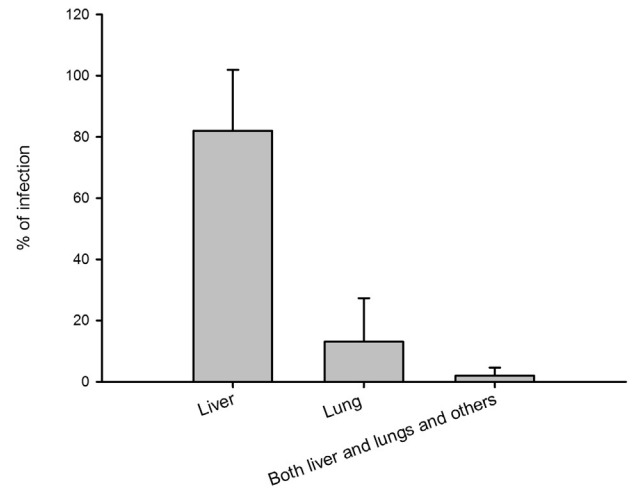


Fig. 6. Mean prevalence (% \pm SD) of hydatid cyst in different organs of slaughtered sheep.

in sheep aged more than 2 years (11.2%: 5/134) (Fig. 4). A highly significant difference in terms of prevalence of infection was found between sheep aged 6–12 months and sheep aged 13–24 months ($P < 0.001$), between sheep aged 6–12 months and sheep aged more than 2 years ($P = 0.001$), but not between sheep aged 13–24 months and sheep aged more than 2 years ($P = 0.051$).

The examination of cyst locations indicated that the liver (Fig. 5A) was the most frequently infected organ with a prevalence of 79.1% (106/134), followed by the lung (Fig. 5B) with a prevalence of 14.9% (20/134), while concurrent infection of both liver and lungs and other visceral organs showed the lowest prevalence of 6% (8/134) (Fig. 6). The location of the cysts revealed a significant difference between liver and lung ($P < 0.001$), liver and concurrent infection of both liver and lungs and other visceral organs ($P < 0.001$), but not between lung and synchronous infection of both liver and lungs and other visceral organs ($P = 0.393$). In all organs the cysts ranged from 1 to 7 cm in diameter.

Fertile cysts were the most common (70.1%: 94/134), and 85.1% (80/94) of these were viable, mostly located in the liver. 29.9% (40/134) of the examined cysts were sterile and no calcified cysts were reported.

5. Discussion

Echinococcosis has a world-wide geographic distribution and is found in every continent except Antarctica in a wide variety of hosts at different levels of prevalence (WHO, 2002). The highest prevalence of the parasite in humans and livestock hosts is found in temperate and rural areas, including Eurasia (southern and cen-

tral parts of Russia, Mediterranean regions, central Asia and China), Africa, Australia and South America (Grosso et al., 2012). Livestock hosts such as sheep, camels and goats, are the essential reservoirs of hydatidosis disease for humans (Daryani et al., 2007). In this context, and since hydatidosis is of public health significance, as well as of economic importance in the Kingdom of Saudi Arabia (Hussein et al., 2012; Abdel-Baki et al., 2016), the objective of the present work was to study the prevalence of hydatidosis infection in slaughtered Sawakny sheep in Riyadh city slaughter houses.

The results showed an overall prevalence of 1.06% (134/12,569) with the highest incidence in winter and the lowest in summer. Previous studies in Saudi Arabia, and in other parts of the world, have reported that the prevalence of echinococcosis is high in sheep compared to some other animals like cattle and goats (Christodouloupoulos et al., 2008; Kebede et al., 2009; Ibrahim, 2010; Toulah et al., 2012; Hayajneh et al., 2014). The prevalence observed in this study (1.06%: 134/12,569) is much lower than those reported in other regions in Saudi Arabia e.g. Ibrahim (2010) [12.61% (823/6525)] in Al Baha, Toulah et al. (2012) [69.6% (29,108/41,822)] in Jeddah and Hayajneh et al. (2014) 13.5% (162/1198) in Al Taif. The lower prevalence in Riyadh city compared to other locations could be attributed to the fact that Riyadh is a large urban area while the other locations are rural to semi-urban characterized by the presence of bedouins and their herds, often with guard dogs living near sheep runs. The amelioration of the standards of living and the augmentation of the consciousness of zoonotic disease threat may also contribute to this diminished rate of prevalence in Riyadh.

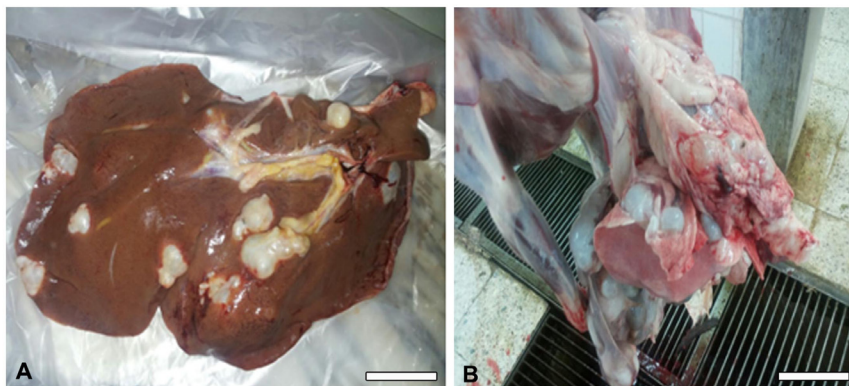


Fig. 5. Representative photos for hydatid cysts in liver of sheep (A), hydatid cysts in lung of sheep (B). Scale-bar = 6 cm.

The variability in prevalence could also be generally related to the differences in the strain of sheep, age factors, the number of examined sheep, the different sources of sheep in the kingdom, culture differences, social activities and availability of dogs (Macpherson et al., 1985; Budke et al., 2006; Ibrahim, 2010; Hayajneh et al., 2014). The present study proved that infection prevailed throughout the year in all seasons but that there was no statistical difference between any of the seasons. Similarly, Elmajdoub and Rahman (2015) found no significant differences in seasonal infection rates in slaughtered sheep in Libya. Interestingly, Daryani et al. (2007) reported significant differences in the prevalence of infection between winter and autumn in Iran while Ibrahim (2010) found significant differences in rates of infection between autumn and spring in Saudi Arabia. These variations could be related to variations in climatic factors, for example rainfall, temperature, humidity and the nature of the pasturage (Ibrahim, 2010; Elmajdoub and Rahman, 2015).

In the current study, the prevalence of hydatid cysts in the liver was found to be higher than that in the lung and other visceral organs, which is in accordance with the previous findings of Azlaf and Dakkak (2006), Haridy et al. (2006), Ibrahim (2010) and Toulah et al. (2012). This may be due to the fact that liver is the first organ to which the blood flows having left the digestive tract, which results in the greater part of the oncospheres being transported to the liver, with only the ones that are not separated in the liver moving on to lungs and other organs (Al-Khalidi, 1998). In contrast, Azami et al. (2013) found that the infection was spread predominantly in the lungs of sheep slaughtered in Iran. The present study also found that male sheep have a higher prevalence of cysts than females, which is in agreement with previous studies from Jordan, Saudi Arabia and Libya (Al-Yaman et al., 1985; Ibrahim, 2010; Elmajdoub and Rahman, 2015).

Information on the fertility and viability of hydatid cysts in different domesticated animals is important to give an indication of the significance of each livestock type as a conceivable wellspring for infection of final hosts, especially dogs. Generally, the hydatid cysts have different fertility rates depending on their size and location and the type of host (Elmajdoub and Rahman, 2015). In the current study, it was observed that the cysts in the liver had higher fertility rates than those in the lung. Similarly, Dalimi et al. (2002), Ibrahim (2010) and Elmajdoub and Rahman (2015) reported that cysts in the livers of sheep were more fertile than those in the lungs.

The study demonstrated that sheep aged 6–12 months had a higher rate of infection compared to older ones, which is in agreement with the results of Hayajneh et al. (2014). This finding, however, is opposite to that in most previous studies (e.g. Ibrahim, 2010; Al-Qurashi and Bahnass, 2012; Elmajdoub and Rahman, 2015) in which the rate of infection was higher among older animals than younger ones. The reason why young sheep were most commonly infected in the present study is probably that the urban residents of Riyadh prefer to slaughter young sheep rather than older ones and therefore most of the sheep slaughtered in Riyadh abattoirs were young (Al-Qureishy, 2008).

In conclusion, fertile cysts in slaughtered sheep could have an important role in the continuation of hydatid cyst transmission to humans through dogs. Considerable effort should therefore be devoted to controlling the transmission of cysts from abattoirs by the secure disposal of infected offal. In addition, plans are required for further epidemiological studies and control programs.

Conflict of interest statement

We declare that we have no conflict of interest.

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