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ORIGINAL ARTICLE

A retrospective survey of hydatidosis based on abattoir data in Kermanshah, Iran from 2008 to 2013

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Abstract A retrospective study was carried out from 2008 to 2013 to estimate the prevalence of hydatidosis in ruminants slaughtered at the Kermanshah municipal abattoir, in western Iran. A total number of 663,633 livestock (393,585 sheep, 81,080 goats and 188,968 cattle) slaughtered in the 5-year period and overall 9,524 (1.43 %) livers and 13,147 (1.98 %) lungs were condemned. The lungs were more frequently infected with hydatid cysts than the livers in all animal species. The average prevalence of hydatidosis was 2.7 % in this area. The prevalence of *Echinococcus granulosus* infection recorded in the present study was generally lower than those reported from other regions of Iran. Greater awareness among farmers, destruction of organs containing hydatid cysts, prevention of access of dogs to raw offals and implementation of national rabies control program could be responsible factors. The results showed a significant difference ($p < 0.001$) in the prevalence of hydatidosis among studied animals with higher prevalence in cattle than sheep, with the lowest prevalence recorded in goats. However the annual prevalence of liver and lung condemnations due to hydatidosis was decreased in some years, but the overall trend had a variable pattern in the prevalence of hydatidosis over the study period. Data showed a significant seasonal pattern for hydatidosis in all studied animals. Liver and lung condemnations due to hydatidosis were higher in the fall for sheep and cattle, whereas in goats were higher in summer. This could be attributed to various factors such as sources of slaughtered animals, changes in management practice and ecological factors. The current results suggest that a systematic investigation that lead to a disease control strategy is required to reduce the economic and public health consequences of hydatidosis. In addition, the present survey provides baseline data for the future monitoring of this potentially important parasitic disease in the region.

Keywords Hydatidosis Abattoir · Prevalence · Kermanshah province · Iran

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Introduction

Parasitic diseases are considered as a major problem in the health and food safety with animal origin and cause economic losses in countries where livestock industry is an important part of the agricultural products (Borji et al. 2012). Information resulting from meat inspection records has been used as useful sources of data for evaluation of the epidemiological aspects of certain diseases in several countries (Schweizer et al. 2003; Ansari-Lari 2005). Among parasitic diseases which are not apparent to the farmers but are of considerable economic and public health importance is hydatidosis. Hydatidosis or cystic echinococcosis is a zoonotic disease with worldwide distribution

caused by an adult or larval stage of cestodes from genus Echinococcus and Species granulosus or multilocularis (Rokni 2009; Zare-Bidaki et al. 2009).

The distribution of *Echinococcus granulosus* is higher in developing countries, especially in rural communities where there is close contact between the dogs and other carnivores as the definitive hosts, and various domestic animals, which may act as intermediate hosts. Humans are encountered as incidental (dead-end) hosts for *Echinococcus* spp. (Eckert and Deplazes 2004; Radfar and Iranyar 2004). Hydatid disease is characterized by cyst containing numerous tiny protoscolices that most often develop in the liver and lungs and also develop in the kidneys, spleen, nervous tissue, bone, and other organs (Magambo et al. 2006).

Based on FAO report (Over et al. 1992), infection with *E. granulosus* are common in all herbivorous animals in southwest Asia. Also, there are several reports from Middle East countries including Iran which found sheep, cattle, goats, buffaloes, and camels infected with hydatid cysts (Abo-Shehada 1993; Molan 1993; Dalimi et al. 2002).

The prevalence of *E. granulosus* has been reported in Iran from 3.3 to 63.3 % in dogs, 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 (Eslami and Hosseini 1998; Ahmadi 2005; Rokni 2009). Sheep and camel (with 88 and 70 % of fertile cysts, respectively) are the most important intermediate hosts, and cattle (with 19 % fertile cysts) have been considered as the weakest intermediate host of *E. granulosus* in Iran (Eslami and Hosseini 1998; Rokni 2009).

Since, no satisfactory test exists for cystic echinococcosis in living ruminants, in the absence of statistically sound epidemiologic data, evaluating the prevalence of liver and lung hydatidosis based on condemnation statistics in abattoirs may prove useful.

However, most of the published hydatidosis reports in Iran are from the central, southern and northern parts of the country (Dalimi and Mobedi 1992; Oryan et al. 1994; Radfar and Iranyar 2004; Ahmadi 2005; Ansari-Lari 2005; Arbabi and Hooshyr 2006; Daryani et al. 2007; Fakhar and Sadjjadi 2007; Ghazani et al. 2008; Rokni 2009; Zare-Bidaki et al. 2009) and there was not any data about hydatidosis in the western Iran. Therefore, this survey was designed to estimate the prevalence of hydatidosis in abattoir populations of cattle, sheep and goats in the west of Iran for the period 2008–2013.

Materials and methods

This study is a retrospective survey covering a period of 5 years from 4 April 2008 to 4 April 2013. All daily condemnation records for cattle, sheep and goats in the municipal abattoir of livestock animals, in Kermanshah (the capital of Kermanshah province, west of Iran) were used as the sources of data. As part of an ongoing surveillance system, each slaughtered animal was examined individually by a meat inspector (veterinarian) in the course of his routine duties. Diagnosis of hydatidosis was done macroscopically either by visual inspection or palpation and, where necessary, one or more incisions were made. The reasons for condemnation of organs were recorded daily on prepared data sheets. The data was collected on a monthly basis. This time interval was chosen as being likely to indicate any seasonal trends.

Chi square test was used for comparison of the prevalence rates of hydatidosis between different animal species and for comparison of the prevalence rates between seasons for the same animal species. Differences were considered significant when $p < 0.05$, using computer software SPSS version 16 for windows.

Results

A total number of 663,633 slaughtered livestock (393,585 sheep, 81,080 goats and 188,968 cattle) was included in this study. In total, 9,524 (1.43 %) livers and 13,147 (1.98 %) lungs were condemned in slaughterhouses due to hydatic cysts. The average prevalence of hydatidosis was 2.7 % in this area. In all animal species, the condemnation rate in the lungs was more than that in livers (Table 1, 2).

The annual prevalence rates of this parasitic infection in the 5-year period are shown in Table 1 and 2. The overall trend had a variable pattern in the prevalence of hydatidosis over the study period. However the prevalence of lung condemnations due to hydatidosis was decreased from 2.3 % in 2008–2009 to 1.7 in 2011–2012 in sheep, but increased from 1.7 and 2.1 % to 2.2 and 2.3 % for goats and cattle, respectively, at the same time. Liver hydatidosis was less prevalent than lungs', but similarly declined from 1.6 % in 88 to 1.1 % in 89 in sheep. The changes in the prevalence of liver condemnations were not remarkable in goats and cattle at the same time.

The seasonal variation of hydatid disease according to prevalence of liver and lung condemnations could be seen in Table 1 and 2. About 178,047, 191,426, 142,520 and 151,640 animals were slaughtered in spring, summer, fall and winter, respectively. The prevalence of infection in spring, summer, fall and winter was 1.38, 1.40, 1.63 and 1.34 % for liver and 1.74, 2.07, 4.50 and 1.79 % for lung, respectively.

Table 1 The total number of animals slaughtered and seasonal prevalence rate (%) of liver hydatidosis in animals slaughtered during 2008 to 2013

Year	Animal	Spring		Summer		Fall		Winter		Total	
		N	Inf (%)	*N*	Inf (%)	*N*	Inf (%)	*N*	Inf (%)	*N*	Inf (%)
2008–2009	Sheep	35,583	498 (1.39)	28,223	446 (1.58)	19,604	391 (1.99)	21,920	325 (1.48)	1,660 (1.6)	105,330
	Goat	6,814	94 (1.37)	8,615	108 (1.25)	7,477	83 (1.11)	4,493	49 (1.09)	334 (1.2)	27,399
	Cattle	12,614	159 (1.26)	13,966	166 (1.18)	11,828	223 (1.88)	12,025	219 (1.82)	767 (1.5)	50,433
2009–2010	Sheep	22,019	339 (1.53)	17,752	320 (1.8)	14,210	280 (1.97)	19,418	340 (1.75)	1,279 (1.7)	73,399
	Goat	5,398	77 (1.42)	6,653	114 (1.71)	6,294	79 (1.25)	5,384	54 (1)	324 (1.4)	23,729
	Cattle	10,523	220 (2.09)	11,537	238 (2.06)	9,595	189 (1.96)	10,167	188 (1.84)	835 (2)	41,822
2010–2011	Sheep	23,015	364 (1.58)	26,340	403 (1.52)	14,996	186 (1.24)	16,105	155 (0.96)	1,108 (1.4)	80,456
	Goat	4,027	50 (1.24)	5,777	70 (1.21)	3,129	8 (0.25)	2,506	0	128 (0.8)	15,439
	Cattle	9,749	194 (1.98)	12,474	214 (1.71)	8,455	166 (1.96)	10,093	230 (2.27)	804 (2)	40,771
2011–2012	Sheep	14,370	90 (0.62)	19,082	97 (0.50)	14,950	172 (1.15)	16,800	142 (0.84)	501 (0.8)	65,202
	Goat	1,814	8 (0.44)	1,684	18 (1.06)	1,728	19 (1.09)	1,497	10 (0.66)	55 (0.8)	6,723
	Cattle	8,225	172 (2.09)	10,440	136 (1.30)	8,076	173 (2.14)	6,767	75 (1.10)	556 (1.7)	33,508
2012–2013	Sheep	17,183	129 (0.75)	20,395	247 (1.21)	14,493	228 (1.57)	17,127	162 (0.94)	766 (1.1)	69,198
	Goat	1,605	7 (0.43)	2,157	21 (0.97)	2,127	37 (1.73)	1,901	27 (1.42)	92 (1.2)	7,790
	Cattle	5,108	68 (1.33)	6,331	87 (1.37)	5,558	94 (1.69)	5,437	66 (1.21)	315 (1.4)	22,434
Total	Sheep	112,170	1,420 (1.3)	111,792	1,513 (1.4)	78,253	1,257 (1.6)	91,370	1,124 (1.2)	5,314 (1.4)	393,585
2008–2013	Goat	19,658	236 (1.2)	24,886	331 (1.3)	20,755	226 (1.1)	15,781	140 (0.9)	933 (1.2)	81,080
	Cattle	46,219	813 (1.8)	54,748	841 (1.5)	43,512	845 (1.9)	44,489	778 (1.7)	3,277 (1.7)	188,968

Table 2 The total number of animals slaughtered and seasonal prevalence rate (%) of lung hydatidosis in animals slaughtered during 2008 to 2013

Year	Animal	Spring		Summer		Fall		Winter		Total	
		N	Inf (%)	*N*	Inf (%)	*N*	Inf (%)	*N*	Inf (%)	*N*	Inf (%)
2008–2009	Sheep	35,583	655 (1.84)	28,223	662 (2.34)	19,604	572 (2.91)	21,920	511 (2.33)	105,330	2,400 (2.3)
	Goat	6,814	109 (1.59)	8,615	60 (1.85)	7,477	115 (1.53)	4,493	79 (1.75)	27,399	463 (1.7)
	Cattle	12,614	212 (1.68)	13,966	264 (1.89)	11,828	303 (2.56)	12,025	285 (2.37)	50,433	1,064 (2.1)
2009–2010	Sheep	22,019	461 (2.09)	17,752	457 (2.57)	14,210	427 (3)	19,418	419 (2.15)	73,399	1,764 (2.4)
	Goat	5,398	114 (2.11)	6,653	161 (2.14)	6,294	120 (1.90)	5,384	67 (1.24)	23,729	462 (1.9)
	Cattle	10,523	290 (2.75)	11,537	257 (2.22)	9,595	197 (2.05)	10,167	226 (2.22)	41,822	970 (2.3)
2010–2011	Sheep	23,015	433 (1.88)	26,340	537 (2.03)	14,996	221 (1.47)	16,105	163 (1.01)	80,456	1,354 (1.7)
	Goat	4,027	76 (1.88)	5,777	85 (1.47)	3,129	15 (0.47)	2,506	0	15,439	176 (1.1)
	Cattle	9,749	227 (2.32)	12,474	248 (1.98)	8,455	160 (1.89)	10,093	197 (1.95)	40,771	832 (2)
2011–2012	Sheep	14,370	56 (0.38)	19,082	216 (1.13)	14,950	268 (1.79)	16,800	247 (1.47)	65,202	787 (1.2)
	Goat	1,814	8 (0.44)	1,684	9 (0.53)	1,728	45 (2.60)	1,497	36 (2.40)	6,723	98 (1.5)
	Cattle	8,225	119 (1.44)	10,440	208 (1.99)	8,076	381 (4.71)	6,767	169 (2.49)	33,508	877 (2.6)
2012–2013	Sheep	17,183	206 (1.19)	20,395	456 (2.23)	14,493	332 (2.29)	17,127	206 (1.20)	69,198	1,200 (1.7)
	Goat	1,605	32 (1.99)	2,157	59 (2.73)	2,127	53 (2.49)	1,901	31 (1.63)	7,790	175 (2.2)
	Cattle	5,108	114 (2.23)	6,331	189 (2.98)	5,558	131 (2.35)	5,437	91 (1.67)	22,434	525 (2.3)
Total 2008–2013	Sheep	112,170	1,811 (1.6)	111,792	2,328 (2.1)	78,253	4,906 (2.3)	91,370	1,546 (1.7)	393,585	7,505 (1.9)
	Goat	19,658	339 (1.7)	24,886	474 (1.9)	20,755	348 (1.7)	15,781	213 (1.3)	81,080	1,374 (1.7)
	Cattle	46,219	962 (2.1)	54,748	1,166 (2.1)	43,512	1,172 (2.7)	44,489	968 (2.2)	188,968	4,268 (2.3)

As it is shown in the table, hydatidosis as a reason for liver condemnation was more prevalent in sheep and cattle slaughtered during fall (1.6 and 1.9 %, respectively) and in goats during summer (1.3 %). Lung condemnations were higher in fall for both sheep (2.3 %) and cattle (2.7 %), whereas in goats were higher in summer (1.9 %).

Discussion

Hydatidosis causes considerable economic losses in livestock due to condemnation of organs. Therefore, it is justifiable to find reliable data for monitoring epidemiologic aspects of disease and prepare a baseline data for future comparison. Although abattoir surveys have limitations, they are an economical way of gathering information on livestock disease (Ansari-Lari 2005).

Based on the literature, Hydatidosis is prevalent in livestock in many parts of Iran. According to abattoir surveys, the mean prevalence of hydatidosis of sheep in different parts of the country has been reported to be 8.1 % and corresponding feature for cattle and goats were 12 and 6.5 %, respectively (Dalimi et al. 2002).

The prevalence of *E. granulosus* infection recorded in the present study was generally lower than those reported from other regions of Iran (Oryan et al. 1994; Ansari-Lari 2005; Arbabi and Hooshyr 2006; Daryani et al. 2007; Borji and Parandeh 2010; Ahmadi and Meshkehkar 2011) and its neighbor countries, i.e., Saudi Arabia (Ibrahim 2010), Iraq (Saeed et al. 2000), and Jordan (Kamhawi et al. 1995).

The differences in prevalence of hydatidosis may arise due to differences in environmental conditions that are conducive for the perpetuation of the parasite, abundance of infected definitive hosts, livestock husbandry, stocking rate, the nature of the pasture and grazing patterns of animals (Ernest et al. 2009). Another explanation is the implementation of a national program which undertaken in recent years in order to control of rabies; during this action, many stray dogs were eliminated (Azizi et al. 2000).

In the current study, a significant difference ($p < 0.001$) in the prevalence of hydatidosis was observed among studied animals with higher prevalence in cattle than sheep, with the lowest prevalence recorded in goats. This difference could be attributed to the fact that cattle are slaughtered at old age increase the risk of exposure to eggs of *E. granulosus*, while sheep and goats are slaughtered at a relatively early age compared to cattle (Getaw et al. 2010).

In addition, the least prevalence of caprine hydatidosis is probably due to the feed of goats. Goats naturally tend to graze on leaves and tall bushes in hilly or mountainous areas. This graze style secures a lesser contact with infective eggs and hence a lower risk of infection in goats compared to cattle and sheep (Ansari-Lari 2005).

The present study showed that the lung was more frequently infected with hydatid cysts than the liver. This result is in agreement with the previous findings of Ansari-Lari (2005) in Shiraz (Southern Iran), Arbabi and Hooshyr (2006) in Kashan (Central Iran), Mansoorlakooraj et al. (2011) in Northern Iran, Getaw et al. (2010) in Ethiopia, Giannetto et al. (2004) in Italy and Azlaf and Dakkak (2006) in Morocco. In contrast, some researchers stated that the livers of cattle are more commonly infected with hydatid cysts than the lungs (Gusbi et al. 1990; Ibrahim 2010; Adinehbeigi et al. 2013).

Livers and lungs were the most frequently infected visceral organs examined. This is explained by the fact that livers and lungs possess the first great capillary sites encountered by the migrating echinococcus oncosphere (hexacanth embryo) which adopt the portal vein route and primarily negotiate hepatic and pulmonary filtering system sequentially before any other peripheral organ is involved (Kebede et al. 2009; Fathi et al. 2012).

In addition, the more predominately infection of lung with hydatid cyst than any other organ is probably due to the presence of greater capillary beds in this organ than other organs (Kebede et al. 2009).

In the present investigations, the seasonal variation in the prevalence of hydatidosis was statistically significant. Higher prevalence of hydatidosis in sheep and cattle was observed in fall, whereas in goats was higher in summer ($p < 0.001$). Similar to our result, significant seasonal effects of hydatidosis on the condemnation of livers and lungs were reported in Fars province (Ansari-Lari 2005), except that the highest prevalence rate of the infection in livers and lungs was found in spring and summer and in summer, respectively.

The epidemiologic implication of this finding might be attributed at least partly to the sources of slaughtered animals. In Fars province, usually a greater proportion of the sheep slaughtered belonged to migratory tribal people in spring and summer. It is reported that the prevalence of hydatidosis and other parasitism is relatively higher in animals belonging to this population (Oryan et al. 1994). Since the number of unsettled tribes in the western provinces is considerably less than that in Fars Province, the causes of seasonal pattern in livestock may be due to changes in management practices and ecological factors.

In conclusion, this survey illustrated the usefulness of meat inspection records in monitoring disease conditions and demonstrated possible annual trends and also prepares a baseline data for future comparison. More importantly a feedback from the slaughterhouses to the individual farm is of great value in the field of preventive medicine. However, abattoir surveys have limitations and it must be remembered that the actual prevalence of the infection in slaughtered animals may be underestimated due to potentially inadequate meat inspection, rapid slaughter rates, and substandard training of inspectors.

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