Echinococcosis in Livestock Slaughtered in Arak Industrial Abattoir in Central Iran During 2006 to 2012

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ABSTRACT

Objective: Echinococcosis or hydatid cyst in humans and livestock is resulted from the larval stage of dog tapeworm, *Echinococcus granulosus*. Although Iran is considered as an endemic focus of echinococcosis in the world, however the status of three well-known aspects of the infection, i.e. canids, livestock and humans populations, is not still completely elucidated in Arak city, the capital of the Markazi province. This study aimed to elucidate the livestock infection in the region.

Methods: In this descriptive cross-sectional study, after necessary coordination with the provincial administration of Iranian Veterinary Organization, totally 860,171 livestock slaughtered in industrial slaughterhouse of Arak city, including 364,682 sheep, 117,495 cattle, and 377,994 goats were investigated during 2006 to 2012. The collected data were statistically analyzed using SPSS software.

Results: The average prevalence of liver and lung infection in studied livestock was 1.94% and 3.24%, respectively. Sheep and goats have the highest and lowest prevalence of both liver and lung infection, respectively. Prevalence of hydatid cyst in goats and sheep, not cattle, in various years of the study period showed a statistically significant difference.

Conclusion: Our results revealed a lower infection rate of hydatid cysts in the livestock of this region compared to the country average and many other Iranian provinces. Moreover, the study may imply an active local transmission cycle of echinococcosis.

Keywords: Echinococcosis, *Echinococcus granulosus*, Livestock, Iran, Markazi

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INTRODUCTION

Helminthic parasite *Echinococcus granulosus* (order Cyclophyllidea, family Taeniidae) is the causative agent of a zoonotic disease known as echinococcosis/hydatidosis/hydatid cyst, which is found throughout the world, especially in sheep farming regions. In natural life cycle of the infection, domestic dogs (*canis familiaris*) and other Canids play the role of definitive hosts that excrete eggs into environment. Many mammals, mainly various ungulates including sheep, goats, pigs, horses and cattle and as well as, humans may serve as intermediate hosts in which larval infection (hydatid disease, hydatidosis) is developed by long term growth of metacestode (hydatid) cysts in their tissues (1-3).

Echinococcosis is prevalent in the most parts of Iran, especially in its nomadic and rural areas where Slaughtering and meat hygiene legislation is not completely enforced and livestock offal is incorrectly disposed and eaten by canids (4).

Adult *Echinococcus granulosus* worms have been detected in various autopsied canids such as stray and farm dogs, red foxes, golden jackals and wolves from many regions of the country (5-7) including rural and urban areas of Kerman (8), Khuzestan (9), Fars (10), Tehran (11), Kashan (12), Mashhad (13), Ardabil (14), Kurdistan(15) and western provinces of Iran (16). The infection rate in stray dogs in different areas of Iran varied from 5% in Kerman up to 49% in Esfahan provinces (17) and the mean prevalence of the infection in sheepdogs has shown to be 27.17% (5). Moreover, detecting *Echinococcus*-specific coproantigens in fecal samples of canids by ELISA showed a total prevalence of 21.6% in the Moghan plian, Ardabil province (18).

Furthermore, many studies have shown that the human infection to hydatid cyst is prevalent throughout the country. Human cases are frequently reported and responsible for approximately 1% of admission to surgical wards of hospitals in different cities of the Iran including Hamadan, Arak, Babol, Yazd Mashhad, Teheran(19, 20), Tabriz (21),Arak (22, 23), Lorestan (24, 25), Kermanshah (26), Ilam (27), northern Iran (28), Isfahan, and Shiraz (4, 17, 19). During 2002 to 2007, a total of 2083 human hydatidosis cases were recorded in Iran, suggesting a prevalence of 0.61 in each

100,000 individuals (29). Besides, Seroprevalence of human hydatidosis in different regions ranged from 1.2% in Ilam up to 13.8% in Khuzestan (17). Additionally, In more recent studies in the country, seroprevalence of human hydatidosis were reported 15.4% from Khoram-Abad (25), 9.2% in the Moghan and 1.79% in Meshkinshahr, both in Ardabil province (30, 31), 3.46% in Arak (32), 2.25% in Ilam (27), 2.4% in Kashan, central Iran and 3% in Zanjan (33).

But in the respect to livestock infection, and based on meat inspection in abattoirs, there are reports that hydatid cyst infection varied from 1.5% to 70% in various ruminants, especially sheep, cattle, camels, goats and buffalos in different regions of the country (19, 34, 35). Average rate of the infection in sheep and cattle populations of Iran has been reported 10% (ranging from 1% to 50%) and 12% (ranging between 1-28%), respectively. In Sanandaj, 51.9% of sheep and 28.02% cattle were infected (15) and in Urmia, 8.6% of the sheep and 2.7% of the cattle and 12.9% of water buffalos (36) and in Kashan, central Iran 2.25% of sheep, 3.1% of goats and 4% of cattle (12) were infected with hydatid cysts. Moreover, Tavakoli and coworkers in a 5-year nationwide study from 2002 to 2007 analyzed all data recorded by veterinary authorities relating to livestock echinococcosis infections in 28 Iranian provinces. Average infection rate in livestock was 6.73% and had an increasing trend in the period. In the 28 studied provinces, the highest rates were observed in Khorasan (18.71%), Semnan (13.29%), East Azerbaijan (12.61%), Mazandaran (11.21%) and the lowest rates were observed in Kerman (2.95%), Qazvin (2.71%), Kermanshah (2.41%) and Yazd (2.40%). Besides, the most contaminated organs were lung 4.33% and liver 2.40%, respectively (29).

The precise status of the echinococcosis infection, regarding all its three well-known sides i.e. canine definitive hosts, livestock and human populations, is not still completely elucidated in our study area. Based on our literature review, there are merely two case reports of human hydatid cyst surgeries (22, 23), a seroepidemiology study of the infection on 578 inhabitants of Arak city and vicinity that showed a seropositivity rate of 3.46% (32) and finally, the raw data recorded by Iranian

Veterinary Organization on livestock slaughtered in Markazi province between 2002-2007 (29). Therefore, the present study aimed to further elucidate the infection status through examination of the livestock animals slaughtered in the Arak industrial abattoir during 2006-2012.

MATERIALS AND METHODS

This study was performed in Arak city, the capital of Markazi province (Markazi means central in Persian) in the west center of the country. Arak has a population of approximately 600,000 and is located around 49° east longitude and 34° north latitude with an average height of 1750 meters above sea levels and a mean annual precipitation of about 300 mm and the annual relative humidity about 50%. The maximum temperature may rise up to 35 °C in summers and may fall to minus 25 °C in winters (figure 1).

In this descriptive cross-sectional study, after necessary coordination with the provincial administration of Iranian Veterinary Organization, all livestock slaughtered in industrial slaughterhouse of Arak city were investigated during 2006 to 2012. The total count of inspected animals was 860,171 including 364,682 sheep, 117,495 cattle, and 377,994 goats. The procedure of the study was in the manner that first, separated entrails of all slaughtered animals were examined precisely by educated experts for the presence of hydatid cysts according to FAO manual (37), and when cysts had been found, all information about the infected livestock and contaminated organs were recorded on specially designed data sheets. The collected data were statistically analyzed using SPSS software.

RESULTS

The results of liver and lung infection with hydatid cysts in slaughtered livestock of Arak city during a seven-year period from 2006 to 2012 are shown in tables 1-3. The average prevalence of

liver and lung infection in studied livestock was 1.94% and 3.24%, respectively. The highest and lowest prevalence of liver infection was respectively found in sheep equals to 2.04% and goats equals to 1.8%. In a similar pattern, the highest and lowest prevalence of lung infection was also found in sheep equals to 3.73% and goats equals to 2.62%, respectively. The prevalence of hydatid cysts in goats and sheep, not cattle, in various years of the study period [tables 1 and 2] showed a statistically significant difference ($p<0.05$). However, the seasonal distribution of the infection in all three groups of animals was not statistically significant [figures 2 and 3].

DISCUSSION

Although echinococcosis in definitive canine hosts infected with hundreds or even thousands of adult worms seldom cause serious pathology, however hydatid cysts in livestock and human populations, due to its chronic nature, may result in huge economic losses, serious veterinary, and health problems. Losses of livestock infections are much greater than human ones and consist of lost productivity (e.g. milk, meat and wool yield) and work capacity, as well as, the abattoir condemnation of the contaminated viscera and organs. Regarding human patients, the losses include direct costs associated with the diagnosis and treatment of the disease and indirect costs that result from patients' inability to work or reduced efficiency and productivity (1, 4).

Iran is one of the most highly endemic foci of echinococcosis in the world (2), so that the infection is prevalent in many parts of the country (17). However the infection status in our study area is not still completely clarified, persuading us to do this study.

Our results revealed a lower rate of infection with hydatid cysts in the livestock slaughtered in the industrial abattoir of Arak City, compared to average prevalence of the country (17, 29) and many other Iranian provinces including Isfahan (35), Kordestan (15), western provinces (16), West

Azarbaijan (36), East Azarbaijan (38), Kerman (39, 40), Hamadan (41, 42), North Khoransan (43) and Ardabil (44).

The lower infection rates may be because Arak is a huge industrial hub of the country that may limit the territories of wild and domestic carnivores. Moreover, special climatic condition such as cold winters and low humidity of the environment that harm to the survival of parasite eggs in the soil, as well as the paucity of nomadic populations in the region and consequently lesser sheepdogs use, may play a role in the matter.

There was a dramatic and significant increase in the frequency of both liver and lung hydatid cysts in goats and sheep in the autumn season of 2012. According to local investigation, a drought in that time made the ranchers to send to slaughterhouse their own old ewe and nanny goats that typically have a higher rate of infection with hydatid cysts (2).

Recently, a seroepidemiological study on human infection with hydatid cyst using AgB- ELISA has showed that 3.46% of patients referred to hospitals and different health centers in Arak city and vicinity were seropositive and the rate was considered to be nearly the same as other parts of the country (32).

Up to the present, there is no published data on *E. granulosus* infection in canids, as crucial components of the parasite life cycle, in the Markazi province. Although more data is needed to elucidate all aspects of the infection, however our results and above-mentioned study indicating an active transmission cycle of echinococcosis in the region.

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Table 1: Frequency of hydatid cyst in goats slaughtered in industrial abattoir of Arak city during 2006 to 2012

Year	Total number	Liver infections		Lung infections	
		n	%	n	%
2006	81744	978	1.20	1464	1.79
2007	57364	703	1.23	1493	2.60
2008	51691	1080	2.09	2413	4.67
2009	44311	582	1.31	1204	2.72
2010	38579	258	0.67	520	1.35
2011	47234	319	0.68	524	1.11
2012	57071	2906	5.09	2319	4.06
Total	377994	6826	1.81	9937	2.63

Table 2: Frequency of hydatid cyst in sheep slaughtered in industrial abattoir of Arak city during 2006 to 2012

Year	Total number	Liver infections		Lung infections	
		n	%	n	%
2006	79749	1006	1.26	1278	1.60
2007	63193	585	0.93	1237	1.96
2008	83486	1901	2.28	4586	5.49
2009	36960	575	1.56	1240	3.35
2010	28575	237	0.83	451	1.58
2011	27028	429	1.59	662	2.45
2012	45691	2731	5.98	4168	9.12
Total	364682	7464	2.05	13622	3.74

Table 3: Frequency of hydatid cyst in cattle slaughtered in industrial abattoir of Arak city during 2006 to 2012

Year	Total number	Liver infections		Lung infections	
		n	%	n	%
2006	24746	445	1.80	962	3.89
2007	18076	400	2.21	830	4.59
2008	17442	366	2.10	596	3.42
2009	14131	426	3.01	760	5.38
2010	12868	243	1.89	414	3.22
2011	14965	251	1.68	384	2.57
2012	15267	228	1.49	364	2.38

Total	117495	2359	2.01	4310	3.67

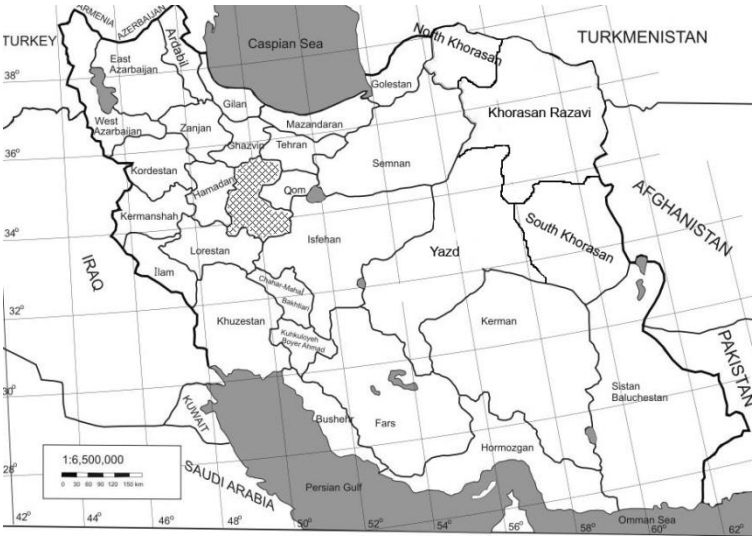

Figure 1. Map of Iran in which the hachured area represents the Markazi Province located in the west center of the country

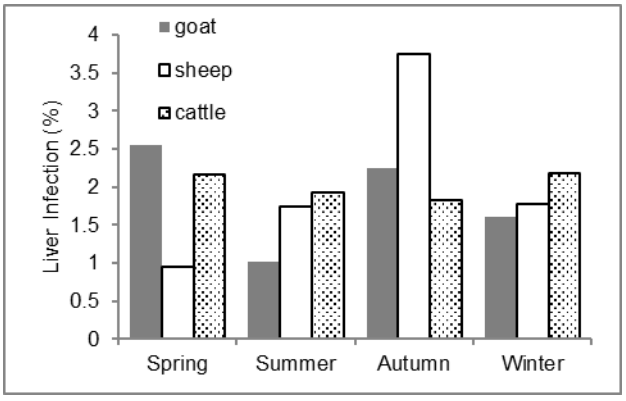

Figure2. Seasonal variation of liver infection with hydatid cysts in livestock slaughtered in Arak during 2006-2012

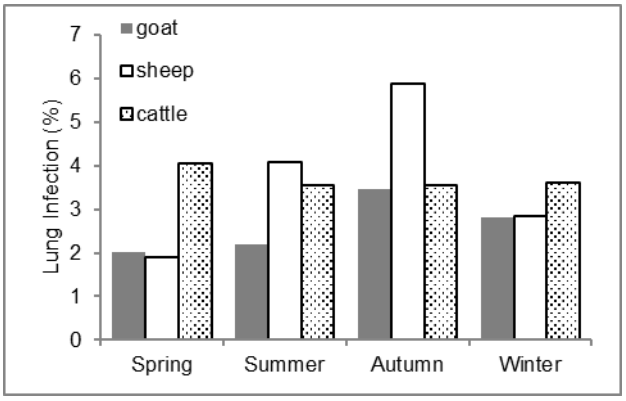

Figure 3. Seasonal variation of lung infection with hydatid cysts in livestock slaughtered in Arak during 2006-2012