The changing epidemiology of echinococcosis in Kazakhstan due to transformation of farming practices


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Abstract

In recent years there has been a substantial increase in cystic echinococcosis in Kazakhstan. There are several factors that have contributed to this change in the epidemiology of the disease. The primary reason was the degradation of traditional nomadic system of livestock breeding and closing of large collective farms. Small private farms have started to keep stock year round in closer proximity to permanent human habitation. Furthermore, routine anthelmintic prophylaxis of dogs has been abandoned and there is inadequate control over the use and disposal of animal carcasses. Large mechanized slaughterhouses are no longer operational. Now more people (7–8 times) and more dogs (8–10 times) participate in the husbandry of 1000 sheep, than during Soviet administration. Because of the close association of dogs with man there is the potential for a substantial increase in eggs of Echinococcus in immediate environment of inhabited houses. Soil samples taken from 61% of yards of village homes contained taeniid eggs and from 35% of yards from around farmsteads. During an examination of 1464 village dogs the average rate of infection with Echinococcus granulosus was 5.8%, whilst the prevalence in 607 shepherd dogs was 23.2%. At present, these dogs represent a major source of infection for people with this dangerous parasite. Examination of hospital records suggested that children and people in occupations associated with animal husbandry were at most risk of infection.

Keywords: Echinococcus granulosus; Epidemiology; Kazakhstan

1. Introduction

Kazakhstan is the largest country in Central Asia with an area of 2.71 million km². The country has a variety of landscape and climatic zones. The north of the country is open wooded steppe zone, whilst further south there is steppe, semi-desert, desert and mountain zones. Traditionally the population is involved in agriculture: livestock husbandry in the south and wheat production on the north of the country.

Echinococcosis is found in people throughout Kazakhstan. This disease is more often seen in the
south of the country, where sheep breeding is well developed. The average annual incidence in the country between 1974 and 1994 was 0.9–1.4 cases per 100,000 of population. Between 1995 and 2000 the number of cases per 100,000 of population increased from 1.4 to 5.9 cases. The absolute number of infected people in the country has increased from 202 cases in 1995 to 807 in 2000 (Torgerson et al., 2002a,b). This paper summarizes some of the recent studies that have been undertaken to investigate this epidemic of echinococcosis.

2. Materials and methods

Sheep and dogs were examined for the presence of echinococcosis from the three Southern Oblasts of Kazakhstan: Almaty, Zhambul and South Kazakhstan Oblast. These are 3 of the 4 most intensely endemic areas in Kazakhstan (Torgerson et al., 2002a,b). In total, 2400 sheep were examined at slaughterhouses for the presence of hydatid cysts. The lungs and liver were examined as described by Torgerson et al. (1998). Dogs were examined by arecoline purgation. Arecoline at a dose rate of 10–13 mg/kg was given orally. The purged material was carefully collected and washed a number of times. The material was then examined in the field by sedimenting the parasites in a large black flat-bottomed pan. The total number of *Echinococcus granulosus* in each dog was enumerated. A total of 2071 dogs were successfully purged and their parasite burden determined. These consisted of 607 shepherd dogs, primarily associated with agriculture and 1464 were village dogs. Faeces were collected from city dogs in Almaty for the presence of Taeniid eggs. Three hundred and fifty samples were examined by a simple flotation technique. A total of 626 soil samples from 175 village house yards and 362 samples from 65 yards of farmsteads were examined for helminth eggs according to the method described by O’Lorcain (1994).

In the study areas, 310 families were asked to answer specially created questionnaire to investigate the access of dogs to offal. Data obtained from the Republic Epidemiological Office on infected people with echinococcosis was analyzed. Archival data from the hospitals in Almaty City were examined for cases of echinococcosis.

Differences in the prevalence rates between groups of dogs and between proportions of soil samples containing taeniid eggs were analyzed by *χ²*-test. Differences in abundance rates were analyzed by a randomization test (Manley, 1998). Confidence limits for the mean abundance of parasites were evaluated by a bootstrap method (with replacement). Each data set was resampled 1000 times.

3. Results and discussion

The regional incidence of human echinococcosis is reported elsewhere (Torgerson et al., 2002a,b). Female subjects composed of 54.5–58.5% of reported surgical cases whilst male subjects were between 41.5 and 45.5%. Children under 14 years were from 27.2 to 33.5% of reported cases. Rural residents account for 68–70.1% of cases whilst, urban residents were between 29.9 and 32% of the total. Before 1995 cases of cystic echinococcosis (CE) were most commonly seen in livestock farmers (28.5–32%) and people living in villages having close contact with animals (20.1–25.3%), followed by children (19.9–32.2%), and least of all-those in the service sector and pensioners (Voloh, 1965; Abdrakhmanov, 1981; Akmatov, 1994; Aliev and Ordabekov, 1996). Between 1990 and 2000 a total of 1230 case records of individuals treated for CE were found in the hospital data. Children under 6 composed 7.8% (96 cases) and children from 7 to 16 years old 23.4% (289). In adults, women compose 53.4% of the diseased, while men account for 46.6%. However, in children the disease was seen more frequently in boys. Among 227 treated during this period children 54% were boys and 46% were girls.

In recent years the unemployed were the largest category of subjects composing 41.5%, followed by children (24.8–33.3%), livestock farmers (12.1%), and the retired (11.6%) (Abdrakhmanova, 2001). However, a detailed analysis of the past activity of the unemployed showed that the majority of them were livestock farmers and rural residents. Due to
major social-economic changes in the present time the country is experiencing an intensive migration of the population from rural regions to the cities. Therefore, the trend for the highest incidence of disease amongst people of rural origin remains. However, the number of cases seen in urban residents is also increasing. This is possibly associated with the increased number of dogs, kept in the urban dwellings for the purpose of security.

The results of the slaughterhouse study indicated that 34.3–52.8% of sheep were infected with cysts of *E. granulosus* in 1999–2001. Parasitic cysts were found in all age groups of sheep. Young animals of 1–2 years old mostly had infertile cysts. Three-year-old animals had between 9.2 and 10% of the fertile cysts, 4-year-old animals 15–20%, and sheep over 5 years old accounted for 30–32%. As many farms had substantial numbers of older ewes for breeding these older animals pose the biggest risk for infection to dogs.

Both the abundance of infection and prevalence of infection in farm dogs was significantly higher then that of village dogs (Fig. 2) (both *P* < 0.001). The higher abundance and prevalence in farm dogs is likely to be related to greater access of shepherd dogs to offal or casualty animals (Figs. 1, 3–5). However, the significance in the transmission to humans is not so clear-cut. Although there is much greater abundance of *E. granulosus* in the shepherd dogs they will have contact with few people compared to the village population. A typical village would be inhabited by 150–200 families and 300–400 dogs. This is illustrated by the widespread contamination of soil close to the homes of village residents. Taeniid eggs were found in 32.1% of 626 soil samples taken from 175 yards of village residences. This compared to the 9.4% of 362 soil samples taken from areas surrounding 65 farmsteads (Table 2) (*P* < 0.0001). The taeniid eggs have not been differentiated between *Echinococcus* and *Taenia* spp. Since infection of village dogs with *Taenia* spp. is widespread, thus many or most of the eggs found close to village homes must be from *Taenia* spp. rather then *Echinococcus* because of the much higher biotic potential of *Taenia* spp. compared to *E. granulosus* (Gemmell, 1990) However, farm dogs are even more intensely (Figs. 3–5) infected with both *Taenia* and *Echinococcus* spp (Table 1). This apparent paradoxical result of greater concentrations of taeniid eggs around village homes can be explained by the fact that dogs are closely confined and this results in a greater concentration of canine faeces near to the house. Farm dogs are free to roam and are thus more likely to defecate at a distance from the home.

In Almaty City 350 samples of dogs’ faeces were examined. Of these the presence of taeniid eggs was found in 18.3% of samples. However, to date no further investigation has been undertaken to determine if these dogs were infected with *Echinococcus* or *Taenia* spp. However, the presence of
taeniid eggs is strongly suggestive that sheep offal is widely fed to city dogs and it is likely that a significant number of these animals will be infected with *Echinococcus*.

Social and economic changes in Kazakhstan since 1991 have brought a number of significant social changes and animal husbandry practices. In 1994 the privatization of collective farms began. Animals are now kept much closer to human habitations than previously and now there are substantial concentrations of animals near large villages. About 85% of the livestock in the country are now reared on family farms, which consist of approximately 15–60 sheep, 2–3 cows, and 2–3 horses. These changes have significantly affected the epidemiology of echinococcosis in recent years (Shaikenov et al., 1999).

Previous studies in Kazakhstan, comparing frequency of incidence of echinococcosis among humans, suggested a correlation between human incidence of echinococcosis and density of livestock in different regions (Schultz, 1963; Ramazanov, 1986; Borovskii, 1989; Kereev, 1999). However, currently this is in a state of flux. The numbers of agricultural animals have decreased substantially since 1995 and the human incidence has increased. Nevertheless, CE is still seen in areas where livestock farming, particularly sheep farming, is most intensely practiced (Torgerson et al., 2002a,b).
A significant factor in the increase in transmission is the decrease in state veterinary service. Previously, in each collective farm there were 4–6 veterinarians employed. These veterinarians, inter alia, ensured that dogs were treated with anthelmintics every 1.5–2 months and supervised the slaughter and disposal of agricultural animals. Presently, private veterinary services are now responsible for these tasks, but due to severe financial constraints these activities have been virtually abandoned. Consequently dogs are now infrequently treated with anthelmintics and results from the questionnaires indicate that offal is frequently fed to dogs. Previously it would have been incinerated. As a consequence of such practice there is now a higher prevalence of *E. granulosus* in dogs than formerly.

Traditionally in Kazakhstan under the nomadic system of livestock breeding the flock consists of 600–700 sheep and is protected by 2–4 dogs. Only a limited number of people (3–4) had contact with such flocks. During the summer period every flock was moved to new pasture about 3–4 times. Because of the dry hot conditions in the summer this effectively reduced the transmission of parasitic disease. Currently, most of the pastureland
previously used has been abandoned. Animal husbandry practices have changed and now livestock are centered around rural farmsteads and villages rather than distant pastures. Although farms have a small number of livestock they usually employ a greater number of dogs. Presently there are 30/40 people and 50/55 dogs involved in the husbandry of 1000 sheep. This increases the potential for transmission of echinococcosis to humans. In private farms the slaughter of livestock intended for sale and consumption within the family takes place in the back yard. The results of the questionnaire indicated that 69% of subjects studied fed the offal of sheep to dogs. Thus dogs can be readily infected by such practices. Taeniid eggs can be readily dispersed locally from dog faeces (Lawson and Gemmell, 1990) leading to the widespread contamination of the environment that was found in the study. This leads to a much greater exposure of the human population.

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**References**


Gemmell, M.A., 1990. Australian contributions to an understanding of the epidemiology and control of hydatid disease

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Table 1
Parasite prevalence and abundance in shepherd and village dogs

<table>
<thead>
<tr>
<th></th>
<th>Prevalence</th>
<th>Confidence limits(^{a})</th>
<th>Mean abundance</th>
<th>Confidence limits(^{b})</th>
</tr>
</thead>
<tbody>
<tr>
<td>Shepherd E. granulosus</td>
<td>23.2</td>
<td>19.9–26.8</td>
<td>1041</td>
<td>227–2231</td>
</tr>
<tr>
<td>Dogs Taenia spp.</td>
<td>44.3</td>
<td>40.3–48.4</td>
<td>5.12</td>
<td>2.89–7.93</td>
</tr>
<tr>
<td>Village E. granulosus</td>
<td>5.8</td>
<td>4.7–7.2</td>
<td>27</td>
<td>11–49</td>
</tr>
<tr>
<td>Dogs Taenia spp.</td>
<td>23.9</td>
<td>21.8–26.3</td>
<td>1.06</td>
<td>0.87–1.30</td>
</tr>
</tbody>
</table>

\(^{a}\) Exact binomial 95% confidence limits.

\(^{b}\) Bootstrap 95% confidence limits.

Table 2
Proportion of soil samples containing taeniid eggs from farm and village premises

<table>
<thead>
<tr>
<th>Number of samples examined</th>
<th>Number of positive samples</th>
<th>Proportion positive</th>
<th>Confidence intervals(^{a})</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total number of samples from village homes</td>
<td>626</td>
<td>201</td>
<td>32.1</td>
</tr>
<tr>
<td>Number of village premises</td>
<td>175</td>
<td>106</td>
<td>60.5</td>
</tr>
<tr>
<td>Total number of soil samples from farmsteads</td>
<td>362</td>
<td>34</td>
<td>9.4</td>
</tr>
<tr>
<td>Total number of farm premises</td>
<td>65</td>
<td>23</td>
<td>35.3</td>
</tr>
</tbody>
</table>

\(^{a}\) Exact binomial 95% confidence limits.