

Target Population, Targeted Health Education: A Case-Based Reasoning Proposed for the Control of Human Hydatidosis

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Abstract

Background: Cystic echinococcosis (CE), caused by *Echinococcus granulosus* sensu lato, is a common zoonotic disease in Iran. Identifying various risk factors of this disease can pave the way for launching control and prevention programs, as well as special health education for target populations. For this purpose, this retrospective study investigated the demographic characteristics and risk factors of human hydatidosis in Hamedan.

Methods: The registered demographic characteristics of 98 patients, the risk factors of echinococcosis transmission, and the involved organs were analyzed through the profile form of patients who underwent CE surgery in two main hospitals of Hamedan province during 2014-2018. Data were analyzed using the chi-square test (or Fisher's exact test), independent t-test, and one-way analysis of variance with Stata 16 software at a significance level of $\alpha \geq 0.05$.

Results: Forty-eight (48.97%) and 50 (51.02%) cases of the 98 registered CE surgeries were females and males, respectively. The age range of the patients was 8-91 years, with the significantly highest rate in 21-30 years old (23.46%, $P < 0.05$). In addition, 77.78% of urban residents reported contact with contaminated vegetables vs. 58.49% of infected rural reported contact with contaminated vegetables and/or dogs ($P < 0.05$). The prevalence of infection merely in the liver (60.20%) was significantly higher than in the other organs ($P < 0.05$).

Conclusion: According to the results, it seems that the targeted health education should be focused on people in their third decade of life and younger. Further, the education of urban residents should be focused more on the health of vegetables and villagers based on the simultaneous explanation of the dangers of contaminated vegetables and dogs.

Keywords: *Echinococcus granulosus*, Hamedan, Hospital records, Risk factors



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Introduction

Human cystic echinococcosis (CE) is caused by the larval stage of *Echinococcus granulosus*. It is one of the most common zoonotic parasitic infections, globally, especially in endemic and hyper-endemic areas with a widespread distribution in the Mediterranean region and Asian countries (1). In Iran, hydatidosis is an endemic zoonotic disease with extensive impacts on the country's economy and public health (2). Dogs and canines are the definitive hosts and humans, and other animals act as intermediate. Carnivores are infected by ingesting contaminated viscera, and humans become infected by ingesting eggs in the environment, direct contact with infected canines, and consumption of contaminated food or water (3).

In humans, hydatid cysts are commonly found in the liver and lungs although it has also been reported in

other organs such as the brain (4), heart (5), bones and spine (6), breast (7), eye (8), ovary and fallopian tube (9), and parathyroid gland (10). Previous studies in Iran have reported that the prevalence of the disease has been relatively high in Mashhad, Kashan, Arak, Yasouj, Babol, and Yazd (11-17). In human patients, the surgical removal of cysts is the choice of treatment in many cases. It imposes a fundamental burden on human life and public health worldwide. Studies have shown that hydatidosis is responsible for 1% of surgical treatment cases in Iran, and the human rate of infection is 0.6-1.2% (18).

Moreover, environmental and cultural conditions, various hosts, and human individuals' behaviors and social characteristics have already changed the prevalence pattern, transmission, and distribution of parasitic diseases (15). Hamedan province is a potential area for



hydatid cyst infection due to the variety of climate zones, the presence of stray dogs, and *pasture*-based animal husbandry. Hamedan livestock is more traditional farming (19,20). Additionally, there have been very limited studies on the prevalence and frequency of human hydatidosis in Hamedan (19,21). Therefore, the spread of the *infectious disease can be controlled using an awareness schedule* of the epidemic status of the disease in the region and considering the effective risk factors. For this purpose, hospital data and records are remarkable, and a vast variety of *sources* are used to assess the epidemiology and distinct feature of the disease. Accordingly, this case-based study was conducted to review again the demographic-geographical aspects, risk factors, and the distribution of parasitic tissue in humans in 2014-2018 in Hamedan province, Iran.

Materials and Methods

In a retrospective case-based analysis, the demographic characteristics of hydatid cyst patients who were candidates for surgery, as well as the place of residence (rural or urban), the involved organs, and based on a history questionnaire, when admitted to the hospital, and the possible mode of infection transmission (contact with dogs and/or contaminated vegetables), were investigated from 2014 to 2018. The registered cases included 48 female and 50 male patients in the age range of 8-91 years who were referred to two main hospitals in Hamedan. The data were analyzed by chi-square (or Fisher's exact test), independent t-test, and one-way analysis of variance (ANOVA) using Stata 16 software at a significance level of $\alpha \leq 0.05$.

Results

Out of a total of 98 CE cases, 48 cases (48.97%) were females and 50 cases (51.03%) were males. The prevalence of infection in villagers was slightly higher than that of urban residents, and the possible route of infection is partly blamed on contaminated vegetables (Tables 1 and 2). The youngest and oldest male patients were 8 and 91 years old, respectively. In general, in females and males, the highest rate of infection occurred in the third decade of life (29.17%) and the third and fourth decades (20.00%) of life, respectively. The infection rate in patients under ten years old and over 70 years old was significantly lower than in other groups (Table 3).

Furthermore, there was a significant difference in gender, place of residence, and the route of infection ($P \leq 0.05$). In

this regard, 77.78% of the urban patients were infected due to the consumption of contaminated vegetables, while 58.4% of rural patients were infected via contaminated vegetables and contact with dogs. Further, 90.48% of rural females claimed that they were simultaneously in direct contact with the dogs and contaminated vegetables, while 62.96% of urban females were infected via contaminated vegetables ($P \leq 0.000$). In contrast, *no association* was found between the infection rate in rural and urban males and both routes ($P = 0.144$).

Additionally, the highest prevalence of infection was significantly reported in the liver (60.2%, $P \leq 0.05$). The other involved organs are listed in Table 4. Moreover, no significant difference was observed between the involved organs and age of patients ($P = 0.079$).

According to the different residential areas of Hamedan province, the highest and lowest rates of reported hydatidosis belonged to Melayar (41.83%) and Faminin (1.02%), respectively (Figure 1).

The highest frequency of the cases was recorded 31.98, 31.63% in 2014 and lowest frequency was reported 7.98: 7.14% in 2017 (Figure 2).

Discussion

In this study, the *hospital* records of CE patients were 98 in Hamedan from 2014 to 2018. Out of 48 infected women, 27 cases were from rural areas and 21 cases were from urban areas, and this ratio for 50 infected men was 26 versus 24, respectively. The infection rate and age did not represent a significant difference based on gender, place of residence, and possible route of infection (Table 2). This finding can result in the same susceptibility of both genders and probably infection transmission *through* direct and/or indirect contact with contaminated sources. Obviously, the most important finding was a significant *age trend* which was focused on the third decade for females, while it was described on the third, fourth, and fifth decades for males (Table 3). For this reason, a high probability of exposure to influential risk factors and even age-specific trends can theoretically have an impact on this event. In this way, there is no scientific *explanation* for the latter, and it comes to mind only as a possible hypothesis. Overall, the young patients who are of working age are more exposed to contaminated sources which can be one of the most common probable hypotheses.

Considerably, 77.78% of urban patients reported the consumption of contaminated vegetables, while 58.4% of

Table 1. Prevalence and Age Distribution of Registered Patients Based on Gender, Place of Residence, and Route of Infection (n=98)

	Gender		Residence		Route of Infection	
	Female (n=48)	Male (n=50)	Rural (n=53)	Urban (n=45)	Veg (n=57)	Veg+ Dog (n=41)
Prevalence, (%)	48.97 (39.12-58.90)	51.03 (41.09-60.87)	54.08 (44.06-63.78)	45.91 (36.21-55.93)	58.16 (48.02-67.65)	41.83 (32.34-51.97)
Age ^a , Mean \pm SD	37.62 \pm 17.15	39.2 \pm 19.37	40.11 \pm 19.26	36.44 \pm 16.96	39.21 \pm 18.71	37.34 \pm 17.74
P value	0.67		0.32		0.62	

Note. SD: Standard deviation; Veg: Probably contaminated vegetables; Veg+ Dog: Probably contaminated vegetables or contact with dogs.

^a Independent t test.

Table 2. Prevalence and Distribution of Registered Patients Based on Gender, Place of Residence and Route of Infection (n=98)

	Female		Male		Total	
	Rural	Urban	Rural	Urban	Rural	Urban
Veg	10 (37.04)	17 (62.96)	12 (46.15)	14 (53.85)	22 (41.51)	31 (55.49)
Veg+Dog	19 (90.48)	2 (9.52)	16 (66.67)	8 (33.33)	35 (77.78)	10 (22.22)
P value	0.000 ^a		0.144 ^b		0.000 ^b	

Note. Numbers in parentheses represent percentages; Veg: Probably contaminated vegetables; Veg+Dog: Contaminated vegetables or contact with dogs.
^a Chi-square; ^b Fisher's exact test.

Table 3. Gender and Age Prevalence of Registered Hydatid Cyst Infection (n=98)

Age (y)	Female	Male	Total
≤10	2.08 (0.29-13.65) 1	10.00 (4.18-22.07) 5	6.12 (2.73-13.13) 6
11-20	12.50 (5.67-25.36) 6	6.00 (1.92-17.23) 3	9.18 (4.79-16.88) 9
21-30	29.17 (17.98-43.61) 14	18.00 (9.56-31.31) 9	23.46 (16.00-33.03) 23
31-40	16.67 (8.49-30.14) 8	20.00 (11.03-33.52) 10	18.36 (11.79-27.46) 18
41-50	10.42 (4.35-22.90) 5	20.00 (11.03-33.52) 10	15.30 (9.35-24.03) 15
51-60	14.58 (7.05-27.77) 7	12.00 (5.44-24.44) 6	13.26 (7.78-21.69) 13
61-70	10.42 (4.35-22.90) 5	6.00 (1.92-17.23) 3	8.16 (4.08-15.65) 8
≥71	4.17 (1.03-15.42) 2	8.00 (3.00-19.66) 4	6.12 (2.73-13.13) 6
Total	48.97 (39.12-58.90) 48	51.03 (41.09-60.87) 50	- 98

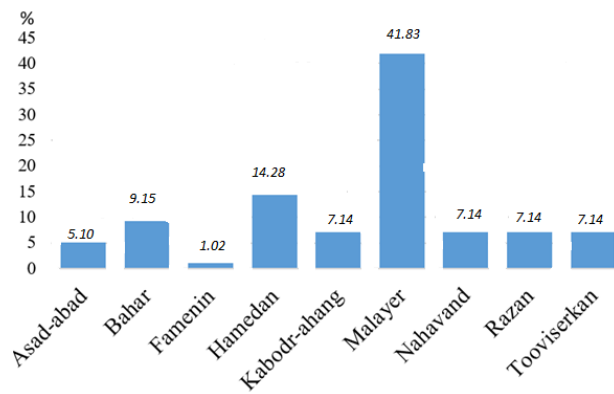
Note. Odd rows: Percentage (95% confidence interval); Even rows: Numbers.

Table 4. Frequency of Tissue Distribution of Hydatid Cyst and its Relationship With Age

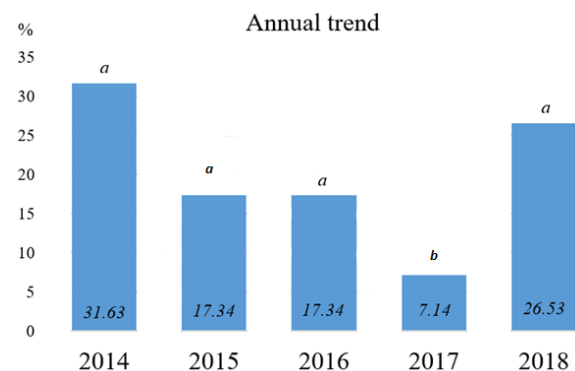
	n	Percentage (CI 95%)	Age (Mean ± SD)
Liver	59	60.20 (50.11-69.50)	41.05 ± 18.94
Lung	14	14.29 (8.59-22.81)	28.50 ± 11.65
Liver and Lung	11	11.22 (6.28-19.26)	31.55 ± 20.95
Coelom	6	6.12 (2.75-13.08)	38.50 ± 14.45
Others	8	8.16 (4.10-15.60)	45.88 ± 14.79
P value		<0.05	0.079 ^a

Note. CI: Confidence interval; SD: Standard deviation; Others: Spleen, Kidney, Bone, Femur, Liver+Stomach+Eye, Liver+Kidney, Liver+Spleen+Eye, Liver+Lung+Coelom each including 1 case (n=8). ^a One-way analysis of variance.

rural patients were infected via contaminated vegetables and/or contact with dogs. However, 90.48% of rural females claimed that they were simultaneously in direct contact with the dogs and/or contaminated vegetables, whereas 62.96% of urban females were infected via contaminated vegetables ($P \leq 0.000$). Nonetheless, there was no remarkable difference between the routes of infestation of rural and urban males ($P = 0.144$, Table 2).

**Figure 1.** The Prevalence of the CE Disease in Different Areas of Hamedan Province.

Note. CE: Cystic echinococcosis. The prevalence of the disease in Malayer has been significantly higher than in the other areas ($P < 0.05$).

**Figure 2.** Annual Trend of Cystic Echinococcosis in Hamedan Province During 2014-2018. Note. The same letters indicate no significant difference in the prevalence of infection in different years ($P < 0.05$).

Several reasons could clarify this finding. For instance, the low health literacy level of rural women can be pointed out as the cause of consuming contaminated vegetables (22). In addition, household activities and rural women's contact with other livestock are traditionally a part of their daily routine life. Hence, education and training strategies for rural and urban females should be established in different subjects. Previous studies mentioned that rural women have the highest chance of contact with the infection sources such as dogs, soil, and vegetables because women are often a vital resource in the agriculture and rural economy. This finding is in line with those of prior studies in Iran and Iraq (12,13,17,18,23). On the other hand, since dogs are more frequent in rural than urban settings, researchers have indicated it as an important risk factor

for CE infection worldwide (24,25). Further, antiparasitic treatments are not often acceptable for the herd and guard dogs in rural areas. Conventionally, the slaughtered infected viscera of ruminants are commonly considered food for dogs (20,22). On the other hand, wild canines are nearby rural areas and can probably pass the egg parasite (3). Thus, training of the mentioned points is imperative for rural people (Table 2). Moreover, large numbers of stray dogs in rural areas are one of the major risk factors for their roaming freely and contaminating vegetables due to dropping feces containing eggs (22,26,27).

It is considerable that the majority of the organs involved in CE cases were merely the liver [59 out of 98: (60.2%)] and lunge [13 (13.27%)]. Simultaneous lung and liver CE were found in 11 cases (11.22%), and in 6 patients (6.12%), they were recognized in the abdominal cavity. The other locations of the hydatid cyst in CE cases are presented in Table 4. Accordingly, our findings conform to those reported in previous studies (28,29).

In this study, the age range of the patients was 8-91 years, with the highest rate in women of 21-30 (14.29%) and men of 31-40 and 41-50 years old (10.2%). Our findings are in agreement with those of Fallah et al (19), Yang et al (30), and Kebede et al (31). It seems that the establishment of infestation occurs even in younger age groups. Hence, improving health literacy via educational programs should focus on the mentioned age groups even younger as the main target populations.

It has already been assumed the liver is the first preferred immunological organ for CE and induces immune tolerance responses (32). Additionally, given that CE has a high affinity for the liver, patients permanently suffer from complications such as liver function disorders and changed metabolic health profiles, particularly liver enzymes (33). Furthermore, CE causes a significant burden of disease (32) among vulnerable populations. In addition, disability-adjusted life years (DALYs) is considered one of the most crucial subsequences of human hydatidosis (34). DALY has been estimated as 1210.12 years (YLD equals 177.12 and YLL equals 1033) in 2018 in Iran (34). Additionally, the highest amount of DALY in males and females were in the age groups of 45-59 and 30-44 years, respectively (34). In our study, the highest infection rate was significantly described in the liver (60.2%, $P \leq 0.05$). Considerably, the other important point in our results was the significant parasitic age trend; it seems that disabilities as a serious concern would lead to long-term life which has a direct impact on increasing YLL.

In the present study, there was no relationship between age and involve organs ($P = 0.079$, Table 4). Although some parasites such as *Coenurus cerebralis* migrate through specific tissues which have evolved by the age trend, in accordance with our research, parasite migration to target tissues has not been supported via age trend, and the liver as the main target organ is at the same risk for all ages.

According to our research, the gradient percentage of infection has been reducing from 2014 to 2017, while the

frequency significantly increased in 2018 (Figure 1) which was mainly due to infection reports relating to Malayer (11 cases), Nahavand (4 cases), and Tooviserkan (1 case) areas (Figure 2). The overall prevalence of CE cases in these areas was 61.53% in 2018 which were noticeable as a particular cultural and geographical zoon. However, the question is why the infection rate was significantly higher in Malayer compared to the other areas. In this regard, some fundamental points should be taken into consideration. Firstly, increasing the education level and public awareness assists in identifying the patients and leading them to medical centers in Hamedan. Secondly, the efficiency of parasitological diagnostic techniques and healthcare tests has been promoted. In other words, inappropriate healthcare management, increasing risk factors, and probable transmission methods can be effective. Thus, it is necessary to perform some hygienic practices, as well as preventive and treatment strategies, and increase public health knowledge in this respect.

Conclusion

According to the results, it seems that the targeted health education should focus on people in their third decade of life and younger. Secondly, the education of urban residents should focus more on the health of vegetables and villagers based on the parasite life cycle and simultaneous explanation of the dangers of contaminated vegetables and/or dogs. Hydatidosis is a public health concern in this area, and further epidemiological surveys are necessary to demonstrate the economic burden, risk factors, target populations, and control of the disease.

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Competing Interests

The authors declare no conflict of interests.

Ethical Approval

this article is a part of Msc student thesis with 2601982 code which has been approved at Bu-Ali Sina university.

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