ORIGINAL ARTICLE

Survey data analysis of the related risk factors of echinococcosis in Inner Mongolia of China and Mongolia

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Received: February 1, 2019 **Accepted:** March 7, 2019 **Online Published:** March 10, 2019
DOI: 10.5430/dcc.v6n1p17 **URL:** https://doi.org/10.5430/dcc.v6n1p17

ABSTRACT

Objective: The aim of the study is to analyze the risk factors of hepatic echinococcosis in mass epidemiological studies in Inner Mongolia of China and Mongolia and provide a basis for related authorities to make appropriate preventive measures.
Methods: Eight areas in Inner Mongolia and Zamyn-Üüd region of Mongolia were selected as epidemiological fields. By distributing epidemiological questionnaires to local residents and performing serological examinations and abdominal ultrasound examinations, the data results were collected and analyzed to obtain the risk factors.
Results: In this research, there were 7,373 cases of valid data in the area of Inner Mongolia and 1,500 cases in the area of Mongolia. The mean age of the whole survey samples was 52.86 ± 13.90, and the ratio of the female (58.35%) was much higher than that of the male (41.65%). Both univariate analysis and multivariate analysis in this study showed that the female (14.7%) had a higher risk of hepatic echinococcosis than the male (10.9%). From the perspective of profession, children, educators and medical personnel had a lower incidence, herdsmen had the highest positive rate of the disease (15.8%). Living in pastoral areas, having been to pastoral areas, eating uncooked food and drinking unboiled water, raising dogs and surrounding activities of foxes and voles can also increase the risk of positivity.
Conclusions: Our findings demonstrate that the most important risk factor of hepatic echinoccosis is unhealthy lifestyles and customs in farmers and herdsmen. It is possible to provide a basis for related authorities to make effective protective measures aiming at hepatic echinococcosis.

Key Words: Hepatic echinococcosis, Epidemiological study, Inner Mongolia of China, Mongolia

1. INTRODUCTION

Echinococcosis is a common zoonotic parasitosis in the pastoral and the farming-pastoral regions.[1] It is made up of cystic echinococcosis (CE) and alveolar echinococcosis (AE). Echinococcus granulosus can induce CE in humans, and echinococcus multilocularis can lead to AE. Echinococcus granulosus is distributed worldwide, and echinococcus multilocularis is only distributed in the Northern Hemisphere. They are main pathogens which cause human diseases. Mongolia, along with the pastoral region in Inner Mongolia of our country, is the affected area of echinococcosis.[2–4] Western China is a high-prevalence area of echinococcosis. Ac-

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cording to a survey, the infection rate of echinococcosis in humans is 3.1%-31.5%, with the prevalence ranging from 0.5% to 5.0%. For herdsmen and farmers, this type of disease is the main reason of "falling into poverty for illness".[5] However, the current therapeutic options are very limited, especially for hepatic alveolar echinococcosis. This type of disease shows concealed clinical symptoms and a malignant tendency. Therefore, it is of great harm to human health. Most of patients with hepatic alveolar echinococcosis accompanying obstructive jaundice are found to be in the terminal stage of disease when they admit to the hospital. At this time, the lesions have invaded important great vessels of the liver and biliary tract, so that there is no opportunity to make a radical operation[6] and it is urgent to seek for proper solutions. Hence, it is imperative to make a specific analysis of the epidemiological characteristics and risk factors of hepatic echinococcosis to establish corresponding prevention and treatment measures. Even though some current researches have revealed conceivable risk factors and behaviors for the prevalence of echinococcosis,[7–9] there is no large sample study with regard to the population in Inner Mongolia of China and Mongolia. Based on 8,873 cases of related data in the epidemiological study of hepatic echinococcosis in this region, this research is designed to analyze the risk behaviors of hepatic echinococcosis and explore the risk factors in Inner Mongolia and Mongolia respectively, providing an epidemiological evidence to establish appropriate prevention and treatment measures of hepatic echinococcosis.

2. OBJECTS AND METHODS

2.1 Survey sites and respondents

Inner Mongolia Autonomous Region, located in the north of our country, has an overall area of 1,180,000 km^2. It is one of the most important bases of animal husbandry. The prairies, the area of which accounts for 50% of the overall area, are distributed in 8 leagues and cities. Echinococcosis is a serious parasitosis which is prevalent in the pastoral area of Inner Mongolia Autonomous Region, and it is also the main cause which leads to the poverty in farmers and herdsmen and impedes the development of local economy. Cluster sampling was applied to this research on the basis of geographical position and economic status, i.e., epidemiological survey sites of echinococcosis were selected designedly and systematically in the pastoral and the farming-pastoral regions in the east, the middle, the west and the north of Inner Mongolia. Erenhot, Sonid Left Banner, Sonid Right Banner, Dongsheng, Baotou, Wuhai, Alxa and Hulun Buir were surveyed in Inner Mongolia. In addition, Zamyn-Üüd region was surveyed in Mongolia. Zamyn-Üüd is a frontier town in the southeast of Mongolia, and it is 550 km away from Ulan Bator, the capital of Mongolia. Besides, Zamyn-Üüd is adjacent to Erenhot, with a population of no more than 10,000 and a backward in economy. Most of herdsmen raise dogs and livestock, take domestic slaughter as the conventional slaughter manner, and feed dogs with abandoned livestock offals. This lifestyle makes people susceptible to echinococcosis. In the earlier stage, the survey team mainly focused on site visit for the epidemiological study, which was started officially in 2012 and lasted for 4 years. By cooperating with local centers for disease control and hospitals, the team executed the sampling survey aiming at residents above 5 years old, which were given physical examinations at home or in hospital. All respondents were given questionnaire survey, hepatic ultrasound examinations and serological examinations. The questionnaire covers general information (such as name, gender, nationality, religion, profession, degree of education, living pattern, raising livestock or not and slaughter manner) and epidemiological profile for hepatic echinococcosis (including working or living in the pastoral area or not, contacting with livestock, diet, past medical history and treatment condition) in detail.

2.2 Diagnostic methods of echinococcosis

2.2.1 *Serological examination for echinococcosis*

2 ml of blood was taken from each case of respondent by use of blood collection tube. After autoagglutination, the blood sample was centrifuged at the rotate speed of 4,000 r/min for 5 min, with the serum taken and placed at -80°C. ELISA was used to measure the level of IgG antibody to echinococcosis in the respondent's serum, with the positive rate of antibodies considered as the infection rate of echinococcosis. All detection reagents are ELISA kits (made by Haitai Biopharmaceutical Co., Ltd.) of IgG antibody to echinococcosis. The registration number of ELISA kit is GXZZ 20153400132, the specification is 98 potions/box, and the sensitivity is 100%. The principle is that the kit is made up of a microplate coated with purified echinococcosis antigens, enzyme conjugate of monoclonal antibody IgG and other types of reagents. The principle of ELISA is applied to the detection of IgG antibody level to echinococcosis in human serum, with the advantage of rapidly determining whether people are infected by hepatic echinococcosis antigens. Nevertheless, the limitation of this method is that it is necessary to diagnose the type of hepatic echinococcosis with the help of imageological examinations.

2.2.2 *Ultrasound examination for echinococcosis*

Portable B-mode ultrasound system was used to perform the abdominal scan to determine whether hydatid cysts existed in the liver. The examination result was required to be recorded in the following way: 1 = Normal (including CE patients

without relapse and patients with normal B-mode image); 2 = CE (including CE patients with relapse after surgery); 3 = AE; 4 = Suspected (including patients with calcification more than 1 cm); 5 = Isolated calcification; 6 = Other abnormal images (such as gallstones an so on). The carriage rate of hydatid cysts was considered as the infection rate of echinococcosis.

2.3 Statistical analysis

SPSS 19.0 software was applied to statistical analysis in this research, continuous data were represented by means ± standard deviation ($\bar{X}\pm$ s), the enumeration data was represented by frequency and percentage, with t-test applied to the comparison between the positive group and the negative group and the comparison of continuous data fitted to normal distribution. Rank sum test was used in the comparison of non-normally distributed data and ranked data. Pearson chi-square test was performed to the categorical data, with backward-stepwise regression adopted in multivariate analysis. Univariate analysis and multivariate analysis were performed with stratified analysis (in view of Inner Mongolia of China and Mongolia) taking into consideration. All tests were two-sided tests, and the difference $p < .05$ was considered to be of statistical significance.

3. RESULTS

3.1 Prevalence and positive rate through serological examination

In Inner Mongolia, 7,373 cases of respondents were given serological examinations, 869 cases showed positive results, and the positive rate was 11.7%; in Zamyn-Üüd of Mongolia, 1,500 cases of respondents were given serological examinations, 311 cases showed positive results, and the positive rate was 20.7%. According to B-mode ultrasound examination, in Inner Mongolia, 5 cases of patients were found to have CE, 103 cases showed suspected results, and the positive rate was 1.46%; in Zamyn-Üüd of Mongolia, 25 cases were found to be with CE and 1 case with AE, 68 cases showed suspected results, and the positive rate was 6.27% (see Table 1). It followed that ultrasound examination result was far more different from serological examination result, and the reason may be that blood samples collected in the pastoral area were required to be taken to the experimental center for detection, so that the positive rate by means of serological examination was increased correspondingly due to long geographical span and distance, repeated freezing and thawing of blood samples and man-made factors in the detection.

Table 1. The results of B-mode ultrasound and serological examinations in the population of two regions

Region	n	B-mode ultrasound examination			Serological examination
		CE	AE	Suspected	Positive (%)
Inner Mongolia	7,373	5	0	103	869 (11.7)
Mongolia (Zamyn-Üüd)	1,500	25	1	68	311 (20.7)

3.2 Basic characteristics of the population

7,373 cases of valid data in Inner Mongolia were included in this research, with 1,500 cases in Mongolia. See Table 2 for details. The mean age of the whole survey samples was 52.86 ± 13.90, the percentage of the female (58.35%) was higher than that of the male (41.65%).

Table 2. Basic characteristics of the population

Region	Sample size	Age	The percentage of female (%)
Inner Mongolia	7,373	54.87 ± 13.03	57.3
Baotou	201	59.44 ± 11.85	53.7
Alxa	2,182	52.39 ± 13.64	60.3
Dongsheng	1,300	53.89 ± 12.27	56.2
Sonid Left Banner	750	53.15 ± 13.40	55.2
Hulun Buir	381	48.79 ± 12.51	63.7
Wuhai	929	54.24 ± 13.16	48.5
Sonid Right Banner	1,630	60.97 ± 10.27	59.3
Mongolia (Zamyn-Üüd)	1,500	42.92 ± 13.79	63.4

3.3 Univariate analysis

The overall analysis in view of Inner Mongolia and Mongolia showed that there was no statistically significant difference in the comparison in the age of positive respondents (53.31 ± 14.01) and negative respondents (52.80 ± 13.88). The percentage of female with positive results (14.7%) was obviously higher than that of males (10.9%). The positive rates of different professions were shown in Figure 1 (house maids and slaughter house workers were classified into the item "others" due to the few amount of cases). Not only the overall positive rate, but also the positive rates of different professions in Mongolia were higher than those in Inner Mongolia. From the perspective of profession, children, educators and medical personnel in Inner Mongolia showed a lower incidence, and herdsmen showed the highest positive rate. In Mongolia, the positive rate in farmers reached up to 50%, and the positive rate in children was 30%. The comparison in the positive rate in different nationalities showed that people

of Zang and Han nationalities had a lower positive rate, but people of Man nationality had the highest positive rate (see Figure 2). However, as people of Han and Mongolia nationalities accounted for a higher percentage, the results about people of other nationalities were considered to be worthless. Generally, the incidence in people of Mongolia nationality was higher than people of Han nationality. In the case of living pattern, the incidence in nomadic people was higher than that in people who settled and who settled in winter and nomadic in summer. Raising livestock, contacting with dogs in the pastoral area, having neighborhood who were raising dogs, having fox furs, domestic slaughter of livestock, burying or burning abandoned offals from sick livestock or feeding dogs with them could significantly increase the risk of hepatic echinococcosis. See Table 3 for specific results.

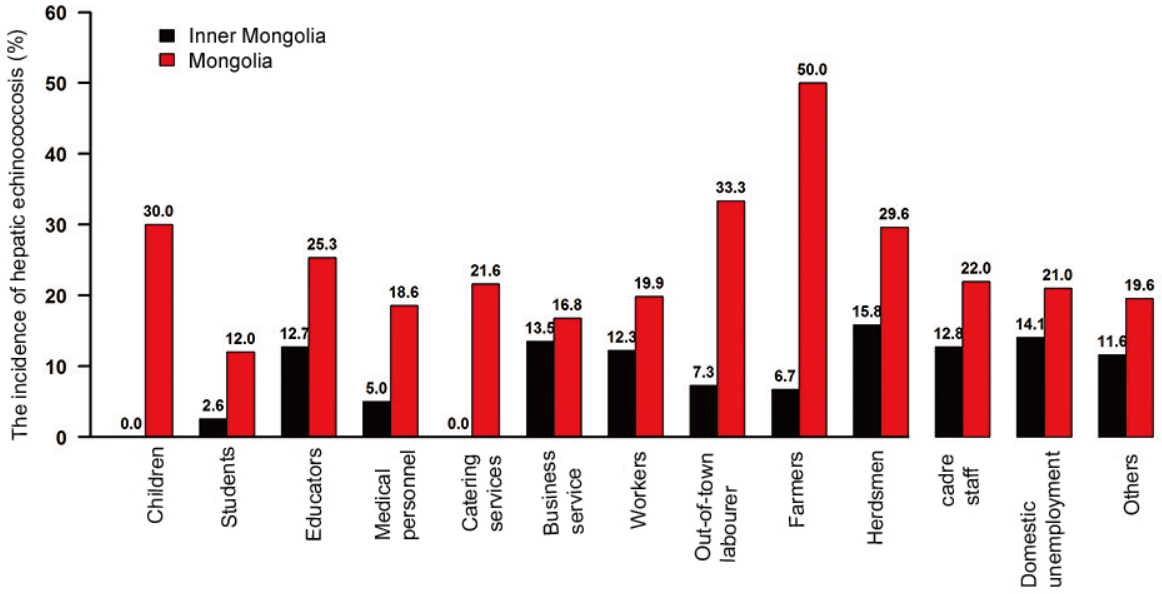

Figure 1. The incidence of hepatic echinococcosis in different professions

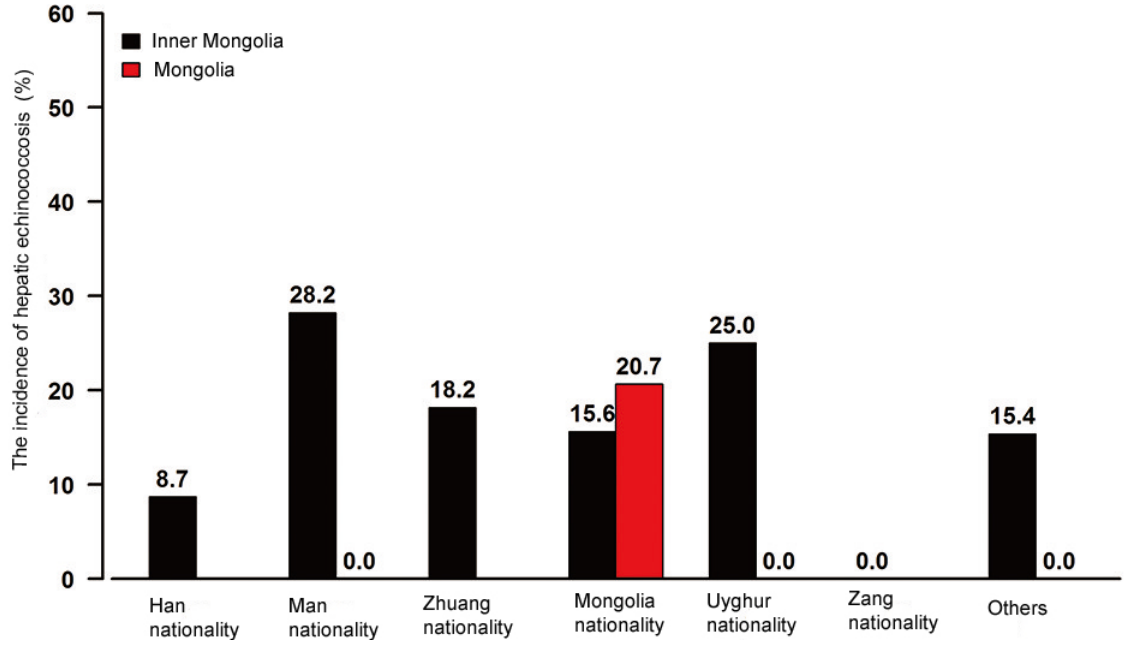

Figure 2. The incidence of hepatic echinococcosis in different nationalities

Table 3. The results of overall univariate analysis

Variate	Negative (%)	Positive (%)	Total	Statistics	*p*
Age	52.80 ± 13.88	53.31 ± 14.01	52.86 ± 13.90	-1.182	.237
Gender					
Male	3,279 (89.1)	400 (10.9)	3,679	28.194	< .001
Female	4,395 (85.3)	760 (14.7)	5,155		
Degree of education					
College degree or above	1,731 (88.0)	236 (12.0)	1,967	38.768	< .001
Senior school	2,405 (87.7)	338 (12.3)	2,743		
Junior school	1,416 (89.5)	166 (10.5)	1,582		
Elementary school	1,043 (83.8)	202 (16.2)	1,245		
Illiteracy	1,090 (83.3)	219 (16.7)	1,309		
Living pattern					
Settled	7,309 (87.0)	1,093 (13.0)	8,402	12.797	.002
Nomadic	182 (79.5)	47 (20.5)	229		
Settled in winter and nomadic in summer	157 (90.2)	17 (9.8)	174		
Raising livestock					
Yes	4,480 (87.9)	616 (12.1)	5,096	13.115	< .001
No	3,135 (85.3)	542 (14.7)	3,677		
Livestock slaughter manner					
Centralized slaughter	861 (92.8)	67 (7.2)	928	47.308	< .001
Sporadic slaughter	729 (91.7)	66 (8.3)	795		
Domestic slaughter	2,927 (85.7)	489 (14.3)	3,416		
Past medical examination for echinococcosis					
Yes	739 (88.6)	95 (11.4)	834	2.387	.122
No	6,930 (86.7)	1,062 (13.3)	7,992		
Living in pastoral areas					
Yes	3,818 (87.3)	557 (12.7)	4,375	1.406	.236
No	3,868 (86.4)	608 (13.6)	4,476		
Having been to pastoral areas					
Yes	4,703 (86.6)	726 (13.4)	5,429	0.496	.481
No	2,970 (87.1)	438 (12.9)	3,408		
Contacting with dogs in the pastoral area					
None	4,345 (88.5)	567 (11.5)	4,912	29.316	< .001
Occasionally	2,414 (85.5)	409 (14.5)	2,823		
Closely	929 (83.1)	189 (16.9)	1,118		
Eating uncooked food and drinking unboiled water in the pastoral area					
None	4,942 (87.4)	711 (12.6)	5,653	3.107	.078
Yes	2,688 (86.1)	434 (13.9)	3,122		
Raising dogs					
Yes	3,181 (86.3)	505 (13.7)	3,686	1.754	.185
No	4,495 (87.3)	656 (12.7)	5,151		
Whether the neighborhood were raising dogs					
No	3,047 (87.7)	426 (12.3)	3,473	6.204	.045
Some	4,326 (86.5)	677 (13.5)	5,003		
Nearly all	314 (83.7)	61 (16.3)	375		
Having fox furs					
None	6,598 (87.7)	929 (12.3)	7,527	18.360	< .001
Yes	852 (82.9)	176 (17.1)	1,028		
Surrounding activities of foxes and voles					
None	4,705 (87.1)	697 (12.9)	5,402	0.759	.384
Existed	2,942 (86.5)	461 (13.5)	3,403		
Source of water					
gutterway	27 (90.0)	3 (10.0)	30	1.666	.948
River	34 (85.0)	6 (15.0)	40		
Well	3,103 (86.6)	479 (13.4)	3,582		
Pond	7 (87.5)	1 (12.5)	8		
Pool	2 (100.0)	0 (0.0)	2		
Spring	5 (100.0)	0 (0.0)	5		
Running water	4,513 (87.0)	676 (13.0)	5,189		
Whether had hepatic echinococcosis before					
Yes	8 (80.0)	2 (20.0)	10	0.422	.516
No	7,595 (86.9)	1,142 (13.1)	8,737		
Past medical therapy					
Medication	66 (82.5)	14 (17.5)	80	0.977	.323
Surgery	4,560 (86.3)	722 (13.7)	5,282		
Disposal method of offals after the slaughter of sick livestock					
Abandoned	6,158 (87.9)	849 (12.1)	7,007	52.202	< .001
Human consumption	472 (87.6)	67 (12.4)	539		
Feeding dogs	747 (81.0)	175 (19.0)	922		
Buried or burned	220 (78.3)	61 (21.7)	281		
Hand-washing when eating food					
Seldom	2,750 (86.6)	426 (13.4)	3,176	10.330	.006
Sometimes	4,631 (86.7)	713 (13.3)	5,344		
Often	297 (92.8)	23 (7.2)	320		
Playing with a dog					
Never	504 (89.2)	61 (10.8)	565	8.319	.016
Occasionally	5,208 (87.6)	739 (12.4)	5,947		
Often	1,846 (85.5)	313 (14.5)	2,159		

Table 4. The results of stratified univariate analysis

Variate	Inner Mongolia			Mongolia		
	Negative (%)	Positive (%)	*p* value	Negative (%)	Positive (%)	*p* value
Age	54.65 ± 13.12	56.53 ± 12.24	< .001	42.58 ± 13.53	44.25 ± 14.70	.060
Gender						
Male	2,830 (90.2)	309 (9.8)	< .001	449 (83.1)	91 (16.9)	.007
Female	3,672 (87.0)	547 (13.0)		723 (77.2)	213 (22.8)	
Degree of education						
College degree or above	1,723 (88.0)	235 (12.0)	.416	8 (88.9)	1 (11.1)	.721
Senior school	2,373 (87.8)	330 (12.2)		32 (80.0)	8 (20.0)	
Junior school	1,375 (89.6)	159 (10.4)		41 (85.4)	7 (14.6)	
Elementary school	610 (88.2)	82 (11.8)		433 (78.3)	120 (21.7)	
Illiteracy	424 (89.3)	51 (10.7)		666 (79.9)	168 (20.1)	
Living pattern						
Settled	6,225 (88.5)	812 (11.5)	.003	1,084 (79.4)	281 (20.6)	.855
Nomadic	93 (78.8)	25 (21.2)		89 (80.2)	22 (19.8)	
Settled in winter and nomadic in summer	152 (91.0)	15 (9.0)		5 (71.4)	2 (28.6)	
Raising livestock						
Yes	4,295 (88.6)	555 (11.4)	.335	185 (75.2)	61 (24.8)	.080
No	2,157 (87.8)	300 (12.2)		978 (80.2)	242 (19.8)	
Livestock slaughter manner						
Centralized slaughter	821 (93.1)	61 (6.9)	< .001	40 (87.0)	6 (13.0)	.174
Sporadic slaughter	656 (94.3)	40 (5.7)		73 (73.7)	26 (26.3)	
Domestic slaughter	2,831 (86.1)	456 (13.9)		96 (74.4)	33 (25.6)	
Past medical examination for echinococcosis						
Yes	723 (88.9)	90 (11.1)	.576	16 (76.2)	5 (23.8)	.691
No	5,775 (88.3)	768 (11.7)		1,155 (79.7)	294 (20.3)	
Living in pastoral areas						
Yes	3,728 (87.5)	535 (12.5)	.006	90 (80.4)	22 (19.6)	.810
No	2,777 (89.5)	325 (10.5)		1,091 (79.4)	283 (20.6)	
Having been to pastoral areas						
Yes	4,345 (87.3)	630 (12.7)	< .001	358 (78.9)	96 (21.1)	.694
No	2,147 (90.4)	229 (9.6)		823 (79.7)	209 (20.3)	
Contacting with dogs in the pastoral area						
None	3,625 (90.4)	387 (9.6)	< .001	720 (80.0)	180 (20.0)	.813
Occasionally	1,995 (87.1)	296 (12.9)		419 (78.8)	113 (21.2)	
Closely	887 (83.4)	177 (16.6)		42 (77.8)	12 (22.2)	
Eating uncooked food and drinking unboiled water in the pastoral area						
None	3,958 (89.9)	446 (10.1)	< .001	984 (78.8)	265 (21.2)	.137
Yes	2,492 (86.3)	394 (13.7)		196 (83.1)	40 (16.9)	
Raising dogs						
Yes	2,768 (86.9)	416 (13.1)	< .001	413 (82.3)	89 (17.7)	.055
No	3,736 (89.4)	442 (10.6)		759 (78.0)	214 (22.0)	
Whether the neighborhood were raising dogs						
No	2,489 (90.1)	273 (9.9)	< .001	558 (78.5)	153 (21.5)	.670
Some	3,792 (87.4)	547 (12.6)		534 (80.4)	130 (19.6)	
Nearly all	227 (85.3)	39 (14.7)		87 (79.8)	22 (20.2)	
Having fox furs						
None	5,699 (89.2)	692 (10.8)	< .001	899 (79.1)	237 (20.9)	.664
Yes	731 (83.3)	147 (16.7)		121 (80.7)	29 (19.3)	
Surrounding activities of foxes and voles						
None	3,591 (89.7)	414 (10.3)	< .001	1,114 (79.7)	283 (20.3)	.094
Yes	2,892 (86.8)	441 (13.2)		50 (71.4)	20 (28.6)	
Source of water						
gutterway	26 (92.9)	2 (7.1)	.955	1 (50.0)	1 (50.0)	.673
River	27 (87.1)	4 (12.9)		7 (77.8)	2 (22.2)	
Well	2,554 (88.2)	342 (11.8)		549 (80.0)	137 (20.0)	
Pond	5 (83.3)	1 (16.7)		2 (100.0)	0 (0.0)	
Pool	2 (100.0)	0 (0.0)		-	-	
Spring	-	-		5 (100.0)	0 (0.0)	
Running water	3,896 (88.4)	511 (11.6)		617 (78.9)	165 (21.1)	
Whether had hepatic echinococcosis before						
Yes	1 (100.0)	0 (0.0)	.717	7 (77.8)	2 (22.2)	.900
No	6,476 (88.4)	853 (11.6)		1,119 (79.5)	289 (20.5)	
Past medical therapy						
Medication	9 (100.0)	0 (0.0)	.238	57 (80.3)	14 (19.7)	.842
Surgery	4,325 (86.6)	668 (13.4)		235 (81.3)	54 (18.7)	
Disposal method of offals after the slaughter of sick livestock						
Abandoned	5,855 (88.3)	775 (11.7)	.037	303 (80.4)	74 (19.6)	.129
Human consumption	355 (91.5)	33 (8.5)		117 (77.5)	34 (22.5)	
Feeding dogs	71 (85.5)	12 (14.5)		676 (80.6)	163 (19.4)	
Buried or burned	134 (83.2)	27 (16.8)		86 (71.7)	34 (28.3)	
Hand-washing when eating food						
Seldom	1,872 (90.4)	199 (9.6)	< .001	878 (79.5)	227 (20.5)	.620
Sometimes	4,352 (87.2)	640 (12.8)		279 (79.3)	73 (20.7)	
Often	276 (93.2)	20 (6.8)		21 (87.5)	3 (12.5)	
Playing with a dog						
Never	404 (92.2)	34 (7.8)	.022	100 (78.7)	27 (21.3)	.791
Occasionally	4,788 (88.3)	637 (11.7)		420 (80.5)	102 (19.5)	
Often	1,184 (89.6)	137 (10.4)		662 (79.0)	176 (21.0)	

The stratified analysis of data from Inner Mongolia and Mongolia was shown in Table 4. Because of the limited number of survey data in Mongolia, it was only concluded that the positive rate in the female was significantly higher than that in the males, and there was no statistically significant difference in the comparison of the positive rates between different risk behaviors. The results of statistical analysis towards Inner Mongolia showed that the age of the patients with positive results was obviously higher than that of the patients with negative results (differing by 2 years old). There was no statistically significant difference in the degree of education. In addition, it was found that living in pastoral areas, having been to pastoral areas, eating uncooked food and drinking unboiled water in the pastoral area, raising dogs and surrounding activities of foxes and voles could increase the risk of positivity. Other results conformed to the overall analytic results.

Table 5. The results of multivariable analysis

Variate	Overall			Inner Mongolia			Mongolia		
	OR	**95% CI**	***p* value**	**OR**	**95% CI**	***p* value**	**OR**	**95% CI**	***p* value**
Age	1.01	1.00-1.02	.034						
Female	1.56	1.29-1.89	.000	1.45	1.19-1.77	.000	2.06	1.04-4.10	.039
Disposal method of offals after the slaughter of sick livestock									
Abandoned	1.00								
Human consumption	0.73	0.46-1.15	.176	0.70	0.43-1.13	.146			
Feeding dogs	2.02	1.28-3.20	.003	1.80	0.87-3.73	.115			
Buried or burned	1.76	1.09-2.85	.022	2.13	1.24-3.65	.006			
No past medical examination for echinococcosis	1.62	1.20-2.20	.002	1.73	1.28-2.34	.000			
Contacting with dogs in the pastoral area									
None	1.00								
Occasionally	1.28	0.98-1.67	.069						
Closely	1.52	1.13-2.03	.005						
Degree of education									
College degree or above	1.00								
Senior school	1.19	0.94-1.51	.152						
Junior school	1.01	0.73-1.38	.974						
Elementary school	1.66	1.12-2.46	.012						
Illiteracy	2.15	1.31-3.53	.003						
Having fox furs	1.45	1.08-1.95	.012	1.47	1.07~2.01	.016			
Livestock slaughter manner									
Centralized slaughter	1.00								
Sporadic slaughter	0.83	0.55-1.24	.362	0.54	0.34-0.87	.011			
Domestic slaughter	2.08	1.53-2.81	.000	2.13	1.55-2.92	.000			
Living in pastoral areas				2.68	2.04-3.52	.000			
Living pattern									
Settled	1.00								
Nomadic	2.20	1.28-3.77	.004	2.20	1.18-4.10	.013			
Settled in winter and nomadic in summer	0.52	0.29-0.93	.027	0.45	0.25-0.82	.009			
Surrounding activities of foxes and voles				1.46	1.17-1.83	.001			
Hand-washing when eating food									
Seldom	1.00								
Sometimes	1.36	1.09-1.69	.006	1.54	1.21-1.95	.000			
Often	0.59	0.31-1.13	.111	0.72	0.38-1.37	.314			
Having been to pastoral areas	1.58	1.17-2.14	.003						

3.4 Multivariate analysis

Backward-stepwise regression was applied to multivariate analysis. Excluding nationality and profession, all variates in the above univariate analysis were considered as candidate variates. Our team believed that nationality and profession can increase the risk of positivity through other related risk behaviors. Nationality and profession were so closely related with other risk behaviors that they would not be integrated in multivariate analysis. Table 5 showed the results of multivariate stratified analysis. Due to the small amount of samples in Mongolia, the results of multivariate analysis were consistent with the results of univariate analysis, and the only finding was that the female had a higher risk of hepatic echinococcosis than the male. Meanwhile, in Inner Mongolia, the results showed that living in pastoral areas, surrounding activities of foxes and voles would increase the risk of positivity, and age, contacting with dogs in the pastoral area, degree of education and having been to pastoral areas were no longer the risk factors for echinococcosis.

4. DISCUSSION

Echinococcosis is generally spread in the biological chain of livestock (intermediate host) to dogs (definitive host), and it is the most harmful parasitosis to people and livestock in the pastoral and farming-pastoral areas. This type of disease not only affects the health of local population in an intensified degree, but also extremely damages the development of animal husbandry in the epidemic area. Based on the large-sample data of sampling survey from Inner Mongolia and Mongolia, this research is designed to analyze the related risk factors for hepatic echinococcosis. Both univariate analysis and multivariate analysis show that the female has a higher risk of hepatic echinococcosis than the male. No past medical examination for echinococcosis, having fox furs, seldom washing hands when eating food, domestic slaughter of livestock, burying or burning offals after slaughtering sick livestock or feeding dogs with them and nomadic lifestyle are independent risk factors for hepatic echinococcosis.

4.1 The correlation of gender to the incidence of hepatic echinococcosis

Ying D et al.[10] found that in their epidemiological study of hepatic echinococcosis, the female had a higher incidence than the male, which was also identified in our epidemiological study. According to the analysis, the main cause may be that it was the female who was engaged in housework in the agricultural and the pastoral areas, such as feeding dogs and livestock, milking, picking up shards and so on, i.e., the female came into contact with dogs, livestock or their feces, so that they had more exposure to the eggs of echinococcus than the male, leading to the highest rate of hepatic echinococcosis in the female.

4.2 The correlation of lifestyle to the incidence of hepatic echinococcosis

The survey showed that having fox furs, seldom washing hands when eating food, domestic slaughter of livestock, burying or burning offals after slaughtering sick livestock or feeding dogs with them and nomadic lifestyle are independent risk factors for hepatic echinococcosis. Residents in the agricultural and the pastoral areas hunt foxes and kill them for their furs without proper disinfection, so that the infection rate is increased eventually. Eating uncooked meat and seldom washing hands when eating food make herdsmen have a higher risk for the infection of echinococcus. Most of families prefer domestic slaughter of livestock and feed dogs with offals of sick livestock, leading to the aggravation of vicious circle in the infection of echinococcosis.

5. CONCLUSIONS

Hepatic echinococcosis is highly prevalent in Inner Mongolia of China and Mongolia, and the female is the risk population. It is recommended to avoid domestic slaughter, the usage of fox furs and burying or burning offals of sick livestock or feeding dogs with them.

FINANCIAL SUPPORT

The research was supported by Program of International S&T Cooperation (No.2011DFA32740).

CONFLICTS OF INTEREST DISCLOSURE

The authors declare they have no conflicts of interest.

REFERENCES

[1] Brunetti E, Kern P, Vuitton DA. Writing panel for the W-I. expert consensus for the diagnosis and treatment of cystic and alveolar echinococcosis in humans. Acta tropica. 2010; 114(1): 1-16. PMid:19931502. https://doi.org/10.1016/j.actatropica.2009.11.001

[2] Ju Y, Tianci L. Progress on the epidemiological study of echinococcosis. Ningxia Medical Journal. 2008; 30(4): 378-379.

[3] Xiang X, Weiping W. Progress on research of prevalent factors of echinococcosis. International Journal of Medical Parasitic Diseases.

2007; 34(5): 262-265.

[4] Bo T, Bin Z, Baobiao D. Epidemiological study and control effect on echinococcosis in Inner Mongolia. Chinese Journal of Zoonoses. 2011; 27(7): 677-678.

[5] Bo R, Hao W, Tuergan•aili, et al. The efficacy of various managements of indurative biliary fistula after hepatic cystic echinococcosis (HCE) operation. Chinese Journal of Hepatobiliary Surgery. 2013; 19(4): 275-277.

[6] Zhihua Y, Xinmin W, Ronghua M, et al. Heptic alveolar echinococcosis in the terminal stage of liver autotransplantation treatment in the plateau area. Chinese Journal of Hepatobiliary Surgery. 2014; 20(2): 148-150.

[7] Dazhong S, Wenke L, Genshu B. Approach to risk factor of human behavior on epidemic of alveolar echinococcosis. Chinese Journal of Public Health. 2003; 19(8): 973-974.

[8] Li L. An epidemiologic study on the echinococcosis of residents in rural areas of Ningxia Hui Autonomous Region. Epidemiology and Health Statistics, Shanxi Medical University, 2007.

[9] Hu W. Analysis on risk factors of human hydatidosis in Qinhai Province. Chinese Journal of Parasitic Disease Control. 2004; 17(4): 214-216.

[10] Ying D, Tianpeng L, et al. Analysis of prevalent status of hydatid disease in Yunnan Province and affecting factors. China Tropical Medicine. 2006; 6(1): 1773-1774.