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MODELING HUMAN BRUCELLOSIS USING ATMOSPHERIC VARIABLES IN FARS PROVINCE DURING THE YEARS 2009 TO 2011 USING GIS

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ABSTRACT

Introduction: Brucellosis (brucellosis) is a common bacterial infectious disease between humans and animals. There is a widespread global dispersal disorder. Illness occurs throughout the world, especially in the Mediterranean countries (Southern Europe, North and East Africa), the Middle East, India and Central Asia. In this study we modeled the effects of atmospheric variables on human brucellosis disease.

Methods: This study is a correlational (ecological) study. In this study, all of the cities of Fars province as sampling units and atmospheric variables including malt fever - temperature, humidity, rainfall, evaporation, sunshine, rain, frost and wind speed were estimated based on city division. It turned out Data were collected by city and city, and data analysis was done using descriptive statistics and regression analysis using GIS.

Results: The incidence of brucellosis in the years 2009, 2010 and 2011 was 11.47 and 14.03 and 20.05 per 100,000 populations, respectively.

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The two variables of mean temperature and evaporation were two variables that influenced the model, which were able to model 21% of the changes in brucellosis.

Conclusion: The present study showed that the incidence of brucellosis is significantly affected by atmospheric factors such as temperature and evaporation.

Keywords: Brucellosis, Occurrence, Epidemiology, GIS, Fars province

INTRODUCTION

Brucellosis (brucellosis) is a common bacterial infectious disease between humans and animals. It is commonly known as brucellosis in humans called brucellosis. There is a widespread dispersal of the disease due to the large spread of infection in domestic and wildlife traps (1). Illness occurs throughout the world, especially in the Mediterranean countries (Southern Europe, North and East Africa), the Middle East, India and Central Asia. (2).about 500,000 cases of human brucellosis are reported annually, and the WHO estimates that the actual incidence of the disease is 10 to 25 times greater than the reported number (3). The highest annual incidence of disease from Middle Eastern countries, such as Syria, Iraq, Iran and Saudi Arabia, is reported (4).Determining the prevalence of brucellosis is difficult due to the lack of complete reporting of the disease, but with a care system, current reports can indicate an increasing trend in the actual incidence of disease. By studying the number and incidence of the disease in the country, the disease has increased from 1979 to 1989, and from 1968 to 1999, with the onset of the first and second development programs, from 170 per cent to about 24 per 100 thousand people has sought to upgrade Disease Care and Reporting System There has been a relatively increasing trend of disease from 1999 to 2005 (5).Because of the country's long frontiers and lack of oversight of livestock imports, large numbers of nomadic people, traditional livestock breeding methods, lack of adequate supervision over the production and distribution of dairy products, and the lack of regular vaccination and testing and slaughter of livestock, (1). This disease is more frequent in the spring and summer of the breeding season of livestock.About 50,000 cases of brucellosis are reported annually in Iran. The highest prevalence is in Khorasan, Hamadan, Lorestan, West Azarbaijan, Kurdistan, Fars, and East Azarbaijan provinces (6). The effects of climate and environment, especially in the last century on medical science, are very important. Among these factors, it is possible to influence latitude, snow and rain, humidity, temperature, pressure, and so forth. There are not many studies on the relationship between brucellosis and atmospheric factors. But in the epidemiology of this, many studies have been done.In Iran, although contact with livestock and livestock products is the most important factor in the

occurrence of brucellosis, but the type of livestock, livestock culture and food behavior of people in each area about the use of livestock products and pathogens in each geographical area of the dissemination pattern Changes the disease (6). Despite the fact that Iran is an indigenous area for brucellosis and is a serious and serious health issue in the country, only a few spatial studies of human brucellosis have been carried out in Iran. In one of these studies in Chaharmahal and Bakhteiari province, a positive correlation was found between brucellosis and atmospheric parameters such as temperature, humidity and precipitation (7).The purpose of this study is to answer these assumptions about whether atmospheric variables such as mean temperature, number of freezing days, evaporation, humidity, height, sunshine and wind speed can model human brucellosis. The main goal of this study is to use the GIS to analyze time and space for assessing this infectious disease to respond to high assumptions.

METHOD

The study is a correlational (ecological) study. In this study, all cities of Fars province as sampling unit and eco-epidemiologic and atmospheric variables were studied including cases of brucellosis - temperature, humidity, rainfall, evaporation, sunshine, rain, freezing, wind speed and demographic information of patients. Patients with mumps disease like:Age, sex, place of residence, occupation and nationality and population were estimated based on city division. Breast cancer information from completing the national form Summary of monthly epidemiological information on brucellosis that has been completed by a physician or expert at the city health center at the end of each month based on the individual assessment form of the disease transmitted from the beginning of 2009 to the end of 2011 has been.Populations from the 2006 census and their estimates for the years studied were calculated taking into account the population growth of the areas for each village because all age and sex groups are at risk of disease and there is no immunity, therefore, the denominator of the fraction of the total population in each period It will be calculated from the census of population and housing in 2006. Data on meteorological and atmospheric precipitation were obtained by referring to the meteorological organization of Fars province in Shiraz.

The linear relationship between brucellosis and ecological variables was investigated by regression analysis of minimum squares. Ecological variables included: average, minimum and maximum temperature, humidity, number of rainy days, wind speed, evaporation and number of freezing days. Meteorological information of synoptic stations was arranged in descriptive tables with unique codes to the central points of the city. Disease data were

collected by split polygons that make up the village. They entered the weight regression model and the disease prediction error map was mapped using a regression model.

RESULTS

The present study was carried out using 1885 cases of patients with brucellosis in Fars province.

The incidence of brucellosis in the years 2009, 2010 and 2011 was 11.47 and 14.03 and 20.05 per 100,000 populations, respectively. The average incidence of brucellosis during the years 2009-2010 was 15.18 per 100,000 populations. In the survey, 57.26% (1086 cases) of male males were 42.38% (799) female. In terms of residence, 55.83% (1053 people) were rural and 33.82% (638 people) were urban residents and 10.33% (194people) were nomadic.

The job of most people is related to livestock, farming, and then housekeeping. According to nationality, 99.52% (1876 people) were Iranians and 0.48% (9 people) was Afghans. The highest incidence of brucellosis in the years 2009, 2010 and 2011 was in the age group of 64 to 60 years old and was 8.62, 29.33 and 58.76 thousand, respectively.

Table 1. Annual incidence of brucellosis disease in different age groups in Fars province in 2009-2011

Incidence	2011	2010	2009	age
6.43	8.55	5.66	5.08	0-4
10.71	17.09	10.64	4.4	5-9
9.9	10.73	12.67	6.31	10-14
11.54	13.39	10.81	10.44	15-19
11.49	12.28	12.07	10.12	20-24
13.88	20.26	11.42	9.96	25-29
18.6	28.93	14.9	11.98	30-34
17.73	23.51	16.69	13.01	35-39
20.64	26	19.1	16.84	40-44
21.31	25.92	18.61	19.42	45-49
27.11	36.95	24.13	20.25	50-54
29.72	41.91	28.88	18.37	55-59
40.48	58.76	29.08	33.62	60-64
26.33	36.88	23.89	18.23	65-69
18.97	23.43	17.39	16.09	70-74
14.03	19.73	11.09	11.29	75-79

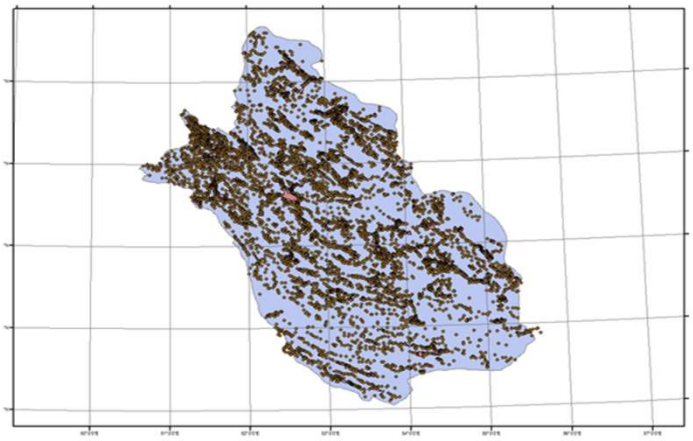

Fig.1. Distribution of healthy human societies in Fars province during 2009-2011 In the above form, each point represents a human society

Table 2: Descriptive statistics of variables recorded in synoptic meteorological stations during 2009-2011 in Fars province.

altitud	Temperatur	Temperatur	Temperatur	Freezin	Sunn	Win	index
1389.5	40.9	6.02	19.32	34.09	144.8	11.97	**average**
1362	41.46	5	19.73	22	140.6	12	**median**
563.75	5.33	3.64	3.66	35.06	26.39	1.87	**Standard**
405	25	1.13	12.63	0.67	125	8	**minimu**
2300	49.06	13.20	25.56	120	264	17	**maximu**

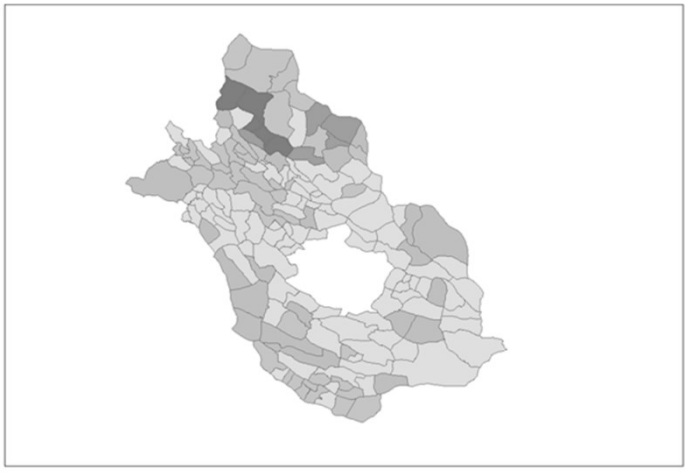

Fig.2. Map of the variable mean temperature as an effective variable in the linear regression model of brucellosis disease in Fars province during 2009-2011

According to the map, bright gray areas represent a greater estimate of the disease than the observed number, the black areas of the regions where the regression model estimates the cases less than the observed number, and the dark gray areas are areas that are well-fitted and have a quantitative error is.

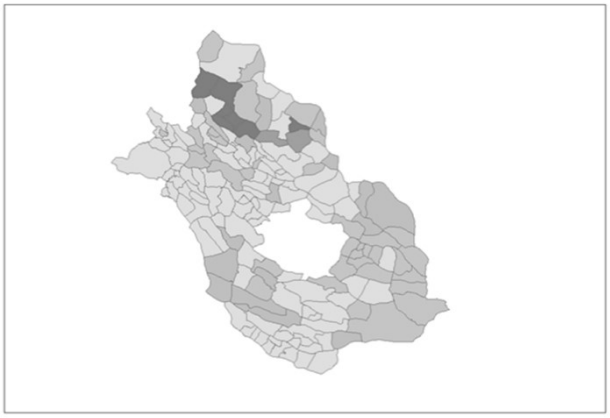

Fig.3. Evapotranspiration map as an effective variable in the linear regression model of brucellosis disease in Fars province during 2009-2011

According to the map, bright gray areas represent a greater estimate of the disease than the observed number, the black areas of the regions where the regression model estimates the cases less than the observed number, and the dark gray areas are areas that are well-fitted and have a quantitative error is.

Table 3. Coefficients of ecological variables predicting malformed brucellosis in Fars province during 2009-2011

Coef	Std Error	T _Stat	Prob	Robust SE	Robust t	Robust Pr	Variable
-0.018	0.2	0.91	0.92	0.15	-.11	0.9	The number of frosty
-6	2.14	-2.8	0.005	2.07	-2.89	0.00	Average temperature
0.11	.04	2.67	0.008	.03	3.06	0.00	Evaporation
0.03	0.66	0.05	0.95	0.59	0.06	0.95	Moisture

Table 3 shows the coefficients and the statistical test, indicating that the results are not chance and that the zero hypothesis is rejected due to the ineffectiveness of the regression coefficients. The two variables of mean temperature and humidity are effective in this model.

A review of the regression characteristics of Table 4 will help judge the work model.

Table 4. Correlation indexes of linear regression model of brucellosis disease based on atmospheric variables (mean temperature, number of freezing days, evaporation and humidity) in Fars province during 2009 -2011

Diag_Name	Diag _value
AIC	1659.92
R2	0.21
AdjR2	0.19
F-Stat	11
F-Prob	0
Wald	17.30
Wald-Prob	0.00
K(BP)	28.5
K(BP)-Prob	0.00
JB	739.31
JB-Prob	0
Sigma2	1329.35

Based on Table 4, the R2 as a measure of the suitability of fitting the model reflects only 21% of changes in brucellosis by the existing regression in the model.

DISCUSSION

In this study, we tried to show the effect of atmospheric factors on human brucellosis by spatial modeling. This study showed an average incidence of human brucellosis from 2009 to 2011 at the rate of 15.18 per 100,000 people, and two atmospheric variables such as mean temperature and evaporation effect on the incidence of human brucellosis.

In a study on the incidence of human brucellosis in Kurdistan province (in Iran) between 1997 and 2001, Dr. Ghasemi and colleagues showed that the incidence of the disease was 23.48% in hundreds of thousands people (7) and, moreover, the study of Dr. Hosseini et al. In South Khorasan (2004), showed the incidence rate was 113.2 per 100,000 people (8), and also Dr. Haghdoust's examination in the Endemic Bardsir district of Kerman province estimated the incidence of brucellosis to be 141.6 per 100,000 people (9). These results indicate that the incidence of brucellosis in different parts of Iran in recent years is high and the results of the present study between 2009 and 2011 show a significant difference with them. In addition to this comparison, the studies conducted in different regions of Iran show that the incidence of

brucellosis in Fars province is low. Perhaps one of the reasons is that the borderline situation in Fars province, and especially in the north of the province, are more at risk, but they are coming to neighboring provinces because of its proximity and neighborhood.

In this study, linear regression was used to estimate the spatial association between environmental data for brucellosis and showed there is a significant association between the increase in human brucellosis in those years and the mean temperature and evaporation. In general, these two variables could predict 21% of the disease's variation. But it was not related to other atmospheric variables such as humidity, number of frost days, and precipitation. Therefore, the two factors of the average temperature and evaporation are likely to be key predictors of brucellosis.

As the study of Entezari and colleagues in Chaharmahal Bakhtiari province of Iran showed, there was a significant positive correlation between increased incidence of brucellosis, temperature and evaporation variables, and a significant negative correlation between precipitation and increase in the incidence of brucellosis (6). That is also in consistent with the present study. Also, in the study of AhmadKhani and et al in Iran, there is a strong positive correlation between human brucellosis and atmospheric factors of temperature and wind speed, and there is a significant negative correlation with precipitation (7).

Melalo et al study in Iran suggested that low temperatures and high precipitation provide the context for the transmission of human brucellosis (10). Similarly, the study of yin-Jun Li and colleagues in China has proved that low temperatures and low-light of sunlight provided the context for the brucellosis epidemic (11) that did not consistent the current study. In the study of Azizi and Park in Iran, drought and high precipitation were contributors to this disease (5).

Mountainous areas are usually located in nomadic villages and due to the special vegetation of these areas, farm and breeding are more prevalent, and given that stockbreeders and nomads use their own dairy products, not pasteurized dairy products, and, on the other hand, contact the frequent working contacts of these people with livestock has increased the incidence of human brucellosis in mountainous areas.

Integrating human and atmospheric data that has been less widely seen in previous studies is the most important advantage of our study.

The limitations of our study may be mentioned as the incomplete data regarding the registration of patients' residence and the lack of information about the city of Jahrom and Fasa.

Conclusions: For better conclusions, further research must be performed on other risk factors, such as the disease incidence among livestock, vaccination coverage for livestock and

livestock products. In addition, we suggest that further studies be conducted to demonstrate the ability to use the GIS system on other common diseases between humans and livestock on a large scale. Considering that a study on the use of ecological variables in predicting the disease of brucellosis has not been done so far, thus to confirm the results of this study, there is a need to repeat similar studies in other areas and at a wider level.

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