Original Article

Epidemiological Aspects of Cutaneous Leishmaniasis in Yazd Province within 2004-2013

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Abstract

Introduction: Cutaneous leishmaniasis is recognized as one of the important neglected parasitic diseases worldwide. The present study aimed to determine the epidemiological patterns of cutaneous leishmaniasis in a period of ten years in Yazd province in Iran.

Materials & Methods: This ecological study was performed on 5784 recorded cases within 2004-2013in health centers in Yazd. Meteorological data including maximum and minimum temperature, relative humidity and rainfall, received from Yazd Meteorological Organization. In order to analyze the study data, descriptive statistics, linear regression, spearman correlation and delay time were applied.

Results: Out of a total of 5784 cases of cutaneous leishmaniasis, the most cases were observed among males (61.3%). The majority of cases were reportedin cities of Khatam, Yazd and Bafgh, respectively. The maximum incidence was observed in October in the autum. The correlation results between disease incidence and climatic factors revealed a weak correlation in regard with the temperature, whereas no significant correlation was observed with respect to the mean relative humidity and rainfall. Furthermore, the results of correlation analysis with a time delay of 9, 10, 11 months demonstrated that the disease incidence has a relatively strong negative correlation with the temperature parameters as well as a relatively strong positive correlation with the relative humidity and precipitation.

Conclusion: Regarding the relationship between these three climatic factors with cutaneous leishmaniasis in Yazd province, we recommended Climatic and environmental factors affecting disease to be measures in this area.

Keywords: Climatic conditions; cutaneous leishmaniasis; Epidemiology; Yazd

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Introduction

Cutaneous leishmaniasis (CL) is regarded as one of the most important neglected tropical diseases worldwide [1]. According to estimation of the World Health Organization (WHO), over 10 million people suffer from CL in 82 countries, which 1.5 million new cases occurred annually [2]. Leishmaniasis is strongly affected by ecological factors. Since the leishmania parasites are transmitted through the bites of infected female phlebotomies and flies، the epidemiology of leishmaniasis depends on the characteristics of the parasite species, the local ecological characteristics of the transmission sites, as well as current and past exposure of the human population to the parasite and human behavior. The current evidence suggests that geographical factors also have a direct influence on the epidemiology of vector-borne diseases [1].

Iran is among the seven countries with a high incidence of CL [3]. As a matter of fact, CL is endemic among the half of the 31 provinces of Iran [4]. Geography and climate conditions of Iran is appropriate for the growth and proliferation of the mosquito vector of the CL [5].While, the number of CL cases has progressively increased from 11505 to 26824 within 2001– 2008 in Iran [6]. Yazd province is one of the main endemic foci of CL with hot and dry weather, located in the center of Iran. The current study aimed to investigate the epidemiological characteristics of CL according to climate conditions (monthly and yearly prevalence), age, gender and residence city over the past 10 years (2004-2013) in Yazd province.

Distribution of CL depends on several factors, including geographical and climatic conditions. Hence, analyzing the epidemiology of CL in the context of climatic factors seems to be beneficial in CL prevention and control . Tommy et al. (2012) demonstrated a seasonal increase in the incidences of CL during July to September, which has a warm and relatively humid temperature in Tunisia [7]. Geographical and climate conditions of Iran are appropriate for the growth and proliferation of the sand fly vector of CL. In this regard, Shirzadi et al. (2015) reported a significant correlation between seasonal climate change and incidences of zoonotic cutaneous leishmaniasis (ZCL) in Golestan province, north of Iran. According to the results of different studies, ZCL incidence is more prevalent in the areas with higher temperature, lower relative humidity, lowest total rainfall, higher evaporation and lower number of rainy days in Golestan province(8). In the same study, Akbari et al. (2014) demonstrated that the maximum incidence of ZCL occurs during the second half of year, specifically in autumn. They also reported a positive correlation of CL with relative humidity and rainfall as well as an inverse correlation with sunshine and temperature. In addition, CL was proved to be more prevalent among women and in the age groups of 10-20 years[9].

Materials and Methods

The province has an area of 131,575 km², which is divided into ten counties according to the most recent divisions of the country, including: Abarkuh, Ardakan, Bafq, Behabad, Khatam, Mehriz, Meybod, Ashkezar, Taft, and Yazd.

Yazd Province, as one of the focal points of the disease occurrence in Iran was studied in this ecological study. The province is located in the central part of the plateau between the provinces of Khorasan, Kerman, Fars and Isfahan consisting of ten cities and 21 sections. Data including age, sex and the place of residence were collected from CL patients. Records of all cases from the period 2008-2013 in the health centers of Yazd University of medical sciences. Incidence rate was calculated separately in each city. Monthly and annual climatic parameters, including temperature, relative humidity and rainfall were obtained from Yazd Meteorological Organization. The meteorological data matched with incidence rate of disease. Collected data were entered into SPSS software (ver,16). The statistical indicators were analyzed for each of these parameters in the mentioned period of time using descriptive statistics and line regression. Then, the Spearman correlation was applied to investigate the correlation between weather elements and the disease incidence .Since there is distance between the sand fly bites and ulceration in the patients so, we calculate correlation delaytime.

Results

The statistical analysis of the collected data showed that the total CL cases reported during that period were 5784 including 3543males (%61.3) and 2241females (%38.7), with the male to female ratio of 1.58:1.0. The mean patient age was 29±18.6 years (range 1 to 94 year) and themaximum patients were in the10-30 yearage group (Table 1).

Khatam, Yazd and Bafgh cities showed the majority of cases respectively , so as most cases were allocated to Khatam city by 1775 (%30.7) and the next ranks belonged to Yazd and Bafq cities with1744 (%30.2) and 820 cases (%14.2) respectively (Table 2).

The maximum incidence rate was observed in 2005 (134.2 per 100,000 person), whereas the lowest incidence was detected in 2013 (26.1 per 100,000 person). However, incidence of disease was decreased significantly in period of study (Figure 1). And also the regression results showed significant downtrend (B=-18.785, P=0.004).

The results of a study on a ten-year period showed that the average temperature was 19.43± 9.13 (with the -1.4-35.4).And July was reported as the warmest month, with an average of 32.2 and January as the coldest month with an average of 5.32.

In the current study, most cases were reported in autumn. The seasonality incidence of disease was limited to August – November months with a major peak occurring in October and November (Figure 2).

The results of correlation analysis between the disease incidence and climatic factors demonstrated that there was a weak correlation

between the minimum temperature (r=-0.118, p=0.009), maximum temperature (r=-0.132, p=0.01) and average temperature (r=-0.134, p=0.009) with the disease incidence. Moreover, no significant correlation was revealed between the disease incidence with the relative humidity and rainfall.

Table 3 illustrates the correlation results with a time delay of 9, 10, 11 months. The disease incidence demonstrated a relatively strong negative correlation with the temperature parameter and relatively a strong positive correlation with relative humidity and precipitation. The highest correlation was indicated with temperature and relative humidity in the delay of 10 months in Bafgh (r=-0.68, r=0.7).

Table 1. Age and gender distribution of reported cases of cutaneous leishmaniasis in Yazd Province within 2004 - 2013

Age and gender group/	Under 10 years		10-30 years		30-50 years		50-70 years		Above 70 years	
Frequency	**Male**	**Female**	**Male**	**Female**	**Male**	**Female**	**Male**	**Female**	**Male**	**Female**
Number	427	433	1892	836	812	565	329	309	83	98
(Percent)	(49.7%)	(50.3%)	(69.4%)	(30.6%)	(59%)	(41%)	(51.6%)	(48.4%)	(45%)	(54%)
Total	860		2728		1377		638		181	

Table 2. Reported cases of cutaneous leshmanisis in Yazd province according to its cities

Residency	Khatam	Yazd	Bafgh	Ardakan	Abarkuh	Mehriz	Taft	Meybod	Ashkezar
Frequency	1775	1744	820	560	359	175	168	98	84
(Percent)	(%30.7)	(%30.2)	(%14.2)	(%9.7)	(%6.2)	(%3)	(%2.9)	(%1.7)	(%1.5)

Table 3. Spearman rank correlation between the monthly CL incidence and climate factors at 9, 10 and 11 months time delay correlation in Yazd province within 2004-2013

City/Parameter		Temperature average	Temperature min.	Temperature max.	Relative humidity	Rainfall
Yazd	9-month	**0.189-	**0.16-	**0.178-	**0.152	0.016
	10-month	**0.267-	**0.21-	**-0.272	**0.219	**0.137
	11-month	**0.245-	**0.196-	**0.247-	**0.208	*0.109
Khatam	9-month	**0.341-	**0.351-	**0.337-	**0.404	**0.299
	10-month	**0.451-	**0.437-	**0.481-	**0.41	*0.236
	11-month	**0.463-	**0.427-	**0.452-	**0.393	0.181
Ardakan	9-month	**0.378-	*0.323-	*0.278-	**0.369	0.257
	10-month	**0.489-	**0.445-	**0.457-	**0.453	*0.356
	11-month	**0.516-	**0.482-	**0.486-	**0.56	*0.302
Yazd	9-month	**0.393-	**-0.418	**0.328-	**0.378	*0.252
	10-month	**0.547-	**0.565-	**0.514-	**0.498	**0.413
	11-month	*-0.6	**0.565-	**0.565-	**0.599	**0.376
Bafq	9-month	*0.441-	**0.54-	0.333-	**0.464	0.028
	10-month	**0.68-	**0.638-	**0.562-	**0.704	0.231
	11-month	**0.638-	**0.574-	**0.502-	**0.638	*0.383
Abarkuh	9-month	*0.279-	*0.267-	*0.269-	*0.268	*0.344
	10-month	**0.465-	**0.457-	**0.411-	**0.41	0.255
	11-month	**0.506-	**0.431-	**0.515-	**0.424	0.253
Meybod	9-month	**0.68-	**0.604-	*0.494-	*0.487	0.171
	10-month	0.337-	0.302-	0.349-	0.262	0.016-
	11-month	0.127-	0.043-	0.113-	0.208	0.021
Mehriz	9-month	-0.246	-0.193	-0.123	0.106	*0.451
	10-month	0.062	0.204	-0.009	-0.057	0.228
	11-month	0.342	0.416	0.339	-0.234	-0.1
Ashkezar	9-month	-0.016	0.056	-0.025	0.049	0.17
	10-month	0.003	-0.026	0.138	-0.102	0.042
	11-month	0.032	-0.089	0.155	-0.027	0.109-

**.Correlation is significant at 0.01 levels

*.Correlation is significant at 0.05 levels

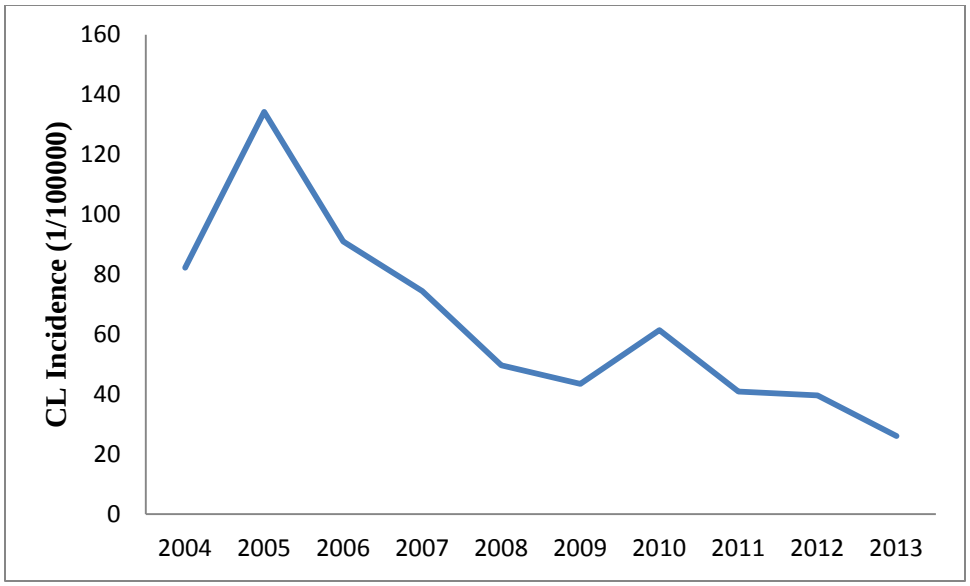

Figure 1. CL incidence rates in Yazd province within 2004-2013

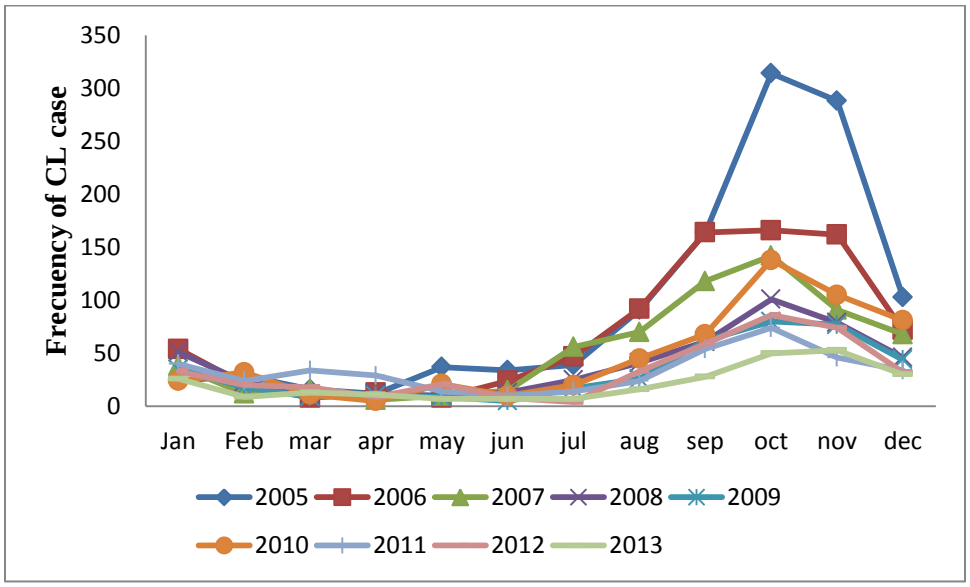

Figure 2. Seasonality of CL occurrence (2004–2013).

Discussion

CL is a parasitic disease that exists in many parts of the world, specifically in tropical and subtropical regions [10]. The present study was performed in Yazd province, one of the main foci of the disease in a warm and dry climate. The study results indicated that both genders were susceptible to the disease. However, majority of cases were detected in males, this is similar with the results of studies Mollalo et al. and Hamzavy et al. [11, 12], which could possibly be explained by the fact that the males are more exposed to the vector than the women, because of behavioral characteristics such as less

covering and more environmental and social activities.

However, it should be noted that some other areas have demonstrated a higher incidence within females [13].

Furthermore, the present study revealed CL seasonal incidence rate similar with the findings of Mollalo and Akbarai [9, 12], which both studies showed the incidence increased during autumn and with major peak in October and November. This is may be association with the more activity of the sand flies in spring and summer considering the incubation period of the disease. Epidemiological studies have demonstrated varying trends in the different area. Indeed, a declining trend has been shown in the most regions [14, 15]. However in the some study, have shown increasing trend of CL [16]. After the disease outbreak, a decreasing trend was observed, which may be attributed to various factors such as better awareness and protection against the vector. As the results of Spearman correlation revealed, climate factors generally did not show any strong correlations with CL incidence rates in the same months. The highest correlation was observed with the time delay, that this could be related to sandflies activity and suitable climatic conditions at the time of transmission of the disease.

In the current study, the correlation between climate parameters and monthly CL incidence was observed in time delay of 10 and 11 months. Comparing the results of time delay analysis with findings of other studies indicates that the highest correlation was observed in months of 4 and 13 in the Fernando's study, and also was reported 1-3 months in the Shirzadi's study[8, 17]. This temporal relationship between climatic factors and the disease incidence maybe vary in the different areas because of different climatic conditions.

Results in the level province was consistent with findings of salahedin et al, who studied CL associations with climate in some countries of the Middle East. Indeed, both studies showed a positive association between CL incidence and temperature variable, whereas no significant relationship was observed with humidity [18]. The results at the level of cities demonstrated a relatively strong negative correlation between CL incidence and temperature. Moreover, a relatively strong positive correlation was detected between relative humidity and precipitating. Comparing the results of correlation analysis between CL incidence and climate factors with studies of Shirzadi et al. (2015) in Golestan province [8], Akbari et al. (2014) in Sabzevar [9] and Yazdanpanah et al. (2013) in Kermanshah province[19] indicates that although a positive correlation was observed between the average temperature and CL incidence in Golestan, this relationship was reported to be negative in Sabzevar and Kermanshah. In contrast, Shirzadi reported that there exists a negative association between CL epidemic and both relative humidity and rainfall. However,Akbari’s study indicated apositive association between CL epidemic with both

relative humidity and rainfall, thoughthis relationship was not held to be significant in kermanshah.

The limitation of present study is probably underestimated due to many reasons such as not reported, not diagnosed or misdiagnosed cases.

The main limitation of the present study was ecological fallacy. However, the phenomenon of ecologic fallacy is often invoked as an important limitation for the use of ecologic correllation. Since all of the differents of Yazd province do not have warm and dry. Therefore, it can not be stated that the incidence rate of disease is the same in all the regions. In addition, the effects climate on populations are different, which is related to the social, economic, environmental and adaptability in different populations.

Conclusion

In general, it can be concluded that Yazd can be stated as one of the main foci of CL in Iran. Regarding the climatic factors (especially temperature) can affect the activity, growth and proliferation of disease vectors, we recommended other climatic and environmental factors affecting disease to be measures in this area.

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