



# Spatial distribution and epidemiological features of cutaneous leishmaniasis in southwest of Iran



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## KEYWORDS

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**Abstract** *Introduction:* Leishmaniasis, as a major health concern exists in 14 out of 22 countries of the Eastern Mediterranean Region (EMR). Therefore, the aim of present investigation was to evaluate the epidemiological features and spatial distribution of cutaneous leishmaniasis (CL) during six consecutive years (2009–2014).

*Material and methods:* In current retrospective cross-sectional study among 2009–2014, simple direct smear was taken from all suspicious CL subjects who referred to health centers affiliated to Ahvaz Jundishapur University of Medical Sciences. For each patient a questionnaire including some demographic details was filled. Eventually data analysis was done by SPSS.16.

*Results:* Trend of CL in the region was unstable. Spatial distribution of CL in central and west cities was higher than in others. During the years, a total of 4137 smear positive individuals were diagnosed. Of these 55.7% lived in urban and 44.3% lived in rural districts. Frequency of CL was higher in men (60.1%) than in women (39.9%). Also based on age range, 11–30 was the most afflicted group (45.7%). Anatomic location of ulcers was as follows: hands 45.7%, feet 27.4%, face 19.1% and other places 7.8%.

*Conclusions:* Regarding high incidence of CL in southwest of Iran, special programs related to vector and reservoir control should be adopted and implemented. Traffic control of immigrants and travelers from neighboring endemic countries, also can be helpful.

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## 1. Introduction

Leishmaniasis is a vector-borne tropical and subtropical disease caused by obligate intracellular protozoa known as *Leishmania* genus. The disease can present clinically in three main ways as follows: cutaneous leishmaniasis (CL), visceral leishmaniasis (VL) and mucocutaneous leishmaniasis (MCL). It is a major global health problem in five continents that estimated 350 million people in about 100 countries are at risk and currently 12 million persons are infected worldwide. Two million new clinical cases occur throughout the world annually that incidence of CL and VL is 0.7–1.2 million and 0.2–0.4 million, respectively. Majority (about 70–75%) of total CL cases occur in 10 countries: Brazil, Peru, Colombia, Costa Rica, North Sudan, Algeria, Ethiopia, Syria, Afghanistan and Iran.<sup>1</sup> Leishmaniasis in the Eastern Mediterranean Region (EMR) is considered as a major health problem. Also CL and VL were seen and are endemic in 14 out of 22 countries of the region such as Palestine, Egypt, Libya, Sudan, Tunisia, Morocco, Jordan, Yemen, Syria, Saudi Arabia, Iraq, Iran, Afghanistan and Pakistan.<sup>2</sup> Pentavalent antimonial compounds such as Glucantime and Pentostam are being prescribed routinely for leishmaniasis treatment as first-line drugs, while unfortunately there is no effective and efficient vaccine against leishmaniasis yet.<sup>3,4</sup>

Leishmaniasis control program was initiated in 1345 in Iran. The disease exists in more than 17 provinces of Iran country particularly in southwest regions, Khuzestan province.

CL occurs in two forms of ACL (Anthroponotic cutaneous leishmaniasis) and ZCL (Zoonotic cutaneous leishmaniasis), and their etiological agents are *L. tropica* and *L. major*, respectively and both of them were identified in Khuzestan province.<sup>5</sup> Despite the performed measures and national and international investments for CL control, the disease still exists in many provinces and new endemic foci have been created and reported constantly.<sup>6,7</sup> Various factors for the establishment and incidence of CL are as follows: environmental changes, development of agricultural projects, unplanned expansion of cities, migration of non-immune individuals to endemic areas, construction of residential buildings in the vicinity of rodent nest, and dams construction and reduced or discontinued programs spraying against malaria vectors.<sup>5</sup>

Khuzestan province due to the special geographical location is considered as a free trade zone and agricultural center in Iran and a considerable number of persons are referred to this province. Moreover, in some seasons of the year embraces several million pilgrims and tourists. Besides, due to its adjacency to Iraq (an endemic country), traffic from foreign nationals is observed over the year.<sup>8</sup> On the other hand, presence of vectors (*Phlebotomus papatasi* and *Phlebotomus sergenti*) and reservoir (a rodent of the genus *Tatera indica*) for CL in the region,<sup>5</sup> makes this province faced at risk. Due to lack of a comprehensive study in this region, the aim of present investigation was to evaluate the epidemiological features and spatial distribution of CL during six consecutive years (2009–2014).



**Figure 1** Location of Khuzestan province in Iran. Ten study regions are shown with asterisks.

## 2. Materials and methods

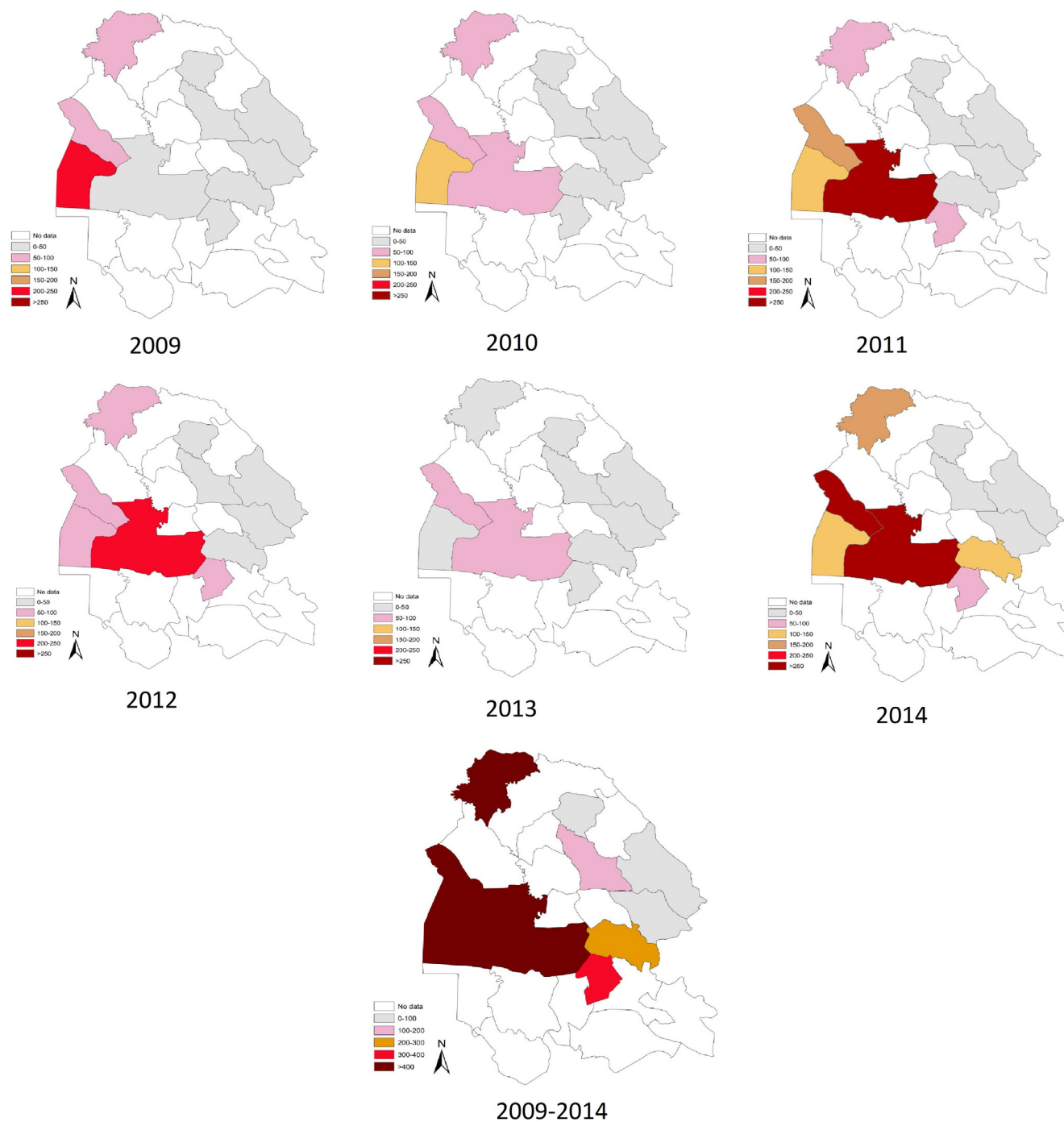
### 2.1. Study area

This epidemiological study was performed in southwestern of Iran that located between  $29^{\circ} 57' - 33^{\circ} 0' N$  latitudes and  $47^{\circ} 40' - 50^{\circ} 33' E$  longitudes with an area of about  $64,055 \text{ km}^2$ . This province with a population of 4,531,720 inhabitants (2,286,209 male and 2,245,511 female) is bordered by Iraq in the west, Chahar Mahal & Bakhtiari and Kohgiluyeh & Boyer

Ahmad provinces in the northeast and east, Lorestan province in the north, Bushehr province in the southeast and Persian Gulf in the south<sup>8</sup> (Fig. 1).

### 2.2. Data collection

Between 2009 and 2014 from all suspicious CL subjects who referred to health centers affiliated to Ahvaz Jundishapur University of Medical Sciences (Fig. 1), after being examined by a physician in the health center, simple direct smear was



**Figure 2** Spatial distribution of CL in southwest of Iran (2009–2014). This map was created using ArcGIS software by Esri (<http://www.esri.com>).

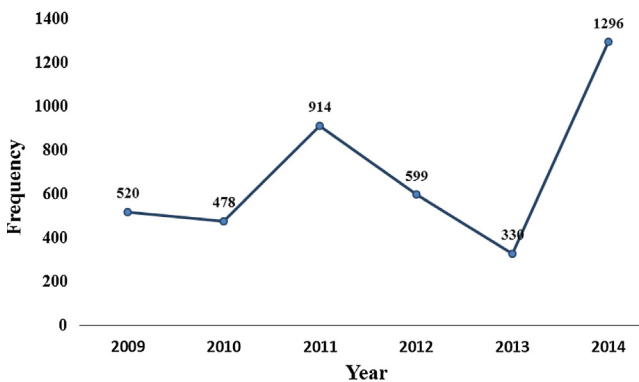
taken from the lesions. Then smears were placed on a microscopic slide. Smears after staining by Giemsa were examined by light microscope in order to perform amastigote detection. It should be mentioned all individuals voluntarily consented to be tested for the cause of ulcers. A questionnaire including some demographic details such as name, gender, age, residence, location of lesions (on hands, feet, face or other places) and other details was filled for each positive subject. Eventually all data were gathered from all mentioned health centers and data were analyzed using SPSS software (version 16) (SPSS Inc., Chicago, IL, USA). Also in order to determine the spatial distribution of infection in the regions between 2009 and 2014, ArcGIS software by Esri (<http://www.esri.com>) was employed.

### 3. Results

During the years 2009–2014, a total of 4137 CL patients were diagnosed smear positive for amastigote forms under light microscope in ten cities affiliated to Ahvaz Jundishapur University of Medical Sciences in southwest of Iran. Overall, spatial distribution of CL in central and west cities was higher than in others (Fig. 2). The trend of leishmaniasis in this geographical regions was highly varied, so that the reported cases in 2013 from 330 increased to 1296 in the end of 2014 (Fig. 3). From ten cities studied, the highest and lowest frequencies of CL patients were registered in Ahvaz city (26% – 1075/4137) as capital of Khuzestan province and Lali county (0.5% 21/4137), respectively (Fig. 4). Distribution of infection based on gender in males and females was 2485 (60.1%) and 1652 (39.9%), respectively. Of these, 2305 (55.7%) individuals lived in urban and 1832 (44.3%) lived in rural regions. Also anatomic location of lesions was as follows: hands 45.7%, feet 27.4%, face 19.1% and other places 7.8%. Based on age categories, the most frequency of disease was observed in 11–30 persons (Table 1).

### 4. Discussion

The incidence of cutaneous leishmaniasis in Iran has been rising trend and several new foci of the disease have been identified in the country during recent years.<sup>6,7</sup> In present investigation, the status of leishmaniasis in southwestern of Iran was fluctuant (Figs. 2 and 3) which is in accordance with previous surveys. For instance based on Athari and Jalallu



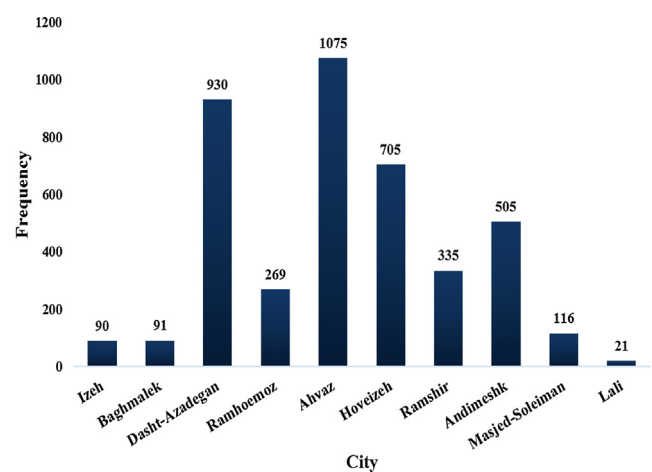
**Figure 3** Trend of CL in southwest of Iran during 2009–2014.

survey, the number of CL positive cases in 2005 (29,824 cases) compared to 2002 (13,729 cases) nearly has doubled in Iran. Also in 2003 the number of CL patients reported was 21,522 and has increased to 27,517 in 2004. Yazd, Bushehr, Khorasan, Fars, Ilam, Khuzestan and Isfahan provinces of Iran with average incidence of 166 cases per 100 thousands of people have the highest incidence in the country, while western and northwest provinces have the lowest incidence (less than 10 cases per 100 thousands).<sup>9</sup>

In our study the prevalence of CL based on gender distribution was higher in males (60.1%) than in females (39.9%) which is in agreement with some investigations such as AlSamarai and AIObaidi in Iraq (57%), Jamal et al. in Pakistan (70.58%), Nateghi Rostami et al. in Qom province (59.2%), Youssefi et al. in Mazandaran province (59.67%) and Karami et al. in Isfahan province (61.8%).<sup>7,10–13</sup> Although in Amraee et al. survey in Poledokhtar town the number of women reported was more than men,<sup>14</sup> this discrepancy may be due to the study population or cultural habit of the region like women's work in livestock breeding or on farming lands. However, in majority of studies cutaneous leishmaniasis is more prevalent in males because of various reasons, such as outdoors social activities, less coverage of body with cloth and traffic in the desert areas.

Based on our result, majority of patients lived in urban areas (55.7%) which is corresponding to India (80%), Northern Khorasan province (60.8%) and Kermanshah province (67%), while in some studies, higher prevalence of the infection was seen in rural areas such as Hormozgan province (79.44%), Mazandaran province (64.52%) and Poledokhtar town (86.77%).<sup>12,14–18</sup> The expansion of CL in Iran from endemic to non-endemic zones is depended upon some environmental factors such as urbanization, development of agriculture projects, irregular immigration, demographic alterations and water supply projects that subsequently lead to enhancement of the incidence and prevalence of infection and imposed economic wastage on society.<sup>5</sup>

In the present study, the age distribution of patients in the age range 11–30 years (45.7%) was higher than in other age groups that is consistent with Hamadan province,<sup>19</sup> while in



**Figure 4** Distribution of CL in cities affiliated to Ahvaz Jundishapur University of Medical Sciences of Khuzestan province during 2009–2014.

**Table 1** Frequency distribution of CL patients based on demographic information from 2009 to 2014 in southwest of Iran.

Year	Total	Gender (n)		Age (n)			Residence		Location of lesions			
		Female	Male	0–10	11–30	> 31	Urban	Rural	Hand	Feet	Face	Other
2009	520	136	384	119	334	67	221	299	286	128	66	40
2010	478	166	312	127	271	80	249	229	240	121	95	22
2011	914	406	508	341	356	217	563	351	392	254	183	85
2012	599	251	348	212	244	143	334	265	281	172	91	55
2013	330	129	201	98	138	94	188	142	132	98	79	21
2014	1296	564	732	436	549	311	750	546	558	362	276	100
Total n (%)	4137 (100%)	1652 (39.9%)	2485 (60.1%)	1333 (32.3%)	1892 (45.7%)	912 (22%)	2305 (55.7%)	1832 (44.3%)	1889 (45.7%)	1135 (27.4%)	790 (19.1%)	323 (7.8%)

some researches, children under 10 years were the more affected group such as Yaghoobi-Ershadi et al. in Isfahan at age group 0–4 (40%) and Sofizadeh et al. in Gonbad kavooos town at age group 0–9 (41.2%).<sup>20,21</sup> The reason for these differences, may be due to intensity of the nativist the infection. So that in some areas such as both Isfahan and Golestan provinces due to abundance the reservoir, carrier and human's high contact with them, the probability of occurrence the disease has exist before 10 years old. Since the acquiring the infection gives a lifelong immunity; thus, CL in endemic regions is very rare in adults and old individuals. It is worth mentioning that at present study rate of infection in this age group has been found 32.3% that indicates significant frequency; therefore, southwest of Iran considered as endemic foci for leishmaniasis.

Lesions caused by CL remain for long period ranged from several months to several years. Approximately 20,000 CL cases were reported from different parts of the Iran annually, although estimated that it is real incidence rate is multifold.<sup>5,9</sup> In the current study the anatomic location of ulcers was assessed in CL patients and obtained results were as follows: hands 45.7%, feet 27.4%, face 19.1% and other places 7.8%. Our finding is similar to the conducted studies such as Hormozgan province (63.35% on the hands and feet), Fasa county (43.24% and 20.44% on hands and feet, respectively) and Poledokhtar town (44.84% and 21.29% on hand and feet, respectively).<sup>14,18,22</sup> Perhaps high temperature and less coverage in these places have been probable reasons. Also, due to short oral appendices of sandflies, may be do not permit the blood-feeding from the covered parts of body. But overall the ulcer sites are depended upon the type of vectors, climate, social and cultural behavior of people.<sup>13</sup> In Jamal et al. study in Pakistan and at Ebadi et al. survey in Isfahan province, face was the most important organ that involved.<sup>10,23</sup>

## 5. Conclusion

Current study has two important limitations. First, since CL is a self-healing infection, some patients might have been cured without any treatment. Second, since our findings are based on data obtained from health centers affiliated to Ahvaz Jundishapur University of Medical Sciences in Khuzestan province, some infected persons might have been referred outside the province for medication. Although the number of these individuals is low and negligible, as mentioned before, the high incidence of CL may be due to the presence of reservoir and

carriers in large numbers in this area. In order to decrease the CL incidence in Khuzestan province during future years, some points are recommended and should be considered such as health education and awareness about disease, traffic control of immigrants and travelers from neighboring endemic countries, personal protection from sandfly biting by curtains and bed nets, eliminating and destroying habitats of the reservoir rodents (*T. indica* in southwest of Iran) and spraying insecticides in habitats of sandflies.

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## Authors contributions

SS, SK, JS and EHG conceived the study; SS, SK and MFR designed the study protocol; SB and EHG collected the data; FHR analyzed and interpreted the data and prepared the maps using Arc GIS software; MFR wrote the manuscript; and MFR and SK critically revised the manuscript. All authors read and approved the final manuscript.

## Conflict of interest

None.

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