

Epidemiological aspects of cutaneous leishmaniasis in Southwest of Iran

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Received: 12-01-2019, **Accepted:** 15-05-2019, **Published online:** 03-06-2019

doi: 10.14202/IJOH.2019.49-53 **How to cite this article:** Darvishi M, Saghaipour A, Moradi-Asl E, Jafari R, Sadati SJA, Darabi H. Epidemiological aspects of cutaneous leishmaniasis in Southwest of Iran. *Int J One Health* 2019;5:49-53.

Abstract

Background and Aim: Zoonotic rodents (Rodentia: Muridae: Gerbillinae) and Phlebotominae sand flies are the major reservoir hosts and vectors of *Leishmania major* causing zoonotic cutaneous leishmaniasis, respectively. This study was carried out to evaluate the epidemiological aspects of cutaneous leishmaniasis (CL) in Tangestan County, Southwest Iran.

Materials and Methods: This descriptive cross-sectional study was carried out on human cases, probable reservoirs, and vectors of CL at Tangestan County in 2017. The data of patients were taken on health centers and analyzed. To determination faunistic of sand flies, they were collected using sticky paper traps and identified using identification keys. The rodent samples were captured using Sherman live traps and determined for amastigote infection.

Results: A total of 436 cases occurred during 2005-2017 and the incidence rate of disease was 0.2-12/100,000 people. Six species of sand flies including three species of *Phlebotomus* and three species of *Sergentomyia* including *Phlebotomus papatasi*, *Phlebotomus sergenti*, *Phlebotomus alexandri*, *Sergentomyia tiberiadis*, *Sergentomyia baghdadis*, and *Sergentomyia clydei* were identified. From 185 trapped rodents, 9 species were identified. We founded, 2 out of 132 *Tatera indica* (1.53%) were positive with *Leishmania* spp. using the microscopic method.

Conclusion: According to the existence of human leishmaniasis cases as a host, *T. indica* with high abundance and infected to *Leishmania* as a reservoir, and existence of *P. papatasi* with high abundance as a suspected vector of disease; there is a potential for transmission of disease in the area. Design of exact control and prevention strategies is highly recommended.

Keywords: cutaneous leishmaniasis, Iran, rodents, sand flies.

Introduction

Leishmaniasis refers to a group of disease which is caused by human pathogens. According to the World Health Organization, with 2 million annual occurrences in the world, leishmaniasis is among the top eight important tropical diseases [1]. Rodents are the largest group of animals with the population greater than other mammals in the world; which are the reservoir of many pathogens [2]. This disease has been expanding throughout its geographical regions.

Recently, cutaneous leishmaniasis (CL) is reported in many rural areas of 17 provinces from Iran [3]. The number of infected people with various species of *Leishmania* is 20,000 people in Iran annually, and its annual incidence is estimated to be about

28 cases/100,000 inhabitants [4]. Zoonotic cutaneous leishmaniasis (ZCL) is prevalent in arid and semi-arid regions of North Africa, Middle East, and Central Asia. In these areas, *Phlebotomus papatasi* and different species of rodents (Rodentia: Muridae) are the main vectors and reservoir hosts. *Rhombomys opimus* and *Psammomys obesus* are the main reservoir in Central Asia and North Africa, respectively [5]. The main reservoir of *Leishmania major*, which is the agent of ZCL is *R. opimus* in Iran. More ever, *Meriones libycus* plays an important role as a secondary reservoir host in areas where *R. opimus* acts as the main reservoir [6]. Furthermore, *Tatera indica* is the main reservoir host and other rodents' species such as *Nesokia indica* and *M. libycus* are the secondary reservoirs in the West and Southern parts of Iran [7].

In Tangestan city in the West of Bushehr Province, there has been a gradual increase in cases of the disease so that the number of cases was 12 and 14 cases in 2016 and 2017, respectively (Reports of Bushehr Health Center). Due to many risk factors such as different topographical conditions of area (coastal, plain, and mountainous), existence of sand

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flies with high abundance as the vector of disease, and expanding rodents as a reservoir host in coastal and plain areas, the issue of the disease expansion to the other areas has been highly raised. Hence, for designing controlling strategies, the epidemiological aspects of disease should be clarified. Therefore, the present study has been carried out to determine the epidemiological aspects of cutaneous leishmaniasis in Tangestan County, Southwest of Iran during 2017.

Materials and Methods

Ethical approval

The study was approved by the Ethical Committee of Bushehr University of Medical Sciences, Iran (Code of ethics: 96-12-95).

Study area and data collection

This cross-sectional study was carried out in all of the urban and rural regions of Tangestan County, Bushehr Province, Southwest Iran. This county is located between 28° 53' N and 51° 16' N in Southwest Iran at the height of 15 m above sea level. The population of the county is 76,706 people according to the recent census in 2016. Its climate is warm and humid. The annual average rainfall is 198-211 mm, and its relative humidity in the central part is 31% at night and 15% in the morning; however, in the coastal area, it is over 11%.

Study design

Data on human cases were prepared by the leishmaniasis diagnostic laboratories and centers of health services. The epidemiological and demographic data of cases including age, gender, number of ulcers, location of the lesion, duration of infection, season, residence place (urban/rural), and history of travel to endemic regions in the past 2 months were registered in "epidemiological survey forms of cutaneous leishmaniasis."

Sand flies were collected using sticky paper traps, from indoor (bathroom, bedroom, guestroom, and toilet) and outdoor places (rodents burrow and around gardens). Sand flies were determined using identification keys [8,9]. Rodents trapping areas were selected based on the history of CL in the county. A totally of 800 Sherman live traps were used for catching rodents. Cucumbers, cheese puffs, and oil-impregnated bread were placed in the traps as bait. The rodents were transferred to Laboratory of Medical Entomology, School of Public Health, Tehran University of Medical Sciences, Iran, and anesthetized by cotton sucked in chloroform.

Rodents were collected and identified using morphological keys. Hence, for parasite identification in rodents, smears prepared from rodents' ears to detect *Leishmania* infection. After that, *Leishmania* infections from rodents were identified morphologically.

Statistical analysis

The data were analyzed using Statistical Package for the Social Sciences software Ver. 22 (Norman

Nie Dale Bent, USA). We used descriptive statistics, including frequency and percent.

Results

Human cases

In term of epidemiological aspects of CL in Tangestan County from Bushehr Province; 436 cases occurred during 2005-2017, and the incidence rate the disease was 0.2-12/100,000 people.

Most cases of CL (33.02%) occur in 2006, and the lowest frequency (0.23%) were observed in 2013, respectively (Figure-1). The majority of the patients (62%) were lived in rural areas. More than half of the cases (57%) were males. The highest frequency of CL was reported in 1-15 age groups (48.50%), and others were observed in 16-40 age groups (41%) and over 40 age groups (10.50%). Based on the incidence of lesions in different body parts; 47% of the ulcers were seen at faces, 28% at the hands, 22% at the feet, and 3% in body of cases. The frequency of lesions was as follows: One lesion, 70%; and >3 lesions, only 7%. In addition, most of the cases were occurred in the autumn (34%) (Figure-2). Furthermore, 17%, 22.5%, and 27.5% were recorded in spring, summer, and winter, respectively.

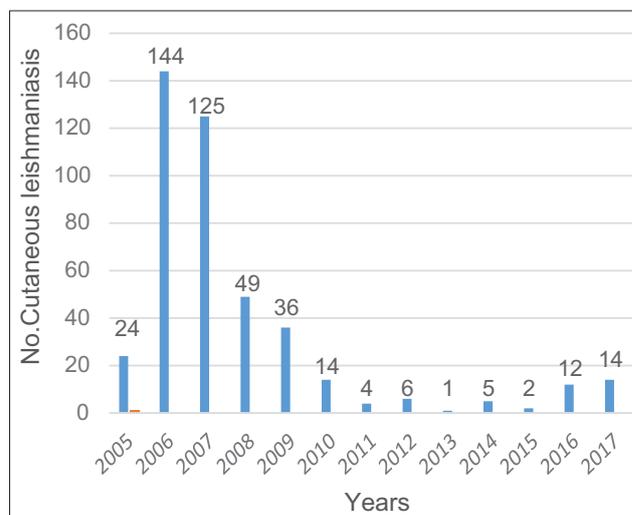


Figure-1: Annually reports of human cutaneous leishmaniasis cases in Tangestan County, Bushehr Province (2005-2017).

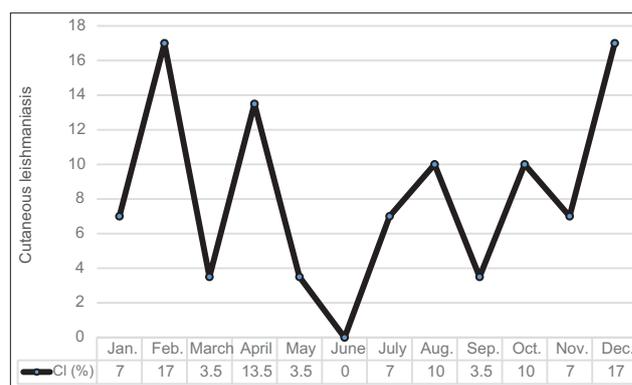


Figure-2: The monthly trend of human cutaneous leishmaniasis in Tangestan County, Bushehr Province (2005-2017).

Sand flies species

During this study period, 1234 sand flies belonging to six species of sandflies (352 [28.53%] and 882 [71.47%] in indoor and outdoor places, respectively) were collected in all locations of Tangestan County. Six species including three species of *Phlebotomus* and three species of *Sergentomyia* including *P. papatasi*, *Phlebotomus sergenti*, *Phlebotomus alexandri*, *Sergentomyia tiberiadis*, *Sergentomyia baghdadis*, and *Sergentomyia clydei* were identified. Totally, 31.2% of the collected sand flies from indoor places were *P. papatasi* (Table-1).

Rodents findings

A total of 185 rodents were trapped and identified to 9 species. The majority of captured rodents were *T. indica* (71.35%), and the least ones were *M. musculus* (0.54%) (Table-2). Out of them, 59.46% of rodents were trapped from the coastal areas and the rest of them from the central part of Tangestan County (Table-2). The most of rodents were captured in autumn. Furthermore, three species; *T. indica*, *N. indica*, and *M. libycus* as main reservoir hosts of CL indifferent areas of Iran were captured as the most frequent species among the trapped rodents. We founded, 2 out of 132 *T. indica* (1.53%) were positive with *Leishmania* spp. microscopically method in Pahlavankoshi village of Delvar Rural District (coastal area) (Table-2).

Discussion

The findings of the current study indicate that the prevalence of the disease was 0.2-12/100,000 people

in Tangestan County from Bushehr Province during 2005-2017. Based on previous studies, the average incidence rate of disease in Iran's provinces was reported as 27/100,000 people in 2011 [10]. Hence, we can conclude that this rate is relatively low in Tangestan County in comparison with other CL foci in Iran. In this present study, more than half of the cases were males. This finding supports erstwhile studies in the country [11]. Furthermore, it was previously proven that males of the working age group are more involved in outdoor activities have higher risk factors for leishmaniasis [12]. The common potential risk factors for the disease including working in open environments in military, nomadic, agricultural, and animal husbandry jobs, and wear less dresses than women which increases the chance of more contact with bites of *Leishmania*-infected sandflies. According to the findings, the majority of the patients were lived in rural areas. In this county, more than half of the people live in rural areas and do not have the measures to prevent disease such as Insecticide-treated bed nets. Most rural homes are also located near the rodent burrows. Furthermore, the breeding place of the sand flies is the burrows of rodents, so people are exposed to bites of sandflies. With this situation, it is expected that the cases of the disease are higher among the villagers. In a similar study conducted in Qom Province, Central Iran, most of the cases were reported in rural areas [13]. The highest frequency of CL (48.50%) was reported in 1-15 age groups. As demonstrated in previous studies, the low

Table-1: The fauna and frequency of sand flies in Tangestan County, Bushehr Province (2005-2017).

Site Species	Total					Each species of the total (%)
	Outdoor n (%)	Indoor n (%)	Male n (%)	Female n (%)	Total n (%)	
<i>P. papatasi</i>	31 (68.88)	14 (31.12)	29 (64.44)	16 (35.56)	45 (100)	3.65
<i>P. sergenti</i>	28 (87.5)	4 (12.5)	21 (65.62)	11 (34.38)	32 (100)	2.59
<i>P. alexandri</i>	1 (100)	0 (0)	0 (0)	1 (100)	1 (100)	0.08
<i>S. tiberiadis</i>	685 (69.05)	307 (30.95)	756 (76.21)	236 (23.79)	992 (100)	80.38
<i>S. baghdadis</i>	136 (83.43)	27 (16.57)	110 (67.48)	53 (32.52)	163 (100)	13.21
<i>S. clydei</i>	1 (100)	0 (0)	1 (100)	0 (0)	1 (100)	0.08
Total	882 (71.47)	352 (28.53)	917 (74.31)	317 (25.69)	1234 (100)	100

P. papatasi=*Phlebotomus papatasi*, *P. sergenti*=*Phlebotomus sergenti*, *P. alexandri*=*Phlebotomus alexandri*, *S. tiberiadis*=*Sergentomyia tiberiadis*, *S. baghdadis*=*Sergentomyia baghdadis*, *S. clydei*=*Sergentomyia clydei*

Table-2: *Leishmania* infection rate in different species of rodents in Tangestan County.

Species	Location of capture		No. rodents n (%)	No. examined n (%)	No. infected	Infected rate (%)
	Central (Ahram)	Coastal (Delvar)				
<i>Tatera indica</i>	56	76	132 (71.35)	130 (98.48)	2	1.53
<i>Rattus norvegicus</i>	0	20	20 (10.81)	20 (100)	0	0
<i>Nesokia indica</i>	12	0	12 (6.48)	12 (100)	0	0
<i>Meriones libycus</i>	1	4	5 (2.71)	5 (100)	0	0
<i>Rattus rattus</i>	0	5	5 (2.71)	5 (100)	0	0
<i>Apodemus sylvaticus</i>	4	0	4 (2.16)	4 (100)	0	0
<i>Gerbillus nanus</i>	0	4	4 (2.16)	4 (100)	0	0
<i>Jaculus jaculus</i>	2	0	2 (1.08)	2 (100)	0	0
<i>Mus musculus</i>	0	1	1 (0.54)	100		
Total	75 (40.54)	110 (59.46)	185 (100)	183 (98.92)	2	1.09

age of cases can be due to the endemicity of disease and local transmission [14]. In this study, reducing the incidence of illness with increasing age was probably due to enough immunity in adults. In addition, more than a third of cases (34%) occurred in the autumn. Regarding the sand flies seasonal activity, previous studies have shown that in the endemic areas of CL in Iran, the majority of sandflies activity and bites are most common in summer and after a short incubation period (about 1-2 months), most patients see lesions in their bodies in the autumn [15]. According to the results, *T. indica*, *N. indica*, and *M. libycus* are the most important species of rodents as the reservoirs of CL. These rodents were captured with high abundant from the coastal areas of Tangestan County. Furthermore, we founded, 2 out of 132 *T. indica* (1.53%) were positive with *Leishmania* spp. In previous studies in Iran, *T. indica* was recorded as reservoir of CL [16]. Some species of the collected rodents in this present study are known as the reservoir of the disease, for instance, in Sistan and Baluchestan Province (East-South of Iran), the *Leishmania* infection rate of *M. libycus* was reported 3.7% [17]. Furthermore, in a study done on the border between Iran and Iraq for determination of the main reservoirs infection (ZCL), the infection rate of *T. indica* to *L. major* with the molecular method was reported 37.19% which indicates the high infection rate of this rodent species in Iran [7]. Comparing the results of this study in the South and Southeast of Iran show that *T. indica* is more widespread in south and southeast areas; however, *Tatera* has not been caught in the North of Iran, and *N. indica* has been caught only by low abundance [18]. In general, the infection rate of various rodents to different species of *Leishmania* in Iran from 1995 to 2015 shows that the average infection rate is 23%, and also in term of spatial distribution, the highest infection rate of rodents is 50% in the North of Iran and the lowest rate is 11% in West of Iran. Three of the major rodents which are more abundant in Iran are *R. opimus*, *M. libycus*, and *T. indica* but the prevalence of *Leishmania* parasite in the *N. indica* species (48%) is greater than all of these three species. In this study, six species including three species of *Phlebotomus* and three species of *Sergentomyia* were identified. *P. papatasi* and *P. sergenti* that were collected in this present study are the main vectors of ZCL and anthroponotic CLACL in foci of Iran and many other old world countries [19,20].

Conclusion

To the best of our knowledge, considering the reported human leishmaniasis cases as a host, *T. indica* with high abundance and infected to *Leishmania* parasite as a reservoir, and existence of *P. papatasi* with high abundance as a suspected vector of disease; there is a high potential for transmission of this disease in this area, and it is recommended that prevention measures should be taken.

Authors' Contributions

AS and EM designed the study. AS, MD, RJ, SJAS, and HD collected the data. AS, EM, and MD interpreted the results and analyzed the data. AS, EM, and MD prepared the manuscript. All authors read and approved the final manuscript.

Acknowledgments

This study was supported by Research Deputy of Bushehr University of Medical Sciences, Bushehr, Iran (Project No: 10297).

Competing Interests

The authors declare that they have no competing interests.

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