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Original Article

# Epidemiology of Cutaneous Leishmaniasis in Isfahan Province in Iran

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## Abstract

**Background & Aims:** Leishmaniasis is one of the parasitic diseases prevalent in most countries, especially in tropical and subtropical regions. The present study aimed to evaluate the epidemiology of cutaneous leishmaniasis in Isfahan province in Iran from 2007 to 2018.

**Materials and Methods:** The present study was a cross-sectional study. The patients' demographic variables were extracted separately from 2007 to 2018 from the epidemiological information system of leishmaniasis in Isfahan Health Center. The collected data were analyzed using the STATA14 software at a significance level of 5%.

**Results:** Information on 27,046 patients with cutaneous leishmaniasis was registered at the Isfahan Health Center. Of these, 61.84% were male and 38.16% were female. The mean age of the infected individuals was 23.68 years, with a standard deviation of 18.63. Isfahan city had the highest incidence among all endemic and non-endemic areas of the province, with 71.4%. The predominant type was *Leishmania* major. Hands were the most vulnerable body parts, accounting for 36%.

**Conclusion:** According to the obtained results, the preventive interventions of the provincial health center have been effective and have led to a reduction in the incidence of the disease in the years following the implementation of these interventions. The sudden increase in disease cases in 2018 may serve as a warning sign of a potential shift in the disease and its spread in non-endemic areas of Isfahan Province. Additionally, considering the importance of leishmaniasis in this province, allocating a higher budget for public education, intensifying preventive measures, and conducting broader studies should be prioritized.

**Keywords:** Cutaneous, Epidemiology, Leishmaniasis, Parasitic diseases

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## 1. Introduction

Despite the increasing progress in the control of human infectious diseases, parasitic diseases are still one of the main problems of the healthcare system. Leishmaniasis is one of these parasitic diseases [1-3]. Leishmaniasis is the second most important tropical disease after malaria, which is endemic in the tropical regions of America, Africa, the Indian subcontinent, the subtropical regions of Southwest Asia, and the Mediterranean region, and one to two cases occur every year. This disease affects millions of people in the world. Leishmaniasis is one of the six important diseases of tropical regions [4].

According to the World Health Organization reports, in 2017, out of 200 countries and regions that reported to the World Health Organization, 97 countries had leishmaniasis. Among these, visceral and cutaneous forms are common in 65 countries, only visceral forms in 10 countries, and only cutaneous forms in 22 countries [5].

In addition, according to the report of the World Health Organization in 2015, the incidence of cutaneous leishmaniasis in Afghanistan was 2.3, in Brazil 8.9, in Pakistan 8.8, in Peru 16.3, in Saudi Arabia 3.9, and in Sudan 9.01 per 100,000 people [6-11].

According to reports by the World Health Organization in 2015, the incidence rate of cutaneous leishmaniasis was approximately 27.8 per hundred thousand people, which is likely 4 to 5 times higher than the reported cases. The highest rates are found in the regions east of the Caspian Sea, as well as in the southern, southeastern, and central parts of the country. [2,12-15].

Leishmaniasis does not lead to death among the infected patients; therefore, it has become a forgotten health problem, while 17 out of 31 provinces of the country are somehow involved in rural cutaneous

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leishmaniasis [16]. Leishmaniasis causes economic, social, and psychological problems and irreparable damage to society. As a fundamental problem, it has attracted an important part of health and social activities. In general, the incidence rate of this disease has been increasing in recent years due to various reasons in most regions of the country, including Isfahan province so that the necessity of conducting a series of epidemiological studies in this field is felt.

In recent years, factors such as climate and weather changes, decrease in rainfall, drought, loss of vegetation, migration to the city, marginalization, and migration of rodents have affected the incidence of the disease and caused the transmission and spread of the parasite and leishmaniasis vector to other uninfected areas. Employment in the open air and animal husbandry are other factors affecting exposure to the vector and contracting this disease [17-20].

Therefore, by conducting this multi-year cross-sectional study using the available data, it is possible to identify the individual, spatial, and temporal characteristics of the disease and use them in the advancement of preventive intervention programs and subsequent studies.

The causative agent of leishmaniasis is a protozoan called *Leishmania*, which belongs to the order Kinetoplastida. It can exist in two forms: free flagellated and amastigote, depending on the living environment. This parasite lives in mononuclear phagocytic cells in vertebrates and multiplies in this environment [21].

Approximately 98 species of female sandflies transmit the infection caused by this protozoan. So far, 56 species of sandflies, 32 species of *Phlebotomus*, and 24 species of *Sergentomyia* have been identified in Iran. [22].

Leishmaniasis is classified as a zoonotic disease, presenting in three forms: cutaneous (seeker), visceral (kala-azar), and mucocutaneous (Espundia). Cutaneous leishmaniasis is the most common form, and it can be observed in two types: dry (urban) and wet (rural) [23].

In urban leishmaniasis, patients are primarily reservoirs of the disease, which is referred to as the dry type due to the appearance of the lesions. The main vector of the disease in this type is *Phlebotomus sergenti*. In rural leishmaniasis, the primary reservoirs are mainly desert rodents, and so far, four species of these rodents have been identified as the main reservoirs of the disease in Iran. *Leishmania major* is the causative agent of rural leishmaniasis, which is called the wet type due to the presence of exudate in the lesions. The definitive and primary vector of wet cutaneous leishmaniasis in Iran and some other countries, such as Turkmenistan, Uzbekistan, Saudi Arabia, Morocco, and Tunisia, is *Phlebotomus papatasi* [21, 23].

The present study was conducted to describe the epidemiological situation of cutaneous leishmaniasis in Isfahan province during 2007-2018. We hope that the findings of this study will help to plan and provide effective measures to control cutaneous leishmaniasis in the province.

## 2. Materials and Methods

The present study was conducted using a cross-sectional (descriptive-analytical) protocol based on data obtained from 27,046 patients with leishmaniasis. The statistical population included all individuals diagnosed clinically with leishmaniasis and confirmed through laboratory tests at healthcare centers in Isfahan province (excluding Kashan County) from 2007 to 2018 who were undergoing treatment and follow-up. Given the nature of the study, all new leishmaniasis cases from 2007 to 2018 were included, and cases that did not meet the criteria were excluded. This study was completed in 2019 in collaboration with the Health Deputy of Isfahan University of Medical Sciences over a period of eight months.

Data related to demographic and disease variables, including age, gender, nationality, occupation, place of residence (city and village), type of agent, location of lesion, and number of lesions separately from 2007 to 2018 from the epidemiological information registration system of cutaneous leishmaniasis in the unit for the fight against diseases at the health center of Isfahan province.

During the study, all the ethical standards related to the patients were observed so that the names and family names of the patients were removed, and all the patients' information was reported in a group.

Mean and standard deviation were employed to describe quantitatively collected data, and percentages with 95% confidence limits were used for qualitative collected data. The collected data were analyzed using STATA14 software at a significance level of 5%.

### *Inclusion and Exclusion Criteria*

All patients registered on the Ministry of Health portal were included in the study. In addition, patients living in Kashan city were excluded from the study because this study was conducted in Isfahan province, excluding Kashan city.

## 3. Results

Information regarding 27,046 cases of patients with cutaneous leishmaniasis was recorded in the health center of Isfahan province. Among them, 16,724 (61.84%) were males and 10,322 (38.16%) were females.

The mean (standard deviation) age of affected people was 23.68 (18.63). The mean (standard deviation) of gender-specific age was 23.67 (17.64) for males and 23.77 (20.15) for females. Incidence rates based on age groups showed that the highest rates were in the 20-29 years old group (27.64%) and the 1-month to 10-year-old group (24.89%). Conversely, the age group of 70 and older had the lowest incidence rate at 2.37%.

Frequency distributions regarding the status of patients by age and gender group are presented in Table 1 and Table 2.

Table 1. Frequency distribution of patients with cutaneous leishmaniasis according to age groups in Isfahan province in 2007-2018

| Age Group | 1-9 Years | | 10-19 Years | | 20-29 Years | | 30-39 Years | | 40-49 Years | | 50-59 Years | | 60-69 Years | | Over 70 Years Old | | Total | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Year | N | P (%) | N | P (%) | N | P (%) | N | P (%) | N | P (%) | N | P (%) | N | P (%) | N | P (%) | N | P (%) |
| 2007 | 798 | 25.21 | 569 | 17.98 | 1113 | 35.17 | 276 | 8.72 | 190 | 6 | 107 | 3.38 | 54 | 1.71 | 58 | 1.83 | 3165 | 100 |
| 2008 | 416 | 21.33 | 335 | 17.18 | 703 | 36.05 | 237 | 12.15 | 115 | 5.90 | 75 | 3.85 | 36 | 1.85 | 33 | 1.69 | 1950 | 100 |
| 2009 | 889 | 27.74 | 667 | 20.81 | 861 | 26.86 | 308 | 9.61 | 213 | 6.65 | 123 | 3.84 | 67 | 2.09 | 77 | 2.40 | 3205 | 100 |
| 2010 | 544 | 25.47 | 394 | 18.45 | 590 | 27.62 | 217 | 10.16 | 170 | 7.96 | 108 | 5.06 | 52 | 2.43 | 61 | 2.86 | 2136 | 100 |
| 2011 | 494 | 20.50 | 417 | 17.30 | 878 | 36.43 | 315 | 13.07 | 124 | 5.15 | 104 | 4.32 | 47 | 1.95 | 31 | 1.29 | 2410 | 100 |
| 2012 | 524 | 22.10 | 390 | 16.45 | 641 | 27.04 | 305 | 12.86 | 207 | 8.73 | 158 | 6.66 | 82 | 3.46 | 64 | 2.70 | 2371 | 100 |
| 2013 | 722 | 27.43 | 503 | 19.11 | 660 | 25.08 | 290 | 11.02 | 173 | 6.57 | 140 | 5.32 | 80 | 3.04 | 64 | 2.43 | 2632 | 100 |
| 2014 | 690 | 26.57 | 467 | 17.98 | 609 | 23.45 | 311 | 11.98 | 202 | 7.78 | 137 | 5.28 | 94 | 3.62 | 87 | 3.35 | 2597 | 100 |
| 2015 | 371 | 22.15 | 329 | 19.64 | 406 | 24.24 | 226 | 13.49 | 131 | 7.82 | 93 | 5.55 | 61 | 3.64 | 58 | 3.46 | 1675 | 100 |
| 2016 | 293 | 25.11 | 241 | 20.65 | 291 | 24.94 | 153 | 13.7 | 82 | 7.2 | 60 | 5.14 | 28 | 2.4 | 17 | 1.46 | 1167 | 100 |
| 2017 | 241 | 26.17 | 160 | 17.37 | 230 | 24.97 | 143 | 15.53 | 59 | 6.41 | 49 | 5.32 | 18 | 1.95 | 21 | 2.28 | 921 | 100 |
| 2018 | 749 | 26.61 | 545 | 19.36 | 492 | 17.48 | 439 | 15.6 | 257 | 9.13 | 156 | 5.54 | 108 | 3.84 | 69 | 2.45 | 3165 | 100 |
| Total | 6731 | 24.89 | 5017 | 18.55 | 7474 | 27.64 | 3220 | 11.91 | 1925 | 7.12 | 1310 | 4.84 | 727 | 2.69 | 640 | 2.37 | 27046 | 100 |

Table 2. Frequency distribution of patients with cutaneous leishmaniasis according to gender groups in Isfahan province in 2007-2018

| Year / Gender | | 2007 | 2008 | 2009 | 2010 | 2011 | 2012 | 2013 | 2014 | 2015 | 2016 | 2017 | 2018 | Total |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Male | N | 1996 | 1270 | 1814 | 1335 | 1600 | 1475 | 1570 | 1555 | 1086 | 776 | 583 | 1664 | 16724 |
| | P (%) | 63.06 | 65.13 | 56.60 | 62.44 | 66.39 | 62.21 | 59.65 | 59.88 | 64.84 | 66.50 | 63.30 | 59.11 | 100 |
| Female | N | 1169 | 680 | 1391 | 803 | 810 | 896 | 1062 | 1042 | 589 | 391 | 338 | 1151 | 10322 |
| | P (%) | 36.94 | 34.87 | 43.40 | 37.56 | 33.61 | 37.79 | 40.35 | 40.52 | 35.16 | 33.50 | 36.70 | 40.89 | 100 |
| Total | N | 3165 | 1950 | 3205 | 2138 | 2410 | 2371 | 2632 | 2597 | 1675 | 1167 | 921 | 2815 | 27046 |
| | P (%) | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 |

The incidence rate of cutaneous leishmaniasis in the endemic centers covered by Isfahan University of Medical Sciences from 2007 to 2013 exhibited an irregular pattern with an overall downward trend.

From 2007 to 2011, the incidence rate of cutaneous leishmaniasis showed a consistent downward trend, decreasing from 58 per 100,000 people in 2007 to 2018 per 100,000 people in 2011. However, by 2018, this trend reversed, with the incidence rising to 60 per 100,000 people.

Regarding the nationality of the patients, out of 27,046 patients, 24,533 (90.72%) were Iranian, 2,496 (9.22%) were Afghan, 11 (0.04%) were Pakistani, and 6 (0.02%) were Iraqi.

Regarding the variable of residence, from the total number of patients, 17,887 people (66.14%) lived in the city, 9123 people (33.74%) lived in the village, 31 people (0.11%) were mobile, and five people (0.01%) were nomads.

Regarding the incidence rate presented for each year across the entire province, 2008 recorded the highest incidence rate at 80 per 100,000 cases, while 2017 had the lowest incidence rate at 19.8 per 100,000 cases during the studied period (2007-2018).

The incidence rate was calculated by dividing the number of new cases in each county by the population of that county each year.

In addition, based on the incidence rate presented in the months of each year for the entire province, October and November had the highest incidence, with 29.66% and 24.80%, respectively, and April, with 0.37%, had the lowest incidence during the studied period (2007-2018).

The monthly statistics provided represent an overall statistic for each month during the 12-year period. It is observed that September consistently had a higher incidence rate compared to other months, whereas March recorded the lowest incidence rate across all the years studied.

Isfahan city had the highest incidence among all endemic and non-endemic regions of the province, with a rate of 71.04%. Regarding the cause of the disease, the dominant type was *Leishmania major*; therefore, in 97.3% of the cases, the disease appeared in the form of cutaneous leishmaniasis.

Frequency distributions regarding the location and number of lesions are presented in Table 3 and Table 4.

Table 3. Frequency distribution of the lesion site in patients with cutaneous leishmaniasis in Isfahan province from 2007 to 2018

| Organ Involved | Hand | Leg | Face | Hand and Leg | Hand and Face | Face and Feet | Hands, Face, and Feet | Other Organs |
|---|---|---|---|---|---|---|---|---|
| N | 9687 | 6221 | 3228 | 3168 | 1503 | 372 | 514 | 2353 |
| P (%) | 35.82 | 23.00 | 11.94 | 11.71 | 5.56 | 1.38 | 1.90 | 8.70 |

Table 4. Frequency distribution of the number of lesions in patients with cutaneous leishmaniasis in Isfahan province from 2007 to 2018.

| Number of Lesions | 1 | 2 | 3 | +3 | Total |
|---|---|---|---|---|---|
| N | 11356 | 6088 | 1106 | 8496 | 27046 |
| P (%) | 41.99 | 22.51 | 4.09 | 31.41 | 100 |

## 4. Discussion

This study examined the epidemiology of cutaneous leishmaniasis in Isfahan province over 12 years. This research included the statistical population of all affected people during the years 86 to 97 in Isfahan province (except Kashan city) who were treated and followed up with the clinical diagnosis of cutaneous leishmaniasis and laboratory confirmation in health centers. The results of this study indicate that, due to effective measures in the prevention and control of the disease, cutaneous leishmaniasis remains one of the health priorities in the province.

According to recent studies, leishmaniasis is increasing worldwide, including in Iran [24]. Identifying the epidemiological aspects of leishmaniasis is essential for developing a control and treatment plan, as it will determine the type of disease, the manifestation of clinical symptoms, and the appropriate treatment strategies for the region. Disease management in indigenous areas is important in order to prevent the spread of the disease and treatment.

The highest rate of cutaneous leishmaniasis was observed in 2009, 2007, and 2018, respectively. Regarding the gender of the affected population in all years, males with an average of 62.42% were more than the female population with cutaneous leishmaniasis. This issue can be due to the employment of males in animal husbandry and agriculture, which is the most prevalent in the leishmaniasis-prone areas of the province and causes an increase in the contact of people with mosquitoes and the transmission of the disease. These results were consistent with the cross-sectional studies of the epidemiologic study of cutaneous leishmaniasis by Mohammadi et al. in Marodasht (Iran) in 2016 on 436 patients and the results of the study by Chegani et al. in Lorestan (Iran) on 300 patients. It was also consistent with another study conducted in Pakistan by Ullah et al., which reported the prevalence of cutaneous leishmaniasis among males more than females [25-27]. However, the study conducted by Jafar Nejad et al. in Lamard (Iran) in 2015, which analyzed 907 patients, reported a higher rate of infection in females (51.8%) compared to males (48.1%). This discrepancy may be attributed to the high prevalence and transmission of the disease agent and vector in residential areas [28].

The findings of the present study indicate that there are disease cases across all age groups, with the highest incidence observed in the 20-29 years and 1-month to 10 years age groups, accounting for 27.64% and 24.89% of cases, respectively. These results align with Nilforosh's study in Isfahan and Nejati et al.'s research in Andimeshk (Iran) [14, 29]. However, due to the absence of a standardized criterion for defining age groups, comparing all studies conducted on this issue is challenging.

The carrier of leishmaniasis cannot bite through clothing, making the hands, feet, and face more vulnerable than other body parts. The findings of the present study also indicate that most lesions occur on the hands, feet, and face, respectively. In the study by Ramezani et al. conducted in Aran and Bidgol (Iran), hands were identified as the most vulnerable area, with a reported rate of 29% [30]. These results are consistent with the findings of Roghani et al. in Ilam (Iran) and Zahirnia et al. in Hamadan (Iran) [31, 32].

In general, according to the results of this study and the growing trend of cutaneous leishmaniasis in the province in 2018, special attention should be paid to this disease, and it should be considered as one of the province's health priorities for the management and control of the disease. The Leishmania program of Isfahan University of Medical Sciences requires the serious cooperation of groups, such as health education, medical entomology, epidemiology, parasitology, laboratory, immunology, environmental health, and pharmacy. In addition, promoting personal protective equipment against the bite of the disease vector, access to bite prevention items, and effective public education are among the most important available solutions.

## 5. Conclusion

In general, according to the results of this study, special attention should be paid to this disease, and it should be considered one of the province's health priorities for the management and control of the disease. The leishmaniasis program of Isfahan University of Medical Sciences requires the serious cooperation of groups, such as health education, medical entomology, epidemiology, parasitology, laboratory, immunology, environmental health, and pharmacy. In order to prevent the spread of the disease, it is essential to allocate necessary funds promptly, foster inter-sectoral cooperation and participation, strengthen effective, diverse, and dynamic educational programs, and conduct studies on a broader scale.

In addition, promoting the use of personal protective equipment against bites from the disease vector, along with ensuring access to bite prevention items and providing effective public education, are among the most important solutions available for controlling leishmaniasis.

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### Authors' Contribution

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## Competing Interests

The authors declared that there is no conflict of interest.

## Ethical Approval

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