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Research Article

A Retrospective Analysis of Human Cutaneous *Leishmaniasis* Epidemiology During 2016 - 2021 in Hoveyzeh County, Khuzestan Province, Iran

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Abstract

Background: *Leishmaniasis*, a significant neglected tropical disease, is caused by obligate intracellular protozoa of the *Leishmania* genus.

Objectives: This research aimed to investigate the epidemiology of cutaneous *leishmaniasis* (CL) from 2016 to 2021 in Hoveyzeh county.

Methods: This study is a retrospective, cross-sectional, descriptive study based on available data. The study population included all individuals treated and followed up in health care centers who were clinically diagnosed with CL and confirmed by laboratory tests.

Results: Among the 628 individuals diagnosed with CL, 324 (51.6%) were male, and 304 (48.4%) were female. The average age of the patients was 16.58 ± 15.17 years. The highest proportion (45.4%) of cases occurred in the 0 - 10-year age group, highlighting the vulnerability of children, while those above 50 years had the lowest incidence (3.7%). Approximately 68.2% of patients resided in urban areas, with the remainder living in rural settings. The hand was the most frequently affected area (44.5%), and the maximum number of lesions reported in a single individual was 25. Most patients (46.82%) were treated with topical glucantime along with cryotherapy. Disease incidence showed seasonal variation, with the highest number of cases reported in autumn (54%) and a significant peak in December (22%). The highest incidence year was 2016 (30.3%).

Conclusions: Effective strategies to combat this disease should include comprehensive public awareness campaigns focused on health education, early recognition of symptoms, and transmission methods. Promoting personal protective measures is crucial for disease prevention efforts.

Keywords: Cutaneous *Leishmaniasis*, Epidemiology, Hoveyzeh, Khuzestan, Iran

1. Background

Leishmaniasis, a significant and often underestimated tropical infectious disease, is caused by obligate intracellular protozoan organisms of the *Leishmania* genus. Transmission typically occurs through the bites of mosquitoes belonging to the *Phlebotomus* genus (1-3). *Leishmaniasis* is endemic in over 98 countries, affecting an estimated 350 million people worldwide, with an additional 2 to 2.5 million new cases reported annually (4, 5).

Clinical manifestations of *leishmaniasis* are classified into three forms cutaneous, mucosal, and visceral depending on the *Leishmania* species involved (3, 6). Approximately 75% of cutaneous *Leishmaniasis* (CL) cases are concentrated in ten countries: Afghanistan, Algeria,

Brazil, Colombia, Costa Rica, Ethiopia, Iran, Sudan, Peru, and Syria (4, 7). In Iran, the estimated incidence of CL is around 20,000 cases across various regions, although the actual number is likely higher (1, 6, 8-10).

The epidemiological and clinical characteristics of CL vary depending on interactions between different factors such as parasite strain, host, vector, and environmental and socioeconomic risk factors (3, 9, 11, 12). In Iran, CL manifests in two forms: Anthroponotic CL (ACL, urban or dry type) and zoonotic CL (ZCL, rural or wet type), caused by *Leishmania tropica* and *Leishmania major*, respectively (9, 13). Currently, 19 of Iran's 31 provinces are affected by ZCL (6).

The spread of CL is influenced by various factors, including environmental changes, agricultural developments, urban sprawl, migration to endemic areas, proximity of homes to rodent habitats, construction of water reservoirs like dams, and fluctuations in vector control efforts targeting CL (9, 10, 14). In Iran, approximately 80% of annual *Leishmaniasis* cases are attributed to ZCL, 0.5% to visceral *Leishmaniasis*, and the remainder to ACL (15). However, these figures likely underestimate the true incidence due to underreporting in underserved areas, challenges in disease diagnosis, and limitations in the sensitivity of laboratory diagnostics (16).

The economic impact of CL is significant, particularly in developing countries, where it places a considerable burden on families, communities, and nations as a whole (17). In Iran, the estimated economic burden of the disease is approximately 5 - 6 million dollars (18).

Khuzestan province, situated in southwestern Iran, holds strategic importance due to its environmental conditions and geographical location (19-22). In recent decades, the province has undergone significant climatic changes (23), which have become critical risk factors for the spread of vector-borne diseases like CL (24). Currently, Khuzestan is one of the most significant endemic areas for CL in Iran (25). Both ACL and ZCL have been reported in Khuzestan, with ZCL being considered endemic (6).

Numerous studies have been conducted on the epidemiology of CL in various regions of Khuzestan province in recent years. For example, between 2008 and 2013, health centers in ten cities within the province reported a total of 4,137 confirmed cases of CL through blood slide examinations, revealing the presence of the amastigote form of the *Leishmania* parasite (26). Due to its proximity to Iraq, a country with a high prevalence of CL, Khuzestan province experiences continuous cross-border movement throughout the year, further contributing to the spread of the disease (27).

Hoveyzeh county is recognized as an endemic area for CL (26). Despite the existing literature on CL epidemiology in various parts of Khuzestan province (26, 28-30), only one study specifically focused on Hoveyzeh county, authored by Jayrvnd and Vaziri (31).

2. Objectives

In light of the significant medical and economic impact of CL, as well as its zoonotic potential, it is essential to conduct epidemiological studies to determine the prevalence of the disease and implement a comprehensive program to prevent and control its spread. Given the lack of comprehensive studies on CL in Hoveyzeh county, this research aims to investigate the epidemiology of CL from 2016 to 2021 in this region.

3. Methods

3.1. Study Design and Area

The current study is a retrospective, cross-sectional, descriptive study based on available data. It was conducted in Hoveyzeh county, which is located at 31.46 degrees North and 48.07 degrees East, in the western part of Khuzestan province. The county comprises two cities: Rofayyeh and Hoveyzeh (Figure 1).

3.2. Setting

The statistical population includes all individuals who were treated and followed up in healthcare centers from 2016 to the end of 2021 in Hoveyzeh county, and were clinically diagnosed with CL, with confirmation through laboratory tests. The epidemiological data for these individuals are summarized in the study forms. All individuals diagnosed with CL during this five-year period were included in the analysis. Patient information is kept strictly confidential, and data is entered using codes rather than any form that could identify the patients.

After receiving ethical clearance from Jundishapur University of Medical Sciences, Ahvaz, the researchers referred to the Hoveyzeh Health Center, where patient information was registered. The required information for each patient, including age, sex, lesion type (dry or wet), place of residence, history of travel, number and shape of wounds, location of wounds, time of infection, type of treatment, and recurrence, was entered into the relevant checklist. All patient information remained confidential, with data being entered using codes instead of names.

Figure 1. Map of the location of Hoveyzeh county in Khuzestan province, southwest Iran

3.3. Statistical Analysis

The data was analyzed using GraphPad Prism software version 15, employing descriptive statistical tests, including mean, standard deviation, frequency, percentages, and 95% confidence interval (CI).

4. Results

A total of 628 patients with CL were identified between 2016 and 2021. Of these, 324 (51.6%) were male and 304 (48.4%) were female. The mean age of the patients was 16.58 ± 15.17 years, with an age range of 1 month to 80 years. The age group with the highest proportion of cases (45.4%) was individuals between 0 and 10 years old, while the group with the lowest proportion of cases (3.7%) consisted of individuals over 50 years old.

In terms of residency, 68.2% of the patients lived in urban areas, while 31.8% resided in rural areas. The largest occupational group was students, comprising 186 individuals (29.6%). Analysis of wound characteristics revealed that wet wounds were more prevalent (95.22%) than dry wounds. The number of wounds in patients ranged from one to 25, with an average diameter of 1.82 ± 1.6 cm. The distribution of affected limbs was as follows: 44.4% on the hand, 21.8% on the foot, 14.8% on the face, 4.6% on both the hand and foot, 4.8% on the arm, and 9.6% on other body parts.

A review of the medical records revealed that approximately 96.97% of patients had no history of previous scars. Regarding treatment, most cases received simultaneous local treatment with cryotherapy (46.82%) (Table 1 and Figure 2).

The incidence of CL showed a fluctuating pattern from 2016 to 2021. There was an upward trend from 2017 to 2018, followed by another increase from 2019 to 2020, with a subsequent decline from 2016 to 2021. The highest proportion of cases (54%) occurred during the fall season, with December recording the highest frequency (22%) among the months, followed by November and October. The peak year for incidence was 2016, which accounted for 30.3% of the cases (Figure 3).

5. Discussion

The present study was conducted to investigate the epidemiological and clinical features of CL in Hoveyzeh county, Khuzestan province, Iran. A total of 628 patients with CL were examined over a period of five years. Neglected tropical diseases often affect impoverished populations due to poor hygiene, substandard housing, and limited access to basic nutrition. *Leishmaniasis*, as a neglected tropical disease, is particularly prevalent in disadvantaged areas (32).

The prevalence of CL varies across different regions, with demographic factors influencing its distribution. The disease affects individuals of all age groups, though some regions show a higher prevalence among the

Table 1. Demographic and Clinical Characteristics of Cutaneous Leishmaniasis Patients in Hoveyzeh County, During 2016 - 2021

Characters and Categories	No (%)
Gender	
Male	324 (51.6)
Female	304 (48.4)
Age group	
0 - 10	285 (45.4)
11 - 20	138 (22)
21 - 30	105 (16.7)
31 - 40	53 (8.4)
41 - 50	24 (3.8)
> 50	23 (3.7)
Residence	
Urban	428 (68.2)
Rural	200 (31.8)
Job	
Child	217 (34.6)
Student	186 (29.6)
Homemaker	120 (19.1)
Employee	32 (5.1)
Soldier	19 (3)
Farmer	10 (1.6)
Other	44 (7)
Travel history	
Yes	43 (6.8)
No	585 (93.2)
Treatment	
Topical glucantime & cryotherapy	294 (46.8)
Topical glucantime	205 (32.6)
Systemic glucantime	121 (19.2)
Cryotherapy	4 (0.7)
Other	4 (0.7)

elderly, while others, including this study, show a higher prevalence among the young. In this study, the age group of 1 - 10 years comprised the largest proportion of patients (45.4%), with 186 students (29.6%). These findings align with previous studies conducted in Saudi Arabia, Dasht-e-Azadegan, and Kerman (28, 33, 34). They indicate an initial increase in CL prevalence among individuals under 15 years of age, followed by a decline due to acquired immunity, making children and students more susceptible (33).

According to the results of this study, the incidence of CL was higher in men, which is consistent with the findings of the Hamedan and Dasht-e-Azadegan studies (28, 35). However, this result differs from that of the study by Akhavan et al. (36). Most studies demonstrate that both men and women are susceptible to infection, but men are more likely to be exposed due to occupational factors such as agricultural work, outdoor activities, and clothing choices that increase vector exposure during travel to endemic areas (35, 37).

Most cases were concentrated in urban areas, a finding that aligns with studies conducted in Kashan by Doroodgar and Doroodgar (38), and in Dasht-e-Azadegan by Kassiri et al. (28). However, this contrasts with the findings of Al-Waaly and Shubber (37) in Iraq. It is important to note that prevalence rates can vary between rural and urban populations in different cities. Urban residents often have easier access to health centers, which may lead to lower reporting of CL cases in rural areas. Additionally, inadequate environmental hygiene and lack of proper sewage systems, particularly in marginal urban areas, contribute to increased mosquito populations, resulting in higher reported cases of CL in cities (28).

The prevalence of lesions was 44.4% on the hands and 21.8% on the feet. Since the hands are often uncovered

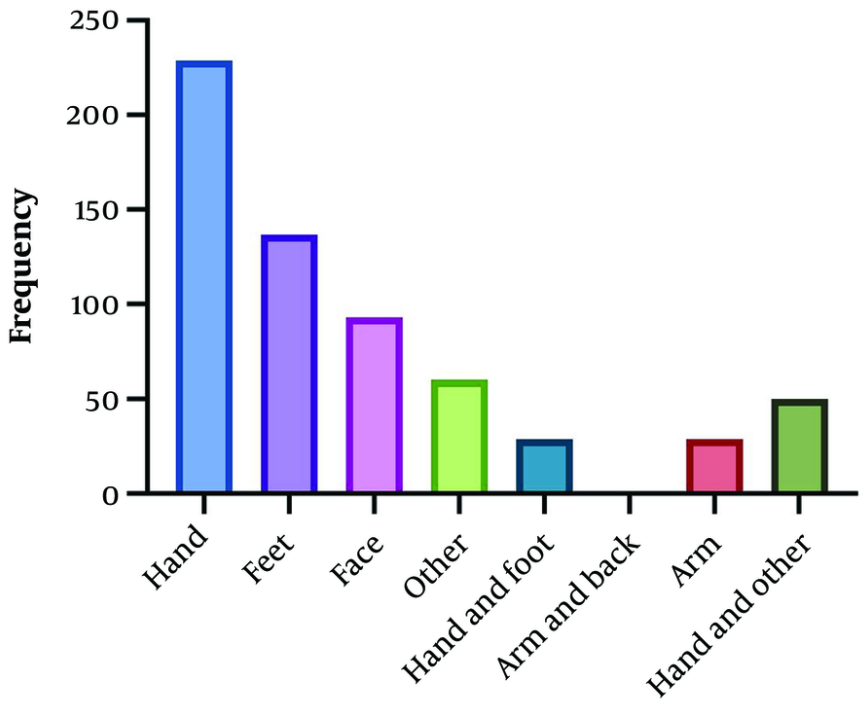

Figure 2. Distribution of cutaneous *leishmaniasis* (CL) patients in Hoveyzeh county, according to lesion site, during 2016 - 2021

and easily exposed to bites from infected sand flies, lesions are more commonly found on the hands than on other parts of the body. These findings corroborate previous research conducted in Dezful and Neyshabur (30, 39). Wet wounds (95.22%) were more common than dry wounds, and 96.97% of patients had no history of previous scars. The mean wound diameter in this study was 1.82 ± 1.60 cm, with the number of lesions ranging from one to 25. The maximum number of lesions documented in a study conducted in Jahrom was 30. A high number of lesions can be attributed to several factors, including the characteristics and behavior of blood-sucking insects, the density of infected sand flies in the endemic area, and the number of bites per feeding by the sand fly (40).

The standard treatment in Iran typically includes the administration of meglumine antimoniate (glucantime) injections, cryotherapy, or a combination of both. Most patients in this study received simultaneous local treatment with cryotherapy (46.8%), which aligns with findings from Libya and Dasht-e-Azadegan (41) but differs from the Doroodgar et al.'s study (38). The seasonal peak of CL occurred in autumn, with the highest number of cases in December (21.97%). This could be due to the disease's incubation period, weather conditions, and the peak activity of sand flies during this time (38). These findings align with research conducted in Kashan (39) and Isfahan (38), but contrast with the higher winter prevalence reported in Kermanshah (42).

Several factors influence the location of lesions on the body, including the species and biting habits of sand flies, social and cultural activities, and weather conditions. Clothing style is one of the most significant factors in determining the location of lesions (17). In general, outdoor occupations increase the risk of CL due to greater exposure to sand fly bites (32).

One of the major challenges in controlling CL, particularly in urban areas, is the combined influence of multiple factors in disease transmission. Variations in the cause of the disease and the vector, the presence of human and animal reservoirs, environmental factors such as weather, agriculture, and rainfall patterns, as well as human behaviors, including habits, residential areas, and working conditions, all play critical roles in disease transmission and infection (43).

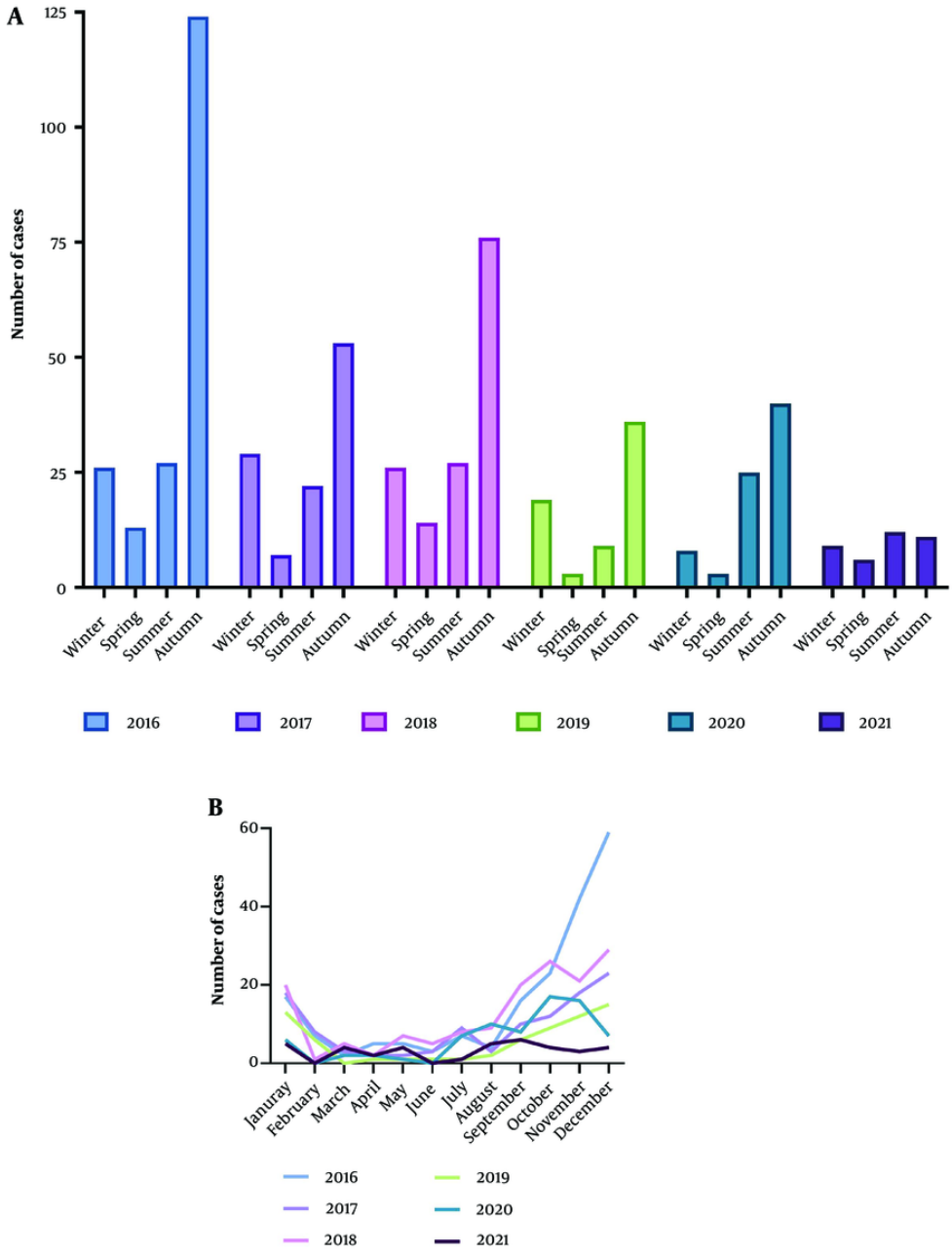

Figure 3. A, distribution of cutaneous *leishmaniasis* (CL) patients in Hoveyzeh county, according to season during 2016 - 2021; B, distribution of CL patients in Hoveyzeh county according to month during 2016 - 2021

From 2016 to 2021, there was a decrease in the incidence of CL, which can be attributed to rising average temperatures that have reduced the occurrence of the disease. Specifically, climate change, warmer temperatures, and lower humidity levels effectively reduce the breeding and activity of sand flies. Sand flies prefer moist environments to lay eggs, survive, and complete their life cycle. Reduced moisture availability

disrupts their life cycle, thereby impacting disease incidence. Community education, promotion of personal protective measures, and increased awareness of CL have been effective strategies in reducing the number of cases in recent years (44).

5.1. Limitations and Strengths of the Study

A limitation of this study was the lack of identification of the *Leishmania* parasite species through molecular studies. However, its strength lies in the comprehensive evaluation of the epidemiology of CL in Hoveyzeh county over several years.

5.2. Conclusions

The findings of this study revealed a decreasing trend in the incidence of CL in Hoveyzeh county; however, the disease remains endemic and a significant health concern in the region. To effectively control and prevent CL, educational initiatives are crucial. These programs should focus on raising awareness among residents about health practices, disease transmission, personal protective measures, early detection for successful treatment outcomes, and the use of insect repellents and insecticide-treated bed nets. Given the endemic nature of the area, implementing a rodent control program within a 500-meter radius around homes is advisable prior to initiating sand fly control efforts. In addition, regular inspections by local health authorities are recommended.

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Footnotes

Authors' Contribution: Study concept and design: S. M., N. H., H. K., and A. N.; study concept and design: S. M., N. H., H. K., and A. N.; acquisition of data: S. M. and H. K.; analysis and interpretation of data: M. K.; drafting of the manuscript: S. M. and M. K.; critical revision of the manuscript for important intellectual content: H. K., S. M., and N. H.; statistical analysis: M. K.; administrative, technical, and material support: S. M. and Z. M.; study supervision: S. M.

Conflict of Interests Statement: This study has no conflict of interest.

Data Availability: The dataset presented in the study is available on request from the corresponding author during submission or after publication.

Ethical Approval: This study has been reviewed and approved by the Ethics Committee of Jundishapur University of Medical Sciences, Ahvaz, Iran (IR.AJUMS.REC.1400.339).

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References

1. Knight CA, Harris DR, Alshammari SO, Gugssa A, Young T, Lee CM. Leishmaniasis: Recent epidemiological studies in the Middle East. *Front Microbiol*. 2022;**13**:1052478. [PubMed ID: 36817103]. [PubMed Central ID: PMC9932337]. https://doi.org/10.3389/fmicb.2022.1052478.
2. Tom A, Kumar NP, Kumar A, Saini P. Interactions between Leishmania parasite and sandfly: a review. *Parasitol Res*. 2023;**123**(1):6. [PubMed ID: 38052752]. https://doi.org/10.1007/s00436-023-08043-7.
3. Montaner-Angoiti E, Llobat L. Is leishmaniasis the new emerging zoonosis in the world? *Vet Res Commun*. 2023;**47**(4):1777-99. [PubMed ID: 37438495]. https://doi.org/10.1007/s11259-023-10171-5.
4. Kyari S. Epidemiology of Leishmaniasis. In: Fernando AS, Flávia de Oliveira C, Ana Lucia AS, Kátia da Silva C, editors. *Leishmania Parasites - Epidemiology, Immunopathology and Hosts*. London: Intechopen; 2024. https://doi.org/10.5772/intechopen.110490.
5. Almeida-Souza F, Lucia Abreu-Silva A, da Silva Calabrese K, de Oliveira Cardoso F. Introductory Chapter: Leishmania Parasites – Epidemiology and Immunopathogenesis. *Leishmania Parasites - Epidemiology, Immunopathology and Hosts*. London: Intechopen; 2024. https://doi.org/10.5772/intechopen.114096.
6. Ghatee MA, Taylor WR, Karamian M. The Geographical Distribution of Cutaneous Leishmaniasis Causative Agents in Iran and Its Neighboring Countries, A Review. *Front Public Health*. 2020;**8**:11. [PubMed ID: 32133334]. [PubMed Central ID: PMC7039857]. https://doi.org/10.3389/fpubh.2020.00011.
7. Abadias-Granado I, Diago A, Cerro PA, Palma-Ruiz AM, Gilaberte Y. Cutaneous and Mucocutaneous Leishmaniasis. *Actas Dermosifiliogr (Engl Ed)*. 2021;**112**. [PubMed ID: 33652011]. https://doi.org/10.1016/j.ad.2021.02.008.
8. Karami M, Gorgani-Firouzjaee T, Chehrazi M. Prevalence of cutaneous Leishmaniasis in the Middle East: a systematic review and meta-analysis. *Pathog Glob Health*. 2023;**117**(4):356-65. [PubMed ID: 36222473]. [PubMed Central ID: PMC10177677]. https://doi.org/10.1080/20477724.2022.2133452.
9. Mohammadbeigi A, Khazaei S, Heidari H, Asgarian A, Arsangjang S, Saghafipour A, et al. An investigation of the effects of environmental and ecologic factors on cutaneous leishmaniasis in the old world: a systematic review study. *Rev Environ Health*. 2021;**36**(1):117-28. [PubMed ID: 32892182]. https://doi.org/10.1515/reveh-2020-0066.
10. Sharifi I, Khosravi A, Aflatoonian MR, Salarkia E, Bamorovat M, Karamoozian A, et al. Cutaneous leishmaniasis situation analysis in the Islamic Republic of Iran in preparation for an elimination plan. *Front Public Health*. 2023;**11**:1091709. [PubMed ID: 37188278]. [PubMed Central ID: PMC10176454]. https://doi.org/10.3389/fpubh.2023.1091709.
11. Valero NNH, Uriarte M. Environmental and socioeconomic risk factors associated with visceral and cutaneous leishmaniasis: a

systematic review. *Parasitol Res*. 2020;**119**(2):365-84. [PubMed ID: 31897789]. https://doi.org/10.1007/s00436-019-06575-5.

12. Remadi L, Haouas N, Chaara D, Slama D, Chargui N, Dabghi R, et al. Clinical Presentation of Cutaneous Leishmaniasis caused by Leishmania major. *Dermatol*. 2016;**232**(6):752-9. [PubMed ID: 28253508]. https://doi.org/10.1159/000456543.
13. Salehzadeh A, Iran SR, Latifi M, Mirhoseini M. Diversity and incrimination of sandflies (Psychodidae: Phlebotominae) captured in city and suburbs of Hamadan, Hamadan province, west of Iran. *Asian Pac J Trop Med*. 2014;**7S1**:S177-81. [PubMed ID: 25312116]. https://doi.org/10.1016/S1995-7645(14)60227-3.
14. Borges MS, Niero LB, da Rosa LDS, Citadini-Zanette V, Elias GA, Amaral PA. Factors associated with the expansion of leishmaniasis in urban areas: a systematic and bibliometric review (1959-2021). *J Public Health Res*. 2022;**11**(3):22799036221115800. [PubMed ID: 36062236]. [PubMed Central ID: PMC9434684]. https://doi.org/10.1177/22799036221115775.
15. Yaghoobi-Ershadi MR. Control of Phlebotomine Sand Flies in Iran: A Review Article. *J Arthropod Borne Dis*. 2016;**10**(4):429-44. [PubMed ID: 28032095]. [PubMed Central ID: PMC5186733].
16. Thakur S, Joshi J, Kaur S. Leishmaniasis diagnosis: an update on the use of parasitological, immunological and molecular methods. *J Parasit Dis*. 2020;**44**(2):253-72. [PubMed ID: 32419743]. [PubMed Central ID: PMC7223249]. https://doi.org/10.1007/s12639-020-01212-w.
17. Grifferty G, Shirley H, McGloin J, Kahn J, Orriols A, Wamai R. Vulnerabilities to and the Socioeconomic and Psychosocial Impacts of the Leishmaniases: A Review. *Res Rep Trop Med*. 2021;**12**:135-51. [PubMed ID: 34188584]. [PubMed Central ID: PMC8236266]. https://doi.org/10.2147/RRTM.S278138.
18. Salimi M, Saghafipour A, Hamidi Parsa H, Khosravi M, Shirzadi MR. Economic Burden Evaluation of Cutaneous Leishmaniasis in Iran. *Shiraz E-Med J*. 2019;**20**(6). e82810. https://doi.org/10.5812/semj.82810.
19. Arvin M, Beiki P, Hejazi SJ, Sharifi A, Atashafrooz N. Assessment of infrastructure resilience in multi-hazard regions: A case study of Khuzestan Province. *Int J Disaster Risk Red*. 2023;**88**. https://doi.org/10.1016/j.ijdrr.2023.103601.
20. Bahadori K, Hedjazizadeh ZB, Saligheh M. Global Warming in Khuzestan Province during 1988-2016, using the nonparametric method. *Adv Appl Geol*. 2020;**10**(1):47-59. https://doi.org/10.22055/aag.2020.32680.2095.
21. Khavarian-Garmsir AR, Pourahmad A, Hataminejad H, Farhoodi R. Climate change and environmental degradation and the drivers of migration in the context of shrinking cities: A case study of Khuzestan province, Iran. *Sustain City Soc*. 2019;**47**. https://doi.org/10.1016/j.scs.2019.101480.
22. Nejadrekabi M, Eslamian S, Zareian MJ. Spatial statistics techniques for SPEI and NDVI drought indices: a case study of Khuzestan Province. *Int J Environ Sci Technol (Tehran)*. 2022;**19**(7):6573-94. [PubMed ID: 35126565]. [PubMed Central ID: PMC8799989]. https://doi.org/10.1007/s13762-021-03852-8.
23. Mohammadi Z, Rahimi D, Najafi MR, Zakerinejad R. The impact of environmental degradation and climate change on dust in Khuzestan province, Iran. *Springer*. 2023;**120**:1-20. https://doi.org/10.21203/rs.3.rs-3345799/v1.
24. Azimi F, Shirian S, Jangjoo S, Ai A, Abbasi T. Impact of climate variability on the occurrence of cutaneous leishmaniasis in Khuzestan Province, southwestern Iran. *Geospat Health*. 2017;**12**(1):478. [PubMed ID: 28555469]. https://doi.org/10.4081/gh.2017.478.
25. Rejali M, Dashtaki NM, Ebrahimi A, Heidari A, Maracy MR. Cutaneous Leishmaniasis Based on Climate Regions in Iran (1998-2021): A Systematic Review and Meta-Analysis. *Adv Biomed Res*. 2022;**11**:120. [PubMed ID: 36798921]. [PubMed Central ID: PMC9926040]. https://doi.org/10.4103/abr.abr_90_21.
26. Khademvatan S, Salmanzadeh S, Foroutan-Rad M, Bigdeli S, Hedayati-Rad F, Saki J, et al. Spatial distribution and epidemiological features of cutaneous leishmaniasis in southwest of Iran. *Alexandria J Med*. 2019;**53**(1):93-8. https://doi.org/10.1016/j.ajme.2016.03.001.
27. Kassiri H, kassiri A, Lotfi M, Farajifard P, Kassiri E. Laboratory diagnosis, clinical manifestations, epidemiological situation and public health importance of cutaneous leishmaniasis in Shushtar County, Southwestern Iran. *J Acute Disease*. 2014;**3**(2):93-8. https://doi.org/10.1016/s2221-6189(14)60024-x.
28. Kassiri H, Khodkar I, Jalali A, Lotfi M. Sociodemographic, Clinical, Laboratory, Diagnostic, Therapeutic and Public Health Aspects of Cutaneous Leishmaniasis in Southwestern Iran. *J Clinic Diagn Res*. 2019;**13**. https://doi.org/10.7860/jcdr/2019/40631.12853.
29. Ahmadi Mirqhaed M, Dastoorpoor M, Behbahani A. Trend Analysis of Cutaneous Leishmaniasis Incidence in Izeh County During 2014-2019. *Dis Diagn*. 2021;**10**(3):99-103. https://doi.org/10.34172/ddj.2021.19.
30. Khosrotaj MH, Rakhshani T, Nazari M, Gheibi Z, Soltani A. Epidemiological and clinical features of cutaneous leishmaniasis and its time trend model in a high-endemic focus of disease in the southwest of Iran from 2014 to 2019. *Trans R Soc Trop Med Hyg*. 2022;**116**(6):538-44. [PubMed ID: 34791489]. https://doi.org/10.1093/trstmh/trab166.
31. Jayrvnd AA, Vaziri F. Epidemiology of cutaneous leishmaniasis in the city of Hawizeh in 2014-2015. *J Health Field*. 2017;**4**(3).
32. Wijerathna T, Gunathilaka N, Gunawardena K, Rodrigo W. Socioeconomic, demographic and landscape factors associated with cutaneous leishmaniasis in Kurunegala District, Sri Lanka. *Parasit Vectors*. 2020;**13**(1):244. [PubMed ID: 32398102]. [PubMed Central ID: PMC7216469]. https://doi.org/10.1186/s13071-020-04122-1.
33. Alraey Y. Distribution and epidemiological features of cutaneous leishmaniasis in Asir province, Saudi Arabia, from 2011 to 2020. *J Infect Public Health*. 2022;**15**(7):757-65. [PubMed ID: 35724436]. https://doi.org/10.1016/j.jiph.2022.05.015.
34. Khosravi A, Sharifi I, Dortaj E, Aghaei Afshar A, Mostafavi M. The present status of cutaneous leishmaniasis in a recently emerged focus in South-west of kerman province, iran. *Iran J Public Health*. 2013;**42**(2):182-7. [PubMed ID: 23515397]. [PubMed Central ID: PMC3595645].
35. Akhlagh A, Salehzadeh A, Zahirnia AH, Davari B. 10-Year Trends in Epidemiology, Diagnosis, and Treatment of Cutaneous Leishmaniasis in Hamadan Province, West of Iran (2007-2016). *Front Public Health*. 2019;**7**:27. [PubMed ID: 30891438]. [PubMed Central ID: PMC6413056]. https://doi.org/10.3389/fpubh.2019.00027.
36. Akhavan AA, Yaghoobi-Ershadi MR, Hasibi F, Jafari R, Abdoli H, Arandian MH, et al. Emergence of Cutaneous Leishmaniasis due to Leishmania major in a New Focus of Southern Iran. *J Arthropod-Borne Dis*. 1970;**1**(1).
37. Al-Waaly AB, Shubber HWK. Epidemiological Study of Cutaneous Leishmaniasis in Some Iraqi Provinces. *J Men's Health*. 2018;**14**(4). https://doi.org/10.22374/1875-6859.14.4.4.
38. Doroodgar M, Doroodgar MSA. Epidemiological Aspects of Cutaneous Leishmaniasis during 2009-2016 in Kashan City, Central Iran. *Korean J Parasitol*. 2018;**56**(1):21-4. [PubMed ID: 29529846]. [PubMed Central ID: PMC5858664]. https://doi.org/10.3347/kjp.2018.56.1.21.
39. Sakhaei S, Darrudi R, Motaarefi H, Sadagheyani HE. Epidemiological Study of Cutaneous Leishmaniasis in Neyshabur County, East of Iran (2011-2017). *Open Access Maced J Med Sci*. 2019;**7**(21):3710-5. [PubMed ID: 32010403]. [PubMed Central ID: PMC6986519]. https://doi.org/10.3889/oamjms.2019.421.

40. Rahmanian V, Rahmanian K, Sarikhani Y, Sotoodeh Jahromi A, Madani A. Epidemiology of Cutaneous Leishmaniasis, West South of Iran, 2006-2014. *J Res Med Dent Sci*. 2018;**6**. https://doi.org/10.5455/jrmds.20186258.
41. Abdellatif MZ, El-Mabrouk K, Ewis AA. An epidemiological study of cutaneous leishmaniasis in Al-jabal Al-gharbi, Libya. *Korean J Parasitol*. 2013;**51**(1):75-84. [PubMed ID: 23467624]. [PubMed Central ID: PMC3587753]. https://doi.org/10.3347/kjp.2013.51.1.75.
42. Hamzavi Y, Khademi N. Trend of cutaneous leishmaniasis in kermanshah province, west of iran from 1990 to 2012. *Iran J Parasitol*. 2015;**10**(1):78-86. [PubMed ID: 25904949]. [PubMed Central ID: PMC4403543].
43. Pedrosa Fde A, Ximenes RA. Sociodemographic and environmental risk factors for American cutaneous leishmaniasis (ACL) in the State of Alagoas, Brazil. *Am J Trop Med Hyg*. 2009;**81**(2):195-201. [PubMed ID: 19635869].
44. Jahanifard E, Hanafi-Bojd AA, Nasiri H, Matinfar HR, Charrahy Z, Abai MR, et al. Prone Regions of Zoonotic Cutaneous Leishmaniasis in Southwest of Iran: Combination of Hierarchical Decision Model (AHP) and GIS. *J Arthropod Borne Dis*. 2019;**13**(3):310-23. [PubMed ID: 31879670]. [PubMed Central ID: PMC6928385].