Research Article

Study of *Cutaneous leishmaniasis* Risk Factors Among Individuals Visiting Health Centers in Kirkuk Governorate

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Abstract | The current study was conducted on 292 cases infected with *cutaneous leishmaniasis* attending hospitals and health centers in Kirkuk Governorate from the beginning of January 2023 to the end of December 2023. The results of the current study recorded the highest infection rate in Hawija District, 61.301%, while the lowest infection rate was in Daquq District, 10.958%. The results of the current study showed that the highest infection rate was in December, 19.520%, while the lowest infection rate was in June, 2.739%. The results of the current study recorded that the highest infection rate with the parasite was within the age group 1-10 years, 53.082%, and the lowest infection rate was within the age group. 61-70 years 1.369%. The current study showed the highest infection rate in males, 50.343%, while in females, the infection rate was 49.657%. The current study showed the highest infection rate with the dry ulcer type, 59.590%, and the lowest infection rate with the wet ulcer type, 40.410%. The current study showed that the highest infection rates were recorded in the face, upper extremities, and lower extremities, 36.301%, 32.191%, and 25.684%, respectively. The lowest infection rate was in the abdomen, 0.342%, and no injury was recorded in the neck area. According to the results of the current study, the highest infection rate was in the patient with one ulcer, 52.397%, and the lowest rate was in the patient with ulcers 4 and 6, where the percentage was 5.821%. The current study showed that the highest infection rate was recorded in patients in areas where sand flies were present or in their homes, 86.301%, and the lowest infection rate was in patients who were far from sand fly transportation sources, 13.698%.

Keywords | *Cutaneous leishmaniasis*, Sand-fly, Epidemiology, Kirkuk Governorate, Hawija District, Daquq District

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INTRODUCTION

Leishmaniasis is a vector-borne disease caused by an obligate parasitic protozoan, from the genus Leishmania (family Trypanosomatidae). It is prevalent in many regions worldwide, as it prevails on four continents. The World Health Organization (WHO) considers it one of the six largest parasitic diseases affecting humans (Man, 2022). There are multiple types of this disease, each with different clinical manifestations: Cutaneous type, diffuse cutaneous type, cutaneous diffuse type, visceral type, and mucocutaneous type (de Vries and Schallig, 2022).

Cutaneous leishmaniasis (CL) is also known as Oriental sore (Baghdad leishmaniasis). It is a disease dangerous to public health. It has a wide range of clinical symptoms as it is widespread in more than 88 countries, including the countries of the Middle East (Hassan *et al*., 2024). Being a broad genus, Leishmania has a complicated life cycle with two main stages: promastigote and amastigote. These stages vary depending on the host, which can be either a mammal or an invertebrate vector like a sandfly. Depending on the

area, anthroponotic or zoonotic transmission can occur through the sandfly (Pace, 2014; Yanase *et al*., 2023).

The female sandfly consumes macrophages or other host cells that carry amastigotes, the intracellular form of Leishmania parasites, as part of its blood meal from an infected vertebrate host. The amastigotes change into promastigotes in the sandfly's midgut after entering the insect. These promastigotes proliferate via binary fission and have a long, hair-like flagellum. They move to the sandfly's gut's anterior region, where they adhere to the wall and split further (Slama *et al*., 2014; Morales-Yuste *et al*., 2022).

The promastigotes develop into infectious metacyclic promastigotes after a few days. These metacyclic promastigotes are contagious and extremely mobile. They move toward the sandfly's proboscis, prepared to transfer to a new vertebrate host. An infected sandfly injects the infectious metacyclic promastigotes into the skin of a vertebrate host after feeding on its blood. Once within the host, phagocytes, including macrophages, consume the metacyclic promastigotes. The metacyclic promastigotes within the phagocytes change into the intracellular parasite stage known as amastigotes. The amastigotes create clusters known as amastigote-laden parasitophorous vacuoles after multiplying inside the host cells, typically in macrophages. Clinical signs of leishmaniasis are caused by an immunological reaction triggered by Leishmania parasites within the host cells. f an infected sandfly takes a blood meal from the infected vertebrate host, it ingests the amastigote-laden macrophages, restarting the cycle (Solano-Gallego *et al*. 2012; Akhoundi *et al*. 2016; Bates 2018) (Figure 1).

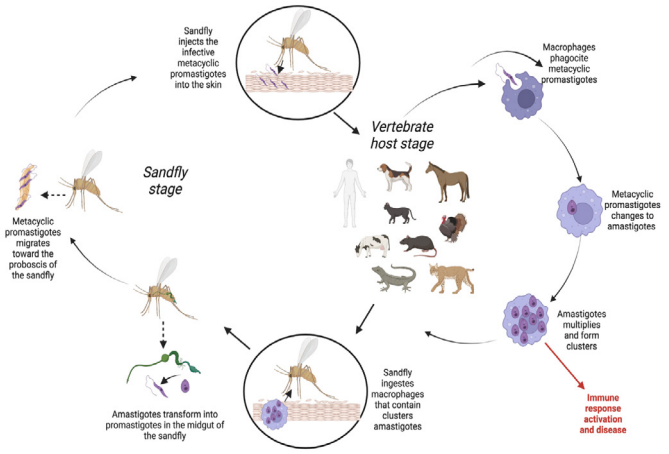

Figure 1: Life cycle of *Leishmania parasite*. Created with Biorender.com

The form of the parasite CL varies from simple to complex, and determining its characteristics is very important in defining strategies for control, treatment, and prevention. Because the disease's symptoms are similar to those of many other skin diseases, confirmation of the type of parasite is necessary when the diagnosis is suspected (Heras-Mosteiro *et al*., 2017). The aim of the study is to know the number of infected people during the year 2023 AD and the most affected areas in Kirkuk Governorate. Knowing the role of the sand flies in the spread of CL in humans. Knowing the age groups most susceptible to infection and the months of the year in which the infection is most common.

MATERIALS AND METHODS

Study design, study setting and time of study

The study was conducted from January 1st to December 31st 2023. Data was collected from the Preventive Health Directorate of Kirkuk and the affected areas in Kirkuk governorate, which include the four administrative districts of Kirkuk Central District, Dibs, Daquq, and Hawija.

Samples collection

All clinically diagnosed CL cases that occurred in Kirkuk governorate in 2023 and were registered in the Center for Disease Control of the Preventive Health Department were included in the study.

Data collection

At the start of the study, data from the hospitals and health centres in Kirkuk governorate were collected. Then, daily visits to the Center for Disease Control were arranged for one week, during which data were collected from the registration book of CL cases there. For each case, complete contact information was obtained to arrange a visit and direct interview. A total of 292 cases of CL were reported at the centre. Data were collected during direct interviews lasting about one hour using a specially designed clinical questionnaire.

The questionnaire

A closed questionnaire was designed and completed during direct interviews. It included (sample number, age, gender, area of residence, wet or dry ulcer, location of the ulcer on the body, date of review, and number of infections per person).

Ethical considerations

The study protocol was approved by the Research Ethics Committee of the Scientific Disciplines Council at the Department of Biology, College of Education for Pure Sciences, University of Kirkuk, Iraq, ethical approval number2725. Written permission was obtained from the Kirkuk Health Department. Verbal consent was obtained from each participant before enrollment in the study.

Diagnostic methods

Clinical diagnostic

The clinical diagnosis was made by a dermatologist.

Direct microscopical diagnosis

A thin blood film smear was prepared from the edge of the ulcer according to the method Daaboul, 2009 (Da'aboul, 2009).

Statistical analysis

This study employed the Statistical Analysis System (SAS) to examine the impact of various variables on the analysed attributes. The means were compared using the least significant difference (LSD), whereas the percentages were analysed with the Chi-square test.

RESULTS AND DISCUSSIONS

According to the health centers affiliated with the study sites, the current study›s results showed that the highest infection rate was in Hawija District, 61.301%. In contrast, the lowest was in Daquq District, 10.958%, as in Table 1.

Table 1: The relationship between the incidence of *CL* and the study site.

Residential location	Number of infected samples	Percentage of infection
Kirkuk	35	11.986
Dibis	46	15.753
Daquq	32	10.958
Hawija	179	61.301
Total	292	100

The results of the current study, through Table 2 and by month of the year, showed that the highest infection rate was in December, 19.520%, while the lowest infection rate was in June, 2.739%. The results of the study revealed that there is a difference in infection rates during the months of the year, as the rate of infection with the parasite increases clearly during the period of low temperature, i.e., the winter season. The rate is lowest in the hot months of the year, i.e., the summer season.

According to the results of the current study, which are shown in Table 3, the age group with the highest parasite infection rate was 1–10 years old (53.082%), while the age group with the lowest infection rate was 61–70 years old (1.369%).

Table 4 showed the findings of the current investigation, which indicated that there are no appreciable differences between the two sexes' levels of CL infection. 50.343% was the highest infection rate in males, whilst 49.657% was the highest in females. When it comes to the parasite CL, males are more likely than females to be infected.

Table 2: The incidence of CL during the months of the study.

Percentage	2022	
	Infection	Month
19.520	57	January
13.356	39	February
10.616	31	March
6.164	18	April
3.767	11	May
2.739	8	June
3.082	9	July
3.424	10	August
6.849	20	September
5.479	16	October
10.958	32	November
14.041	41	December
100	292	Total

Table 3: Distribution of the incidence of *CL* according to age groups.

Percentage	N. of infected samples	Age group
53.082	155	1-10
20.205	59	11-20
10.958	32	21-30
5.479	16	31-40
5.821	17	41-50
3.082	9	51-60
1.369	4	61-70
100	292	Total

Table 4: The incidence of CL by gender.

Percentage	N. of infected samples	Gender
50.343	147	Male
49.657	145	Female
100	292	Total

According to the type of ulcers in patients with CL, the largest percentage of infection with the dry ulcer type was found to be 59.590%, as indicated by the results of the current study, which are displayed in Table 5. 40.410% was the lowest infection rate for the moist ulcer type.

Table 5: The incidence of CL by ulcer.

Percentage	N. of Infected Samples	Ulcer
40.410	118	Wet
59.590	174	Dry
100	292	Total

The results of the current study showed, through Table 6, according to the location of the ulcers in people with CL, that the highest percentage was recorded in the face, upper extremities, and lower extremities, 36.301%, 32.191%, and 25.684%, respectively, while the lowest percentage of infection was in the abdomen, 0.342. %, and no injury was recorded in the neck area.

Table 6: The infection rate according to the location of the ulcers in people with CL.

Percentage	N. of infected samples	Location of Ulcer
3.082	9	Head
36.301	106	Face
-	-	Nick
32.191	94	Upper extremities
25.684	74	Lower extremities
0.342	1	Abdomen
2.739	8	Back
100	292	Total

The results of the current study are shown in Table 7. According to the number of ulcers in people with CL, the highest infection rate was in the patient with one ulcer, 52.397%, and the lowest percentage was in the patient with ulcers 4 and 6, where the percentage was 5.821%.

Table 7: The infection rate according to the number of ulcers in people with CL.

Percentage	N. of infected samples	Location of Ulcers
52.397	153	1
21.232	62	2
8.219	24	3
5.821	17	4
6.506	19	5
5.821	17	6
100	292	Total

The results of the current study showed, through Table 8, that according to the presence of the vectors of infection, i.e., sand flies, the highest percentage of infection was recorded in patients who are in areas where sand flies are present or in their homes, 86.301%, and the lowest percentage of infection was recorded in patients who are far from sources of transmission of sand flies, 13.698%.

Table 8: The relationship between the number of infestations and the presence of the sand fly vector.

Percentage	N. of infected samples	Use of pesticides
86.301	252	No
13.698	140	Yes
100	292	Total

This increase in the infection rate is due to the decline in society's health level in recent years due to a lack of attention to public hygiene and raising animals in or near residential areas, which causes permanent colonization of the parasite (Hasan, 2016).The reason for the spread of the parasite during this period is that the house fly has finished laying eggs and, therefore, needs blood, i.e., protein, to complete the maturation of the eggs and increase its sexual activity (Man *et al.*, 2022).

The reason is the large number of infections in this group. The age range is 1-10 years, indicating that the insect prefers ages that have attractive factors in terms of skin vitality as well as frequent contact with the external environment (Hong *et al.*, 2020; Tsakmakidis *et al.*, 2024).The cause for this is that social customs and traditions are that females wear clothes that cover all areas of the body, especially in villages and rural areas, unlike males who play without clothes that cover the entire body, especially within the age group 1-10 years, areas of the body are vulnerable to the language of sand flies, as well as the presence of Male children spend the longest time outside the home. Insect activity is more than inside the home (Hassan *et al.*, 2023; Bilgic *et al.*, 2019).

The purpose may be due to the clinical manifestations of the disease that are affected by the climate in the region, or clinical variations may sometimes reflect the resistance of the host variant (Alzahrani *et al.*, 2023), or early diagnosis of the infection before it develops and turns into the wet form (Torres-Guerrero *et al.*, 2017).The highest incidence of injuries is found in the face, upper extremities, and lower extremities, and the least affected areas are the abdomen and neck. This is because the face and upper and lower extremities are constantly exposed, especially in males (Sghaier *et al.*, 2022).

The rate of one ulcer is common in the number of ulcers calculated during the study period, and it is consistent with the Center for Disease Control - Atlanta study of patients in the working area in 2002 and 2003 (Al-Dhafiri *et al.*, 2023). The reason for the low incidence of ulcers is attributed to the development of a special type of immunity in most people against infection with the parasite as a result of their exposure to low doses of the parasite Leishmania cutaneum transmitted by the sand fly (Sharifi *et al.*,1998). The current study showed a relationship between infection with CL and the presence of insect vectors, sandflies and other vectors, and reservoir animals such as dogs, cats, and rats (Tabasi *et al.*, 2020).

There is a relationship between the seasonal presence of CL and its transmission, the sand fly. Therefore, we notice the concentration of the disease in the winter months, and it disappears in the summer. In contrast, the

insect that transmits the disease disappears in the winter and appears in the spring, summer, and the first months of autumn. This means that there is a period separating the two. However, the sand fly is in dire need of protein during this period to mature the eggs. So, it bites people and spreads infection among people. This is consistent with what has been confirmed by special reports on the diseases that arthropods are involved in transmitting to humans (Sabbahi *et al*., 2024; Tiwary *et al*., 2013).

CONCLUSIONS AND RECOMMENDATIONS

Cutaneous leishmaniasis is not an endemic disease in Kirkuk governorate but became a public health challenge in 2023. Most of the cases were reported in the Hawija district, and the highest infection rate was 19.520% in December, while the lowest infection rate was in June, at 2.739%. Most cases were among males in the productive age of 1-10 years. There is a need to raise the awareness of health professionals regarding the epidemiological and clinical aspects of CL. The Centers for Disease Control employees need more training on the correct methods for fogging and spraying. The Iraqi Ministry of Health should provide information about the endemic areas of CL. Better control also needs information about the Leishmania species causing CL in Kirkuk, through parasite typing on positive slide smears by the regional reference centres.

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NOVELTY STATEMENT

This research has highlighted the *Cutaneous Leishmaniasis* of common in Kirkuk Governorate from the beginning of January 2022 to the end of December 2022.

AUTHOR'S CONTRIBUTION

Shajaan and Farhan contributed to the conception of the manuscript, acquisition of data, drafting, and final approval of the manuscript. Feedan contributed to the acquisition of data, revising the manuscript. All authors read and approved the final manuscript.

Conflict of interest

The authors have declared no conflict of interest.

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