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Original Article

Cutaneous Leishmaniasis in Diyala Province from Eastern Part of Iraq during the Period of 2011 to 2021

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Abstract

Background: Cutaneous leishmaniasis (CL) is a neglected tropical disease endemic in Iraq. However, epidemiological data from Diyala Province are limited. Diyala province is located in eastern of Iraq, on the border with Iran, and adjacent to Kermanshah Province, Iran. We investigated the prevalence and distribution of CL in Diyala Province from 2011-2021.

Methods: Anonymous patient records on 25,474 confirmed CL cases in Diyala during 2011-2021 were analyzed to determine demographic, temporal, and geographic distributions.

Results: Overall, 52% of cases occurred in females and 48% in males. The 5-14 yr age group had the highest burden (33%) while infants <1 year had the lowest (5%). Annual cases peaked at 4,425 in 2015 but declined to 2,158 by 2021. Among districts, Khanaqeen had the most cases (28%) while Mansouriyah had the least (10%). Monthly cases peaked in winter (November-February) and were lowest in summer (June-August).

Conclusion: A high burden of CL was observed in Diyala during 2011-2021, with the highest risk among children. Significant geographic and seasonal variations were also evident. These findings can inform prevention and control strategies. The prevalence in this province in 2019 was 126 per 100000.

Introduction

Leishmaniasis is an old protozoan parasitic disease that is caused by *Leishmania* species. The infection is widespread in approximately 100 countries, and more than 10 million people are infected with the parasite. Additionally, 350 million people are at

risk of acquiring the infection (1). Asia, Africa, the Americas, and the Mediterranean are the endemic regions. All over the world, nearly 15 million people are infected and 350 million people are at the risk of being infected. About 1.5–2 million new cases occur each year, out of which 70,000 people die annually. Leishmaniasis occurs in different clinical forms in the different endemic areas of the world. It ranges from the most commonly occurring stigmatic disease called cutaneous leishmaniasis (CL) to usually fatal visceral leishmaniasis (VL) if left untreated. Approximately 600,000–1,000,000 cases of CL and 50,000–90,000 cases of VL new cases occur worldwide annually (2). Leishmaniasis can present itself in three forms: CL, mucocutaneous leishmaniasis (MCL), and VL (3). The spread of cutaneous leishmaniasis is linked to multiple economic and environmental factors such as population growth, population migration, population expansion, and agricultural activity. Population movement and rapid urbanization projects and the invasion of disease-endemic areas are the most important factors in the emergence and survival of the disease (4).

CL is a neglected tropical disease caused by protozoan parasites of the *Leishmania* genus and transmitted through the bites of female phlebotomine sandflies (5-6). It is associated with poverty and causes significant morbidity and disability with its symptomatic skin lesions (7- 9). In Iraq, CL is highly endemic across most of the country (10). The primary sandfly vectors implicated are *Phlebotomus sergenti* and *P. papatasi*, which spread the causative parasitic agents *L. major* and *L. tropica* (10). The disease is endemic in 98 countries of 5 continents with a total of 350 -million people at risk and 12 million cases. Among the 98 endemic countries, with an estimated incidence of 1- 1.5 million cases of CL and approximately 100, 000 cases of visceral VL. Cutaneous leishmaniosis in Iraq has 2 forms, zoonotic cutaneous leishmaniasis (ZCL), which is mainly caused by *L. major*, and anthroponotic cutaneous leishmaniasis (ACL), which is mainly caused by *L. tropica* (11).

VL also known as kala azar, is a vector borne disease caused by a protozoan of *L. donovani* (12). A phlebotomize sand fly transmits the parasite from person to other or via an animal reservoir. This disease is the second-largest parasitic killer in the world (after malaria), responsible for an estimated 500,000 cases each year worldwide that recently decreased to 100,000 cases (13). The disease is endemic in tropical and subtropical regions except Australian and Antarctica (14). In Iraq it represents one of the serious public health problems and it is more in south and middle and lowest in north, with highest frequency in winter followed by spring and lower in summer and autumn (15).

However, strengthening disease surveillance, enhancing reporting practices, and elucidating epidemiological patterns, especially in provinces where data are scarce, are critically needed. Thus, given the insufficiency of data from Diyala Province (eastern Iraq), the current study aims to investigate the prevalence and distribution leishmaniasis Diyala from 2019 to 2021.

Materials and Methods

Diyala Province

Diyala Province is located in eastern Iraq, on the border with Iran, and adjacent to Kermanshah Province, western Iran. The population of this province is 2,120,000 and its area is 17,685 square km (Fig. 1).

Fig. 1: The Diyala province's location in Iraq and proximity to the Iranian border

Data collection and ethical standards

The data for this study were obtained with ethical approval from the Public Health Department of the Diyala Health Directorate (Baqubah, Iraq).

Anonymous patient records on the distribution of cutaneous leishmaniasis cases for the period 2019-2022 were collected under research ethics approval numbers DHD-RKA-32879 (August 16, 2021) and DHD-RKA-36258 (July 10, 2023). The records provided information on confirmed CL by age group, district and month of diagnosis.

The study was based on the data obtained from the Public Health Department of the Diyala Health Directorate which carried out with parasitological method that obtained smears from patients and stained with Giemsa stain and evaluated with microscope.

Statistical analyses

The GraphPad Prism software was used to assess the data statistically. To describe demographic patterns and temporal trends in CL incidence, the frequency and percentages were used. The *P* of <0.05 was considered statistically significant.

Results

From 2011 to 2021, a total of 25474 CL cases were reported in Diyala Province (Table 1). The number of annual cases peaked at 4,425 in 2015, but declined steadily from 2017 (4,243 cases) to 2021 (2,158 cases, Fig. 2). Overall, males comprised 51.9% (n=13,285) and females 48.1% (n=12,189) of cases (Table 1). Children aged 5-14 years accounted for the highest proportion of cases (33%, n=8,460), followed by those aged 15-44 years (26%, n=6,686). Infants under 1 year old had the lowest burden (5%, n=1,291, Table 2).

The distribution of CL cases across districts of Diyala Province from 2011 to 2021 is summarized in Table 3. Over this period, a total of 25,474 cases were reported, with the highest number of 7,245 cases (28%) occurring in Khanaqeen district. In general, the results in Table 3 demonstrate a high disease burden of CL across all six districts of Diyala province from 2011 to 2021, with the highest prevalence concentrated in Khanaqeen.

Moreover, the monthly distribution of reported CL cases in Diyala province from 2011 to 2021 is shown in Table 4. The highest number of cases occurred in the month of December, with 4,619 cases constituting 18% of the total. January and February also saw a high prevalence, with 4,292 (17%) and 4,322 (17%) cases respectively. The lowest number of cases was reported in June, with only 417 cases making up 2% of the total. May, July, and August also had relatively low case numbers, ranging from 357 to 558 cases over the 11-year period. These results demonstrate a seasonal trend, with the winter months of November, December, January and February accounting for the highest proportion of cutaneous leishmaniasis cases in Diyala province

Table 1: Total number of cutaneous leishmaniasis cases for the period 2011-2021 (*P*<0.06)

Year	Males		Females		Total
	N	%	N	%	
2011	177	49%	181	51%	358
2012	269	53%	239	47%	508
2013	142	48%	155	52%	297
2014	337	52%	315	48%	652
2015	2170	49%	2255	51%	4425
2016	1357	52%	1264	48%	2621
2017	2174	51%	2069	49%	4243
2018	1822	54%	1545	46%	3367
2019	1367	51%	1306	49%	2673
2020	2310	55%	1862	45%	4172
2021	1160	54%	998	46%	2158
Total	13285	52%	12189	48%	25474

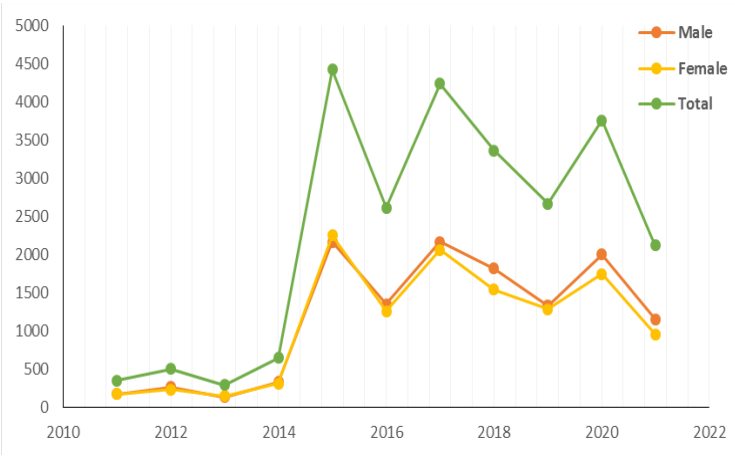

Fig. 2: Annual distribution of cutaneous leishmaniasis cases for total cases and based on gender, for the period 2011-2021

Table 2: Distribution of Cutaneous leishmaniasis based on age group (2011-2021)

Age (yr)	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	Total, n(%)	*P*=value
>1	27	30	19	49	217	105	209	167	173	211	84	1291(5)	0.02
1-4	100	166	86	161	1128	586	1051	719	630	876	428	5933(23)	
5-14	137	192	91	284	1696	972	1359	1282	816	1185	724	8460(33)	
15-44	79	106	88	131	1163	819	1367	1036	836	310	717	6686(26)	
>45	15	14	13	27	220	139	257	163	173	3768	139	3104(12)	
Total n(%)	**358(1)**	508(2)	297(1)	652(3)	4425(17)	2621(10)	4243(17)	3367(13)	2673(10)	4172(16)	2158(8)	**25474(100)**	

Table 3: Distribution of Cutaneous leishmaniasis in Diyala province based on district (2011-2021)

District	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	Total, n(%)
Baqubah	62	55	29	182	1288	303	478	355	387	597	426	4162(16)
Miqdadiyah	82	34	8	41	639	625	662	705	564	679	319	4358(17)
Khalis	57	59	40	50	533	490	586	296	222	293	195	2821(11)
Khanaqeen	111	257	168	131	531	830	2024	953	594	990	656	7245(28)
Balaruz	45	94	50	222	988	227	270	445	496	1161	445	4443(17)
Mansouriyah	1	9	2	26	446	146	223	613	410	452	117	2445(10)
Total n(%)	**358(1)**	508(2)	297(1)	652(3)	4425(17)	2621(10)	4243(17)	3367(13)	2673(10)	4172(16)	2158(8)	25474(100)
***P* value**	**0.001**											

Table 4: Monthly distribution of cutaneous leishmaniasis in Diyala Province (2011-2021) (*P*<0.001)

Month	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	Total, n(%)
Jan	72	71	72	88	335	767	838	562	530	187	776	4298(17)
Feb	69	148	62	69	665	719	941	538	437	152	522	4322(17)
Mar	23	96	34	28	636	106	584	542	266	98	426	2839(11)
Apr	10	26	19	23	617	54	124	466	124	34	184	1681(7)
May	12	13	6	2	181	61	129	258	49	42	93	846(3)
Jun	5	0	4	0	116	27	28	49	21	80	87	417(2)
Jul	3	8	2	6	35	33	32	51	32	96	59	357(1)
Aug	5	5	8	10	93	14	75	66	15	266	1	558(2)
Sep	8	17	8	6	112	20	129	104	50	366	1	821(3)
Oct	6	26	12	22	158	54	361	128	129	706	3	1605(6)
Nov	33	29	17	29	644	140	480	259	406	1070	4	3111(12)
Dec	112	69	53	369	833	626	522	344	614	1075	2	4619(18)

Total, n(%)	**358(1)**	508(2)	297(1)	652(3)	4425(17)	2621(10)	4243(17)	3367(13)	2673(10)	4172(16)	2158(8)	25474(100)

Discussion

Our study provides epidemiological insights into the burden of CL in Diyala Province, Iraq over an 11-year period. A concerningly high incidence of 33,072 CL cases was reported from 2011-2021, with a peak of 4,425 cases in 2015 before declining to 2,123 cases by 2021. The consistently high caseloads agree with Iraq's endemicity for CL, which has prevalence estimates up to 10% in Diyala Province and some other regions (16).

In the study of Al-samarai et al., (17) the incidence rate of leishmaniasis was 45 cases per 10,000. This rate was higher than those reported for other geographical areas in Iraq. In two community based studies, the incidence was 2.5 case / 10,000 for Tikrit (18) in 2000 and 15 cases / 10,000 for Kirkuk city (19) in 2000. Additionally, in a hospital-based study performed in Samara (20), the incidence rate was 5.5 cases / 10,000 for the year 1994. However, the incidence rate was similar to that reported for Afghanistan (21) (46 per 10,000) and Eastern Venezuela (22) (50.1 per 10,000) but higher than that reported for Turkey (4.6 per 10,000) (23).

Regarding demographic distributions, males accounted for 51.9% of cases. This aligns with trends observed regionally, where CL afflicts both genders equally (24-26). However, a male predominance was noted in 2018-2021, contrasting an earlier female predominance during 2011-2017 (Table 1). This alternating gender ratio needs further study.

The results of Rahi et al., (11) study showed the percent of infection in males were about (60%), while female was (40%), the percent of infection in males were higher than females.

In study of Al-samarai *et al.,* (17) CL cases occurred more in males (57%) than in females (43%). Also agree with those reported by AL-sabawi for Nineveh govern ate (27), Al-Naimy for Baghdad (28), Sanei-Dehkordi et al. for Iran (29), Talari (30) for Iran, and Arfan for Pakistan. In contrast, AL Zaidawi (31) in Baghdad who reported higher rates in females. These differences may be explained on the basis of variations between studies with regard to factors such as the size of the study population, the study design, climatic variations, and culture. Also The reason of higher infection take out in males more than females, possibly, due to the high incidence of working or sleeping males in open areas (surfaces of houses) with less coverage of body as well as more exposure to infected vectors 1.5 compared with the females (32). The gender difference observed in some parasitic disease can be attributed to hormonal effects (33). However, controversy still exists regarding the role of sex hormones in the cellular immune response (34). On the contrary of other studies that found the higher incidence of infection among females than males (35).

Importantly, children aged 5-14 years bore the highest CL burden, comprising 31.7% of cases (Table 2). This is expected since childhood and adolescence are known risk factors for CL, likely due to increased outdoor activities and sandfly exposure (36). In addition, the young children's susceptibility to CL aligns with other evidence that naïve immune status elevates infection risk, while older individuals have more prior exposure and protective immunity (37). However, infants <1 year old had the lowest burden (4.7%), possibly attributable to lower mobility and less vector exposure.

The incidence rate of CL infection was 57% in patients over 15 years old (17). This finding is lower than that reported for Colombia (86%) (8), but higher than findings reported for Iran (38%) (30) and Turkey (45%) (23). In the two latter studies, the investigators postulated that the decrease in incidence with age was due to development of immunity by previous infections. Incidence of CL was 25.23% in male patients over 15 years of age, while in females the incidence of CL was 31.7% in women over 15 years of age.

Geographically, Khanaqeen district had the most cases (28.8%) while Mansouriyah had the least (9.2%, Table 3). Significant spatial heterogeneity is expected due to micro-environmental variations influencing sandfly breeding and transmission dynamics (38). Moreover, a clear seasonal pattern was observed, with peak cases in winter (November-February) and nadirs in summer (June-August, Table 4). This agrees with the known seasonal dynamics of CL determined by sandfly activity (39), (40).

The prevalence in this province in 2019 was 126 per 100000. In a study in Kermanshah Province in Iran was 15.4 per 100000, whereas for Ghasreshirin that located in border of Iraq was 139 per 100000 that is close to prevalence in Diyala Province. In the period of 2011-2019 in Kermanshah 75.9 % were male and 24.1% were female. In Diyala Province 48.1% male and 51.9% female. In Kermanshah the most prevalence was in ages 30-59 and in Diyala was in ages under 15 (41,42).

This study had several limitations including:

1. The lack of individual-level clinical information limits risk factor analysis.
2. As well, the findings may not be generalizable beyond Diyala province. Further prospective cohort studies tracking exposures, seroconversions and clinical outcomes are needed to elucidate transmission dynamics.
3. Molecular characterizations of circulating Leishmania species and vectors are also required to inform prevention strategies.
4. Long-term surveillance can clarify trends and assess control program impacts.
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8. Long-term surveillance can clarify trends and assess control program impacts.

Conclusion

This study provides evidence-based updates on the CL situation in Diyala Province, validating its endemicity. Cutaneous leishmaniasis lesions affecting both sexes, but male is more prone to infection than female and age range 5-14 years were more affected during winter season. The high-risk groups and seasons identified can guide prevention activities. However, shifts in gender distribution require monitoring. More research is still needed to fully elucidate the climatic and ecological factors driving CL transmission in Diyala.

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Conflict of Interest

The authors declare that there is no conflict of interests.

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