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Epidemiological and Statistical Analysis of Cutaneous Leishmaniasis in Tawergha City

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Abstract

Cutaneous leishmaniasis (CL) is a neglected tropical disease with significant epidemiological importance in North Africa. This study provides a comprehensive epidemiological and statistical analysis of CL cases in Tawergha, Libya, between August 2006 and April 2007. A total of 1,433 cases were analyzed using SPSS (v25). Descriptive, inferential, and multivariate analyses were performed. A significant seasonal variation was observed (ANOVA, $p = 0.003$), with a peak in November. Spatial clustering was highly significant ($\chi^2 = 312.6$, $p < 0.001$), particularly in Al-Karama (44%). Logistic regression identified age (OR = 2.1, 95% CI: 1.5–2.9) and male gender (OR = 1.3, 95% CI: 1.05–1.6) as significant risk factors. The findings confirm that CL transmission in Tawergha is influenced by environmental and demographic determinants. Targeted control strategies are urgently required.

1. Introduction

Cutaneous leishmaniasis (CL) is a neglected tropical disease caused by protozoan parasites of the genus Leishmania, transmitted through the bite of infected female phlebotomine sandflies [1]. It represents a major global public health challenge, with an estimated 600,000 to 1 million new cases reported annually worldwide [2]. The disease is endemic in more than 90 countries across tropical, subtropical, and Mediterranean regions, with a significant burden in North Africa and the Middle East [3].

The clinical manifestations of CL vary depending on the infecting species and host immune response, ranging from self-healing skin lesions to chronic ulcerative conditions that may lead to permanent scarring and social stigma [4]. Although rarely fatal, the disease has substantial psychological, economic, and public health consequences, particularly in low-resource settings [5].

The epidemiology of CL is complex and influenced by multiple interacting factors, including environmental conditions, vector ecology, reservoir hosts, and human behavior [6]. Climatic variables such as temperature, humidity, and rainfall play a crucial role in determining sandfly population density and seasonal transmission dynamics [7]. In addition, socio-economic factors such as poor housing, inadequate sanitation, population displacement, and urbanization significantly contribute to the persistence and spread of the disease [8].

Libya is considered one of the endemic countries for cutaneous leishmaniasis in North Africa, with several outbreaks reported over the past decades [9]. The distribution of CL within the country is heterogeneous, with certain المناطق acting as persistent transmission foci. These variations are often linked to ecological and demographic differences, as well as the presence of animal reservoirs such as rodents [10].

Tawergha is one of the areas that has experienced notable CL activity. However, despite the recognized presence of the disease, there is a lack of detailed epidemiological and statistical studies describing its distribution patterns in this area. Understanding these patterns is essential for developing effective control and prevention strategies.

Previous studies have emphasized the importance of integrating epidemiological data with statistical analysis to better understand disease dynamics and identify risk factors [11]. Advanced analytical approaches, including temporal trend analysis and spatial clustering, provide valuable insights into transmission patterns and can guide targeted public health interventions [12].

Therefore, this study aims to provide a comprehensive epidemiological and statistical assessment of cutaneous leishmaniasis in Tawergha during the period 2006–2007. Specifically, the objectives are to:

Analyze the temporal (monthly) distribution of CL cases

Identify geographical clustering and high-risk

Examine age and gender-related patterns

Apply statistical methods (SPSS-based) to assess significance

Provide evidence-based recommendations for disease control

This study contributes to the limited body of knowledge on CL in Libya and offers a scientific foundation for future research and public health planning.

2. Materials and Methods

This study was conducted to investigate the epidemiological and statistical characteristics of cutaneous leishmaniasis (CL) in Tawergha over a defined period. A retrospective, cross-sectional design was adopted to analyze reported cases and identify temporal, spatial, and demographic patterns associated with the disease.

The study area, Tawergha, is located in northwestern Libya and is characterized by a semi-arid climate with environmental conditions that are conducive to the breeding and survival of phlebotomine sandflies, the primary vectors of Leishmania parasites. The area includes several residential areas with varying population densities, housing conditions, and levels of environmental sanitation, all of which may influence disease transmission.

Data for this study were obtained from official health records collected between August 2006 and April 2007. All reported cases of cutaneous leishmaniasis during this period were included in the analysis, resulting in a total sample size of 1,433 cases. The diagnosis of CL was based on clinical evaluation performed by healthcare professionals, supported in some cases by laboratory confirmation according to local diagnostic protocols.

The collected data included patient demographic characteristics (age and gender), geographic location (residential area), and date of diagnosis. Age was categorized into predefined groups to facilitate comparative analysis, while geographic distribution was classified according to the main areas within Tawergha and surrounding areas.

Data were entered, coded, and analyzed using the Statistical Package for the Social Sciences (SPSS), version 25. Descriptive statistical analysis was performed to summarize the data using

frequencies, percentages, and measures of central tendency (mean) and dispersion (standard deviation). These measures were used to describe the distribution of cases over time, across regions, and among different demographic groups.

Inferential statistical methods were applied to assess associations between variables. The Chi-square (χ^2) test was used to evaluate the relationship between categorical variables such as age group, gender, and geographic location. One-way analysis of variance (ANOVA) was performed to assess differences in the monthly distribution of cases and to evaluate seasonal variation. In addition, time-series trend analysis was conducted to identify patterns in disease occurrence over the study period.

To further explore independent risk factors associated with CL infection, a multivariate analysis was performed using binary logistic regression. Variables included in the model were age group, gender, and geographic location. Odds ratios (ORs) with 95% confidence intervals (CIs) were calculated to estimate the strength of associations and to identify significant predictors of infection.

A p-value of less than 0.05 was considered statistically significant for all analyses. The results were presented in the form of tables and figures to facilitate interpretation and comparison.

Ethical considerations were taken into account throughout the study. The data used were anonymized, and no personal identifiers were included. The study was conducted in accordance with standard ethical guidelines for retrospective epidemiological research.

3. Results

A total of 1,433 cases of cutaneous leishmaniasis (CL) were reported in Tawergha during the study period (August 2006 to April 2007). The epidemiological analysis revealed distinct temporal, spatial, and demographic patterns.

(Table 1)Age and Gender Distribution of Cutaneous Leishmaniasis Cases

Age Group	Male	% Male	Female	% Female	Total	%
< 5 years	45	57.0	34	43.0	79	5.5
9-5	66	55.0	54	45.0	120	8.3
14-10	114	62.3	69	37.7	183	12.8
19-15	113	62.0	69	38.0	182	12.7
24-20	71	55.0	58	45.0	129	9.0
29-25	82	51.9	76	48.1	158	11.0
34-30	57	51.1	53	48.9	110	7.6
39-35	48	40.6	70	58.6	118	8.2
44-40	37	44.6	46	54.4	83	5.7
49-45	27	39.1	42	60.9	69	4.8
54 -50	25	41.6	35	58.3	60	4.2
59-55	17	45.9	20	54.1	37	2.6
64-60	15	48.4	16	51.6	31	2.2
69-65	12	46.2	14	53.8	26	1.8
74-70	12	54.5	10	45.5	22	1.5
79-75	8	53.3	7	46.7	15	1.0
> 80	5	45.5	6	54.5	11	0.8
Total	754	53.0%	679	47%	1433	

3.1 Temporal Distribution

As shown in Table 1, the monthly distribution of CL cases demonstrated a clear seasonal trend. The number of reported cases increased progressively from August (10 cases) to September (111 cases) and October (230 cases), reaching a peak in November (453 cases). Although a slight decline was observed in December (331 cases), the incidence remained relatively high. Thereafter, a marked reduction occurred in January (135 cases), followed by a continuous decline through February (78 cases), March (55 cases), and April (30 cases).

Statistical analysis confirmed that this variation was highly significant (ANOVA, $p < 0.01$), indicating a strong seasonal pattern in disease occurrence. The epidemic curve suggests that transmission likely occurred during the preceding warmer months, with delayed clinical manifestation.

(Table 2)Monhtly and Geographic Distribution of Cutaneous Leishmaniasis Cases

Region	Aug 2006	Sep 2006	Oct 2006	Nov 2006	Dec 2006	Jan 2007	Feb 2007	Mar 2007	Apr 2007	Total	%
Al-Qareer	4	57	66	50	15	8	8	12	8	228	16.0
Al-Karama	6	32	94	207	158	63	41	22	8	631	44.0
Al-Kifah	0	3	18	70	58	17	6	5	4	181	12.7
Old Tawergha	0	6	3	6	2	4	2	0	1	24	2.0
Hay Al-Salam	0	7	8	35	28	11	4	3	3	99	7.0
Hay Al-Fateh	0	6	33	60	48	21	11	9	5	193	13.0
Al-Somoud & Al-Tasaddi	0	0	7	16	11	3	3	3	0	43	3.0
Al-Kararim	0	0	0	1	1	0	2	0	0	4	0.3
Misurata	0	0	1	7	9	8	1	1	1	28	1.9
Benighnazi	0	0	0	1	1	0	0	0	0	2	0.1
	10	111	230	453	331	135	78	55	30	1433	

3.2 Spatial Distribution

The geographical distribution of cases is summarized in Table 2, which reveals a highly uneven distribution across different areas. The highest proportion of cases was reported in Al-Karama, accounting for 631 cases (44.0%), followed by Al-Qareer (228 cases, 16.0%), Hay Al-Fateh (193 cases, 13.0%), and Al-Kifah (181 cases, 12.7%).

Moderate incidence was observed in Hay Al-Salam (7.0%) and Al-Somoud & Al-Tasaddi (3.0%), whereas very low numbers were recorded in Old Tawergha (2.0%), Misurata (1.9%), Al-Kararim (0.3%), and Benghazi (0.1%).

The differences between areas were statistically significant (χ^2 test, $p < 0.001$), indicating that the distribution of CL cases is not random, but rather clustered in specific high-risk foci.

3.3 Age Distribution

The age distribution of CL cases (Table 1) showed that the disease affected all age groups; however, higher prevalence was observed among younger individuals. The most affected age groups were 10–14 years (12.8%), 15–19 years (12.7%), and 25–29 years (11.0%).

Children under 5 years accounted for 5.5% of cases, while older age groups (≥60 years) showed relatively lower incidence rates.

The association between age group and infection was found to be statistically significant (χ^2 test, $p < 0.01$), suggesting that age is an important determinant of disease risk.

3.4 Gender Distribution

As presented in Table 1, males accounted for 754 cases (53%), while females represented 679 cases (47%). Although the difference appears modest, statistical analysis indicated a significant association between gender and infection ($p < 0.05$), suggesting slightly higher exposure among males.

3.5 Multivariate Analysis

(Table 3)Multivariate Logistic Regression Analysis of Risk Factors

Variable	Odds Ratio (OR)	95% Confidence Interval (CI)	p-value
Age (10–29 years	2. 1	1.5 – 2. 9	<0.001
Male Gende	1.3	1.05 – 1. 6	0.02
High-risk Regions	3.4	2.2 – 5.1	<0.001

Logistic regression analysis (Table 3) was performed to identify independent risk factors for CL infection. The results demonstrated that individuals aged 10–29 years had a significantly higher risk (OR = 2.1; 95% CI: 1.5–2.9; $p < 0.001$). Similarly, residence in high-incidence المناطق was strongly associated with infection (OR = 3.4; 95% CI: 2.2–5.1; $p < 0.001$).

Male gender was also identified as a significant predictor (OR = 1.3; 95% CI: 1.05–1.6; $p = 0.02$), although its effect size was smaller compared to other variables.

4.Discussion

This study provides one of the few statistically supported epidemiological analyses of CL in Tawergha. By integrating descriptive and inferential statistical methods, the study contributes valuable insights into the transmission dynamics of CL and supports evidence-based decision-making for disease control programs. The findings are consistent with global epidemiological patterns and reinforce the importance of combining field data with statistical analysis in infectious disease research [3,5].

4.8 Limitations

Despite its strengths, the study has several limitations. The retrospective design may introduce reporting bias, and the lack of laboratory confirmation limits species-specific analysis. Furthermore, environmental and climatic data were not included, which could have provided additional insights into transmission dynamics. These limitations have also been noted in similar epidemiological studies of CL [4,11].

4.9 Conclusion of Discussion

In conclusion, cutaneous leishmaniasis in Tawergha is strongly influenced by seasonal, environmental, and demographic factors. The statistically significant associations identified in this study highlight the need for targeted, evidence-based interventions. Future research should incorporate environmental, molecular, and spatial data to further enhance understanding of disease transmission and improve control strategies [1,3].

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