

# Cutaneous Leishmaniasis: Associated Risk Factors and Prevention in Hubuna, Najran, Saudi Arabia

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**Background:** Many countries are currently affected by leishmaniasis, and cutaneous leishmaniasis is ranked among the ten most neglected diseases. The aim of this study was to determine the risk factors related to cutaneous leishmaniasis and preventive measures among people living in Hubuna, Najran, Saudi Arabia.

**Methods:** A community-based cross-sectional survey was conducted from January to October 2022. A convenience sampling technique was used, with 396 individuals invited to participate in the current study and 391 included. A self-administered questionnaire was utilized for collecting data. Descriptive analysis was used for risk factors and preventive measures, while  $\chi^2$  tests were used for determining associations with risk factors.

**Results:** Among participants, 38.1% (n=149) reported having cutaneous leishmaniasis clinically diagnosed and under treatment. Age 0–10 years was found to be associated significantly with cutaneous leishmaniasis infection (AOR 3.08, 95% CI 1.6–6.4;  $P=0.002$ ) compared to other groups. A significant association was noted too for those residing in/around planted areas versus those who were not (AOR 1.18, 95% CI 0.13–2.24;  $P<0.001$ ). In terms of occupation, farming was significantly associated with cutaneous leishmaniasis (AOR 2.54, 95% CI 1.15–3.76;  $P=0.010$ ). No significant associations were observed in regard to sex (AOR 1.4, 95% CI 0.7–1.6;  $P=0.11$ ), education ( $P=0.072$ ), or preventive measures used ( $P>0.05$ ).

**Conclusion:** The cutaneous leishmaniasis endemicity level in Hubuna was high. Several socioeconomic and environmental factors contribute enormously to the spread of the disease in the area. Further investigation of risk factors of cutaneous leishmaniasis all over the country and setting up appropriate interventions to prevent its spread are recommended.

**Keywords:** cutaneous leishmaniasis, preventive measures, risk factors, Hubuna, Saudi Arabia

## Introduction

Leishmaniasis is a vector-borne endemic disease with an array of parasite species. Worldwide, leishmaniasis affects approximately 87 countries.<sup>1</sup> Cutaneous leishmaniasis (CL) is distributed throughout most of Asia, the Middle East, north Africa, and North and South America.<sup>2</sup> In terms of neglected tropical diseases, it is ranked in the top ten. **There are >12 million infected globally with 0.9–1.6 million new cases annually**, in addition to 350 million people at risk of infection.<sup>3</sup> According to Abass et al, Saudi Arabia has the fourth-highest prevalence of zoonotic CL following Afghanistan, Iran, and Pakistan.<sup>4</sup> During the course of CL three patterns of lesions exist on the skin (ulcerative type, nodules and nodulo-ulcerative type).<sup>5</sup>

CL is confined to six regions, including Najran, though it remains a major public health concern.<sup>6</sup> Accordingly, a case-notification system has been launched by Saudi Arabia's health ministry to control the disease, which resulted in a noticeable reduction in the incidence of CL.<sup>7</sup> CL is known to be transmitted by infected female sandflies. It is estimated that there are between 21 and 30 protozoan species responsible for CL infection in humans.<sup>8</sup> Based on the reservoir hosts,

leishmaniasis was divided into two major categories: zoonotic (for wild and domestic animals) and anthroponotic (where the main source is humans).<sup>6,9</sup> In regard to human leishmaniasis, CL is considered the most prevalent type.<sup>10,11</sup>

Despite being a non-life threatening mild condition, CL can affect communities devastatingly. This condition manifests clinically in many ways, but disfiguring skin ulcers are worst. The lesions often develop on exposed body parts, such as the face and extremities. The mucous membranes of the mouth, nose, and throat cavities, as well as surrounding tissue, can be totally or partially destroyed by ulcerations that may result in lifetime scarring, which can cause severe psychological and/or social stigma, particularly among young girls.<sup>12</sup>

In Saudi Arabia, it has been documented that over the last 10 years, the average number of infected cases was more than 2500 per year, ranging between 1464 and 4131 cases, and in regard to Hubuna, the incidence was reported to be 5–10 cases/100,000 population.<sup>13</sup> Numerous studies have reported that the incidence of CL is elevating globally. Accordingly, this survey was intended to determine the prevalence of CL and highlighting the potential risk factors and preventive measures in Hubuna, Najran, Saudi Arabia.

## Methods

### Study Area and Population

The current study was undertaken in Hubuna, which is one of the governorates in the Najran region in southern Saudi Arabia along the border with Yemen. The total study population comprised 20,400 individuals currently residing in Hubuna according to the last census carried out in 2017 by the Saudi General Authority for Statistics.<sup>17</sup>

### Sampling Process

Convenience sampling was adopted for recruiting the sample. Yamane's formula<sup>18</sup> was utilized to attain the maximum representation of the study population, which were 20,400 individuals. The selection of participants was based on those who responded to the [electronic questionnaire](#). Accordingly, the sample size was calculated:

$$\text{Slovin's formula: } n = \frac{N}{(1+Ne^2)}$$

$$n = \frac{20400}{(1+20400*0.05^2)} = 392 \text{ individuals.}$$

Where n is desired sample size, N Hubuna's total population (20,400), and e margin of error (0.05).

### Dependent Variable

The dependent variable was CL.

### Independent Variables

The independent variables were various sociodemographic characteristics of the respondents in terms of sex, age, educational level, plus living environment, climate, preventive measures, and occupation.

### Inclusion Criteria

All persons of all ages and nationalities who are currently living in Hubuna whether infected with CL or not. Patients who were already clinically diagnosed in the local hospital based on physical examination, pathological history, or microscopic examination were included in this study.

### Exclusion Criteria

Anyone who declined to be part of the study or patients who were severely ill or disoriented to answer the questionnaire. A total of 396 individuals were participated in the study. After checking data, five questionnaires were found to be incomplete or completed incorrectly, so they were omitted.

## Data-Collection Process

A self-structured and electronic questionnaire was utilized for collecting data. The questionnaire was distributed via social media groups (Facebook, WhatsApp, email and Instagram). It was composed of two main sections. Section one was for sociodemographic data. Section two was for determining the risk factors besides the used preventive measures stated by the participants.

The questionnaire was translated into Arabic and tested for content validity by a jury of five medical experts, while reliability using Cronbach's  $\alpha$  was 0.84, which showed acceptability. Furthermore, a pilot study was performed on 15 participants who were excluded from the main sample to ascertain the instrument's clarity and applicability, and accordingly necessary changes were undertaken.

## Statistical Analysis

After cleaning and coding, data analysis was performed using SPSS 22. The categorical variables age-groups, sex, and were summarized and reported as frequency distribution,  $\chi^2$  tests were used to examine associations between different categorical binary variables (age with leishmaniasis status), *t*-tests or ANOVA for other variables (sex, education, residence, occupation, preventive methods, and leishmaniasis status), and AOR for analysis of independent determinants of leishmaniasis between those infected with CL and healthy ones.  $P < 0.05$  was considered statistically significant.

## Results

### Characteristics of Study Participants

Participants' mean age was  $24.4 \pm 18$  (4–76) years. In terms of sex, males predominated in the sample (59.8%). In regard to education, a majority of participants (196, 50.1%) corresponding to intermediate and secondary schools. Regarding living condition, the survey revealed that a majority of Hubuna's residents (51.7%) preferred to live on or nearby farms or at least have multiple houses, which may put them at greater risk of being exposed to sandfly bites. As stated by the participants, almost 28% prefer to use insecticide-treated bed nets as a preventive method against sandfly bites (Table 1).

### Cutaneous Leishmaniasis Situation in Hubuna

Among the 391 participants, CL was self-reported to be 38.1% ( $n=149$ ). It was higher among males (41.1%) than females (35.2%), and the situation has changed among older people. In terms of disease severity in the current study, the number of lesions per patient ranged from one to eight, with 22.6% of located on the face, 31.4% on the upper extremities, 39.4% on the lower extremities, and 6.6% on other body parts. Patients saw physicians late after onset. The average duration of lesions before seeking medical services was 1.7 (1–4) months. Most subjects (56.2%) had a single lesion.

### Association Between Age-Groups and CL

Our observations have shown that CL spares no age-group. In general, all age-groups were affected by this problem, with children (0–10 years), dominating (almost 76%) out of this age group, followed by those aged 21–30 years (42.9%). A lower percentage was observed among other age-groups (Table 2).

### Risk Factors Associated with Cutaneous Leishmaniasis

Although, there was no socioeconomic restriction for the disease, in the adjusted analysis the findings showed that the risk factors that were associated significantly with CL included the youngest age-group (0–10 years). Likewise, the younger the age, the greater the risk of having CL (AOR 3.08, 95% CI 1.6–5.4;  $P=0.002$ ). The odds of getting leishmaniasis among children under 10 years old was almost six times that of the odds those age  $>31$  years. A significant association was noticed also for those residing in/around planted areas versus those who are not (AOR 2.13, 95% CI 0.13–2.24;  $P < 0.001$ ). In terms of occupation, farmers had a significantly higher risk of having CL (AOR 2.64, 95% CI 1.55–3.76;  $P=0.010$ ).

Based on the findings of the distribution of CL cases according to sex, both sexes were affected by this pathological problem, although the ratio was in favor for females versus males, as mentioned previously. Therefore, no significant

**Table 1** Sociodemographic characteristics of the respondents (n=391)

	Characteristics	n	%	Infected	Uninfected
<b>Sex</b>	Male	234	59.8	80	154
	Female	157	40.2	69	88
<b>Age, years</b>	≤10	54	13.8	41	13
	11–20	91	23.3	39	52
	21–30	136	34.8	51	85
	≥41	110	28.1	18	92
<b>Education</b>	Uneducated or primary school	73	18.7	48	25
	Intermediate and secondary school	196	50.1	62	134
	Higher education (university graduates)	122	31.2	39	83
<b>Residence</b>	Rural	202	51.7	119	83
	Urban	189	48.3	30	159
<b>Occupation</b>	Child/student/unemployed	194	49.6	61	133
	Teachers/education employees	31	7.9	14	17
	Health professionals	33	8.4	12	21
	Farmers	59	15.1	43	16
	Others	74	18.9	19	55
<b>Preventive measures reported by participants</b>	Woodsmoke	99	25.3	53	46
	Insecticide-treated bed nets	108	27.6	61	47
	Spraying insecticides	74	18.9	40	34
	Insect-repellent lamps	81	20.7	18	63
	Others	29	7.4	7	22

associations were observed between CL and sex (AOR 1.4, 95% CI 0.7–1.6;  $P=0.11$ ), education ( $P=0.072$ ) and preventive measures ( $P>0.05$ ), as represented in Table 2. As far as prevention was concerned, most of Hubuna's citizens believed that most indoor sandflies were infected. Accordingly, prevention measures are crucial for minimizing the effects of sandfly bites. In the current survey, the most cited preventive method among participants was using insecticide-treated bed nets followed by using woodsmoke for repelling mosquitoes, as displayed in Figure 1.

## Discussion

CL is one of the largest public health problems worldwide, impacting both developed and developing nations.<sup>19</sup> The present survey revealed that CL is in endemic form with estimated prevalence about 38.1%. This result is similar to numerous studies conducted in various regions of Saudi Arabia and Iran.<sup>4,20</sup> In contrast, it is lower than what has been documented in Afghanistan, Bolivia, northwestern Saudi Arabia, and Tunisia.<sup>5,21–23</sup>

The current survey's data show that CL affects all age-groups. However, one interesting point to be highlighted is that children <10 years old are more likely to be affected than other age-groups. Similar findings have been reported by various studies conducted in central northern Morocco, northoern Ethiopia, southwestern Ethiopia, and western Iran.<sup>24–27</sup> In Kuwait, Al-Tagi et al documented that the most affected population was people aged >21 years.<sup>28</sup> Furthermore, in

**Table 2** Multivariate logistic regression analysis for independent determinants of leishmaniasis (n=391)

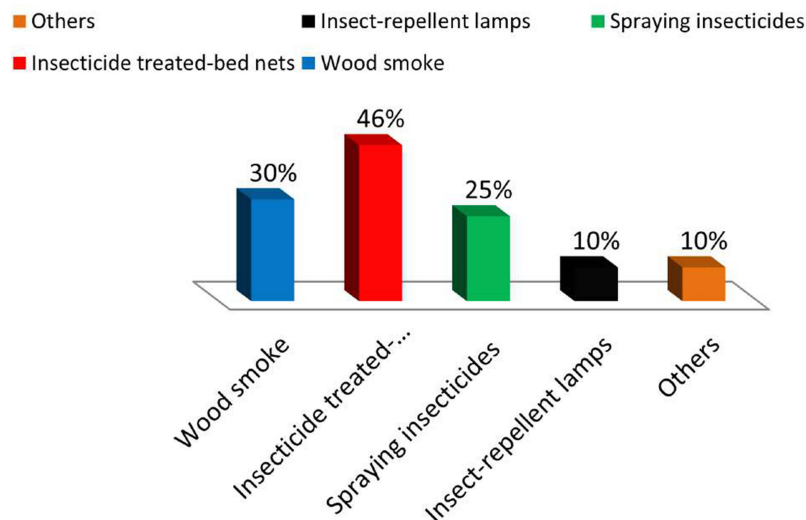
	Leishmaniasis status		AOR (95% CI)	P
	Infected	Uninfected		
<b>Sex</b>				
Male	80	154	1.4 (0.7–1.6)	0.11
Female	69	88	1	
<b>Age, years</b>				
≤10	41	13	3.08 (1.6–5.4)	0.002*
11–20	39	52	2.1 (0.07–51.5)	
21–30	51	85	0.23 (0.09–0.62)	
≥31	18	92	1	
<b>Education</b>				
Uneducated or primary school	48	25	1.18 (0.63–2.21)	0.072
Intermediate and secondary school	62	134	0.96 (0.30–1.43)	
Higher education (university graduates)	39	83	1	
<b>Residence</b>				
Rural	119	83	2.13 (0.13–2.24)	<0.001*
Urban	30	159	1	
<b>Occupation</b>				
Child/student/unemployed	61	133	1	0.010*
Teachers/education employees	14	17	2.36 (1.07–1.19)	
Health professionals	12	21	0.38 (0.09–1.61)	
Farmers	43	16	2.64 (1.55–3.76)	
Others	19	55	1.58 (1.69–2.09)	
<b>Preventive methods reported by participants</b>				
Woodsmoke	53	46	0.81 (0.52–1.19)	0.061
Insecticide-treated bed nets	61	47	1.15 (0.79–2.01)	
Spraying insecticides	40	34	1.46 (0.21–5.78)	
Insect-repellent lamps	18	63	0.68 (1.31–3.06)	
Others	7	22	1	

Note: \*Significant.

a recent study conducted in Asir, Saudi Arabia, it was found that male Saudi citizens were the most affected group and children <13 years old the age-group most affected by CL.<sup>29</sup>

During the course of the current study, another important risk factor was the farming occupation. It was noticed that farmers were the most exposed to insect bites and thus affected by CL significantly (AOR 2.64, 95% CI 1.55–3.76;  $P=0.010$ ). In this regard, Alsamurai and Alobaidi reported the same findings in Iraq.<sup>30</sup> Sex too was identified to be one of

### Used preventive measures as stated by respondents (n=391)



**Figure 1** Preventive measures stated by participants (n=391).

the potential risk factors of CL in this study area. It was observed that the prevalence of CL was higher among males than female, although the difference was not significant (AOR 1.4, 95% CI 0.7–1.6;  $P=0.110$ ). This finding is in accordance with numerous epidemiological studies conducted in Sri Lanka, Iran, Pakistan, Saudi Arabia, and Bolivia.<sup>13,22,31–33</sup> High temperature and high humidity were recognized as important factors associated significantly with CL transmission in Hubuna. Travelling to and from Hubuna was also recognized among the risk factors.

One interesting point to be highlighted is that children <10 years old are more likely to be affected than other age-groups. This could be due to the nature of children, who play outdoors for long periods near or inside farms and places that are good media for sand flies to live, thus putting them at a greater risk of sandfly bites. Furthermore, sex was identified to be one of the potential risk factors of CL in this study area. It was observed that the prevalence of CL was higher among males than females. The difference in the risk of susceptibility to CL infection between males and females could be due to an array of reasons. In Saudi Arabia, these disparities could be explained, specially in the southern region, by men being more involved in outdoor activities mainly done by males, besides farming, while females often stay at home or have to dress in a way that covers their bodies totally when going outdoors and thus will be protected from sandfly bites. In contrast, Nawaz et al, and Alsamarai and Alobaidi documented that females were more infected with CL than men.<sup>30,34</sup>

Several risk factors make Saudi Arabia vulnerable to CL epidemics and outbreaks. Among these, it was noticed that Hubuna residents prefer living near or inside farms. High rate of rainfall and humidity, climate and environmental changes, poor domestic and housing sanitary conditions, rapid urbanization, malnutrition, and huge population movements, as well as many job seekers from all nationalities coming regularly to Saudi Arabia are considered among the most important issues behind this problem.<sup>14–16</sup> In one study conducted in Turkey, it was found that risk factors for leishmaniasis are no bed nets and living close to dogs or cattle,<sup>35</sup> in Pakistan the infection was more linked to older females than others,<sup>36</sup> and in Bolivia males were more at risk of CL than females.<sup>22</sup> In terms of number of lesions, the current article revealed that most patients with CL have a single lesion. These findings are in agreement with those reported from Algeria and Tunisia.<sup>23,37</sup> On the other hand, some studies have concluded that CL usually appears in the form of multiple lesions.<sup>12,38–40</sup>

Another important point to be addressed is that our study showed that most sandfly bites were located on the lower extremities. There may be an explanation for this finding, as sandflies are found near the ground, where they can easily

bite the lower extremities. Numerous studies have concluded the same.<sup>33,41</sup> Conversely, other studies have reported that CL lesions are most common on the face and upper extremities.<sup>42,43</sup>

For prevention methods, a majority of participants in this study were using insecticide-treated bed nets followed by using woodsmoke for repelling insects, which is inconsistent with what was reported by Kroeger et al in Venezuela.<sup>44</sup> In the similar vein, a study conducted in Afghanistan showed that the most common protective methods against CL were insecticide-treated bed nets and spraying inside houses,<sup>45</sup> while another study suggested that using the vaccine for prevention from leishmaniasis is safe<sup>46</sup> and in Colombia three strategies were suggested for prevention of CL: better house construction, appropriate arrangement of houses, and provision of the health services needed for diagnosis and treatment.<sup>47</sup>

The major strengths of the current study include the high rate of access to the target population, which was able to prevent selection bias to some extent, and that we pointed out important risk factors endemic CL, which could greatly facilitate the establishment of strategic plans more effectively. On the other hand, the primary limitation of this survey was that it was cross-sectional, which may limit any causal evidence. Another limitation is that it was conducted in one region of Saudi Arabia and so lacks generalizability, in addition to the electronic data-collection approach, which could have affect the accuracy of the data collected.

## Conclusion

CL endemicity in Hubuna remains high. Accordingly, for combating this disease, combined effort and integrated approaches are needed. For handling potential risk factors, it is advisable to apply control activities in terms of conducting various health-education programs on the use of personal protection measures regularly. Several socio-economic and environmental factors contribute enormously to the spread of CL in the area, and this would help in better understanding the disease's epidemiology for effective control of its transmission.

For designing effective vector-control strategies, it is crucial to report updated information and continuously evaluate and assess sandfly density and distribution, as well as their behavior. Such conditions must be prevented in timely fashion through extensive awareness campaigns on vector control, which may help in suppression of vector density. Further investigation of risk factors of CL all over the country and setting up appropriate intervention programs to prevent the spread of CL are recommended.

## Data Sharing

The data are available upon request. Please contact the corresponding author for data.

## Ethics Approval and Consent to Participate

Official permission and ethics approval (NU/RG/MRC/11/1) was obtained from the Deanship of Scientific Research at Najran University, Saudi Arabia. This study complied with the Declaration of Helsinki. Additionally, official permission was obtained from Hubuna hospital officials. Written informed consent indicated that the participant had the right to decline or withdraw at any point during the course of the study and was obtained from all participants and parents or legal guardians of those aged <18 years. Confidentiality was assured each participant.

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## Author Contributions

All authors made a significant contribution to the work reported, whether in conception, study design, execution, acquisition of data, analysis and interpretation, or all these areas, took part in drafting, revising, or critically reviewing the article, gave final approval of the version to be published, have agreed on the journal to which the article has been submitted, and agree to be accountable for all aspects of the work.

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## Disclosure

The authors declare no competing interests in this work.

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