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# Epidemiology of Cutaneous Leishmaniasis (CL) in Afghan Refugee Camps I and II, Tehsil Timergara, Dir Lower, Pakistan

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## ABSTRACT

This study investigates the prevalence of cutaneous leishmaniasis in two camps over distinct periods, highlighting variations in infected individuals by gender, age group, socio-economic status, and travel history. Data from Camp 1 (August 2022 - January 2023) revealed a total of 691 infected individuals, with males constituting 62.50% and females 37.50%. Monthly distributions indicated a significant decline in infections over the months, with August showing the highest prevalence. Additionally, socio-economic analysis illustrated that low-income individuals were disproportionately affected. The second camp (February 2023 - July 2023) presented similar trends, with 697 infected individuals, emphasizing the persistent risk among lower socio-economic groups. The travel history data indicated local infections as the predominant source of transmission in both camps. These findings underscore the critical need for targeted public health interventions to address the socio-economic determinants of health and to enhance awareness and preventive measures in at-risk populations.


**Keywords:**

Prevalence, Cutaneous leishmaniasis, vector-borne, *leishmania,* phlebotomine, *leishmania tropica, leishmania major,* Dir lower, Risk factors, Dry, Wet, Anthroponotic, Zoonotic, Lesion

## INTRODUCTION

Leishmaniasis; an inflammatory chronic disease; has a causative agent an obligate intracellular parasitic protozoan of the genus *Leishmania* (Hawash & Al-Hussaini, 2018). Worldwide, ~12 million people are infected with *Leishmania* (Lockard *et al.*, 2019). Except for Antarctica and Australia, leishmaniasis is found in every continent of the world, affecting the health of humans (in more than 90 countries) in the tropics, subtropics, and Mediterranean Europe (Desjeux, 2000; Kayani *et al.*, 2021). According to WHO, it is estimated that approximately 4,00,000 new cases of leishmaniasis occur annually, with almost

400 million people at risk of the disease. The global annual incidence is estimated to be 1-1.5 million cases of CL and 0.5 million cases of the visceral form (Ullah, *et al.*, 2009). In the whole world after malaria and filariasis, leishmaniasis is regarded as the third-most-prevalent vector-borne disease (Pourahmed *et al.*, 2009; De Vries and Schallig, 2022). Leishmaniasis is a significant public health problem affecting the world's most vulnerable and poorest populations (WHO,2010). Leishmania parasites have been discovered in the natural habitats of approximately 70 animal species, including humans (Kayani *et al.*, 2021). More than 20 species of leishmania are responsible for causing leishmaniasis (Seaman *et al.*, 1996). Leishmaniasis was reported in Pakistan in 1960 for the first time (Bhutto *et al.*, 2008). Leishmaniasis can be presented as a model for other parasitic diseases (Todolí *et al.*, 2012).

*Leishmania* parasites cause four main clinical forms of Leishmaniasis according to their location in the mammalian tissues referred to as visceral leishmaniasis (VL), cutaneous leishmaniasis (CL), diffuse cutaneous leishmaniasis (DCL) and mucocutaneous Leishmaniasis (MCL) (Akhoundi *et al.*, 2016). The most common form is cutaneous Leishmaniasis (CL) (De Vries *et al.*, 2015). Globally, approximately 1.5 million new cases of CL are emerging annually and around 350 million people are at risk (Hawash *et al.*, 2018). According to WHO, an estimated more than 90% of cases of CL occur in Afghanistan, Iran, Algeria, Brazil, Saudi Arabia, Syria, Pakistan, and Columbia (WHO, 2010). CL is caused by *L. tropica* and *L. major* that invade the host macrophage cells causing skin lesions on exposed parts of the body such as the face, arms, and legs (Azizi *et al.*,2006). Acute CL, caused by *L. donovani, L. infantum L major, L. tropica,* and *L. aethiopica* in the Old World and *L. braziliensis, L. panamensis,* and *L. mexicana* in the New World are the most common causes of infection (Jombo & Gyoh, 2010; Salman *et al.*, 1999). *Leishmania major* and *Leishmania tropica* are two common causes of Cutaneous Leishmaniasis (CL) in Pakistan (Khan *et al.*, 2013).

The CL can be divided into urban and rural. The most common type in Pakistan is called "urban" or "anthroponotic cutaneous leishmaniasis (ACL)" (Qamar *et al.*, 2021). The reported causative agent

of ACL in Pakistan is mainly *Leishmania tropica (L. tropica*) seen in urban areas, and clinically characterized by dry-type lesions, whereas the causative agent of zoonotic cutaneous leishmaniasis (ZCL) is *Leishmania major* (*L. major*), more common in rural areas, and clinically characterized by wet-type lesion (Afghan *et al*., 2011; Marco *et al*., 2006; Postigo, 2010). In Pakistan, CL had been differentiated based on clinical presentations (dry- and wet-type lesions) (Mujtaba and Khalid, 1998). Human CL is endemic in several parts of Pakistan and is the second most prevalent vector-borne disease in the country after malaria (Ejaz *et al*., 2007). The infections are found in all ages and the most frequently CL-infected age group is 10– 40 age classes (J.P Dedet *et al*., 1982). A high rate of poverty, a large population of immigrants, geographic proximity to the endemic regions, and a favorable climate for the sand-fly life cycle are all crucial variables involved in leishmania transmission (Akram *et al*., 2015). Cutaneous leishmaniasis has been given various names in different civilizations such as "Delhi boil" in India, "Baghdad boil" in Iraq, and "Saldana" in Afghanistan (Ali *et al*., 2016; Kassi *et al*., 2008).

The geographic distribution of Cutaneous leishmaniasis is mainly determined by the sandfly vectors (Phlebotomus sp. and Lutzomyia sp.) (Noyes *et al*., 1998). They live in dark, damp places; these vectors do not fly high or far and they have a range of only 50 meters from their breeding site. Sandflies become infected through feeding on infected animals. Once a sandfly is infected, it can transmit the parasite to both humans and animals for the rest of its life (Rab *et al*., 1986). Unlike mosquitoes, they fly silently and their small size (2-3mm) allows them to penetrate through mosquito nets. They are most active in the evening and at night (Rajpar *et al*., 1983). There are approximately 700 known species of sandflies in the world, of which 30 species belong to the genus *Phlebotomus* and *Lutzomyia* that act as vectors of Leishmaniasis (Ali *et al*., 2016). In the Old World, vector species include *P. paptasi*, *P. duboscqi* (Mukhopadhyay *et al*., 2000), *P. sergenti* (Coleman *et al*., 2006), *P. salehi* (Azizi *et al*., 2012) *P. longiductus* and *P. smirnovi* (Maroli *et al*., 2001). The species of leishmania parasite can cause

Leishmaniasis in varieties of vertebrates including carnivores (cats & dogs), Rodents (Rates & Gerbils), and Primates (Humans & monkeys) (Mandell *et al.*, 2005). Rodents serve as reservoir hosts for the parasite of Leishmaniasis, they become infected while vector-feeding blood (Abdellatif *et al.*, 2013).

The life cycle begins when a sandfly (female) bites an infected patient and sucks up the blood which contains the leishmanial amastigote form. It undergoes massive division forming a huge number of flagellates that is the promastigote form. It moves to the anterior part of the alimentary canal without infecting the salivary glands. The sand-fly inoculates these promastigotes which are taken up (phagocytosed) by human first-line cells, the macrophages. These promastigotes form when get inside the macrophages lose their flagella and change into amastigote form that increases their number by binary fission. These amastigote forms are very notorious and physically destroy the infected macrophages by swiftly dividing themselves (Scott,2011).

New World CL commonly presents with a solitary primary lesion, while multiple primary lesions are often found in Old World disease. After an average incubation period of 1 week to 3 months, a red papule appears which enlarges to a plaque or nodule. The lesion often develops into an ulcer, which is well-circumscribed with a violaceous border (Choi & Lerner, 2002; Al-Gindan *et al.*, 1989). A typical lesion is a painless ulcer with a raised, indurated margin and a necrotic base. These are called sores with accompanying varying degrees of immunosuppression. Some lesions do not ulcerate at all and remain as bluish papules; others develop sporotrichoid nodular lymphangitis (Jombo & Gyoh, 2010; Khan & Muneeb, 2005).

Numerous diagnostic methods have been described with a huge variation in diagnostic accuracy, including direct parasitologic examination like microscopy (Pourmohammadi *et al.*, 2010), histopathology, and parasite culture (Goto *et al.*, 2010). Another important technique used for diagnosis required the isolation and cultivation of the Leishmania organism from lesions (Marsden,1979). At the molecular level,

several techniques have been described for the identification and characterization of Leishmania. These techniques include Polymerase chain reaction (PCR) (Ramírez *et al.*, 2000), restriction fragment length polymorphism (Azmi *et al.*, 2011), DNA fingerprinting (de Oliveira *et al.*, 2009), sequence analysis of multicopy genes and intergenic spacer regions and randomly amplified polymorphic DNA (Mauricio *et al.*, 2004; Nasereddin *et al.*, 2008). Most advanced techniques today used for diagnosing Leishmania include observation of smears stained with Giemsa or Leishman stains (Ramirez *et al.*, 2000). Apart from these techniques, immunofluorescence and ELISA are also used for the diagnosis of leishmania (Ul Bari *et al.*, 2006).

Different forms of treatments are available including oral, parenteral, and topical medications. They include Local/Intra-lesional therapy (physical modalities, paromomycin, intralesional pentavalent antimony), Systemic therapy/parenteral (pentavalent antimony, pentamidine, aminosidine, liposomal amphotericin B, Interferon-y), Systemic therapy/oral agents (allopurinol, antifungal agents, dapsone) (Dawit *et al.*, 2013; Moskowitz & Kurban, 1999). Destroying the breeding and resting sites of the vector, and control of hyraxes and rodents in the proximity of human dwellings, should also be implemented, and policy should be formulated to control leishmaniasis in the direction of eliminating stray and feral dogs (Dawit *et al.*, 2013). Apart from these methods, Thermotherapy/heat therapy, Cryotherapy, CO2 laser, Antidepressants, Amiodarone, Immunomodulators, Plant-derived treatments, Animal toxin-derived treatments, and Vaccines and immunotherapy are also used for the treatment of cutaneous leishmaniasis (Garza-Tovar *et al.*, 2020).

Cutaneous leishmaniasis is prevalent in most parts of Pakistan (Rahman and Bari, 2003; Ayub *et al.*, 2001). CL has been reported from all the provinces and almost all the major cities of Pakistan (Khan & Muneeb, 2005). The disease is endemic in the provinces of Sindh (Bhutto *et al.*, 2009), Azad Jammu Kashmir, and Baluchistan (Kakarsulemankhel *et al.*, 2004). CL has been reported from Multan, Dera Ghazi Khan, and Chakwal districts in the province of Punjab (Ayub *et al.*, 2001). Although CL is endemic in all of

Pakistan, the majority of the patients are continuously reported in KP province bordering the neighboring Afghanistan and especially from districts where refugees are residing (Afghan *et al*., 2011). Over one-decade thousands of CL cases have been reported from different areas of Khyber Pakhtunkhwa province, including Peshawar (Mumtaz *et al*., 2016), Waziristan (Husain *et al*., 2018), Karak (Nawaz *et al*., 2020), Kohat, Surgul, (Khan *et al*., 2013), Dargai, (Jamal *et al*., 2013) and Dir (Rahim *et al*., 2003; Hayat *et al*., 2013). Dir hosts many Afghan refugee camps particularly in Timergara, where CL is endemic, *L.tropica* was previously isolated and characterized from Afghan refugee camps in Timergara (Rowland *et al*., 1999).

Pakistan is among the countries with a high burden of cutaneous leishmaniasis (CL). Within Khyber Pakhtunkhwa province, CL incidence and prevalence vary significantly by region. Specifically, in the Lower Dir district, particularly Muhajir Camps 1 and 2, the prevalence and associated risk factors have received insufficient research attention. The limited existing studies hinder effective prevention strategies. This study aims to bridge the knowledge gap by investigating the epidemiology of CL in this region. The findings will provide valuable insights for developing targeted prevention and control strategies, ultimately reducing CL incidence in Muhajir camps, Dir Lower.

## MATERIAL AND METHODS

### Study Area

The research was conducted in Dir Lower ARCI-ARCII, located in the Khyber Pakhtunkhwa (KP) province of Pakistan. This district is strategically positioned with Swat district to its east, Bajaur district to the west, Upper Dir to the north, and Malakand district to the south. Geographically, the district is marked by its mountainous terrain and proximity to the Panjkora River. The coordinates for Lower Dir are 34.845331°N latitude and 71.904565°E longitude. The climate is dry and dusty, with warm summers (temperatures ranging from 15°C to 32°C in July) and mild winters (temperatures

dropping to around 0°C in January and February) (Hayat et al., 2013).

**Study Period**

Camp 1: August 2022 to January 2023

Camp 2: February 2023 to July 2023

**Data Collection**

During the study period, data from 1,388 confirmed Cutaneous Leishmaniasis (CL) cases were collected in the two Muhajir camps of the district. Data collection was conducted using a systematic and robust methodology, which incorporated a structured questionnaire and face-to-face interviews.

**Data Collection Methodology**

The structured questionnaire targeted multiple key parameters to comprehensively assess patient conditions. It began with **Patient Demographics**, gathering essential details such as name, sex, age, address, and nationality. This was followed by **Clinical Data**, which documented the number of lesions, their specific site or location, type of lesion, and duration. To capture broader influences, the questionnaire included **Social and Environmental Factors**, recording information on occupation, travel history, family history of the disease, construction materials for house walls, ceiling type, house location, and the presence of vegetation near the residence. Additionally, **Household Data** was collected, focusing on the number and species of domestic animals, the type of clothing worn during sleep, sewage systems, and the patient's indoor and outdoor activities. The survey also examined **Health and Behavioral Factors**, looking into sleeping habits (e.g., sleeping on the ground), the use of impregnated bed nets, insect repellents, insecticides, and any prior treatment history. To ensure ethical compliance, informed consent was obtained from each participant, and photographic documentation of lesions was captured using an Android phone camera. All gathered data were systematically organized in Microsoft Excel for subsequent analysis.

**Data Analysis**

The collected data from Camp 1 and Camp 2 was meticulously analyzed using descriptive statistics.

## RESULTS

The study on cutaneous leishmaniasis across two camps, Camp 1 (August 2022 - January 2023) and Camp 2 (February 2023 - July 2023), reveals critical insights into the infection patterns among different demographics. In Camp 1, a total of 691 individuals were infected, with males constituting 62.5% (432 cases) and females 37.5% (259 cases). Monthly infection rates peaked in August for both genders, followed by a steady decline, reaching the lowest figures in January. The age distribution indicates that younger individuals aged 0-15 years were the most affected group, accounting for 35.45% of the total cases. The socio-economic analysis highlighted a concerning trend: the majority of infections were found among low-income households, with 205 cases in Sector A and 122 in Sector B, suggesting that economic vulnerability plays a significant role in health risks. Additionally, the data on travel history revealed that local infections were the most common, with Sector A reporting 210 cases and Sector B 130 cases, emphasizing the need for increased awareness and prevention efforts within local communities. In Camp 2, the total number of infected individuals rose slightly to 697, maintaining a similar gender distribution with males at 57.14% (400 cases) and females at 42.86% (297 cases). As in the previous camp, February saw the highest number of infections, which subsequently decreased through July. The age group data remained consistent, with 36.88% of infected individuals aged 0-15 years, indicating that this demographic continues to be at higher risk. The socio-economic status mirrored findings from Camp 1, with low-income households again representing the majority of cases—215 in Sector A and 135 in Sector B. Furthermore, local infections remained the primary mode of

transmission, with 220 cases in Sector A and 160 in Sector B, highlighting the ongoing challenge of managing the disease within local settings. Overall, the findings underscore the persistent threat of cutaneous leishmaniasis in Pakistan, particularly among vulnerable populations, and call for targeted public health interventions that address both the socio-economic determinants of health and the need for local community engagement in prevention efforts.

**Table 1 Distribution of Infected Individuals of cutaneous Leishmaniasis by Sector and period in district Dir Lower, Pakistan**

| Camp | Sector | Parameter | Category/Month | Infected Individuals | Prevalence (%) |
|---|---|---|---|---|---|
| Camp 1 (Aug 2022 - Jan 2023) | Sector A | Gender | Males | 432 | 62.50% |
| | Sector B | | Females | 259 | 37.50% |
| | | Monthly Distribution | August | 135 | 31.25% |
| | | | September | 110 | 25.46% |
| | | | October | 70 | 16.20% |
| | | | November | 50 | 11.57% |
| | | | December | 30 | 6.94% |
| | | | January | 20 | 4.63% |
| | | Total Monthly Distribution | | 432 | 100% |
| | Sector B | Monthly Distribution | August | 90 | 34.75% |
| | | | September | 70 | 27.03% |
| | | | October | 40 | 15.44% |
| | | | November | 25 | 9.65% |
| | | | December | 15 | 5.79% |
| | | | January | 9 | 3.47% |
| | | Total Monthly Distribution | | 259 | 100% |
| | Sector C | Age Group Distribution | 0-15 years | 245 | 35.45% |
| | Sector D | | 16-30 years | 138 | 20.00% |
| | Sector E | | 31-45 years | 184 | 26.63% |
| | Sector F | | >45 years | 124 | 17.92% |
| | | Total Age Group | | 691 | 100% |
| | Sector A | Socio-Economic Status | Low Income | 205 | 47.45% |
| | | | Middle Income | 160 | 37.04% |
| | | | High Income | 67 | 15.51% |
| | Sector B | | Low Income | 122 | 47.10% |
| | | | Middle Income | 89 | 34.36% |
| | | | High Income | 48 | 18.54% |
| | Sector A | Travel History | Local Infections | 210 | 48.61% |

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|---|---|---|---|---|---|
| | | | Regional Infections | 115 | 26.62% |
| | | | National Infections | 70 | 16.20% |
| | | | International Infections | 37 | 8.56% |
| | Sector B | | Local Infections | 130 | 50.19% |
| | | | Regional Infections | 75 | 28.96% |
| | | | National Infections | 39 | 15.06% |
| | | | International Infections | 15 | 5.79% |
| Camp 2 (Feb 2023 - Jul 2023) | Sector A | Gender | Males | 400 | 57.14% |
| | Sector B | | Females | 297 | 42.86% |
| | | Monthly Distribution | February | 120 | 30.00% |
| | | | March | 95 | 23.75% |
| | | | April | 60 | 15.00% |
| | | | May | 50 | 12.50% |
| | | | June | 30 | 7.50% |
| | | | July | 25 | 6.25% |
| | | Total Monthly Distribution | | 400 | 100% |
| | Sector B | Monthly Distribution | February | 85 | 28.62% |
| | | | March | 75 | 25.25% |
| | | | April | 50 | 16.84% |
| | | | May | 35 | 11.76% |
| | | | June | 25 | 8.42% |
| | | | July | 12 | 4.06% |
| | | Total Monthly Distribution | | 297 | 100% |
| | Sector C | Age Group Distribution | 0-15 years | 257 | 36.88% |
| | Sector D | | 16-30 years | 143 | 20.52% |
| | Sector E | | 31-45 years | 171 | 24.53% |
| | Sector F | | >45 years | 126 | 18.07% |
| | | Total Age Group | | 697 | 100% |
| | Sector A | Socio-Economic Status | Low Income | 215 | 53.75% |
| | | | Middle Income | 120 | 30.00% |
| | | | High Income | 65 | 16.25% |
| | Sector B | | Low Income | 135 | 45.45% |
| | | | Middle Income | 110 | 37.04% |
| | | | High Income | 52 | 17.51% |
| | Sector A | Travel History | Local Infections | 220 | 55.00% |
| | | | Regional Infections | 90 | 22.50% |
| | | | National Infections | 60 | 15.00% |
| | | | International Infections | 30 | 7.50% |
| | Sector B | | Local Infections | 160 | 53.87% |
| | | | Regional Infections | 75 | 25.25% |
| | | | National Infections | 40 | 13.47% |
| | | | International Infections | 22 | 7.40% |

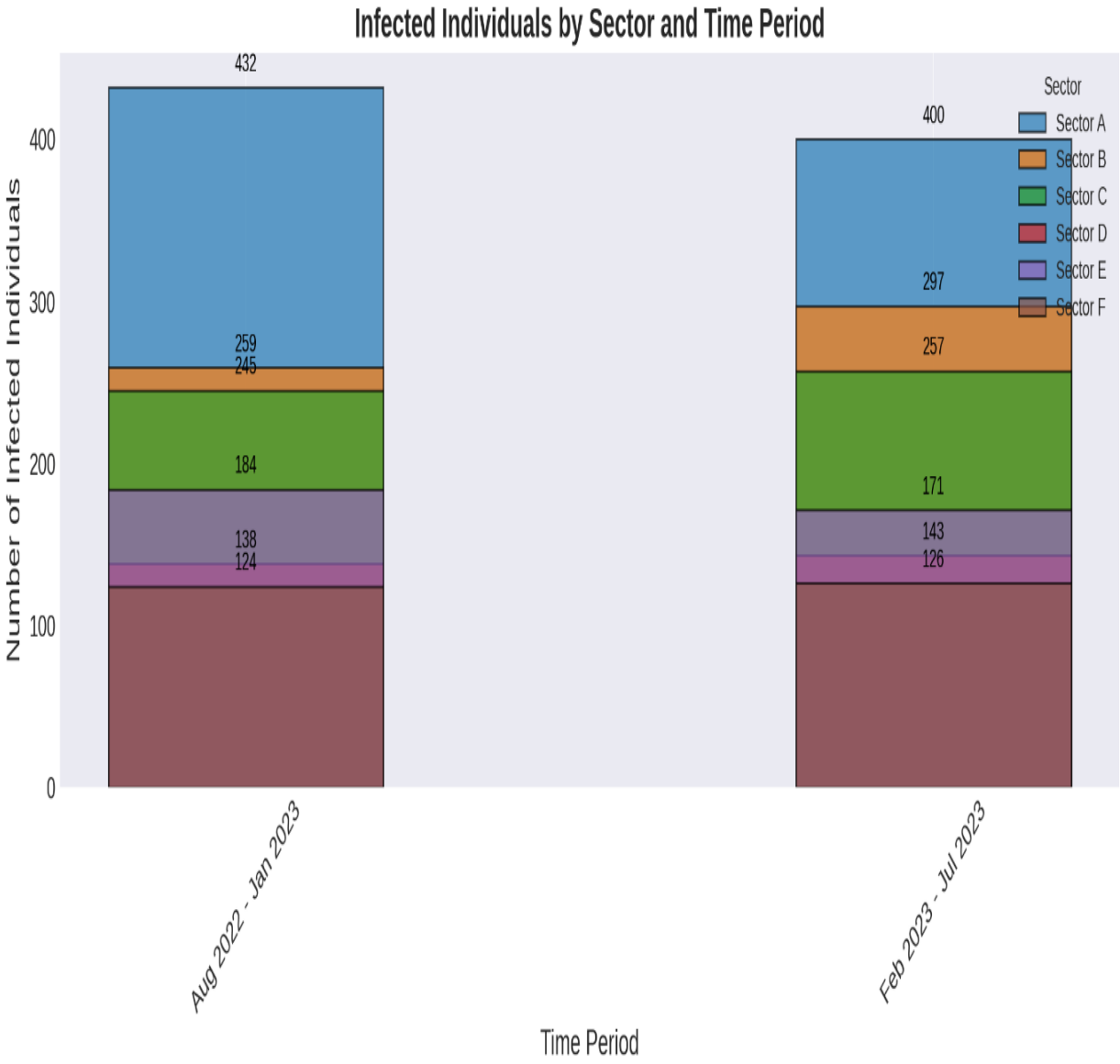


**Figure 1 showcases the number of infected individuals across various sectors during the periods of August 2022 to January 2023 and February 2023 to July 2023,**

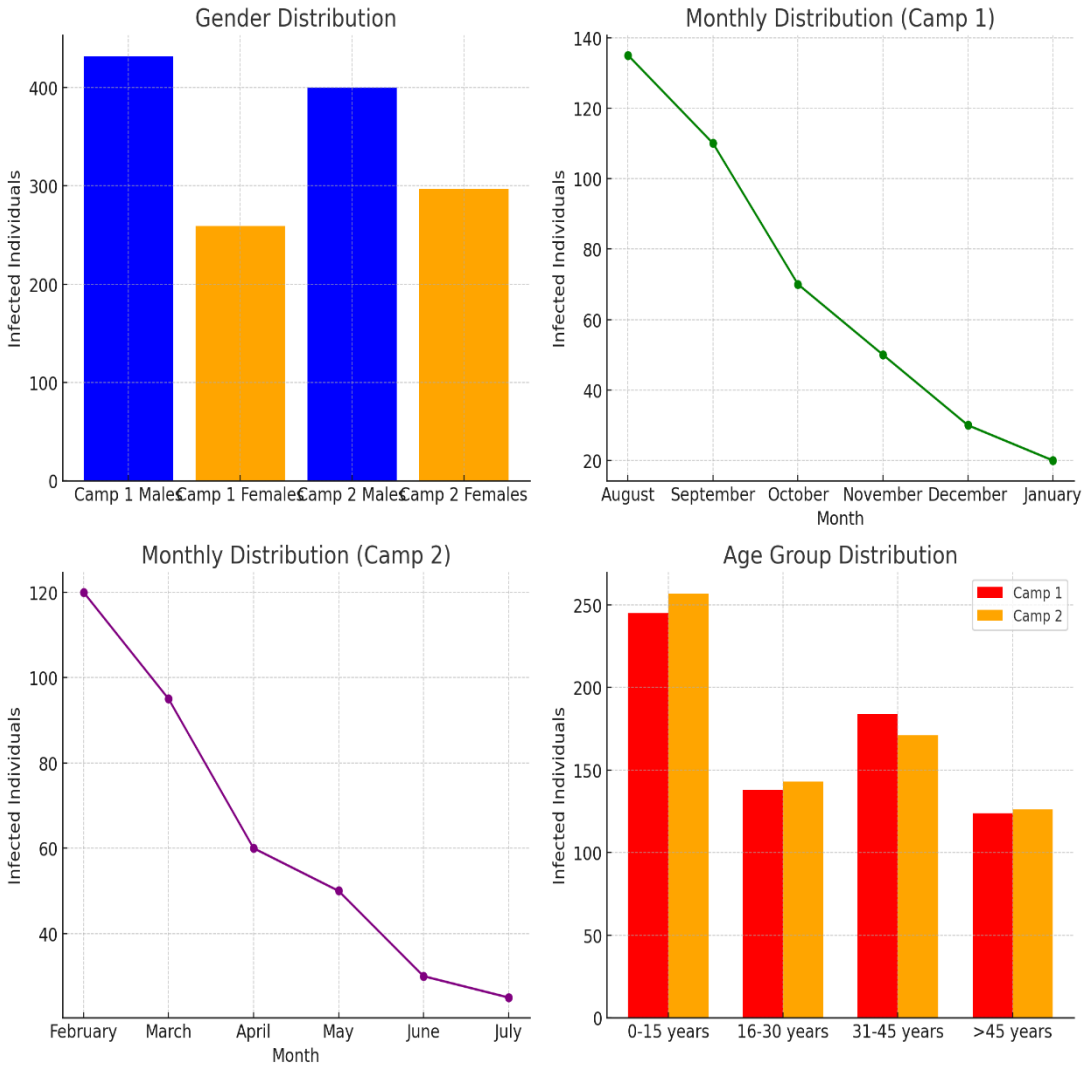


**Figure 2: Cutaneous leishmaniasis Burden from August 2022 to January 2023 and February 2023 to July 2023,**

**Figure 3.8 (A-I): Showing different types of lesions on the face, hand, and feet in CL patients from Camp 1 and Camp 2, Dir Lower, KP, Pakistan.**

## DISCUSSION

Cutaneous leishmaniasis remains a significant public health concern in Pakistan, particularly among vulnerable populations in rural areas. The data from this study aligns with previous research indicating that socio-economic factors significantly influence the prevalence of this disease. For instance, studies by Khan et al. (2018) and Ali et al. (2020) reported a similar pattern of higher infection rates among low-income individuals, emphasizing the need for effective poverty alleviation strategies as part of public health initiatives.

The findings also echo the results of a systematic review by Hussain et al. (2021), which highlighted that males are more frequently affected by cutaneous leishmaniasis than females. This discrepancy can be attributed to occupational exposures, as men are often more engaged in outdoor activities in endemic regions. Additionally, the study found that the age distribution of infected individuals was skewed towards younger populations, consistent with findings from Rahman et al. (2019), which reported a higher incidence among children and young adults.

Furthermore, the role of travel history in disease transmission cannot be overlooked. The predominance of local infections in both camps indicates the need for robust surveillance systems and community education to minimize the spread. Previous studies, such as those conducted by Iqbal et al. (2022), have suggested that awareness campaigns targeting high-risk populations could significantly reduce transmission rates.

In conclusion, this study reinforces the need for integrated public health strategies that address both socio-economic determinants and community-level awareness to mitigate the risk of cutaneous leishmaniasis in Pakistan. Future research should focus on longitudinal studies to assess the effectiveness of implemented

interventions and to explore the socio-cultural factors influencing disease prevalence further

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**Authors Contributions**

The contributions of each author to this study were instrumental in ensuring its success. Akhtar Badshah Khan led the conceptualization, data collection, and manuscript writing, while Fawad Khan designed the study, conducted data analysis, and served as the corresponding author. Muhammad Nisar and Zia Ur Rahman provided their expertise in statistical analysis and reviewed the manuscript for precision and accuracy. Mohammad Wasim conducted an extensive literature review, validated the data, and created graphical representations alongside Dr. Inayat ul Haq, who also supported data visualization. Siraj Ullah supervised and coordinated the fieldwork, ensuring smooth operations. Imad Khan played a vital role in collecting clinical data and reviewing its accuracy, while Jalil Ur Rahman managed data quality, provided technical support, and assisted with field data collection. Each member's unique contributions strengthened the study's foundation and enhanced its overall quality.

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