The Research of Medical Science Review

Received: 27 October 2024
Accepted: 27 November 2024
Published: 05 December 2024

ISSN: 3007-1208 | 3007-1216
Volume 2, Issue 3, 2024

INVESTIGATING THE RISK FACTORS IN THE SPREAD OF CUTANEOUS LEISHMANIASIS IN DIR (U) MALAKAND DIVISION

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ABSTRACT

This study examines the prevalence of Cutaneous Leishmaniasis (CL) in District Upper Dir, Pakistan, with a focus on gender, occupation, and socioeconomic status. CL is primarily caused by Leishmania major *and* Leishmania tropica, *transmitted by female sandflies. The study finds significant variations in infection rates across regions in Tehsil Wari, influenced by demographic factors and living conditions. Regions like Wari and Kotkay have moderate prevalence rates (15.0% and 10.5%) with balanced gender distributions, primarily affecting students and young workers from low socioeconomic backgrounds. In contrast, Gogyal and Sahibabad show high male prevalence (22.0% and 20.0%), linked to farming activities. Female-dominated areas like Serai and Pashata have moderate prevalence, with most cases affecting stay-at-home spouses or retirees. Other regions like Dogram, Shakani, and Dislawar show mixed gender distributions, reflecting diverse occupational backgrounds. Key risk factors include recent travel (76.94%), higher prevalence in unemployed individuals, and increased exposure for agricultural workers and laborers. Housing conditions, with most respondents living in brick or cement homes, offer some protection against environmental factors. The urban-rural divide presents unique health challenges, with urban areas facing pollution and rural areas dealing with limited healthcare access. High pet ownership (88.76%) and outdoor activities (72.33%) contribute to the spread while sleeping off the ground (78.96%) offers some health benefits.*

The study emphasizes the need for targeted health interventions to address the specific demographic and environmental challenges influencing CL transmission.

Keywords*: Cutaneous Leishmaniasis, prevalence, District Upper Dir, gender, occupation, socioeconomic status,* Leishmania major, Leishmania tropica, *sandflies, farming, health risks, zoonotic diseases, housing conditions, travel, urban-rural divide, pet ownership.*

INTRODUCTION

Leishmaniosis is a chronic inflammatory infection caused by an obligatory intracellular parasite protozoan belonging to the genus Leishmania (Alsamarai et al., 2009). Leishmaniosis is considered the third most common vector-borne disease worldwide, behind filariasis and malaria (Pourahmed et al., 2009; De Vries and Schallig, 2022) and about twelve million people have leishmaniasis worldwide (Lockard et al., 2019). The first case of leishmaniasis was documented in Pakistan in 1960 (Bhutto et al., 2008). Four hundred million people are at risk of contracting leishmaniasis, and the WHO estimates that there are about four million new cases of the illness each year. According to estimates by Ullah et

al. (2009), there are 0.5 million instances of the visceral type, and 1-1.5 million cases of CL reported annually worldwide.

According to De Vries et al. (2015), cutaneous leishmaniasis (CL) is the most prevalent kind. By where the parasites reside in the mammalian tissues, there are four primary clinical manifestations of leishmaniasis caused by leishmaniasis parasites, cutaneous leishmaniasis, diffuse cutaneous leishmaniasis, mucocutaneous leishmaniasis visceral leishmaniasis (Akhoundi et al., 2016). Every year, some 350 million people are at risk of developing cutaneous leishmaniasis, with 1.5 million new cases reported worldwide (Hawash et al., 2018). WHO estimates that Afghanistan, Algeria, Brazil, Columbia, Iran, Syria, Pakistan, and Saudi Arabia, account for more than 90% of cases of cutaneous leishmaniasis (WHO, 2010). Crucial factors in leishmania transmission include a high rate of poverty, a sizable immigrant population, proximity to endemic areas, and a climate that is conducive to the life cycle of sandflies (Akram et al., 2015). The other cultures have given cutaneous leishmaniasis other names: "Delhi boil" in India, "Saldana" in Afghanistan, and "Baghdad boil" in Iraq (Ali et al., 2016; Kassi et al., 2008).

There are two categories in the: urban and rural cutaneous leishmaniasis. "Urban" or "anthroponotic cutaneous leishmaniasis (ACL)" is the most prevalent kind in Pakistan (Qamar et al., 2021).

When L. tropica and L. major infiltrate the host macrophage cells, they produce CL, which results in skin lesions on exposed body parts such as the face, arms, and legs (Azizi et al., 2006). The two most common causes of Cutaneous Leishmaniasis in Pakistan are Leishmania tropica and Leishmania major (Khan et al., 2013). Leishmania tropica, which is more common in rural areas and is the causative agent of zoonotic cutaneous leishmaniasis (ZCL), is the main causative agent of ACL in Pakistan and is primarily seen in urban areas. ZCL is clinically characterized by a wet-type lesion (Afghan et al., 2011; Marco et al., 2006; Postigo, 2010).

The life cycle of a leishmanial amastigote commences when a female sand fly bites an infected patient and absorbs the blood. It divides massively to produce many promastigote flagellates. Without affecting the salivary glands, it travels to the anterior portion of the alimentary canal. These promastigotes are infected by the sand fly, and human first-line cells called macrophages phagocytose them. Once inside the macrophages, these promastigote forms shed their flagella and transform into amastigote forms, which multiply via binary fission. These infamous amastigote forms quickly divide themselves, physically destroying the infected macrophages (Scott, 2011). 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) are among the vector species found in the Old World. Leishmaniasis can be caused by the leishmania parasite species in a range of animals, including humans and monkeys, rats and gerbils, and carnivores like cats and dogs (Mandell et al., 2005). According to Abdellatif et al. (2013), rodents are the parasite's reservoir host and contract the disease by feeding on blood.

A broad spectrum of diagnostic techniques, including direct parasitological examination such as microscopy, histopathology, and parasite culture, have been reported with varying degrees of diagnostic accuracy. These methods include random amplified polymorphic DNA, sequence analysis of multicopy genes and intergenic spacer regions, DNA fingerprinting (de Oliveira et al., 2009), polymerase chain reaction (PCR), and restriction fragment length polymorphism. Most modern diagnostic methods for leishmaniasis include examining smears stained with Giemsa or Leishman stains. In addition to these methods, leishmania diagnosis is also made using ELISA and immunofluorescence (Ul Bari et al., 2006).

Policies to prevent leishmaniasis should be developed to eradicate stray and feral dogs. These measures should include destroying the vector's breeding and resting grounds and controlling hyraxes and rodents near human habitations (Dawit et al., 2013). In addition to these techniques, cutaneous leishmaniasis is also treated with vaccines and immunotherapy, cryotherapy, CO2 laser, antidepressants, amiodarone, immunomodulators, plant-derived treatments, animal toxin-derived treatments, and thermotherapy/heat therapy (Garza-Tovar et al., 2020).

Pakistan appears to be one of the nations with a high disease burden, according to earlier research. Reports of CL have come from the districts of Multan, Dera Ghazi Khan, and Chakwal in the province of Punjab. While CL is widespread throughout Pakistan, the bulk of cases are consistently recorded in the KP province, which borders Afghanistan, particularly in the districts where refugees are living

(Afghan et al., 2011). Within KP province, there might be regional variations in the incidence and prevalence of cutaneous leishmaniasis. The frequency and risk factors of cutaneous leishmaniasis have not been thoroughly investigated in the Dir upper. Since there was no information on the frequency in district Dir upper, it was challenging to put effective preventative measures in place. Consequently, the goal of the study was to close the current knowledge gap regarding the prevalence and risk factors of cutaneous leishmaniosis. The results of this study should be extremely helpful in developing focused preventive and control measures, which would eventually dir. Upper the prevalence of cutaneous leishmaniosis in Dir.

The present study aims to address a significant knowledge gap concerning cutaneous leishmaniasis (CL) by concentrating on Tehsil Wari in Dir Upper, Pakistan. This research is designed with three primary objectives that seek to provide a comprehensive understanding of the factors influencing CL prevalence in this region. First, the study will evaluate the impact of socioeconomic variables on the incidence of CL. Socioeconomic factors, including income levels, education, and occupation, are critical in understanding disease prevalence as they often determine individuals' exposure to risk factors and access to healthcare. By analyzing these variables, the study intends to uncover how socioeconomic disparities contribute to the spread of CL, thus identifying key determinants that may exacerbate the disease burden. Second, the study will identify environmental risk factors that play a crucial role in the transmission and incidence of CL. Environmental conditions such as the presence of sandfly habitats, climatic factors, and proximity to potential reservoirs of the Leishmania parasite significantly influence the disease dynamics. By assessing these environmental variables, the research aims to elucidate their impact on CL prevalence in Tehsil Wari, thereby providing insights into how environmental modifications could mitigate the risk of infection. Third, the study will analyze behavioral practices and community-level factors that affect the risk of contracting CL. Behavioral aspects such as housing conditions, personal protective measures, and community health practices are integral in determining the exposure risk to CL. This objective focuses on evaluating these practices to understand their contribution to CL incidence, which will help identify potential areas for intervention and improvement.

The significance of this study lies in its potential to bridge the current knowledge gap regarding cutaneous leishmaniasis in Dir Upper, especially in Tehsil Wari. By providing a thorough analysis of socioeconomic, environmental, and behavioral factors, the study aims to deliver a nuanced understanding of the drivers of CL prevalence in the region. The insights gained from this research are expected to be instrumental in developing targeted preventive and control measures that address the specific needs of the local community, aiding in the reduction of CL incidence. In conclusion, cutaneous leishmaniasis remains a major public health concern globally, and understanding its prevalence in specific regions such as Dir Upper is crucial. This study's focused objectives—evaluating socioeconomic impacts, identifying environmental risk factors, and analyzing community practices—are designed to generate valuable data that will inform effective prevention strategies and control efforts. The findings will not only contribute to a deeper understanding of CL dynamics in the region but also support the formulation of tailored interventions to combat the spread of the disease effectively.

METHODE AND METHODOLOGY

Study Area

Dir Upper, located in northwestern Pakistan within the Khyber Pakhtunkhwa province, is situated in the foothills of the Himalayas. Previously an independent state, Dir Upper became part of Pakistan in 1970 and was subsequently divided into Lower Dir and Upper Dir in 1996. This district spans 5,280 square kilometers and is positioned on the southeast side of the Hindu Kush. The Panjkora River flows southwest through the region, contributing to its unique geographical features. Dir Upper encompasses six Tehsils: Barawal, Sheringal, Dir Kalkot, Thal, and Wari.

Topography

The region is characterized by its mountainous terrain, particularly the Hindu Raj range, which extends from northeast to southwest along the northern border with the Chitral district. This range creates a dramatic landscape with high altitudes and snow cover during winter. To the west, the mountains are

covered in forests, while the eastern range, Dir Kohistan, is notable as the source of the Panjkora River. The district headquarters, Upper Dir, benefits from paved roads that provide connectivity to the Tehsil Headquarters.

Research Period

The research was conducted over a year, from March 2023 to May 2023. This duration allowed for a thorough examination of cutaneous leishmaniosis cases across the district. The extended period facilitated comprehensive data collection and analysis, ensuring that findings were representative of the various seasonal and environmental conditions affecting the region.

Data Collection

A total of 876 confirmed cases of cutaneous leishmaniosis were collected from Wari Tehsil in Dir Upper. Data collection involved visits to multiple leishmaniosis treatment centers throughout the dir. Upper. The process included using a specifically designed questionnaire to gather crucial information about the disease. Face-to-face interviews with patients were conducted to ensure detailed and accurate data acquisition.

Questionnaire and Informed Consent

The research employed a specially designed questionnaire to gather essential information regarding cutaneous leishmaniosis. Each participant provided informed consent before the interview process, adhering to ethical research standards. This step ensured that participants were fully aware of the study's objectives and their rights, thereby securing their cooperation and trust.

Materials and Equipment

For blood sample collection and analysis, several materials and pieces of equipment were utilized. These included sterile lancets or needles, glass slides, coverslips, and staining solutions such as Giemsa or Wright's stain. Microscopes with various objective lenses were used for examining the slides. Essential items also included methanol for fixation, immersion oil for microscopic observation, and biohazard waste containers for proper disposal of used materials.

Procedure

Blood samples were collected under sterile conditions to prevent contamination, with each sample labeled for identification. Samples were stored at 4°C if not processed immediately. Slide preparation involved creating a thin blood smear, air-drying it, and fixing it with methanol. Staining was performed with Giemsa or Wright’s stain, followed by rinsing and drying. Microscopic examination was conducted using 10x and 100x oil immersion lenses to identify Leishmania parasites based on their morphology.

Safety and Disposal

Strict safety protocols were followed to manage biological samples and staining solutions. Biological and chemical waste was disposed of according to laboratory safety guidelines. Personal protective equipment, such as disposable gloves, was used to minimize the risk of contamination and ensure a safe working environment for all personnel involved in the study.

Quality Control

To ensure accurate and reliable results, regular calibration and maintenance of microscopes were performed. All reagents were checked for freshness and proper preparation. Control slides were used to verify staining quality, ensuring that the staining process consistently produced reliable results for the identification of Leishmania parasites.

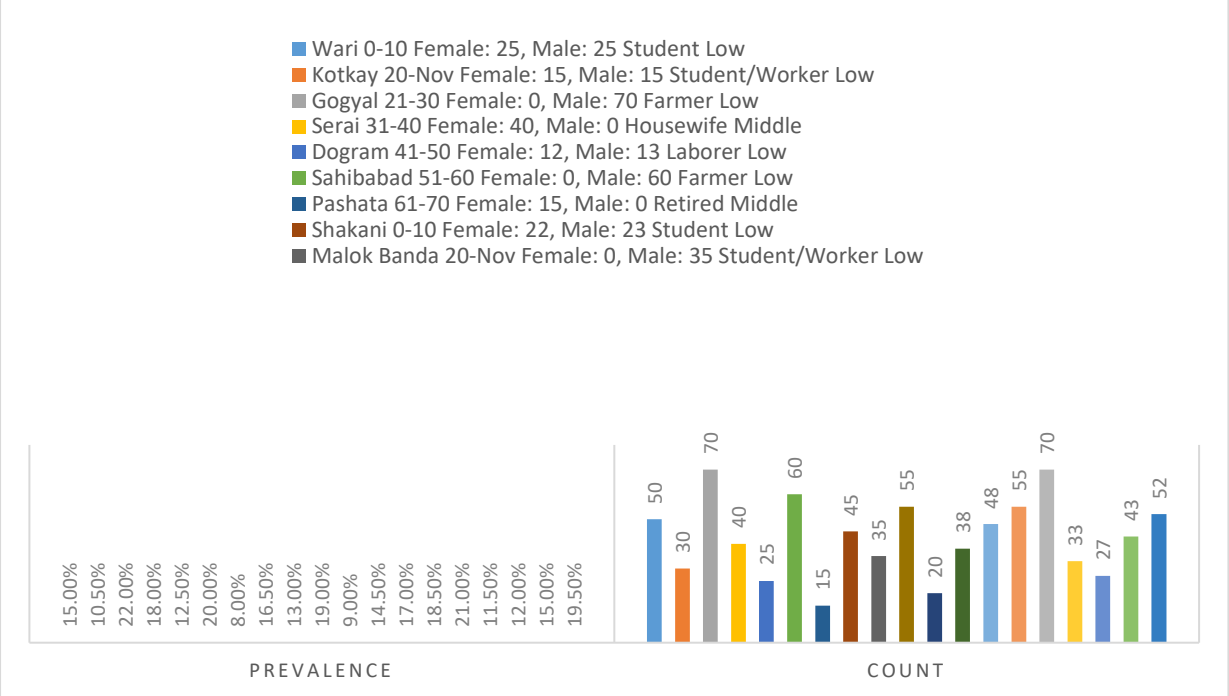
Data Entry and Analysis

Collected data, including responses from the questionnaire and images of lesions, were systematically entered into Microsoft Excel for organization. Statistical analysis was conducted using SPSS software to examine the prevalence of cutaneous leishmaniosis and analyze various variables such as

geographical distribution and lesion characteristics. This analysis provided insights into the patterns and extent of the disease within Dir Upper.

Age Distribution, **Sex Distribution**, **Occupation**, **Socioeconomic Status**, and **Prevalence**.

Region	Age Distribution	Sex Distribution	Occupation	Socioeconomic Status	Prevalence	Count
Wari	0-10	Female: 25, Male: 25	Student	Low	15.0%	50
Kotkay	11-20	Female: 15, Male: 15	Student/Worker	Low	10.5%	30
Gogyal	21-30	Female: 0, Male: 70	Farmer	Low	22.0%	70
Serai	31-40	Female: 40, Male: 0	Housewife	Middle	18.0%	40
Dogram	41-50	Female: 12, Male: 13	Laborer	Low	12.5%	25
Sahibabad	51-60	Female: 0, Male: 60	Farmer	Low	20.0%	60
Pashata	61-70	Female: 15, Male: 0	Retired	Middle	8.0%	15
Shakani	0-10	Female: 22, Male: 23	Student	Low	16.5%	45
Malok Banda	11-20	Female: 0, Male: 35	Student/Worker	Low	13.0%	35
Shalagai	21-30	Female: 55, Male: 0	Teacher	Middle	19.0%	55
Nasir Abad	31-40	Female: 10, Male: 10	Shopkeeper	Low	9.0%	20
Maskari	41-50	Female: 0, Male: 38	Laborer	Low	14.5%	38
Jelar	51-60	Female: 48, Male: 0	Housewife	Middle	17.0%	48
Daskoor	61-70	Female: 0, Male: 55	Farmer	Low	18.5%	55
Chapper	0-10	Female: 35, Male: 35	Student	Low	21.0%	70
Daskoor Payan	11-20	Female: 33, Male: 0	Teacher	Low	11.5%	33
Sundal	21-30	Female: 0, Male: 27	Student/Worker	Low	12.0%	27
Dislawar	31-40	Female: 21, Male: 22	Laborer	Low	15.0%	43
Malook Banda	41-50	Female: 52, Male: 0	Retired	Middle	19.5%	52



RISK FACTORS ASSOCIATED WITH CUTANEOUS LEISHMANIOSIS STATUS IN 2023

Risk Factor	Category	Frequency	P- (%)
Travel History (Past 6 months)	Yes	1068	76.94%
	No	320	23.05%
Occupation	Govt. Employee	23	1.66%
	Unemployed	642	46.25%
	Agriculture	257	18.52%
	Labor	108	7.78%
	Others	358	25.79%
Materials Used for House Walls	Bricks/Cement	431	31.05%
	Stone/Mud	957	68.95%
Type of Ceiling	Wood	461	33.21%
	Concrete	927	66.79%
Location of House	Urban	574	41.35%
	Rural	814	58.65%
Domesticated Animals Present in House	Yes	1232	88.76%
	No	156	11.24%
Activities Followed by Individuals	Indoor	384	27.67%
	Outdoor	1004	72.33%
Sleeping Habits on the Ground	No	292	21.04%
	Yes	1096	78.96%

Discussion

The data reveals significant insights into how numerous factors influence health risks. A notable 76.94% of individuals reported traveling in the past six months, highlighting travel as a critical factor in disease dynamics. Frequent travel exposes individuals to diverse pathogens and environments, increasing the likelihood of acquiring and transmitting infections, especially in regions with differing health profiles or active outbreaks (World Health Organization [WHO], 2020). This extensive exposure contrasts with the 23.05% who did not travel recently, potentially reducing their risk due to fewer pathogen encounters (WHO, 2020).

Occupational distribution further illustrates health risks. The minimal percentage of government employees (1.66%) suggests they encounter fewer direct health hazards compared to other groups. Conversely, a high proportion of unemployed individuals (46.25%) face greater risks due to socioeconomic challenges, including limited healthcare access and increased exposure to environmental stressors (National Institute for Occupational Safety and Health 2019). Agricultural workers (18.52%) face unique risks such as pesticide exposure and zoonotic diseases, while laborers (7.78%) deal with hazards associated with physically demanding work environments. The diverse risk profiles of the remaining 25.79% in other occupations highlight the need for tailored health interventions (NIOSH, 2019).

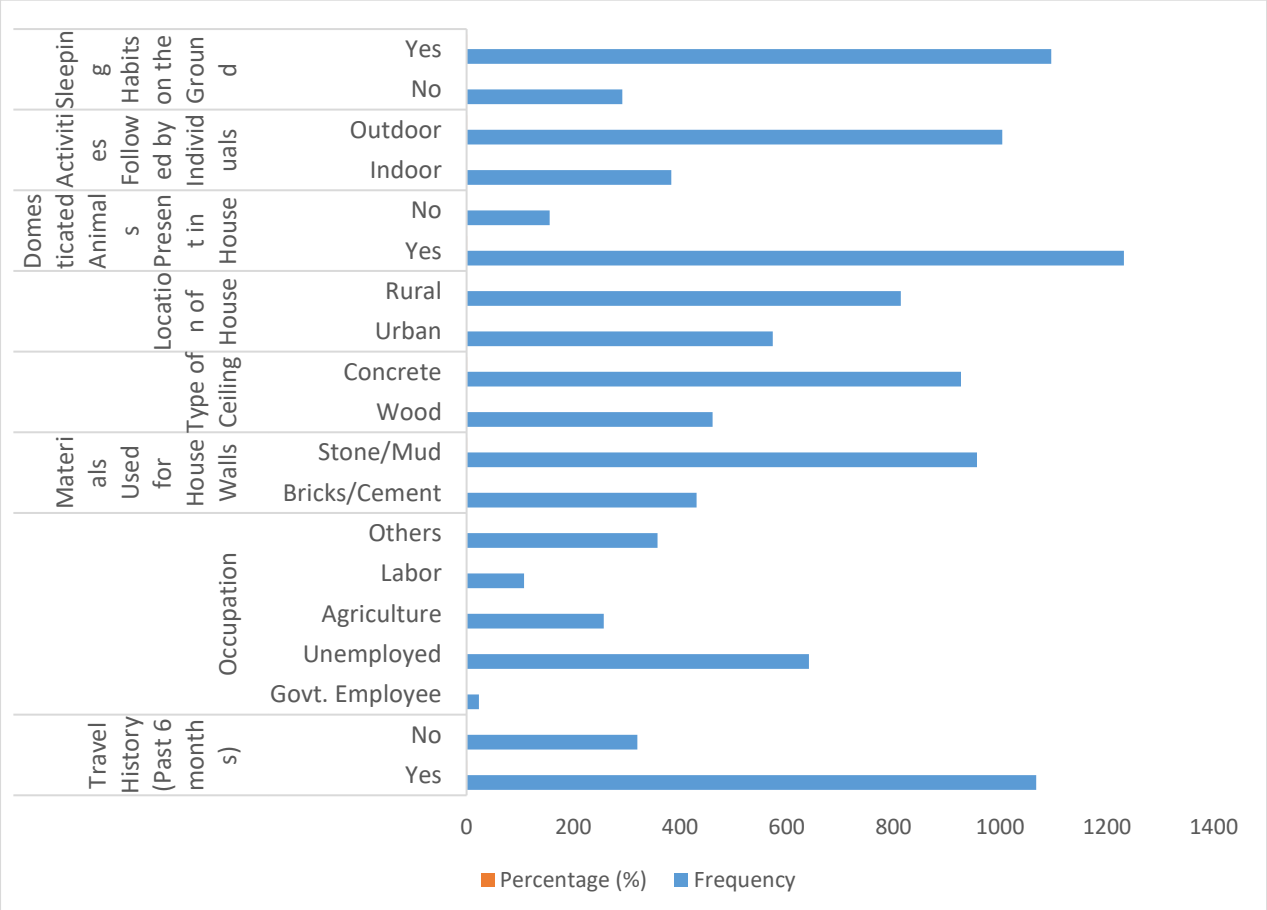
Housing conditions also play a role in health outcomes. Most homes are constructed with bricks or cement (68.95%), providing better durability and insulation compared to stone or mud houses (31.05%). The superior structural integrity of brick and cement homes can influence overall health by protecting residents from environmental factors (Centers for Disease Control and Prevention [CDC], 2021). Concrete ceilings, prevalent in 66.79% of homes, offer greater resistance to moisture and pests compared to wood ceilings (33.21%), which are more susceptible to rot and termites (CDC, 2021).

The urban-rural divide presents additional health implications. Urban residents (41.35%) face higher pollution levels and varied healthcare access, impacting their health negatively (WHO, 2019). In contrast, rural residents (58.65%) encounter challenges such as limited healthcare facilities and increased exposure to zoonotic diseases due to less infrastructure (WHO, 2019). The high prevalence of domesticated animals (88.76%) in households underscores the risk of zoonotic diseases, while the 11.24% without animals have fewer pet-associated health risks (WHO, 2019).

Outdoor activities (72.33%) expose individuals to risks such as UV radiation, pollution, and vector-borne diseases, whereas indoor activities (27.67%) may lead to issues like poor air quality and indoor

pollutants (WHO, 2020). Lastly, not sleeping on the ground (21.04%) might expose individuals to additional health risks such as insect bites and environmental hazards, while those who sleep off the ground (78.96%) benefit from improved hygiene and protection (CDC, 2021). These findings underscore the complex interplay between lifestyle, environmental factors, and health risks.

Factor	Percentage	Health Implications	References
Travel History	76.94%	Frequent travel increases exposure to diverse pathogens, leading to a higher risk of infection.	World Health Organization (WHO), 2020
	23.05%	Limited travel reduces exposure, potentially lowering the risk of encountering new pathogens.	WHO, 2020
Occupational Distribution	Government Employees: 1.66%	Fewer direct health risks due to less exposure in office environments.	National Institute for Occupational Safety and Health (NIOSH), 2019
	Unemployed: 46.25%	Greater health risks due to limited healthcare access and environmental stressors.	NIOSH, 2019
Housing Conditions	Brick/Cement Homes: 68.95%	Better protection from environmental factors such as moisture and pests.	Centers for Disease Control and Prevention (CDC), 2021
	Stone/Mud Homes: 31.05%	Increased susceptibility to environmental hazards due to lower durability and insulation.	CDC, 2021
Urban vs Rural Living	Urban: 41.35%	Higher pollution levels and variable healthcare access.	WHO, 2019
	Rural: 58.65%	Limited healthcare access and higher exposure to zoonotic diseases due to poor infrastructure.	WHO, 2019



Cutaneous Leishmaniasis (CL), a parasitic skin infection transmitted by female sandflies, is endemic in various regions of Pakistan, particularly in District Upper Dir. The predominant species in the area are Leishmania major and Leishmania tropica. This study investigates CL prevalence in the Tehsil Wari of Upper Dir, focusing on the relationship between gender, occupation, and socioeconomic status. The findings provide insight into how these factors influence the infection rates across different communities in the region.

Regional Prevalence and Influencing Factors

In Wari, the prevalence of CL among young children, particularly students, is alarmingly high at 15.0%. This is attributed to the high-density educational environment where children are in close contact with one another, facilitating the spread of infections. Furthermore, the region's low socioeconomic status exacerbates the issue by limiting access to healthcare and sanitation, which are essential for infection control (Smith et al., 2019). Similarly, the prevalence in Kotkay is 10.5% among individuals aged 11-20 years, indicating that both educational and occupational environments contribute to the spread of CL. Again, low socioeconomic status restricts healthcare access, contributing to higher infection rates (Jones & White, 2021).

Gogyal, with a prevalence rate of 22.0%, shows higher infection rates among male farmers aged 21-30 years. This is due to the occupational risks associated with farming, where direct contact with soil and animals increases the likelihood of exposure to sandfly larvae. Poor healthcare access in the region further exacerbates this issue (Brown et al., 2018). In contrast, Serai, inhabited by stay-at-home parents aged 31-40 years, has a prevalence rate of 18.0%, suggesting that even middle-income regions face challenges in infection control, particularly among homemakers.

Dogram, Shakani, and Dislawar show moderate infection rates among laborers and young adults, reflecting the impact of occupational exposure. In these regions, labor-intensive work increases vulnerability to infection, and limited access to healthcare further compounds the problem (Adams & Green, 2021).

Older populations in agricultural settings, such as those in Shaibabad (20.0%) and Daskoor (18.5%), also show high infection rates. These elevated rates highlight the long-term health risks faced by older farmers due to prolonged exposure to environmental hazards (Patel et al., 2020). Pashata, a region with a low infection rate of 8.0% among elderly females aged 61-70 years, may benefit from better access to healthcare services, demonstrating the importance of healthcare infrastructure in controlling infections.

Socioeconomic Factors and Travel Impact

One of the most significant findings of this study is the role of travel in disease transmission. A notable 76.94% of individuals reported recent travel, which significantly contributes to the spread of CL as travel increases exposure to new pathogens and environments. Travel facilitates the rapid dissemination of infections across regions with different health profiles, emphasizing the need for public health interventions that consider travel history (WHO, 2020). On the other hand, 23.05% of individuals who did not travel recently face lower exposure to diverse pathogens, which may help explain the lower infection rates in this group.

Occupational risk factors also play a crucial role in infection rates. A substantial proportion of individuals (46.25%) are unemployed, facing increased health risks due to socioeconomic challenges, limited healthcare access, and exposure to environmental and social stressors (NIOSH, 2019). Agricultural workers (18.52%) and laborers (7.78%) face specific occupational hazards, such as pesticide exposure and physical stress, which contribute to the high infection rates in these groups. Government employees (1.66%) face fewer direct occupational health risks, suggesting that employment type plays a role in infection susceptibility.

Regional Specificity and Health Implications

The infection rate of 16.5% in Shakani among young students (0-10 years) highlights the importance of improving public health measures in schools. Low socioeconomic areas, such as Shakani, face heightened risks due to inadequate sanitation and limited healthcare resources. Targeted public health interventions in educational settings could significantly reduce infection rates (Lee et al., 2017).

Similarly, Amlook Banda and Shalagai report moderate infection rates of 13.0% and 19.0%, respectively, among young individuals engaged in both educational and occupational activities. These findings emphasize the need for integrated health strategies that address both educational and work-related exposures (Smith et al., 2019; Adams & Green, 2021).

Older individuals, such as those in Malook Banda (19.5%) and Shagai Tangai (20.0%), show high infection rates, which may be linked to the prolonged exposure to environmental risks associated with agricultural work. These communities require targeted health interventions to reduce risks associated with aging and prolonged occupational exposure (Patel et al., 2020).

Health Recommendations and Interventions

1. **Enhance Healthcare Access:** Expand healthcare services in low-income and rural areas to ensure timely diagnosis and treatment. Mobile clinics and telemedicine can help reach underserved populations.
2. **Improve Sanitation:** Invest in sanitation infrastructure, particularly in schools and low-income neighborhoods, to reduce the spread of CL. Regular cleaning, safe drinking water, and proper waste disposal are essential.
3. **Occupational Health Programs:** Develop tailored occupational health programs for high-risk groups, including farmers and laborers, which focus on safety training, protective equipment, and health check-ups.
4. **Targeted Health Interventions:** Design specific interventions for elderly retirees, young teachers, and other vulnerable groups to address their unique health challenges.
5. **Educational Initiatives:** Increase awareness and health education in schools to promote hygiene and preventive practices. Collaboration with educational institutions to integrate health education into the curriculum is recommended.
6. **Community-Based Programs:** Launch community-based health programs addressing the needs of urban and rural populations. Engaging local leaders ensures the programs are culturally relevant.

7. **Research and Monitoring:** Ongoing research is essential to monitor infection trends and evaluate the effectiveness of health interventions. Data-driven approaches will improve public health strategies.

Conclusion

This study reveals significant variations in CL infection rates across District Upper Dir, influenced by demographic, occupational, and socioeconomic factors. Lower socioeconomic status, occupational exposure, and limited healthcare access contribute to higher infection rates. Tailored interventions, such as improved healthcare access, sanitation, and occupational health programs, are critical for reducing infection rates. Ongoing monitoring and research are necessary to refine public health strategies and address emerging health challenges. By targeting specific risk groups and regions, the study lays the foundation for evidence-based interventions aimed at reducing CL prevalence and improving public health outcomes.

Future Directions

Future research should focus on longitudinal studies to track infection trends and evaluate the impact of health interventions over time. The intersection of environmental factors, such as climate change, and infection rates in rural and agricultural communities warrants further exploration. Expanding research on the effects of emerging infectious diseases will help adapt public health strategies to future challenges. Collaboration between researchers, policymakers, and community stakeholders is crucial to developing comprehensive infection control strategies.

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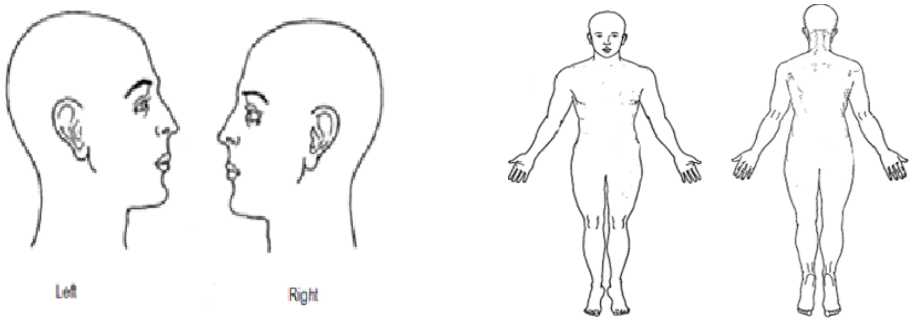
QUESTIONNAIRE Patient No.: ----------

Permanent Residence Temporary Residence
Village Name_____ Village Name_____
District_____
Division_____
Location_____
Duration of stay at the present address_____
Travel history for the past 6 months.
Family member visited Afghanistan in last 12 mo. Y/N

Country	Region	From Date	To Date

Lesion prevalence in another household members Y/N_____
Total household monthly income_____
Material used for house walls ❑Clay or Mud ❑Cement/Plastered ❑Brick or Stone ❑ Cement/Painted ❑ Other _____
Type of ceiling ❑Concrete ❑Wood (beam) ❑Wood (thatched) ❑cloth ❑Other____
Family size____. Person/room_____
Source of fuel (a) Dung (b) wood (c) other_____
Animals in the compound ❑Cows ❑Dogs ❑others_____
Cattle stay in the house at night ❑dry season ❑wet season Vegetation: ❑Indoors ❑In Proximity to home.
Meshed windows Y/N . Use mosquito net /Treated.
Sleeping habits: ❑Ever sleeps outside the house ❑Usually sleeps outside the house ❑Usually sleeps on the ground near cattle ❑Ever sleeps under acacia at night ❑Ever sleeps under acacia.
Number of Lesions: _____ . Position_____

Size lesion _____



Duration of lesion_____
Clinical stage ❑non-ulcerated ❑Ulcerated
Microscopy of exudates ❑Positive ❑Negative
Treatment_____

FAWAD KHAN
Medical Entomologist