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EPIDEMIOLOGY OF CUTANEOUS LEISHMANIASIS IN DISTRICT KARAK, KHYBER PAKHTUNKHWA, PAKISTAN

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ABSTRACT

Cutaneous Leishmaniasis is a vector-borne infection caused by flagellated parasitic protozoans in the genus Leishmania. . The bite of an infected female sandfly from the genera Phlebotomus or Lutzomyia can spread the infectious promastigote stage to humans. In many regions of Pakistan, especially Khyber Pakhtunkhwa, CL is regarded as one of the main public health issues. The goal of the current study was to look at the clinical and demographic trends of CL in Pakistan's Karak District, Khyber Pakhtunkhwa. Between March 2022 and April 2023, the survey was conducted with both local residents and temporarily displaced people (TDPs) living in 14 distinct villages within the district. There is total no588 people that were analyzed, 35 were TDPs and 553 were members of the local population. In the local population, the general prevalence of CL was 7.80%, whereas in TDPs, it was 7.00%. According to the age-wise distribution, children ages 1 to 10 had the highest occurrence in both categories, suggesting that younger people are more susceptible. Males had a much higher incidence than females, according to a gender-wise analysis. This could be because males are more likely to be exposed to sandfly bites outside. A comparison of the villages showed that Panos had the highest prevalence (11.00%) while Alamsheri had the lowest frequency (1.40%). The findings suggest that CL remains endemic in the Karak District, with notable variation in prevalence across different age groups, genders, and localities. These

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results highlight the need for targeted awareness programs, preventive measures, and vector control strategies to reduce disease transmission. Moreover, timely diagnosis and effective treatment facilities are required, particularly for vulnerable groups such as children and displaced population.These results indicate that cutaneous Leishmaniasis as much common in male individual as compared to female. Suggesting that male individual are more exposed to the fly.

1. Introduction

Leishmaniasis is a serious global health concern caused by intracellular protozoan parasites of the genus *Leishmania*, belonging to the family Trypanosomatidae. Recognized as a neglected tropical disease (NTD), it disproportionately affects populations in resource-limited regions. Although *Leishmania* parasites were first identified in the late 1980s (Tarr et al., 1988), the disease continues to pose a major public health threat due to its complex epidemiology and inadequate control strategies. The parasites reside and proliferate within host macrophages, resulting in three primary clinical manifestations such as cutaneous leishmaniasis (CL)**,** which affects the skin and mucocutaneous leishmaniasis which targets mucous membrane and which visceral leishmaniasis (VL) at invades internal organs (Hotez et al., 2006).

The two main species that cause CL in Pakistan are Leishmania major and Leishmania tropica (Alexander et al., 1998). Asia, Europe, and South America are among the regions where CL is endemic. Because of its constantly increasing incidence—more than one million new cases are recorded each year—the World Health Organization (WHO) has ranked it as one of the most urgent global health challenges (WHO, 2001).

Leishmaniasis is a serious and unmanaged public health issue in Pakistan, especially in regions that border Afghanistan and in cities that house sizable refugee populations (Kassi et al., 2008). The growing incidence of CL is caused by a number of environmental factors, including urbanization, poor sanitation, and sleeping outside, as well as personal risk factors, such as HIV infection, malnourishment, genetic predisposition, and low socioeconomic status (Rijal et al., 2010). Furthermore, it is thought that the spatial distribution and dynamics of transmission of vector-borne illnesses such as leishmaniasis are impacted by climate change (Patz et al., 2000). Numerous anatomical locations, including the lips, genitalia (chancriform), fingertips (paronychial), pulp of fingers (whitlow), eyelids, scalp, and palms/soles, can be impacted by cutaneous leishmaniasis (Ul Bari, 2006). In Pakistan, there are two epidemiological types of CL: anthroponotic CL (ACL), where humans are the only reservoir, and zoonotic CL (ZCL), which involves animal reservoirs (Desjeux, 2004). The main cause of ACL, which is prevalent across the nation, particularly in the province of Khyber Pakhtunkhwa (KP), is Leishmania tropica (Amtul et al., 2001 & Hussan et al., 2017). In endemic areas, lesions are locally known as "Kandahar sores," "tropical sores," or "Baghdad boils" (Soomro et al., 2009).

There have been reports of autochthonous transmission of ACL in a number of Pakistani regions, which are frequently characterized by a greater frequency among children and family clustering (Kolaczinski et al., 2004). Leishmania donovani is the main cause of the disease's more severe visceral form, known as VL (Tanoli et al., 2005). Both L. donovani and L. infantum are agents of VL, and Phlebotomus alexandri is the vector for both of them (Azizi et al,2006).

When female sand flies inject promastigotes into the host's skin while feeding on blood, the transmission cycle starts (Gawade et al., 2012). Neutrophils and other phagocytic cells

quickly absorb these promastigotes. Promastigotes change into amastigotes and then the replicative form that propels the course of disease within the phagolysosomes of macrophages (Sacks et al, 2001). About 30 species of blood-feeding sand flies from the genera Phlebotomus and Lutzomyia are known to transmit leishmaniasis out of the 700 species of blood-feeding sand flies that are known to exist worldwide (Ali et al., 2016). There are roughly 37 species of sand flies known to exist in Pakistan (Kakarsulemankhel, 2009).

Leishmaniasis treatment is still difficult since it necessitates the long-term use of costly and toxic medications. There are currently no approved vaccinations for human use, despite the fact that vaccine development has been a priority for more than a century (Selvapandiyan et al., 2006). Results from early attempts to create a vaccine utilizing entire dead Parasite were mixed (Handman, 2001). Clinical examination serves as the primary basis for CL diagnosis, which is then verified by microscopic inspection of lesion samples (WHO, 2010). Particularly in cases of post-kala-azar dermal leishmaniasis (PKDL), lesions that manifest as hypopigmented macules, papules, or nodules may go untreated because there are no systemic symptoms (Mondal et al., 2010).

Remarkably, those who recover from visceral and cutaneous leishmaniasis frequently develop protective immunity against recurrent infections (Evans et al., 2012). Leishmanization, a technique that involves purposeful exposure to live parasites to provide long-lasting immunity following lesion healing, has historically been used to capitalize on this immunological response (Khamesipour et al., 2005). A robust cellular immune response that includes efficient parasite removal and macrophage activation is the main mediator of host resistance. The establishment of protective immunity depends on both innate and adaptive immunological components, including dendritic cells and antigen-specific CD4+ and CD8+ T cells (Stanley & Engwerda, 2007).

2. Material and Methodologies

2.1. Study Area:

The study was carried out from March 2022 to April 2023 at 14 different villages of District Karak including small number of Tdps residing in the district. The studied areas are given in tabulated form. The population data provided by the population department of District karak.

Table 2.1: Village Wise Detail of Studied Area

S .No	Village Name	Total Population
1	Jatta Ismail Khel	**6083**
2	Mami Khel	**4757**
3	Ahmadi Banda	**3448**
4	Nar Banda	**2017**
5	Panos	**7215**

6	Dandedal Khel	**4961**
7	Talab Khel	**2320**
8	Faqir Abad	**3155**
9	Rahmat Abad	**7587**
10	Kamangar	**1792**
11	Shagai	**3910**
12	Shnawa Nasrati	**1915**
13	Chakmanzai	**4238**
14	Alamsheri	**3227**
	Total Population	**56625**

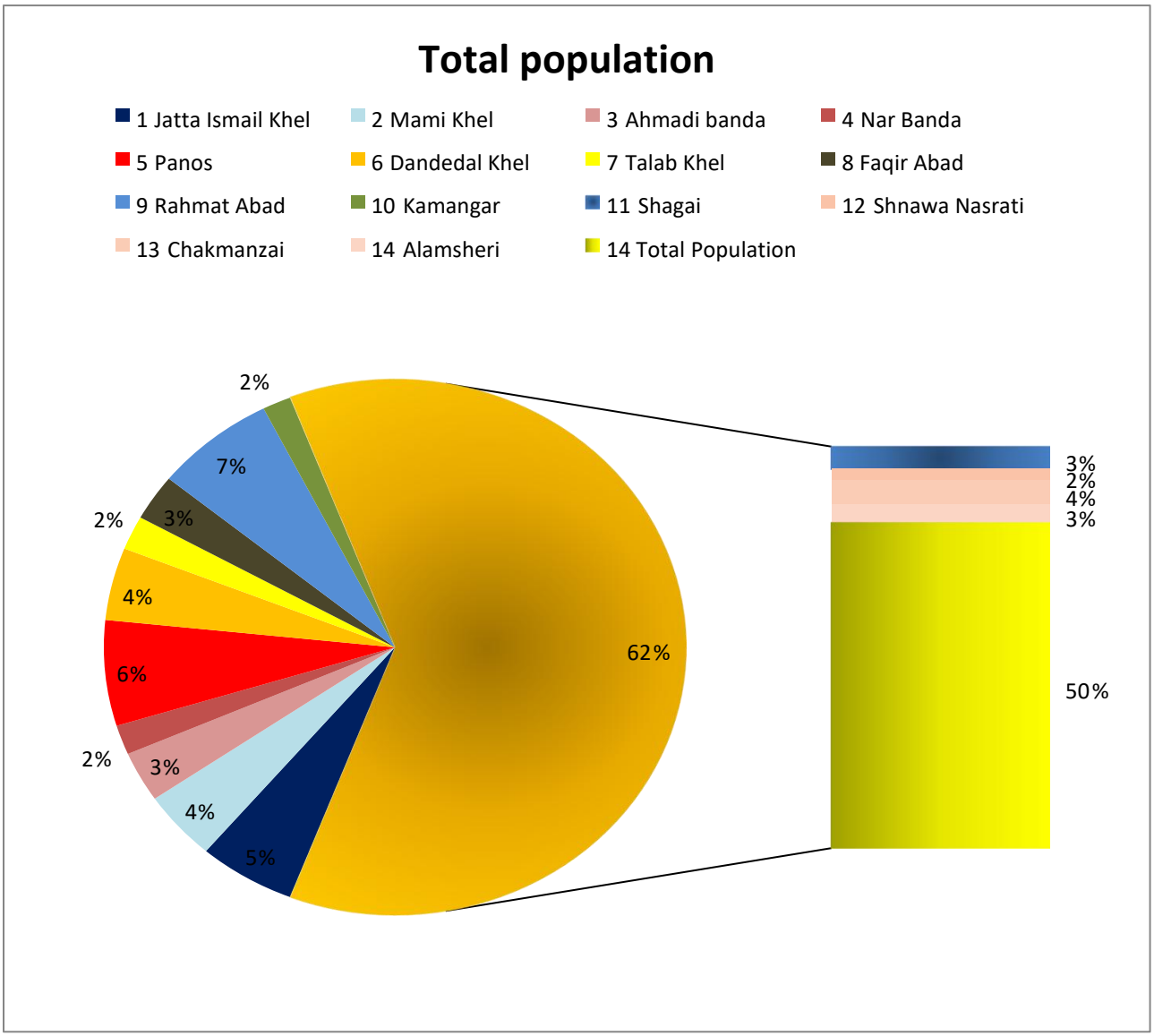

Chart 2.2: Village Wise Detail of Studied Area

2.2.Sampling:

The study of cutaneous leishmeniasis in various villages was based upon the data provided by the woman & children hospital karak city leishmeniasis center /opd. From the information supplied, we paid the patients a visit at their residence. On a questionnaire, other details were gathered, such as name, sex, age, occupation, type of lesion (active, scarred, dry, or wet), number of lesions, lesion location, travel history to an endemic area, house type (brick or mud),

Presence of animal and treatment profile.

In all, 7500 local residents (7000) and tdps (n=500) who lived in the area under study were surveyed. House to house survey was carried out by a team comprising of research supervisor and research student. Information were obtained from head of each house from randomly selected house in east west and north south directions. All individuals of a selected endemic village were eligible, while only active lesions individual were selected for the study.

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2.3. Sampling design

A team of research project supervisors and students from the Zoology Department at GDC Takht-e-Nasrati Karak, along with a medical technologist and a representative from the leishmaniasis clinic of the civil hospital district of Karak, conducted a door-to-door survey in each of the 14 villages in the district that had previously been tabulated and a small number of idps living in the village. Patients with leishmaniasis were given questionnaires that asked about their age, sex, the number of lesions they had, and whether or not they used bed nets. Additionally, the heads of the households were questioned about their work, length of stay, number of animals (dogs, cattle), home type (concrete or mud), and hygienic conditions. Additionally, heads of households were asked if any members had active skin lesions or scars from CL or other causes. For additional care, several probable CL patients were sent to Leishmansis center. Information on each case was documented based on the quantity and location of lesions and scars, as well as factors that contributed to the infection, such as travel history, contact with an infected person, and sleeping outside.
In order to determine the prevalence, people having lesions were regarded as cases of active CL.

3. Results:

There are total 500 Tdps and 7,500 members of the local people were surveyed in 14 distinct villages in the District of Karak. Patients were given questionnaires to complete in order to collect data for research (Table No.1). From these localities, a total of 355 tdps cases (both active scar cl lesions) and 553 local residents were reported. There were 256/553 (46.29%) females and 297/553 (53.70%) males among them. A recorded 14.8% overall prevalence, which included 7.00% in tdps and 7.80% in the local population

Table 3.1: Shows that overall high prevalence was recorded in the local Population.

Population	**N**	**Type Of Lesion (%)**		**Overall Prevalence (%)**
		Active	**Scars**	
Local	7000	5.80	2.00	7.80

IDPS	500	4.06	2.46	7.00
Total	7500	12.80	6.00	14.80

Chart 3.2: Showing Overall Prevalence of Cutaneous Leishmaniasis Patients

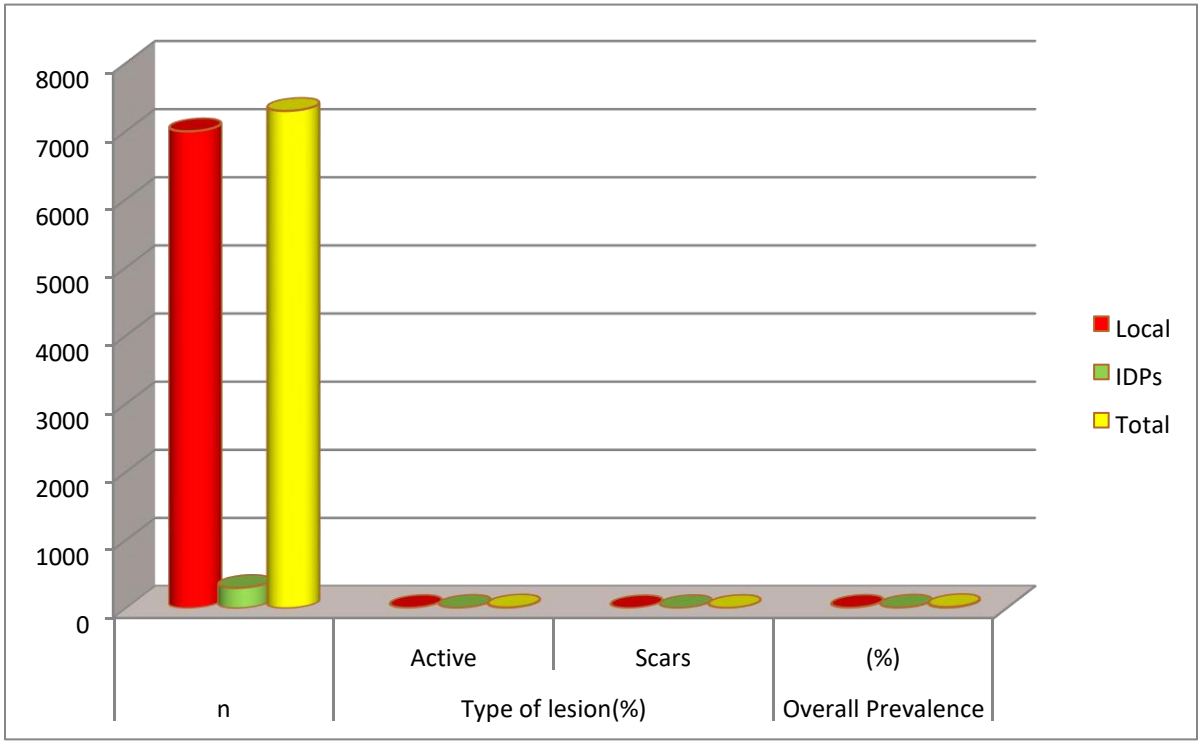


Table 3.3: Shows the Prevalence of Cutaneous Leishmaniasis in Local Population Of District Karak Kpk Pakistan.

Location	Total Population	Population Surveyed	Positive Cases	Active Cases	Scars	Total Prevalence (%)
Jatta Ismailkhel	**6083**	**824**	**101**	**71**	**30**	**8.61**
Mami Khel	**4757**	**512**	**47**	**32**	**15**	**9.2**
Ahmadibanda	**3448**	**260**	**21**	**14**	**7**	**8.1**
Nar Banda	**2017**	**158**	**09**	**06**	**3**	**5.7**

Panos	**7215**	**1272**	**140**	**11 2**	**28**	**11.0**
Dandedalkhe	**4961**	**550**	**32**	**18**	**14**	**5.8**
Talab Khel	**2320**	**304**	**23**	**17**	**6**	**7.6**
Faqir Abad	**3155**	**454**	**41**	**35**	**6**	**9.0**
Rahmat Abad	**7587**	**960**	**94**	**77**	**17**	**9.8**
Kamangar	**1792**	**72**	**04**	**3**	**1**	**5.6**
Shagai	**3910**	**250**	**9**	**7**	**2**	**3.6**
Shawanasrati	**1915**	**130**	**4**	**4**	**0**	**3.1**
Chakmanzia	**4238**	**764**	**18**	**11**	**7**	**2.4**
Alamsheri	**3227**	**706**	**10**	**08**	**2**	**1.4**
Total	**5665**	**726**	**553**	**45**	**2**	**7.%**
				5.8%	**2.0%**	

As we See from the above table 3.3 data that highest prevalence was recorded in village " Panos" (11.0%) in lowest in"Alamsheri" (1.4%).

Chart 3.4: Showing Overall Prevalence "CL''Patient in District Karak

3.1.Age Wise Distribution Of CL In District Karak

The Patients were separated into age groups ranging from 1 year to >80 years in order to examine the susceptibility of CL with age. The young age group (1–10 years old) had the highest prevalence (55.9%) in local people, whereas the 11–20 age group had the highest frequency (57.4%) in TDPS. However, in both local and TDPS, people older than 80 years were less vulnerable. Additionally, as shown in table 04, the prevalence rate was higher in males in both local and TDPS. The percentage of patients in the local and IDPS populations by age and gender from March 2022 to April 2023.

Chart Showing "CL" Patients In Different Location Of District Karak.

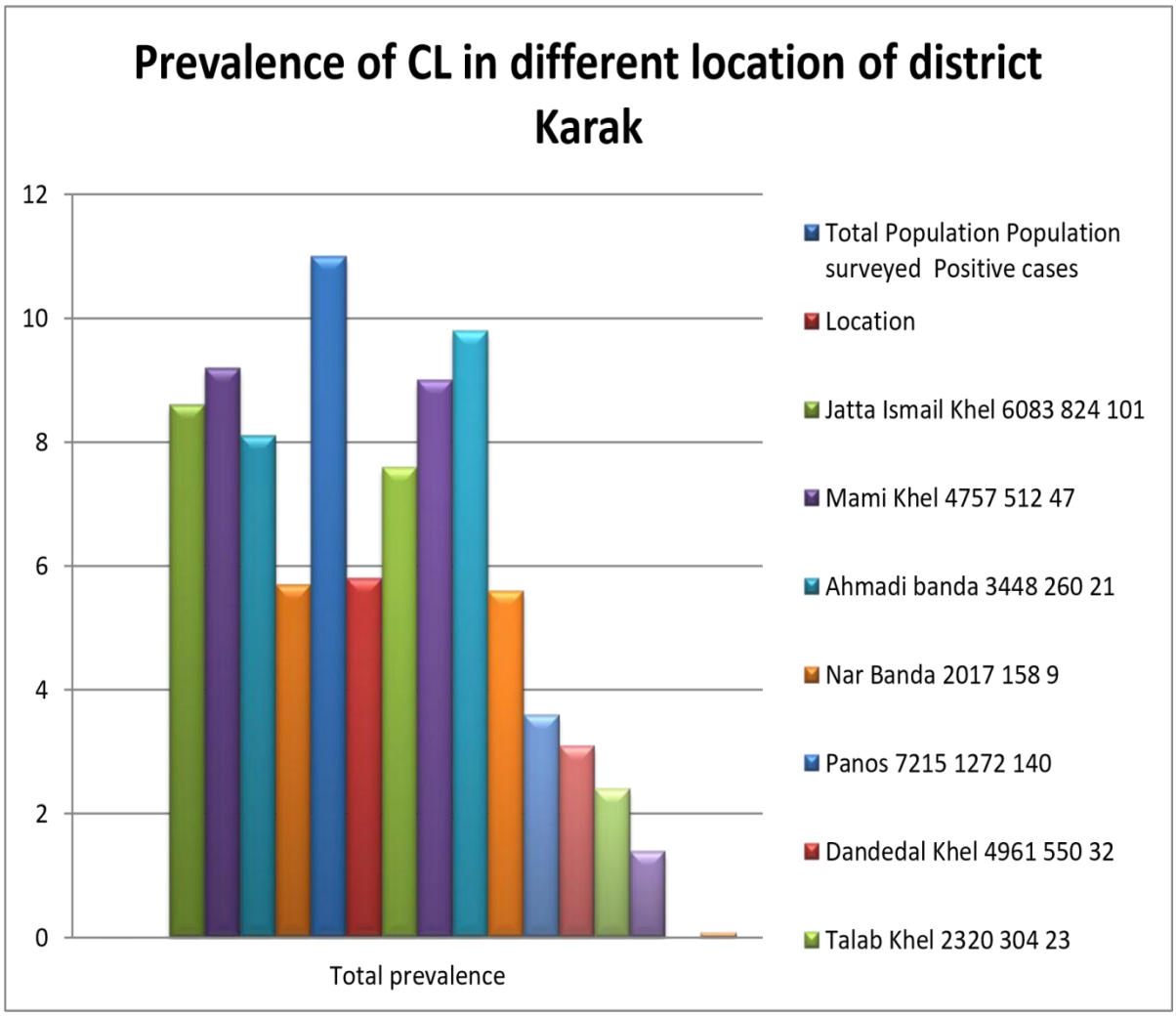
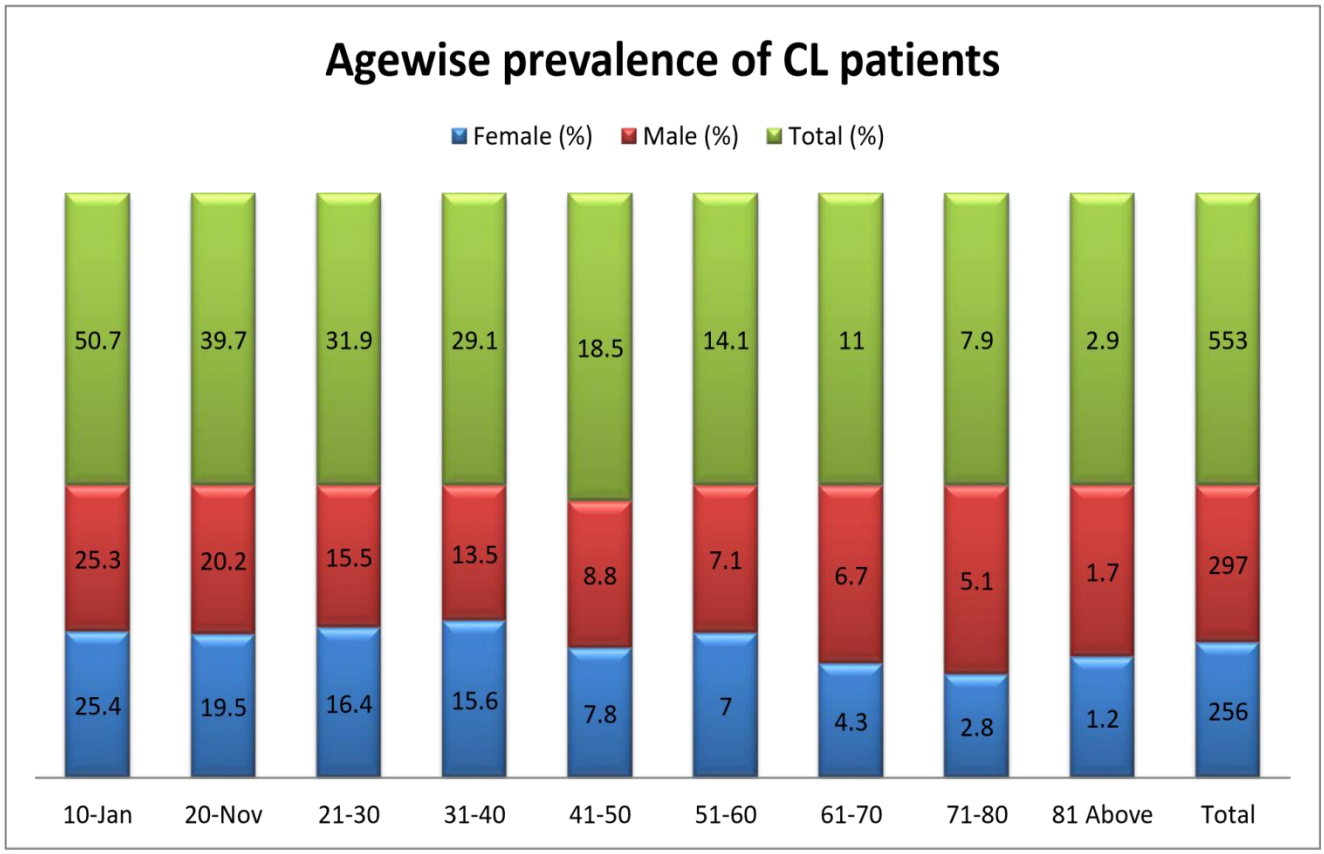


Table 3.5: Shows the Age Wise Distribution of CL in District Karak.

		Local Population			Temporarily Displaced People(TDPS)		
S No.	Age In Year	Female (%)	Male (%)	Total (%)	Female (%)	Male (%)	Total
1	1-10	25.4	25.3	50.7	16.7	11.1	27.8
2	11-20	19.5	20.2	39.7	33.3	4.1	57.4
3	21-30	16.4	15.5	31.9	12.1	5.6	17.7
4	31-40	15.6	13.5	29.1	10.6	16.7	27.3
5	41-50	7.8	8.8	18.5	7.6	13.0	20.5
6	51-60	7.0	7.1	14.1	6.1	11.1	17.2
7	61-70	4.3	6.7	11.0	6.1	3.7	9.8
8	71-80	2.8	5.1	7.9	4.5	93	13.8
9	81abov	1.2	1.7	2.9	3.0	5.6	8.6
	Total	256	297	553	20	15	35

Chart 3.6: Showing Age Wise Distribution Among Patient
3. Chart Showing Age Distribution Among Patient



3.2.Lesion Characteristics in Local and Tdps Patients Of Cl in District Karak.

Furthermore patients were also analysed on the basis of different characteristics of lesion like active (Dry and Wet) and scar, number of lesions and position of lesion (table no.5).it was observed that, in both types of population, the highest number (55.15%) of patients were having single active or scar cl lesion while majority of patients exhibited active dry form of lesion

Table 3.7: Shows Lesion Characterstics in Local and Tdps Patient of Cl District Karak

Population n	Lesion Type	Lesion Number	Lesion Number

	Active	Scars %	Single %	Double %	Multiple %	Dry %	Wet %
Local Population	415	142	55.15	33.45	11.39	71.97	28.02
IDPs	23	12	51.67	26.67	21.67	63.33	36.67
Total	438	154	106.82	60.12	33.06	135.30	64.69

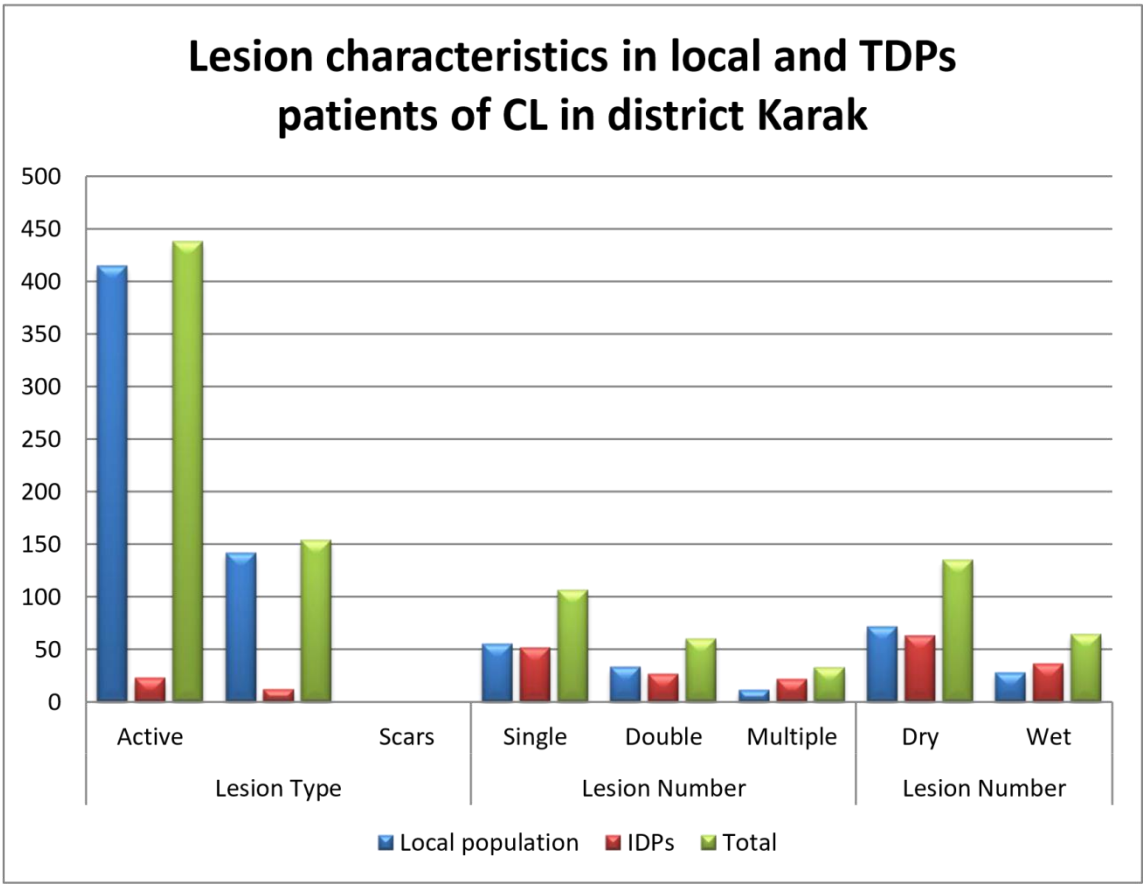


Chart 3.8: Shows Lesion Characterstics in Local and Tdps Patient of CL in District Karak.

The most noticeable site of the lesion was on exposed body parts, such as the face, hands, and feet. Factors such as house type (cemented or non-cemented), roof type, presence of animals in or near the house, education profile of the infected population, knowledge of the disease, and access to treatment were also investigated, along with a few other unusual clinical presentations and some individuals (not identified separately in the results)

4. Discussion

Humans constitute a host reservoir for the cl parasite, human population mass plays a crucial role in the transmission of cl. As a result, it may be assumed that cl is more common in places with high population density. Due to the prevalence of both ACL and ZCL caused by l Tropica and l. Major, Pakistan is particularly significant in terms of leishmaniasis. The seasonal recurrence of disease shows that physical factors have an impact on the transmission of CL. Variations in the weather and climate limit or worsen the conditions that are conducive to the spread of disease. For instance, higher humidity affects the growth and development of the leishmanial parasite by shortening its incubation time. The regions of our country that are close to the Afghan border, such as the towns and villages of Baluchistan province, Kurram, Mohmand, and the north Waziristan District of Khyber Pakhtunkhwa, cutaneous leishmaniasis is more prevalent. Our findings show that the most important factor raising the likelihood of cl incidence is the relocation of IDPS from the hipper endemic zone.

The goal of the current study was to determine the prevalence of cutaneous leishmaniasis in the Karak, KPK, Pakistan area between March 2022 and April 2023. Our study found that the prevalence of CL in local populations is higher (8.66%) than that of IDPS (7.00%). The official from the district Karak health department attributes this high prevalence to the movement of IDPS from the cl hyper endemic zone (north and south Waziristan) and the movement of animals from Baluchistan province to the district Karak for commercial purposes. Similar to the previous study from Peshawar. The overall prevalence rate of cutaneous leishmaniasis was higher in men, and sex-wise differences were also previously reported. In the 2019 study conducted in District Kohat, the prevalence was higher in men than in women and the study conducted and also showed that the disease is more common in men than in women. The results obtained and showed that 54 (90%) of the patients were male, while 10% were female, which is extremely high in men (UL bari et al., 2006). The other studies likewise demonstrate that CL affects both sexes to differing degrees at all ages and that the disease affects both sexes. We discovered an overall prevalence of 7.00% among idps resident in the local community, with an active lesion of 6.46% and scars of 2.20%. In comparison to the 2017 study conducted in the Kohat district of KPK, where the act of lesion prevalence was 39195 and the scars lesion prevalence was 1.26% (Hussain et al., 2017), and the study conducted in the refugee camp by brokered al., where the active lesion prevalence was 2.7% and the scars lesion prevalence was 4.7%, the district has a 4.60% active lesion and 2.40% scars. The percentage of idps in the research region was also included, but our main goal was to ascertain the prevalence of leishmaniasis in the local population of District Karak. The majority of cases were found to have dry type lesions, with a small number having wet type lesions, which is similar to the study. The current study also found a very high prevalence of active lesions compared to scars lesions, and other studies in Afghanistan have also looked into high prevalence of scars lesions. Additionally, the findings were broken down by age group, with the highest prevalence (55.9%) occurring in the 1–10 age group. This is in contrast to the findings of the study carried out in the Dargai region Kpk, where the highest prevalence (34.32%) was examined in the 11–20 age group . We also concur with I Khan et al.'s 2013 study, which found that leishmaniasis was most common in patients aged 1–10 years. Our study also found that children aged ≥10 years had the highest rates of

leishmaniasis (55.9%), which may be due to social factors as the kids play outside without adequate body protection from sand flies, which are the leishmaniasis vector. The 61.11% of patients had a single type of lesion, 29.28% had a double lesion, and 9.61% had multiple lesions. In contrast to our study, a previous study conducted in Kohat revealed a higher prevalence percentage of patients with a single type of lesion (6,07%) double 968.75) and multiple lesions (86.67%) also found a lower parentage of single lesions (50.9%) and double lesions (24.6%) and 29.4% of patients had numerous (3–15) lesions. Our results exceeded those of a study in Karak, which found that 58.4% of patients had a single lesion, 29.2% had two, and 12.38% had more than two lesions. In contrast, our study found slightly fewer patients with more than two lesions.

5. Conculsion

Cutaneous leishmaniasis emerged as a serious health issue in a number of Karak district communities. Its prevalence in Karak is influenced by a number of environmental variables, including a poor sewage system, inadequate sanitation, particularly in rural areas, a lack of safe drinking water, a dense population, and deforestation. The community should be educated about sand flies and control initiatives should be started in order to reduce the vector population in Karak. Based on our findings, it was also determined that men are more likely than women to have CL. Men are more gregarious and spend more time outdoors in the evening and night, which exposes them to sand fly bites, which accounts for the high occurrence in men. The current study also found that the population of people under the age of fifteen had the highest rate of infection compared to the other groups.

6. Refrences

1. Tarr, P. I., R. F. Aline, *et al*. **(1988**). "Lr1: A Candidate Rna Virus Of Leishmania." Proceedings Of The National Academy Of Sciences 85(24): 9572-9575.
2. Hotez, P. J., D. H. Molyneux, et al. (2006). "Incorporating A Rapid-Impact Package For Neglected Tropical Diseases With Programs For Hiv/Aids, Tuberculosis, And Malaria." Plos Medicine 3(5): E102.
3. Alexander, B., C. Lozano, *et al*. (**1998**). "Detection Of Leishmania (Viannia) Braziliensis Complex In Wild Mammals From Colombian Coffee Plantations By Pcr And Dna Hybridization." Acta Tropica 69(1): 41-50.
4. Organization, W. H. (2001). "Communicable Disease Profile Afghanistan And Neighbouring Countries." Geneva: World Health Organization.
5. Kassi, M., M. Kassi, *et al*. (**2008).** "Marring Leishmaniasis: The Stigmatization And The Impact Of Cutaneous Leishmaniasis In Pakistan And Afghanistan." Plos Neglected Tropical Diseases 2(10).
6. Rijal, S., S. Uranw, *et al*. (**2010).** "Epidemiology Of Leishmania Donovani Infection In High-Transmission Foci In Nepal." Tropical Medicine & International Health 15: 21-28.
7. Patz, J. A., T. K. Graczyk, *et al*. (**2000)**. "Effects Of Environmental Change On Emerging Parasitic Diseases." International Journal For Parasitology 30(12-13): 13951405.
8. Ul Bari, A. (2006). "Epidemiology Of Cutaneous Leishmaniasis." J. Of Pakistan Association Of Dermatologists 16: 156-162.
9. Desjeux, P. (**2004**). "Leishmaniasis: Current Situation And New Perspectives." Comparative Immunology, Microbiology And Infectious Diseases 27(5): 305-318.
10. Amtul, H. And S. Shaheen (**2001**). Laboratory Diagnosis Of Leishmaniasis By Pcr. Souvenir Of 3rd Annual Hamdard Symposium.

11. Hussain, M., S. Munir,*et al*. (**2017)**. "Epidemic Outbreak Of Anthroponotic Cutaneous Leishmaniasis In Kohat District, Khyber Pakhtunkhwa, Pakistan." Acta Tropica 172: 147-155.
12. Soomro, F. R., G. M. Pathan, *et al.* (**2009**). "A Survey Of Cutaneous Leishmaniasis At Village Gaibi Dero, District Larkana, Sindh, Pakistan." Gomal Journal Of Medical Sciences 7(2).
13. Kolaczinski, J., S. Brooker, *et al.* **(2004)**. "Epidemiology Of Anthroponotic Cutaneous

14. Tanoli, Z. M., M. E. Rai, *et al*. **(2005**). "Clinical Presentation And Management Of Visceral Leishmaniasis." Journal Of Ayub Medical College Abbottabad 17(4).
15. Azizi, K., Y. Rassi, *et al*. (**2006**). "Phlebotomus (Paraphlebotomus) Alexandri: A Probable Vector Of Leishmania Infantum In Iran." *Annals Of Tropical Medicine & Parasitology* 100(1): 63-68.
16. Gawade, S., M. Nanaware, *et al.* (**2012**). "Visceral Leishmaniasis: A Case Report." The Australasian Medical Journal 5(2): 130.
17. Sacks, D. And S. Kamhawi (**2001**). "Molecular Aspects Of Parasite-Vector And Vector-Host Interactions In Leishmaniasis." Annual Reviews In Microbiology 55(1): 453-483.
18. Ali, N., K. Khan, *et al,*. (**2016)**. "Species Composition And Activity Patterns Of Sand Flies (Psycodidae: Phlebotomine) In Four Tehsils Of Dir Districts, Khyber Pakhtunkhwa, Pakistan." *Acta Tropica* 156: 144-151

19. Kakarsulemankhel, J. K. (**2009**). "Taxonomic Review Of Sand Flies Of The Subgenus

20. Selvapandiyan, A., R. Duncan, *et al,*. **(2006)**. "Genetically Modified Live Attenuated Parasites As Vaccines For Leishmaniasis." Indian Journal Of Medical Research 123(3): 455

21. Handman, E. (2001). "Leishmaniasis: Current Status Of Vaccine Development." Clinical Microbiology Reviews 14(2): 229-243.
22. Mondal, D., K. N. Nasrin, *et al.* **(2010).** "Enhanced Case Detection And Improved Diagnosis Of Pkdl In A Kala-Azar-Endemic Area Of Bangladesh." Plos Neglected Tropical Diseases 4(10).
23. Evans, K. J. And L. Kedzierski **(2012).** "Development Of Vaccines Against Visceral Leishmaniasis." Journal Of Tropical Medicine 2012.

24. Khamesipour, A., Y. Dowlati, et al. (2005). "Leishmanization: Use Of An Old Method For Evaluation Of Candidate Vaccines Against Leishmaniasis." Vaccine 23(28): 3642-3648.Khan, S. J. And S. Muneeb (2005). "Cutaneous Leishmaniasis In Pakistan." Dermatology Online Journal 11(1).
25. Stanley, A. C. And C. R. Engwerda (**2007**). "Balancing Immunity And Pathology In Visceral Leishmaniasis." Immunology And Cell Biology 85(2): 138-147.