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EPIDEMIOLOGICAL INSIGHTS INTO *CUTANEOUS LEISHMANIASIS* SURVEILLANCE IN TRIBAL DISTRICT BAJAUR, PAKISTAN

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Abstract

Cutaneous leishmaniasis is caused by over 15 different species of the protozoan parasite *Leishmania*, transmitted by infected female sandflies. The present study aimed to check the surveillance of *cutaneous leishmaniasis* among the people of district Bajaur. The study was ethically approved by the district headquarters hospital Bajaur. Clinical exams were done on 1000 infected patients who went to the ISDK regularly and had active lesions. Information like name, father's name, sex, age, job, location of lesions, number of lesions, date of the first sign of the disease, previous history, address, ethnicity, treatment, previous diagnosis through microscopic examination and or biopsy test, other family members affected, etc. was filled out on a pre-designed proforma. We found that CL lesions were much more likely to happen in men than in women from the same areas. Most of the infected respondents were between the ages of 11-20, and between 21-40 moreover, in the present investigation, 27% and 21% of the positive cases were noted from the Tehsil Mamud and Salarzai due to overcrowded in population. The significance of my study is finding the cutaneous leishmaniasis patient of the tribal district Bajaur. Low socioeconomic positions were the ones who were most infected by CL. The main risk factors associated with the disease were people who lived in mud-made houses stone buildings or outdoors sleeping less or no use of bed nets and insecticide spray poverty and low sanitization had a higher risk of developing CL compared to those who lived in brick dwellings. This study concluded that the majority of patients presented singular lesions with a mean duration was 3-4 months.

Keywords: Leishmaniasis; Leishmania; Sandflies; Bajaur; socioeconomic status

INTRODUCTION

Leishmaniasis is a protozoan disorder caused by parasites in the genus Leishmania (Steverding, 2017). These parasites infect many mammals, including humans, and are spread by the bite of phlebotomie sandflies (Arya et al., 2021). Clinical symptoms of human leishmaniasis, which is caused by about 20 different species of Leishmania, are very different and can be put into two main groups: visceral leishmaniasis (VL), which is a severe disease caused by the spread of Leishmania in the phagocytes, mostly macrophages, and is almost always fatal if not treated; and cutaneous leishmaniasis (CL), which is a harmless but often disfiguring disease caused by Leishmania. Neglected tropical diseases like leishmaniasis pose a serious threat to public health yet receive comparatively little attention. People of lower socioeconomic standing are disproportionately affected (Bagcchi, 2022; Bilal[a,b,c] et al., 2024).

The first case of Cutaneous Leishmaniasis (CL) was discovered in Pakistan in the late 1960s (Bhutto et al., 2003). The rise of cutaneous leishmaniasis may be traced in large part to human actions that have altered sandfly habitat and distribution, such as conflicts, deforestation, and agricultural practices (Hashemi et al., 2018). Pakistan is home to a number of vector-borne diseases (Khan et al., 2021), infectious zoonosis, and vectors (Khan et al., 2021). Two morphological types exist in the protozoa, which range in size from 2 to 5 m. The female sand fly's stomach contains the flagellar form (promastigote), whereas the non-flagellar form (amastigote form) is present in the macrophages of humans and other hosts (Nawaz et al., 2020). The mitochondrial DNA is structured in orderly arrays of tiny fibrils in the kinetoplast, a portion of the mitochondrion that is prior to the nucleus (Lian et al., 2020). The natural transmission of Leishmania spp. through the biting of sandflies might be influenced by climate change. Temperature and climatic change, on the other hand, may have an impact on parasite reproduction and proliferation, sand fly abundance, and the spread of leishmaniasis (Bates, 2007; Gonçalves et al., 2020). Visceral leishmaniasis has been observed to have a significant yearly cycle connection by (Franke et al., 2002). Leishmaniasis and its vector distributions in connection to climate change have been discussed in the context of spatial-temporal modeling (Franke et al., 2002; Valero and Uriarte, 2020).

In most cases, a minor erythema at the bite site of the host skin is the initial symptom of CL infection. The redness develops into a papule, and finally a nodule, over time. The usual lesion, known as a localized cutaneous lesion, is produced if the nodule is left untreated for anywhere from two weeks to six months (LCL). People of all ages can get cutaneous leishmaniasis. The social toll of sickness cannot be underestimated; severe abnormalities and personality changes can have a profound effect on a patient's social life, increasing the risk of isolation. Symptom-free papules, nodules, and ulcers with varied degrees of deformity are all part of the range of possible lesion presentations (Bilgic-Temel et al., 2019). The mucus membranes of the nasal cavity, oral cavity, larynx, and pharynx become severely inflamed due to mucocutaneous leishmaniasis (MCL). In the worst-case scenario, this might result in the total or near-complete destruction of these organs or tissues. New World species (subgenus Viannia) such as *L. braziliensis*, *L. guyanaensis*, and *L. panamensis* have the highest prevalence of mucosal infections (90%). In most cases, the initial signs of MCL are congestion and bleeding in the nose. The infection destroys nasal cartilage, leading to the so-called "tapir" nose if it is not treated. Infections of the lips and palate might develop later (Kharfi et al., 2003). In Pakistan, there are between 21,000 and 35,000 annual cases of anthroponotic and zoonotic cutaneous leishmaniasis, respectively. Urban regions in KP, Baluchistan, Punjab, Azad Jammu Kashmir (AJK), and tribal areas bordering Afghanistan have all recorded cases of the ACL, suggesting that it occurs at random there. Most cases of ZCL, or zoonotic cutaneous leishmaniasis, have been documented in rural and semi-urban regions of the provinces of Sindh, Punjab, and Baluchistan (Strazzulla et al., 2013). Iran, Egypt, Pakistan, Iraq, Afghanistan, Morocco, Tunisia, Palestine, Saudi Arabia, Sudan, Syria, Yemen, Jordan, and Libya are only few of the countries where *L. majoris* is widely recognized as the primary cause of CL. The endemic severity of leishmaniasis in Pakistan is concentrated in the country's mountainous regions, while cases have been documented

throughout (Khan and Muneeb, 2005). The spread of leishmaniasis to new geographic regions is altering the disease's epidemiology. Changes in epidemic conditions occur because of human population movement and the natural environment (Kolaczinski et al., 2004).

The sandfly (order Diptera, family Psychodidae, subfamily Phlebotominae, genus *Phlebotomus*) is the insect vector for leishmaniasis. They may be found all across the world, but thrive best in the hot, dry temperatures of the tropics. There are over 600 species in the Phlebotominae subfamily's 5 genera. Transmission of leishmaniasis has been linked to species from the genera Sergentomyia, Phlebotomus, and Lutzomyia, with *Phelobotomus* being the most virulent. Members of the genus *Phelobotomus* and the genus lutzomyia are responsible for transmitting leishmania parasites in the Old World and the New World, respectively. Female sand flies reach adulthood as tiny insects (about 2-5 mm in length) with curled bodies, upturned wings, and long, hairy legs. Black and somewhat wide eyes (Reyburn et al., 2003). In the Old World, sandflies breed in forest litter, gaps in buildings and roofs, and the burrows of wild rodents (Stewart and Brieger, 2009). Each species of Leishmania has its unique geographical range, however, they all share the same life cycle between a mammal and an infected vector of the Phlebotomus genus. Disease manifestation and consequences are intrinsically connected to the host and parasite. Infectious vectors initiate the life cycle by injecting the promastigote, the parasite's infective stage, into a blood meal. Reticuloendothelial cells ingest the circulating, flagellated promastigotes (macrophages or mononuclear). Active lesions from CL often heal on their own after 8-12 months. Having a facial lesion (on the cheeks, nose, lips, or chin) for a whole year can be extremely trying because of the disfigurement and subsequent bacterial and fungal infection that can arise as a result (Aflatoonian et al., 2022). Topical ointments that combat bacteria and fungi are also commonly utilized. When coupled with methyl benzethonium chloride, paromomycin (aminindine) showed improved efficacy against major infections instead of *L. tropica* larger lesions on the nose or lips might sometimes take longer than 8-12 months to heal (observations from patients with chronic lesions). Lesions that are younger than 3-4 weeks are often not treated so that patients can establish long-lasting natural active immunity (Escrivani et al., 2021).

Some methods of management involve reducing animal reservoirs, such as rats, removing food and water supplies for animals, or even demolishing rodent burrows, as was done in Jordan and Tunisia in the past (Vasconcellos, 2015). Watershed and parasite control, active case diagnosis and treatment, pesticide usage, and other measures are now used to combat leishmaniasis (Boelaert et al., 2000; Davies et al., 2003; Sundar et al., 2018; Dantas-Torres et al., 2019) yet there is still a lack of anti-leishmanial vaccinations. Relapses of illness are common, and dogs can recover infectivity weeks after therapy, while being clinically cured, meaning that treatment options for infected dogs are ineffective as a means of disease management (Blum et al., 2012; Medkour et al., 2020). Human leishmaniasis has been treated with sodium stibogluconate, meglumine antimoniate, and pentamidine as first-line medications in several countries for almost 70 years (Ameen, 2007; Varzandeh et al., 2021).

Antimonials are still used in many developing nations. In certain countries with significant treatment failure rates, conventional amphotericin B has replaced antimonial as the first-line therapy for illness (Sundar et al., 2000). Treatment with traditional amphotericin B is associated with the practically ubiquitous side effects of fever, chills, and rigidity, as well as the potentially fatal side effects of hypokalemia and nephrotoxicity. Using milte fosine is strongly prohibited for pregnant women or women who may get pregnant within two months of therapy since it is a teratogenic medicine. Milte fosine has a lengthy half-life and it is simple to establish resistance in parasites (Pérez-Victoria et al., 2006). At the moment, preventing CL is mostly about keeping sand flies from coming into contact with people and reducing the number of vectors. There are different ways to do this, such as using insecticides and taking care of the environment, or using personal protection like bed nets (González et al., 2015). Other steps include reducing the number of rodents and dogs that serve as hosts for the parasite (Esterhuizen et al., 2015).

Community-based interventions can take place in a variety of settings, including homes, institutions, and organizations, such as schools, churches, businesses, and volunteer groups (François, 2022). Community mobilization, education and training, reducing financial obstacles, and getting people to

health facilities are what Lassi and his colleagues suggest interventions should be prioritized when dealing with NTDs (Bhutta et al., 2014; Lassi et al., 2014). They further claim that if these factors are addressed, disease-related KAP (knowledge, attitudes, and behaviors), healthcare access and coverage, and death rates will all improve (Keats et al., 2021).

The following aims were taken into consideration in the design of this study: In order to determine the sensitivity and specificity of parasitological. It is The purpose of this study to report leishmaniasis infection rate in the humans of the Tribal district Bajaur. To determine whether there is any correlation between the risk variables evaluated and the presence of Tribal district Bajaur. To investigate potential vectors and possible reservoirs (humans) of the Tribal district Bajaur involved in the dissemination of disease. To increase awareness of the disease, and to elucidate some aspects of the interaction between the parasite and the human immune system.

MATERIAL AND METHODS

Study Area

The current survey was carried out among the general leishmaniasis patients from the Tribal District Bajaur, Pakistan to check the surveillance of cutaneous leishmaniasis specification.

The study area is located in a rural tribal district in western Pakistan, which is located between latitude 34°30′–34°58′N and longitude 71°11–71°48′E (Fig. 1). The district is spread over an area of 1290 KM^2 with a 1.1 million population Bajaur District is a district located in the Malakand Division of Pakistan's Khyber Pakhtunkhwa province. Up until 2018, it was a Federally Administered Tribal Areas, but now as a Part of Newly Merged areas Tribal District and Khyber Pakhtunkhwa, it was transformed to a District. Bajaur is around 45 miles (72 km) long and 20 miles (32 km) wide. It is situated at a high elevation to the east of the Kunar Valley in Afghanistan and Pakistan, from which it is divided by a continuous series of rugged frontier hills, some of which may be crossed with ease. The old route from Kabul to Pakistan went via the barrier before the Khyber Pass became the main route. The Khan of Nawagai was once protected by the British government in order to maintain the Chitral Road, and Nawagai is the capital of Bajaur.

A rough hilly region can be found in Mohmand District, which is south of Bajaur District. Another Pashtun ethnic group makes up the majority of the population of Swat District, which is east of the Panjkora River. The bigger Tehsil of Bajaur to the south and the smaller tehsil of Dir to the north are divided by a watershed. The new road to Chitral crosses this watershed and travels through the Dir valley on its way from Malakand and the Punjab. A prominent geographical feature is a mountain ridge that protrudes from the Kunar range. The district is situated on a slope that slowly descends from the Kunar ridge to the Panjkora river as a result of Bajaur's drainage, which flows eastward and starts on the eastern slopes of the mountain where it looks out over the Kunar (Chisholm, 1910).

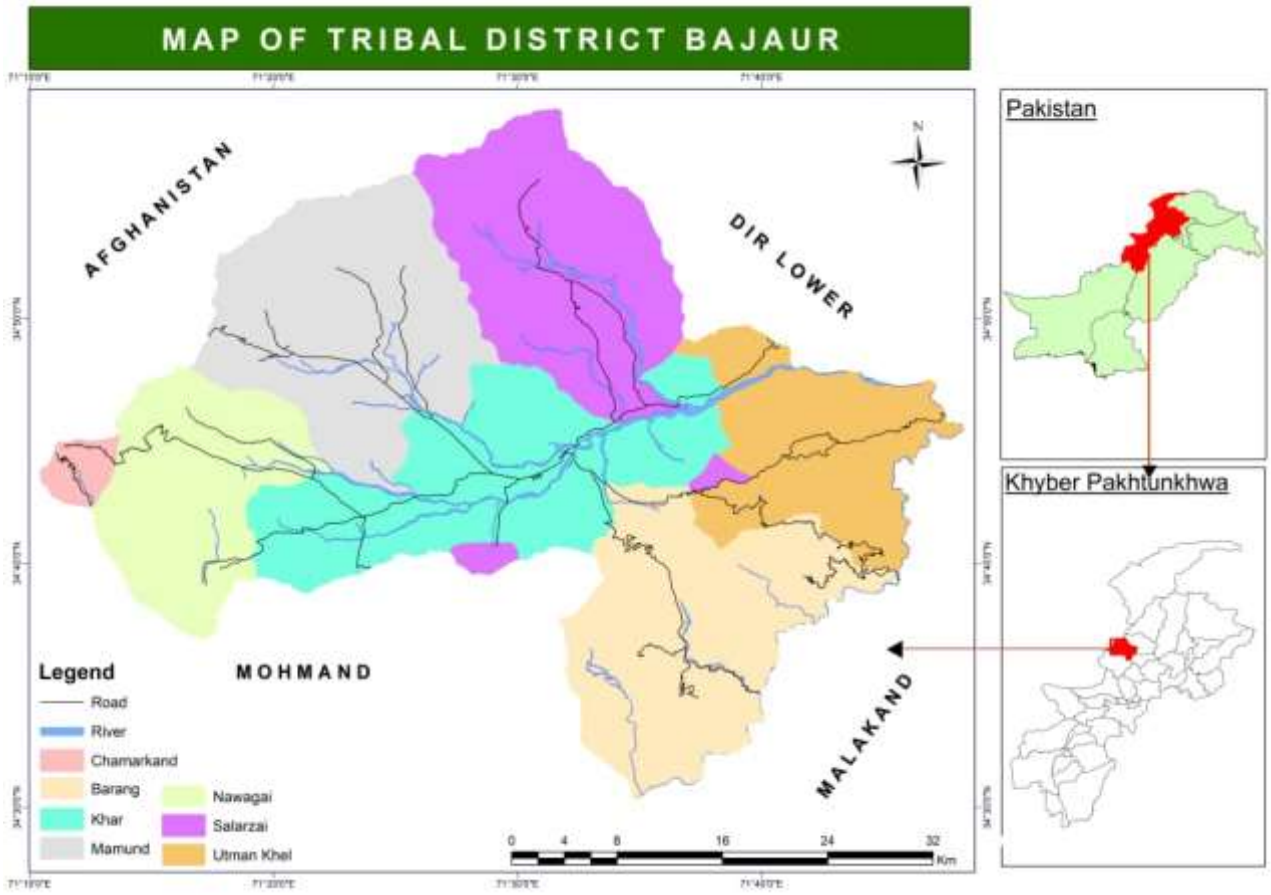

Figure 1. Map of the rural Tribal District of Bajaur

Study design

The study was ethically approved by the District headquarters hospital in Bajaur. Clinical exams were done on 1000 infected patients who went to the ISDK regularly from August 2021 to 2022 March to and had active lesions. Information like name, father's name, sex, age, job, location of lesions, number of lesions, date of the first sign of the disease, previous history, address, ethnicity, treatment, previous diagnosis through microscopic examination and or biopsy test, other family members affected, etc. were filled out on a pre-designed Performa. Face-to-face interviews with the patient were used to get information about different variables. A digital camera or cell phone was used to take pictures of the spot.

Data Collection

The survey was conducted through the questionnaire during the period of August 2021 to March 2022 comprised of different questions related to physical activity, lifestyle, and associated disease with acne, sleep patterns, workload, and occupational stress.

Statistical Analysis

Data were analyzed by using a mini tab. Differences in the prevalence of acne, its risk factors, and the impact of acne on the life of women were analyzed using the chi-square test.

Ethical approval

Everyone who took part in the study was told how it would work and what the criteria were. People who took part in the study gave their verbal permission so that nothing bad would happen in the future. Complete privacy of the participants was assured and the person taking the interview was of the same gender. The name, age, and other personal information of the participants were not disclosed to any third party.

RESULTS

The data from the questionnaire were examined using the Statistical Package for the Social Sciences (SPSS). We checked the data's reliability using Cronbach's Alpha before we ever looked at it. When analyzing our data, we identified the main theme by using descriptive statistics like frequency (average), median (average), mode, measures of dispersion, and shape. What we did was as follows: Cross tabulation was then utilized to determine how well one attribute performed when another attribute was present. These tests look for relationships between features, and we base our conclusions on their p-values. They are all used to search for connections and go by the names Chi-square test, likelihood ratio test, and line-to-line test.

We were able to describe the variables using frequency distribution tables, means, standard deviations, and bar graphs. Due to the individual-to-individual matching method and the matched quadruplet data type, the marginal model was employed for both univariate and multivariate data modeling. Both were estimated using the generalized estimating equations (GEE) approach. GEE can be used to determine how to estimate a generalized linear model with unidentified correlations between outcomes.

Reliability Test

The validity of the questionnaire is examined using a reliability test. Because of this, it's crucial to confirm the accuracy of the data before continuing with a more involved study. Take into account Cronbach Alpha, which is defined as: In terms of Cronbach Alpha, the computed result is 0.845, which is great. Consequently, our next computational discoveries are dependable and efficient because to Cronbach Alpha's efficient value.

Table 1: Cronbach's Alpha along with its Internal Consistency levels

The Cronbach's Alpha	The value of Internal Consistency
$\alpha \geq 0.90$	Excellent
$0.90 < \alpha \geq 0.80$	Good
$0.80 < \alpha \geq 0.70$	Accepted
$0.70 < \alpha \geq 0.60$	Questionable
$0.60 < \alpha \geq 0.50$	Fair
$0.50 < \alpha$	Unaccepted

Table 2: Represents gender wise Surveillance of Leishmaniasis

Gender	No of Patients	Percentage
Male	579	57.9
Female	421	42.1

Demographic characters

This survey-based study conducted in Tribal District Bajaur Pakistan. Table 1 and figure 1 represents gender wise surveillance of leishmaniasis. We used graph pad latest version for statistical analysis there were 57.9% of male and 42.1% where female majority of the effected respondents were male because they have to move out of their houses for work and have more chance of exposure to sand fly and leishmaniasis causing agents in compare to women.

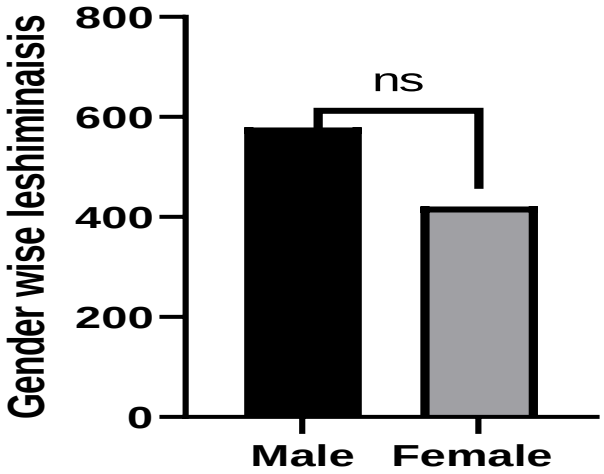

Figure 1: Represents gender wise Surveillance of Leishmaniasis

Lesihminiasis age-wise surveillance is shown in Table 2 and Figure 2. Five age categories were used to split up the responses. For statistical analysis, we utilised the most recent version of Graph Pad and one sample t tests for each age group. Nearly 20.9% out of the impacted respondents were between the ages of 11 and 20. Only 15% of the respondents were between the ages of 21 and 40. For all age groups, a non-significant P value is found. Table 3 and figure 2 represents body part wise surveillance of leishmaniasis. We applied single sample t test to compare each part on the basis of gender. The most affected part in the people of district bajaur was their face almost 20.4% male and 15.7% of female of total respondents were affected from leishmaniasis at their face.7.6% of male and 5.3% of female were having disease at their foot, 9.9% male and 8.1% were having at nose, 6.7% male and 5.3% of female respondents of total respondents were affected from leishmaniasis at their arms and almost 13.3% male and 8.8% of female respondents were having multiple infections.

Table 3: Represents age wise Surveillance of Leishmaniasis

Age	Male	Female	Total	Male %	Female %	P-Value
0-10	117	93	210	11.70%	9.30%	0.0724
11-20	209	176	385	20.90%	10.70%	0.0544
21-40	145	107	252	15%	10.70%	0.0953
41-60	65	35	100	6.50%	10%	0.1855
60+	43	10	53	4.30%	1%	0.3545

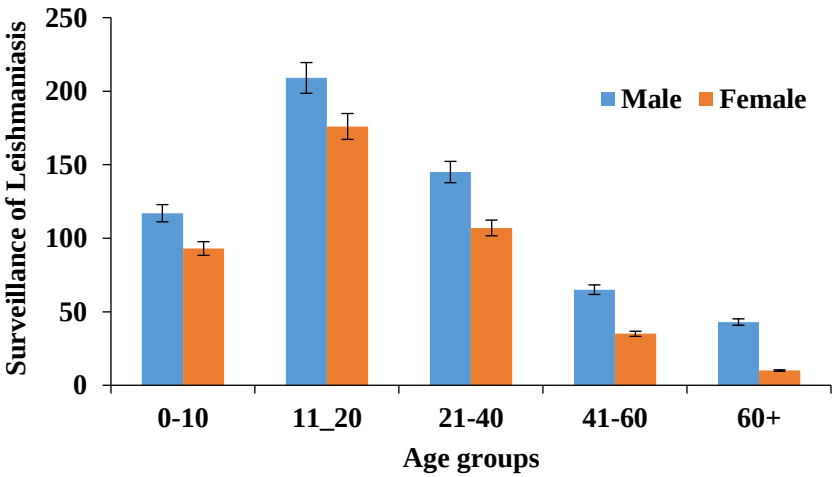

Figure 2: Represents age wise Surveillance of Leishmaniasis

Table 4 and figure 3 represents body part wise surveillance of Leishmaniasis. We applied single sample t test to compare each part on the basis of gender. The most affected part in the people of district bajaur was their face almost 20.4% male and 15.7% of female of total respondents were affected from Leishmaniasis at their face.7.6% of male and 5.3% of female were having disease at their foot, 9.9% male and 8.1% were having at nose, 6.7% male and 5.3% of female respondents of total respondents were affected from leishmaniasis at their arms and almost 13.3% male and 8.8% of female respondents were having multiple infections.

Table 5 and figure 4 represents area wise surveillance of leishmaniasis. There are 7 tehsils of district Bajaur, we collected data from each separately. The higher number of infected persons was from tehsil Mahmund almost 27.4% were infected 18.7% were residents of Tehsil Salarzai. The lowest number of suspected patients were residents of Tehsil Bar Chamerkand (38/1000). The highest positivity of CL was reported from Tehsil Mahmund (274/1000), followed by Tehsil Salarzai.

Table 4: Represents body part wise Surveillance of Leishmaniasis

Body parts	Male	Female	Total	Male %	Female %	P-Value
Face	204	157	400	20.43%	15.70%	0.0824
Foot	76	53	129	7.60%	5.30%	0.1123
Nose	99	81	180	9.90%	8.10%	0.0635
Arms	67	53	120	6.70%	5.30%	0.0739
Multiple sites	133	88	171	13.30%	8.80%	0.1279

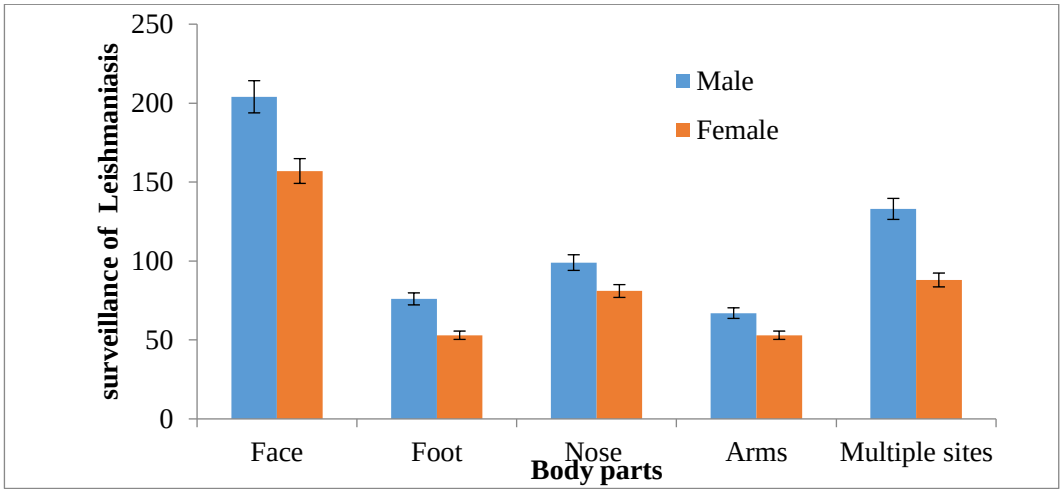

Figure 3. Body part wise surveillance of Leishmaniasis

In Table 5, of the 1122 patients, samples on what man filter paper and in cultures were successfully collected from 128 and 110 patients, correspondingly. Only 42 of the 128 lesions could be grown and propagated so they could be further tested with species-specific PCRs, despite the fact that 51 of the total 128 lesions were culture-positive. All 16 of the patients examined at KTH and 41 of the 69 patients seen at CMH had microscopy data available. At KWH, microscopy wasn't done. The agreement standard was used to evaluate the sensitivity and specificity of each diagnostic PCR assay on filter paper samples. The highest sensitivity (82.4%) and specificity (89.3%) were demonstrated by kDNA PCR. Additionally, this PCR technique had the lowest rate of false negative results (NPV = 95.2%). Although it had poor specificity (48.3%), rDNA PCR was the second-most sensitive approach (39.5%). The ITS2 PCR performed the best in terms of specificity (100%), however it was the least sensitive (70.3%). Sensitivity estimates from parasite culture and microscopy were 69.2% and 59.5%, respectively. Only the kDNA and rDNA PCRs significantly matched the consensus standard statistically (McNemar's test; $P > 0.05$). Using the chi-square test, we check the positive relationship between culture and rDNA PCR.

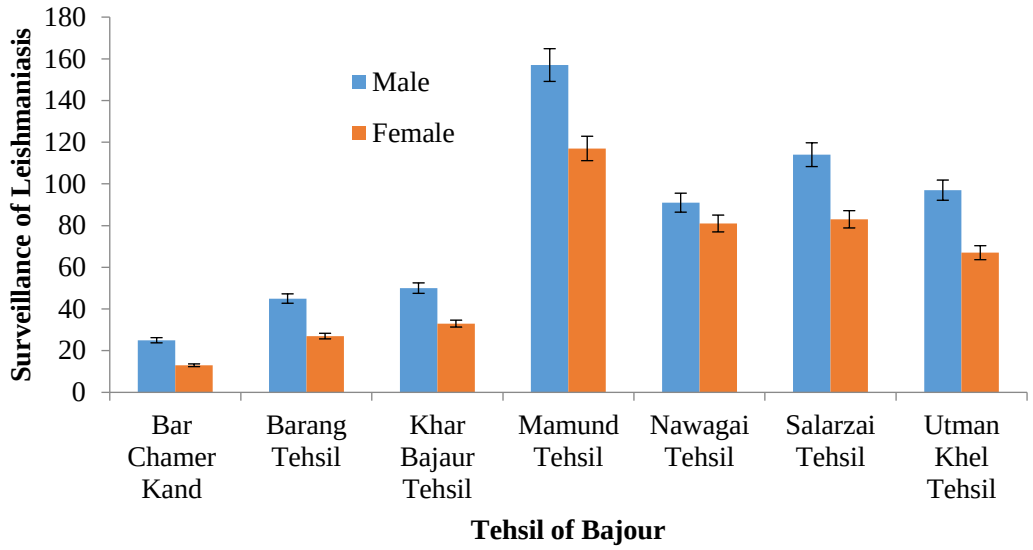

Figure 4. Represents area wise Surveillance of Leishmaniasis

Table 5. Comparative performance of diagnostic methods

Methods	Positivity	Sensitivity	Specificity	PPV	NPV	P- value
KDNA PCR	78 (72.3)	82.4	89.3	95.2	78.3	0.084
ITS2 PCR	82 (49.2)	69.4	100	100	89.2	0.004
rDNA PCR	79 (56.3)	71.2	49.2	70.2	50	0.0001
Microscopy	35 (39.5)	59.3	100	100	53.5	<0.001
Culture	49 (42.5)	48.3	100	100	69.2	<0.01

The value of chi-square us 32.734 with 36 degree of freedom. The likelihood ratio is 37.741 and the linear association between variables is 0.201. The p-value of this test is 0.625, 0.390 and 0.654. The p-value is greater than the level of significance. So, the results are statistically non-significant. The null hypothesis is not rejected. We conclude that there is a positive association between culture and rDNA PCR.

Using the test, we check the positive relationship between KDNA PCR and Microscopy. The value of chi-square us 44.386 with 36 degrees of freedom. The likelihood ratio is 42.402 and the linear association between variables is 4.182. The p-value of this test is 0.159, 0.214 and 0.041. The p-value is greater than the level of significance but the p-value of linear association is 0.041 is less than the level of significance. So, the results are statistically significant. The null hypothesis is rejected. We conclude that there is a positive association between KDNA PCR and Microscopy.

Table 6: One way ANOVA

	Sum of Squares	Df	Mean Square	F	Sig.
Between Groups	4.838	6	.806	.273	.950
Within Groups	1031.934	349	2.957		
Total	1036.772	355			

Using the ANOVA table, we check the difference between the variables. The sum of square between groups is 4.838 with degree of freedom is 6. The value of sum of square within groups is 1031.934 with 349 degrees of freedom. The mean square between groups is 0.806 and the value of mean square within groups is 2.957. The value of F-calculated is 0.273 and the p-value is 0.950. The p-value is greater than the level of significance 0.05. So, the results are statistically non-significant. We don't reject the null hypothesis. We conclude that there is no difference between variables.

Table 7: Chi-square Test

	Value	Df	Asymp. Sig. (2-sided)
Pearson Chi-Square	32.734[a]	36	.625
Likelihood Ratio	37.741	36	.390
Linear-by-Linear Association	.201	1	.654
N of Valid Cases	356		

In this table, we check the difference between variances of the Bar ChamerKand and the Salarzai Tehsil. The z-statistic is 70.728 for Bar ChamerKand and the z statistic for Salarzai Tehsil is 38.015. The value of degree of freedom is 354. The significance value is 0.0001. The p-value less than the 0.05 threshold for significance. The conclusions are therefore statistically significant. The null hypothesis is rejected. The value of 95% confidence interval is 4.573 to 4.835. The confidence interval is the ranges of the difference between means.

Table 8: 95% Confidence interval of the differences between Tehsils

	Z	Df	Sig. (2-tailed)	Mean Difference	95% Confidence Interval of the Difference	
					Lower	Upper
Bar ChamarKand	70.728	354	.0001	4.7042	4.573	4.835
Salarzai Tehsil	38.015	353	.0001	3.3870	3.212	3.562

In this correlation analysis, we check the relationship between Bar Chamarkand, Barang, Khar Bajaur, Nawagai, Mamund, Salarzai and Utman Khel. The correlation between variables is positive and the correlation between some variables is negative. The correlation between Mamund and Barchamarkand. The correlation between variables is negative correlation. Moreover, the correlation between all the other variables is positive correlation. Most of the results of correlation is greater than the 0.50, It denotes a strong positive correlation between the two variables. The p-value is greater than the significance value. The findings are therefore statistically significant. The null hypothesis is rejected. So, we conclude that there is a positive relationship between Tehsils.

In this correlation analysis, we check the relationship between multiple sited and body parts. The correlation between variables is positive instead of the correlation between arms and nose. The correlation between arms and nose is -0.59. The correlation between variables is negative correlation. Moreover, the correlation between all the other variables is positive correlation. Most of the results of correlation is greater than the 0.50, It denotes a strong positive correlation between the two variables. The p-value is greater than the significance value. The findings are therefore statistically significant. The null hypothesis is rejected.

Using the regression analysis, we check the relationship between body parts and the multiple sited. The value of intercept is 4.808. The regression coefficient for face is -0.115, the regression coefficient for foot is 0.113, the regression coefficient for probably known for nose is -0.034 and the slope of regression for arms is 0.193. If we change the value of higher perceived website reputation than the value of intercept is changed. It means that the positive effect on the website quality. The standard error of this analysis is minimum it means that the model is good. The p-value is 0.034 and 0.003. The significance value is less than the level of significance (0.05). So, the conclusions are statistically significant. The null hypothesis is rejected.

Table 9: Correlation analysis between Tehsils

Tehsils	Bar Chamarkand	Barang	Khar	Nawagai	Mamund	Salarzai	Utman Khel
BarChamarkand	1	0.56	0.23	0.45	0.12	0.52	0.38
Barang	0.56	1	0.49	0.21	-0.82	0.49	0.84
Khar	0.23	0.49	1	0.43	0.50	0.42	0.28

Nawagai	0.45	0.21	0.43	1	0.98	0.78	0.34
Mamund	0.12	-0.82	0.50	0.98	1	0.53	-0.33
Salarzai	0.52	0.49	0.42	0.78	0.53	1	0.62
UtmanKhel	0.38	0.84	0.28	0.34	-0.33	0.62	1

Table 10: Correlation Analysis between Body parts

Body parts	**Face**	**Foot**	**Nose**	**Arms**	**Multiple sited**
Face	1	0.43	0.23	0.49	0.94
Foot	0.43	1	0.32	0.74	0.29
Nose	0.23	0.32	1	0.59	0.52
Arms	0.49	0.74	-0.59	1	0.38
Multiple sited	0.94	0.29	0.52	0.38	1

Using the regression analysis, we check the relationship between tehsils and the higher gender and culture. The value of intercept is 4.680. The regression coefficient for barang tehsil is 0.055, the regression coefficient for gender is 0.069, and the regression coefficient for culture is 0.068. The standard error of this analysis is minimum it means that the model is good. The p-value is 0.304 and 0.233. The significance value is greater than the level of significance (0.05). So, the conclusions are statistically non-significant. The null hypothesis is not rejected.

Table 11: Regression Analysis for Body Parts

Model	**Unstandardized Coefficients**		**Standardized Coefficients**	**T**	**Sig.**
	B	**Std. Error**	**Beta**		
(Constant)	4.808	.453		10.614	.000
Face	-.115	.054	-.114	-2.126	.034
Foot	.113	.060	.101	1.889	.060
Nose	-.034	.057	-.032	-.593	.554
Arms	.193	.065	.159	2.969	.003

Table 12: Regression Analysis between Tehsils

Model	**Unstandardized Coefficients**		**Standardize Coefficients**	**T**	**Sig.**
	B	**Std. Error**	**Beta**		
(Constant)	4.680	.403		11.617	.000
Barang Tehsil	.055	.053	.055	1.030	.304
Gender	.069	.057	.064	1.197	.232
Culture	.068	.057	.064	1.196	.233

DISCUSSION

Leishmaniasis is common in many places around the world, especially in tropical areas. Most Asian communities are made up of people who live in poor areas and don't have very good lives. People like this are more likely to get diseases spread by vectors.According to (Durrani et al., 2011). Leishmaniasis is common in India, Iran, Afghanistan, and China, as well as Pakistan. In Central Asia, where Pakistan is, Leishmaniatropica is usually the cause of anthroponotic CL. It is spread (anthroponically) from person to person by female sand flies of the genus Phlebotomus. The infection is more common in places with a lot of people and bad sanitation and hygiene, where it can spread quickly. L. tropica has been found to cause CL in a number of places in Pakistan and India (Metzdorf et al., 2017).

Figure 3. Leishmania affected patients in District Bajour

CL is a disease that can be found in all of Pakistan, even in Azad Kashmir and the former FATA. People moving back and forth across the border between Afghanistan and Iran put those areas more at risk of getting sick.Leishmaniasis is a big health problem because the parasite has become immune to the drugs that used to treat it. Some drugs that used to have very high cure rates are now getting very low (Kassi et al., 2008). Since a few years ago, the disease has spread like wildfire through the district of Bajaur. Every day, people report tens of cases. At the District Headquarter Hospital in KharBajaur, a place has been set up to diagnose and treat leishmaniasis. But it's hard for people from faraway villages to get to the centre on time (Arif et al., 2022).

(Jamal et al., 2013; Jawad et al., 2023), evaluated that CL is more common in the local population than in the Dargai refugee camp, according to a study in Malakand Agency, Khyber Pakhtunkhwa.Leishmaniasis is new to the areas mentioned, so locals may not have developed immunity. Leishmaniasis is endemic in Afghanistan, and refugees have developed immunity (Jamal et al., 2013). (Rahman et al., 2009) reported Peshawar and Hayatabad's CL prevalence. These studies show that cutaneous leishmaniasis is common in KP, especially near Afghanistan (Rahman et al., 2009; Sajjad et al., 2024; Noor et al., 2024).

Our study and others show that CL is common in Pakistan. CL is most common in Pakistan from April to September because to sand fly activity and altitude. Pakistan reported 1,200 CL cases in 2006 (Marco et al., 2006; Bilal et al., 2021).

According to findings of (Ullah et al., 2009; Ullah et al., 2016), Cutaneous leishmaniasis is more common in people between the ages of 1 and 15 who were reported from KPK. In a similar vein, they discovered that men are significantly more likely to get the illness (60.5% vs. 39.5%) than women. This report of (Ullah et al., 2009) is consistent with the current study, in which we found that 59% of the patients were male and 42% were female (out of a total of 1,000 cases).

Patients with a single CL lesion were more common than those with several lesions. Seventy-seven percent of patients were found to have a single CL lesion, whereas 23 percent had two or more lesions in line with the study of (Ayaz et al., 2018). Severely infected flies may have difficulty engorging a blood meal due to a clogged proboscis, leading the fly to bite the same host multiple times in order to get the best possible blood meal, which in turn increases the number of lesions.

We found that CL lesions were much more likely to happen in men than in women from the same areas. In studies done in Iran and Pakistan, it was also found that CL is more common in men than in women. Males are probably more exposed to sand flies because they work outside and do things like sleep outside without a bed net to protect them. This is why males have a higher prevalence rate. Our results back up the idea that older people are less likely to have active CL lesions because they have built up immunity. Most of the infected respondents were between the ages of 11 and 20, and between 21 and 40 in line with the study of (Mujtaba and Khalid, 1998; Ayaz et al., 2018; Arif et al., 2022).

Moreover, in the present investigation 27% and 21% of the positive cases were noted from the Tehsil Mamud and Salarzai due to overcrowded in population in line with the study of (Arif et al., 2022).

Conclusions

It is concluded that one of the primary causes of CL is poor socioeconomic status because persons of low socioeconomic position were the ones who were most impacted by CL. This came about as a result of our research. People who lived in mud or stone buildings had a higher risk of developing CL compared to those who lived in brick dwellings. The primary factors that contribute to an increase in the number of vectors and the subsequent spread of CL include shifts in the global and local environment, as well as agriculture and the way people spend their lives. We recommend here that you limit its vector by spraying from certain non-conventional insecticides. This is especially important from the final week of August up to December, as the adult flies during this time period are abundant on their breeding grounds.

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CONFLICT OF INTERESTS

There is no conflict of interest between the authors.

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