DISTRIBUTION OF CUTANEOUS LEISHMANIASIS BY SEX, AGE GROUPS AND RESIDENCE IN YEAR 2020 IN CUTANEOUS LEISHMANIASIS POPULATION OF DISTRICT D.I.KHAN, PAKISTAN

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ABSTRACT

Background: Leishmaniasis is not an uncommon tropical disease. Cutaneous leishmaniasis is its most common form. The objectives of our study were to determine the distribution of cutaneous leishmaniasis by sex, age groups and residence in year 2020 in cutaneous leishmaniasis population of District D.I.Khan, Pakistan.

Materials & Methods: This cross-sectional study was conducted in Department of Community Medicine, Gomal Medical College, D.I.Khan, Pakistan from January 1, 2021 to January 23, 2021. The data for cutaneous leishmaniasis was retrieved from District Health Office, D.I.Khan for year 2020. A sample size of 419 was calculated from population at risk of 1,750,000 with 0.1034% margin of error, 95% confidence level and 0.01164% assumed prevalence of cutaneous leishmaniasis. Sex, age groups and residence were our three nominal variables. Distribution was analyzed by count and percentage with 95% confidence intervals. Three hypotheses for distribution were testified by chi-square goodness of Fit test.

Results: Out of 419 positive cases of cutaneous leishmaniasis, 269 (64.20%) were men and 150 (35.80%) women, 254 (60.62%) were in age group up to 19 years, 101 (24.11%) in age group 20-39 years and 64 (15.27%) in age group ≥40 years, and 113 (26.97%) were urban and 306 (73.03%) rural. Our distribution by sex (p=0.01327), age groups (p=<0.0001) and residence (p=<0.0001) were not similar to expected.

Conclusions: The prevalence of cutaneous leishmaniasis in year 2020 in cutaneous leishmaniasis population of District D.I.Khan, Pakistan was higher in men than women, highest in age group up to 19 years than age groups 20-39 and ≥40 years, and higher in rural than urban. The prevalence for men was higher than expected for men and prevalence for women was lower than expected for women. The prevalence for age group up to 19 years was highest than expected for this age group than age groups 20-39 and ≥40 years. The prevalence for rural was higher than expected for rural and the prevalence for urban was lower than expected for urban.

KEY WORDS: Cutaneous Leishmaniasis; Leishmania Donovani; Distribution; Sex; Age Groups; Residence; Pakistan; Urban; Rural; Skin.

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1. INTRODUCTION

1.1 Background

We have placed the burden of cutaneous leishmaniasis (CL) as distributed by sex, age groups and residence from global and regional studies and then from national and local studies.

Armijos, et al.¹ from area of subtropical rainforest in North-West Ecuador showed the prevalence of confirmed cases of CL as 13.95% (65/466).

Omari, et al.² from Fez-Meknes region, Central Morocco for the period from 2009-2015 reported 70 confirmed cases of CL, including 38 (54.29%) urban and 32 (45.71%) rural.

Aksoy, et al.³ from Sanliurfa, Turkey for the period from 1998-2014 reported 8,786 confirmed cases of CL, including 4,050 (46.10%) men and 4,736 (53.90%) woman, and 3,098 (35.26%) cases in age

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group up to 5 years, 3,464 (39.43%) in age group 6-10 years and 2,224 (2224*100/8786=25.31%) in age group 11-15 years.

Rajapaksa, et al.\textsuperscript{4} from Matara and Hambanthota districts of Southern Province of Sri Lanka reported in 2006 a sample of 113 confirmed cases of CL, including 57 (50.44%) men (57*100/113=50.44) and 56 (49.56%) women (56*100/113=49.56), and 42 (37.17%) in age group up to 19 years, 26 (23.01%) in age group 20-39 years and 45 (39.82%) in age group ≥40 years.

Ayaz, et al.\textsuperscript{5} published a report from Metropolitan City of Multan, Pakistan in 2018 and showed 198 positive cases of CL including 101 (51.01%) men and 97 (48.99%) women.

Hayat, et al.\textsuperscript{6} from District Dir, Khyber Pakhtunkhwa, Pakistan reported 300 confirm cases of CL in July-August 2013, including 171 (57%) men and 129 (43%) women, and 142 (47%) in age group up to 15 years, 84 (28%) in age group 16-30 years and 75 (25%) in age group ≥31 years.

Rahim, et al.\textsuperscript{7} from village Wantangi, District Dir, Pakistan reported 37 positive cases of CL in August 2001, including 34 (85%) cases in age group up to 20 years, 5 (12.5%) in age group 21-40 years and 1 (2.5%) in age group 40-60 years.

Jamal, et al.\textsuperscript{8} from Dargai Tehsil of Malakand, Khyber Pakhtunkhwa, Pakistan reported 102 confirm cases of CL reported in 2013, including 72 (70.59%) men and 30 (29.41%) women, and 48 (47.06%) in age group up to 20 years, 33 (32.35%) in age group 21-40 years and 21 (20.59%) in age group ≥40 years.

Ullah, et al.\textsuperscript{9} from Peshawer Pakistan reported 9,631 CL patients spanning from April 2011-Octbar 2014, including 5,605 (58.20%) men and 4,026 (41.80%) women.

Hussain, et al.\textsuperscript{10} from-war affected Wazirastan areas of Pakistan surveyed a sample of 7,548 persons during 2013-2015 from different endemic areas of North Waziristan and South Waziristan agencies and reported 273 (3.61%) positive cases of CL.

1.4 Research Objectives (ROs)

The objectives of our study were to determine the:

RO 1: distribution of cutaneous leishmaniasis (CL) by sex in year 2020 in cutaneous leishmaniasis population of District D.I.Khan Pakistan.

RO 2: distribution of CL by age groups in year 2020 in cutaneous leishmaniasis population of District D.I.Khan Pakistan.

RO 3: distribution of CL by residence in year 2020 in cutaneous leishmaniasis population of District D.I.Khan Pakistan.

1.5 Null Hypotheses

Following three null hypotheses were formulated from literature. These were tentative answers to our three RQs. Accordingly, we collected data for relevant variables, analyzed and interpret these to get observed answers for our research questions, which filled our three knowledge gaps and solved our three research problems.

H\textsubscript{01}: The observed distribution of cutaneous leishmaniasis (CL) by sex in year 2020 in cutaneous leishmaniasis population of District D.I.Khan Pakistan is similar as expected.

H\textsubscript{02}: The observed distribution of CL by age groups in year 2020 in cutaneous leishmaniasis population of District D.I.Khan Pakistan is similar as expected.

H\textsubscript{03}: The observed distribution of CL by residence in year 2020 in cutaneous leishmaniasis population of District D.I.Khan Pakistan is similar as expected.

1.6 Significance

Until we know the overall and group wise burden of a disease, we cannot optimally allocate the required and available resources. Through this cross-sectional inquiry, we can determine the distribution of CL by sex, age groups and residence and then recommend to the service providers (government and NGOs) to allocate their resources optimally to combat cutaneous leishmaniasis. Further, this investigation will help in further research by providing baseline data.

2. MATERIALS AND METHODS

2.1 Design, Setting & Duration

This descriptive study was conducted in the Department of Community Medicine, Gomal Medical College, D.I.Khan, Pakistan from January 1, 2021 to January 23, 2021. This research project was approved by the “Research Evaluation and Ethics Committee of this Institute”. Ethical approval was not required as it was record-based study. This project was supervised by Dr. Muhammad Marwat of this institute.

2.2 Population, Sample Size & Technique and Sample Selection

The population of District D.I Khan, Pakistan was 1,627,132 as per census 2017. For the year 2020,
It is estimated to be around 1.75 million. District Health Office, D.I.Khan and three Tehsil HQ Hospitals; Kulachi, Paroa and Paharpur are providing curative facilities for CL in District D.I.Khan. Out of 1.75 million population, a sample size of 419 was calculated, with 0.1034% margin of error, 95% confidence level, assumed prevalence of CL 0.01164%, using an online calculator Raosoft through consecutive sampling technique.

Inclusion Criteria
All diagnosed patients of cutaneous leishmaniasis of district D.I. Khan were eligible for inclusion in this study. The diagnosis was confirmed by isolation of LD bodies from skin lesions.

Exclusion Criteria
No subject was excluded.

2.3 Conduct of Procedure: DHO office, D.I.Khan maintains the record of cutaneous leishmaniasis. The data for cutaneous leishmaniasis was retrieved from this office in Excel spreadsheet for the duration of 1-1-2020 to 31-12-2020.

2.4 Data Collection Plan
Sex (men and women), age groups (up to 19 years, 20-39 years & ≥40 years) and residence (urban and rural) were our three nominal variables.

2.5 Data Analysis Plan
2.5.1 Descriptive Statistics and Estimation of Parameters: Sample’s distribution was described by count and percentage. Population distribution was described by 95% CI using normal approximation method through an online statistical calculator “Statistics Kingdom”. The comparison between the attributes/groups/cATEGORIES was based on overlapping of confidence intervals in results and also in discussion.

2.5.2 Hypotheses Testing: Adjusted expected counts and percentages for distribution by sex, age groups and residence were calculated. Three hypotheses (H₀₁ to H₀₃) for distribution of CL by sex, age groups and residence were verified each by chi-square goodness-of-fit test. Observed & expected counts and their difference, with chi-square value, degree of freedom and p-value were shown at alpha .05 by an online statistical calculator.¹³

3. RESULTS
3.1 Descriptive Analysis & Estimation of Parameters
3.1.1 Distribution of positive cases of cutaneous leishmaniasis by sex, age groups and residence
The distribution of positive cases of CL by sex, age groups and residence in cutaneous leishmaniasis population of District D.I.Khan is shown in Table 3.1.1. Out of 419 positive CL cases, 269 (64.20%) were men and 150 (35.80%) women, and 254 (60.62%) were in age group up to 19 years, 101 (24.11%) in age group 20-39 years and 64 (15.27%) in age group ≥40 years, and 133 (26.97%) were urban and 306 (73.03%) were rural. Here the prevalence of cutaneous leishmaniasis in sample was higher in men (64.20%, 95% CI 59.61-68.79) than women (35.80%, 95% CI 31.21-40.39), and higher in age group up to 19 years (60.62%, 95% CI 55.94-65.30) than age group 20-39 years (24.11%) and age group ≥40 years (15.27%, 95% CI 11.83-18.72), and higher in rural (73.03%, 95% CI 68.78-77.28) than urban (26.97%, 95% CI 22.72-31.22).

3.2 Hypotheses Testing
3.2.1 Observed vs. expected distribution of positive cases of cutaneous leishmaniasis by sex (H₀₁)
Our observed distribution for men versus women was 269:150 out of 419 positive cases of CL against expected distribution of 5,605:4,026 out of 9,631 positive cases of CL from study by Ullah, et al. Having different sample sizes/denominators, comparison was not justified. Then we adjusted the expected counts & percentages for a sample of 419. The expected counts of 5,605:4,026 were replaced by

| Variables | Attributes | Sample statistics | 95% CI for proportion |
|-----------|------------|-------------------|-----------------------|
|           |            | Count | Percentage | Lower | Upper |
| Sex       | Men        | 269   | 64.20%      | 59.61 | 68.79 |
|           | Women      | 150   | 35.80%      | 31.21 | 40.39 |
| Age groups| Up to 19 years | 254   | 60.62%      | 55.94 | 65.30 |
|           | 20-39 years | 101   | 24.11%      | 20.01 | 28.20 |
|           | ≥40 years  | 64    | 15.27%      | 11.83 | 18.72 |
| Residence | Urban      | 113   | 26.97%      | 22.72 | 31.22 |
|           | Rural      | 306   | 73.03%      | 68.78 | 77.28 |

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adjusted expected counts of 244:175 and adjusted percentages were similar as the expected percentages. (Table 3.2.1.1)

Chi-square goodness-of-fit test gave p-value less than .05. Hence $H_{01}$ was rejected, showing that the observed distribution did not match the expected distribution. Simply, our observed distribution of CL in men 64.20% was statistically higher than what we expected (adjusted expected) for men 58.20% & our observed distribution in women 41.80% was less than what we expected (adjusted expected) for women 41.80% from Ullah, et al. 15 (Table 3.2.1.2)

3.2.2 Observed vs. expected distribution of positive cases of cutaneous leishmaniasis by age groups ($H_{02}$)

Our observed distribution for age group up to 19 years versus 20-39 years and ≥40 years was 254:101:64 out of 419 positive cases against expected distribution of 48:33:21 in age group of up to 19 years versus 20-39 years and ≥40 years out of 102 positive cases of CL as showed by Jamal, et al. 7 Having different sample sizes/ denominators, comparison was not justified. Then we adjusted the expected counts & percentages for a sample of 419. The expected counts of 48:33:21 were replaced by adjusted expected counts of 197:136:86 and expected percentages 47.05%:32.36%:20.59% were replaced by adjusted expected percentages 47.01%:32.46%:20.53% respectively. (Table 3.2.2.1)

Chi-square goodness of Fit test gave p-value less than .05. $H_{02}$ was rejected, showing that the observed distribution did not match the expected distribution. It simply means that our observed distribution of CL in age group of up to 19 years 60.62% was statistically higher than what we expected for age group of up to 19 years 47.01% (adjusted expected) and our observed distribution in age group 20-39 years

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Table 3.2.1.1 Observed, expected and adjusted expected counts and percentages for distribution of positive cases of cutaneous leishmaniasis by sex in 2020 in cutaneous leishmaniasis population of District D.I.Khan, Pakistan (n=419)

| Presence of CL       | Observed counts (O) | Observed %ages | Expected counts | Expected %ages | Adjusted expected counts (E) | Adjusted expected % |
|----------------------|---------------------|----------------|----------------|----------------|------------------------------|---------------------|
| Men                  | 269                 | 269*100/419 = 64.20% | 5,605          | 5,605*100/9,631 = 58.20% | 244*100/419 = 58.20% |
| Women                | 150                 | 150*100/419 = 35.80% | 4,026          | 4,026*100/9,631 = 41.80% | 175*100/419 = 41.80% |
| Total positive       | 419                 | 100%            | 9,631          | 100%            | 419                          | 100%                |

Table 3.2.1.2 Observed vs. expected distribution of positive cases of cutaneous leishmaniasis by sex in 2020 in cutaneous leishmaniasis population of District D.I.Khan, Pakistan ($H_{01}$) (n=419)

| Variable | Attributes | O  | E  | O-E | (O-E)^2 | (O-E)^2/E | $\chi^2$ | d.f | p-value |
|----------|------------|----|----|-----|---------|------------|----------|-----|---------|
| Sex      | Men        | 269| 244| 25  | 625     | 2.56       | 6.133    | 1   | 0.01327 |
|          | Women      | 150| 175| -25 | 625     | 3.57       | H_{01} rejected at alpha .05 |

Total 419 419 Chi-square-goodness-of-fit test with Yates correction

Table 3.2.2.1: Observed, expected and adjusted expected counts and percentages for distribution of positive cases of cutaneous leishmaniasis by age groups in 2020 in cutaneous leishmaniasis population of District D.I.Khan, Pakistan (n=419)

| Presence of CL       | Observed counts (O) | Observed %ages | Expected counts | Expected %ages | Adjusted expected counts (E) | Adjusted expected % |
|----------------------|---------------------|----------------|----------------|----------------|------------------------------|---------------------|
| Positive cases in age group up to 19 years | 254 | 254*100/419 = 60.62% | 48 | 48*100/102 = 47.05% | 48*100/102 = 47.05% | 197*100/419 = 47.01 |
| Positive cases in age group 20-39 | 101 | 101*100/419 = 24.11% | 33 | 33*100/102 = 32.36% | 33*100/102 = 32.36% | 136*100/419 = 32.46 |
| Positive cases in age group ≥40years | 64 | 64*100/419 = 15.27% | 21 | 21*100/102 = 20.59% | 21*100/102 = 20.59% | 86*100/419 = 20.53 |
| Total positive       | 419                 | 100%            | 102            | 100%           | 419                          | 100%                |
24.11% was lower than what we expected for age group 20-39 years 32.46% (adjusted expected) and our observed distribution in age group ≥40 years 15.27% was lower than what we expected for age group ≥40 years 20.53% (adjusted expected). (Table 3.2.2.2)

3.2.3 Observed vs. expected distribution of positive cases of cutaneous leishmaniasis by residence (H_03)

Our observed distribution for urban versus rural was 113:306 out of 419 positive cases against expected distribution of 38:32 in urban versus rural out of 70 positive cases of CL as reported by Omari, et al.² Having different sample sizes/ denominators, comparison was not justified. Then we adjusted the expected counts & percentages for a sample of 419. The expected counts of 38:32 were replaced by 227:192 and expected percentages of 54.29%:45.71% were replaced by adjusted expected percentages of 54.18%:45.82% respectively. (Table 3.2.3.1)

Chi-square goodness of Fit test gave p-value less than .05. H_03 was rejected, showing that the observed distribution did not match the expected distribution. It simply means that our observed distribution of CL in urban 26.97% was statistically lower than what we expected for urban 54.18% (adjusted expected) & our observed distribution in rural 73.03% was higher than what we expected for rural 45.82% (adjusted expected) (Table 3.2.3.2)

4. DISCUSSION

4.1 Distribution of positive cases of cutaneous leishmaniasis by sex (H_01)

The prevalence of CL in our study was more in men 269 (64.20%, 95% CI 59.61%-68.79%) than women 150 (35.80%, 95%CI 31.21%-40.39%) as per our confidence intervals. Similar to our study with higher prevalence in men than women was reported by Jamal, et al.⁸ from Dargai Tehsil of Malakand, Khyber Pakhtunkhwa, Pakistan reported 102 confirm cases of cutaneous leishmaniasis reported in 2013, including 72 (70.59%, 95% CI 60.75-79.20) men and 30 (29.41%, 95% CI 20.80-39.25) women and by Ullah, et al.⁹ from Peshawar, Pakistan reported 9,631 CL patients spanning from April 2011-October 2014 including 5605 (58.20%, 95%CI 57.20-59.19) men and 4026 (41.80%, 95%CI 40.81-42.80) women.

Unlike our study, there was similar prevalence of CL in men and women as reported by Ayaz, et al.⁵ from Metropolitan city of Multan, Pakistan in 2018, showing 198 positive cases of CL including 101 (51.01%,
306 (73.03%, 95% CI 68.78-77.28) than urban 113

The prevalence of CL in our study was more in rural

The prevalence of cutaneous leishmaniasis by age groups in our study was higher in age group up to 19 years (60.62%, 95% CI 55.94-65.30) than age group 20-39 years (24.11%, 95% CI 20.01-28.20) and age group ≥40 years (15.27%, 95% CI 11.83-18.72) as per our confidence intervals.

Similar to our study with highest prevalence in age group up to 19 years than age group 20-39 years and age group ≥40 years was reported by Rahim, et al.7 from village Wantangi, District Dir, Pakistan reporting 37 positive cases of CL in August 2001, including 34 (85%, 95% CI 78.09-98.30) cases in age group up to 20 years, 5 (12.5%, 95% CI 45.37-28.77) cases in age group 21-40 years and 1 (2.5%, 95% CI 25.22-79.28) case in age group above 40 years. Also similar report was by Jamal, et al.8 from Dargai Tehsil of Malakand, Khyber Pakhtunkhwa, Pakistan, with 102 cases of CL in 2013, showing 48 (47.06%, 95% CI 37.10-57.20) in age group up to 20 years, 33 (32.35%, 95% CI 23.42-42.34) in age group 21-40 years and 21 (20.59%, 95% CI 13.22-29.73 ) in age group ≥40 years.

Contrary to our findings, no study could be isolated.

The prevalence of CL by age groups in our study was higher in age group up to 19 years 254 (60.62%, 95% CI 55.94-65.30) than age group 20-39 years 101 (24.11%, 95% CI 20.01-28.20) and age group ≥40 years 64 (15.27%, 95% CI 11.83-18.72) as per our confidence intervals.

5. CONCLUSIONS

The prevalence of cutaneous leishmaniasis in year 2020 in cutaneous leishmaniasis population of District D.I.Khan, Pakistan was higher in men than women, highest in age group up to 19 years than age groups 20-39 and ≥40 years, and higher in rural than urban. The prevalence for men was higher than expected for men and prevalence for women was lower than expected for women. The prevalence for age group up to 19 years was highest than expected for this age group than age groups 20-39 and ≥40 years. The prevalence for rural was higher than expected for rural and the prevalence for urban was lower than expected for urban.

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CONFLICT OF INTEREST
Authors declare no conflict of interest.

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AUTHORS’ CONTRIBUTION
The following authors have made substantial contributions to the manuscript as under:

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Acquisition, Analysis or Interpretation of Data: MR, YR, MU, MY, MB, MJ, AK, ZK, AW, NU

Manuscript Writing & Approval: MR, YR, MU, MY, MB, MJ, HU, ZKA, AK, AU

All the authors agree to be accountable for all aspects of the work in ensuring that questions related to the accuracy or integrity of any part of the work are appropriately investigated and resolved.

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