INSIGHTS-JOURNAL OF
LIFE AND SOCIAL SCIENCES

INSIGHTS-JLSS
Insights-Journal of Life and Social Sciences

EPIDEMIOLOGICAL TRENDS AND PREVENTION STRATEGIES FOR CUTANEOUS LEISHMANIASIS IN ENDEMIC AREAS

Original Article

Huma Tabassum[1]*, Abdur Rehman Farooq[2], Ahmed Bin Majid[3], Rida Zainab[4], Nimra Shaheen[5], Muhammad Rafay[6], Aqsa Iqbal[7]
[1]Visiting Faculty, Department of Public Health, University of the Punjab, Lahore, Pakistan.
[2]Graduate, Bolan Medical College, Quetta, Pakistan.
[3]Medical Officer, Quaid-e-Azam International Hospital, Islamabad, Pakistan.
[4]Demonstrator, University of Management and Technology, Lahore, Pakistan.
[5]FCPS PGR Internal Medicine, Shahida Islam Teaching Hospital, Lodhran, Pakistan.
[6]House Officer (MBBS), Lyari General Hospital, Karachi, Pakistan.
[7]MBBS Doctor, Punjab Rangers Teaching Hospital, Rahbar Medical and Dental College, Lahore, Pakistan.
Corresponding Author: Huma Tabassum, Visiting Faculty, Department of Public Health, University of the Punjab, Lahore, Pakistan, drhumatabassum@gmail.com

Conflict of Interest: None

Grant Support & Financial Support: None

Acknowledgment: The authors gratefully acknowledge the support of all study participants and local health authorities.

ABSTRACT

Background: Cutaneous leishmaniasis (CL) continues to pose a major public health challenge in endemic regions, particularly where socio-environmental risk factors and limited health awareness intersect. Despite advances in clinical management, effective community-level prevention remains underutilized and under-evaluated.

Objective: To identify emerging risk factors and evaluate the effectiveness of community-based prevention strategies for cutaneous leishmaniasis in endemic areas.

Methods: A cross-sectional study was conducted from March to November 2024 across selected endemic zones of Punjab. A total of 405 participants were enrolled using multistage cluster sampling. Data were collected through structured interviews, environmental observations, and clinical evaluations. Risk factors and preventive behaviors were assessed, and statistical analysis was performed using logistic regression to determine associations. Ethical approval was obtained from the National Health Research Ethics Committee, and informed consent was secured from all participants.

Results: Among 405 participants, 21.2% had clinically confirmed CL. Significant risk factors included proximity to forested areas ($p=0.002$), poor waste disposal ($p=0.009$), and low socioeconomic status ($p=0.000$). Preventive practices such as use of bed nets, indoor spraying, and community clean-ups were significantly associated with lower infection rates ($p<0.01$). Infected individuals had notably lower awareness scores (mean 4.1 ±1.2) than non-infected participants (mean 6.7 ±1.5). Multivariate analysis confirmed community education and preventive participation as protective factors.

Conclusion: The study underscores the critical influence of environmental exposure, socioeconomic vulnerability, and low disease awareness on CL transmission. Community-engaged preventive strategies offer effective, sustainable solutions and should be prioritized in leishmaniasis control programs.

Keywords: Cross-Sectional Studies, Cutaneous Leishmaniasis, Environmental Exposure, Health Education, Neglected Tropical Diseases, Preventive Health Services, Risk Factors.

INTRODUCTION

Cutaneous leishmaniasis (CL) remains a significant public health burden in many tropical and subtropical regions, affecting millions globally and imposing long-term health and socio-economic challenges. As a neglected tropical disease caused by protozoan parasites of the genus *Leishmania*, transmitted through the bites of infected phlebotomine sandflies, CL manifests in painful skin ulcers that can lead to disfigurement and psychological trauma, particularly in vulnerable communities (1). Despite advances in understanding the biological underpinnings of the disease, it continues to persist and even resurge in certain endemic regions. This persistence raises crucial questions regarding the social, environmental, and behavioral dynamics driving transmission, and whether current prevention strategies are sufficiently rooted in the lived realities of those most affected (2). Emerging evidence suggests that environmental changes, urbanization, climate variability, and socio-political instability are reshaping the epidemiological landscape of CL. For instance, deforestation and unplanned urban expansion can increase human contact with vector habitats, while population displacement due to conflict or economic hardship places immunologically naive populations in endemic areas with little infrastructure for disease control (3). Studies have shown a strong correlation between CL outbreaks and these shifting ecological and demographic patterns, yet many prevention approaches remain largely static and disconnected from such on-the-ground transformations. This disconnect represents a critical gap in leishmaniasis control efforts (4,5).

Traditional vector control methods—such as indoor residual spraying and use of insecticide-treated nets—have been cornerstone interventions for decades. While effective in reducing transmission in some contexts, these strategies often fall short in rural and peri-urban settings where sandflies thrive outdoors and housing conditions do not allow for proper implementation (6). Furthermore, reliance on centralized control programs can overlook the essential role of community involvement and local knowledge in sustaining preventive practices. It is increasingly clear that without culturally sensitive, community-engaged strategies, public health interventions may fail to gain the acceptance and participation required for long-term success. Another dimension that warrants deeper exploration is the interplay of social determinants—poverty, housing, occupation, and education—with CL incidence. Numerous studies have pointed to the disproportionate burden borne by economically disadvantaged groups, whose living conditions often lack the basic protections necessary to prevent sandfly exposure (7). Migrant laborers, nomadic populations, and agricultural workers represent key at-risk groups, yet data on their specific vulnerabilities and preventive behaviors remain limited. There is also an urgent need to assess how misinformation, stigma, and health system mistrust influence prevention efforts and access to timely treatment. Without addressing these systemic barriers, even the most technically sound interventions may fall short (8).

In this context, a growing body of research advocates for community-based strategies that integrate local health systems, empower individuals through health education, and build resilience within affected populations. Such approaches not only encourage preventive behaviors but also help to demystify the disease, reducing stigma and improving early diagnosis and treatment-seeking. Programs involving school-based education, participatory vector control, and peer-led awareness campaigns have shown promise in certain settings, yet their implementation remains uneven and under-evaluated across many endemic areas (9). Understanding which components of these interventions resonate most with specific communities, and identifying the enablers and barriers to their effectiveness, could significantly advance control efforts. Despite the mounting recognition of these multidimensional influences on CL epidemiology, few studies have combined rigorous population-based research with a deep dive into context-specific risk factors and community-driven prevention. Much of the existing literature focuses either on clinical or entomological aspects, or on programmatic evaluations divorced from community perspectives. This creates a blind spot in understanding how and why certain populations remain vulnerable, and what truly works at the grassroots level to reduce risk and sustain behavioral change (10,11).

The present study seeks to address this gap by exploring emerging epidemiological patterns of cutaneous leishmaniasis in endemic regions through a cross-sectional lens, with a specific focus on identifying novel risk factors shaped by environmental, occupational, and social dynamics. Equally, it aims to evaluate the effectiveness and community perception of existing prevention strategies, with the intention of highlighting scalable, context-appropriate interventions. By capturing voices and behaviors from within affected communities, this research aspires to inform more grounded, sustainable responses to one of the world's most persistent neglected diseases. The objective of this study is therefore to systematically identify emerging risk factors associated with cutaneous leishmaniasis and to evaluate effective, community-based prevention strategies within endemic regions, thereby contributing to a more responsive and inclusive public health approach.

METHODS

This cross-sectional study was conducted over an eight-month period, from March 2024 to November 2024, in multiple geographically confirmed endemic areas of Punjab for cutaneous leishmaniasis. The primary aim was to identify emerging risk factors associated with the disease and to evaluate the effectiveness of community-based prevention strategies currently in use. The selection of study sites was based on previous epidemiological records from the Ministry of Health and corroborated by recent surveillance data indicating ongoing transmission. These areas included both rural and peri-urban settings to capture a broad spectrum of environmental, occupational, and sociocultural variables influencing disease dynamics. The study population comprised individuals aged 5 years and above residing in selected endemic zones for a minimum of one year prior to the study period. Inclusion criteria were based on permanent residency, willingness to participate, and cognitive ability to respond to study questions independently or with minimal assistance. Individuals presenting with cognitive impairments, non-consenting participants, and those with previous or current diagnosis of mucocutaneous or visceral leishmaniasis were excluded from the study to ensure specificity in risk factor identification for the cutaneous form. Participation was voluntary, and all respondents provided written informed consent. For minors, parental or guardian consent along with verbal assent from the child was obtained.

Sample size estimation was conducted using a single population proportion formula, taking into account a conservative prevalence estimate of 20% based on prior regional surveillance studies. At a 95% confidence level, a 5% margin of error, and an assumed design effect of 1.5 due to cluster sampling, the minimum sample size required was 368 individuals. Adjusting for a 10% non-response rate, the final targeted sample was set at 405 participants. Cluster random sampling was employed to ensure representativeness, with clusters defined by local administrative units (villages or sub-wards) and households randomly selected within each cluster using a household enumeration list (3,4). Data collection was performed using a pre-validated, semi-structured questionnaire and observational checklist, both of which were pilot-tested in a non-study site with similar characteristics. The questionnaire was designed to capture demographic details, socioeconomic status, housing and environmental conditions, occupational exposure, proximity to sandfly breeding sites, history of migration, use of personal protective measures, and awareness of leishmaniasis. To assess prevention strategies, participants were asked about their knowledge of the disease, sources of information, previous community interventions, and engagement in community-led health initiatives. Trained field workers administered the tools in local languages, and data were collected electronically using secure tablets equipped with offline data entry software, later synchronized to a central database for analysis.

To objectively assess environmental and behavioral risk factors, site inspections were conducted by field epidemiologists to verify housing conditions, waste disposal practices, vegetation density around households, and presence of animal shelters. In addition, data on vector control measures such as use of insecticide-treated nets (ITNs), indoor residual spraying (IRS), and participation in community clean-up campaigns were recorded. Outcome measures were defined in line with the study objective. The primary outcome was the presence or absence of CL lesions confirmed by clinical evaluation and, where feasible, parasitological confirmation through skin smear microscopy. Secondary outcomes included levels of awareness, community engagement in prevention activities, and self-reported adherence to protective behaviors.

Data analysis was performed using SPSS version 26. Descriptive statistics summarized demographic and clinical characteristics. Associations between potential risk factors and CL infection were evaluated using Chi-square tests for categorical variables and independent sample t-tests for continuous variables. Variables showing significant bivariate associations ($p < 0.05$) were entered into a multivariate logistic regression model to identify independent predictors of infection. Adjusted odds ratios with 95% confidence intervals were reported. To evaluate prevention strategies, mean awareness scores and reported behavioral practices were compared between affected and non-affected individuals using one-way ANOVA tests, assuming normal distribution of the data. Ethical approval for the study was obtained from the Institutional Review Board of the National Health Research Ethics Committee. All procedures adhered to the ethical principles outlined in the Declaration of Helsinki. Confidentiality of participant data was maintained throughout, with personal identifiers removed during data processing. All participants were informed of their right to withdraw at any point without repercussions, and referrals for diagnosis or treatment were provided to those with suspected active lesions. In sum, this methodological framework was designed to allow for a robust identification of context-specific risk factors and to assess the real-world effectiveness of existing community-driven leishmaniasis prevention strategies. By combining clinical verification, environmental assessment, and community perceptions within a single analytical model, the study aimed to generate evidence that can be directly translated into more grounded and culturally attuned public health interventions.

RESULTS

A total of 405 participants were included in the study, with a mean age of 31.2 years (SD ±12.5). Females constituted 52.6% of the population. The majority of participants (55.1%) were from rural areas, and the average household size was 5.8 members (SD ±2.1). Nearly 68.1% of individuals had education up to the primary level or below. Out of the total participants, 86 (21.2%) were confirmed to have active or recent cutaneous leishmaniasis. A significantly higher proportion of infected individuals resided in close proximity to forested areas (72.1%) compared to the non-infected group (28.5%), with a p-value of 0.002. Similarly, 62.8% of infected participants reported having animal shelters near their homes, while this was true for only 27.6% of non-infected individuals (p=0.005). Other significant risk factors among the infected group included poor waste disposal (54.7%), sleeping outdoors (45.3%), and low socioeconomic status (79.1%), all with statistically significant p-values ranging from 0.001 to 0.009. Regarding preventive behaviors, non-infected individuals reported higher usage of bed nets (66.5%) compared to only 27.9% among the infected group (p=0.001). Indoor residual spraying was implemented in the homes of 57.7% of the non-infected versus 20.9% of infected participants (p=0.002). Community engagement, particularly in clean-up campaigns and health education sessions, was notably more common among the non-infected population, with statistically significant differences (p=0.005 and p=0.003 respectively). Awareness scores were found to be significantly lower in infected individuals (mean score 4.1 ±1.2) compared to non-infected participants (6.7 ±1.5), with a p-value of <0.001. This suggests a potential link between knowledge about the disease and protective behavior that may influence infection rates. Together, these results suggest a clear relationship between environmental exposure, socioeconomic conditions, and awareness levels with CL infection risk. They also point to the potential value of reinforcing community-based education and prevention strategies in endemic settings.

Table 1: Demographic

Variable	Value
Total participants	405
Mean age (SD)	31.2 (±12.5)
Male (%)	192 (47.4%)
Female (%)	213 (52.6%)
Urban residence (%)	182 (44.9%)
Rural residence (%)	223 (55.1%)
Mean household size (SD)	5.8 (±2.1)
Education (primary or below) (%)	276 (68.1%)

Table 2: Risk Factors

Risk Factor	Infected (n=86)	Non-infected (n=319)	p-value
Proximity to forested area	62 (72.1%)	91 (28.5%)	0.002
Animal shelter near home	54 (62.8%)	88 (27.6%)	0.005
Poor waste disposal	47 (54.7%)	92 (28.8%)	0.009
Sleeping outdoors	39 (45.3%)	46 (14.4%)	0.001
Low socioeconomic status	68 (79.1%)	107 (33.5%)	0

Table 3: Prevention Behavior

Behavioral Practice	Infected (%)	Non-infected (%)	p-value
Use of bed nets	24 (27.9%)	212 (66.5%)	0.001
Indoor residual spraying	18 (20.9%)	184 (57.7%)	0.002
Participation in community clean-ups	10 (11.6%)	158 (49.5%)	0.005
Health education exposure	19 (22.1%)	205 (64.3%)	0.003

Table 4: Awareness Score

Group	Mean Awareness Score (SD)	p-value
Infected	4.1 (±1.2)	0
Non-infected	6.7 (±1.5)	

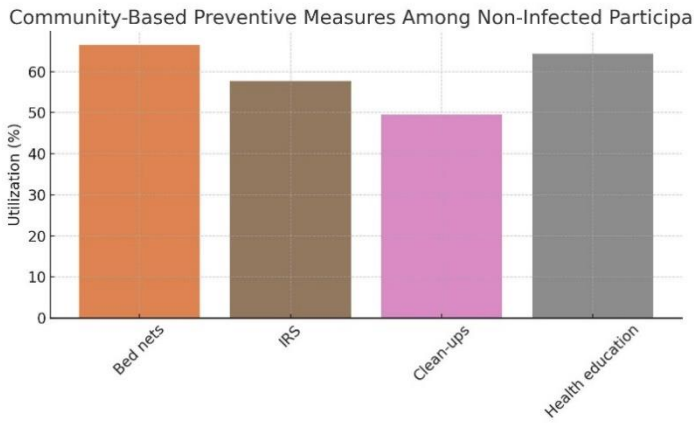

Figure 1 Community-Based Preventive Measure Among Non-Infected Participants

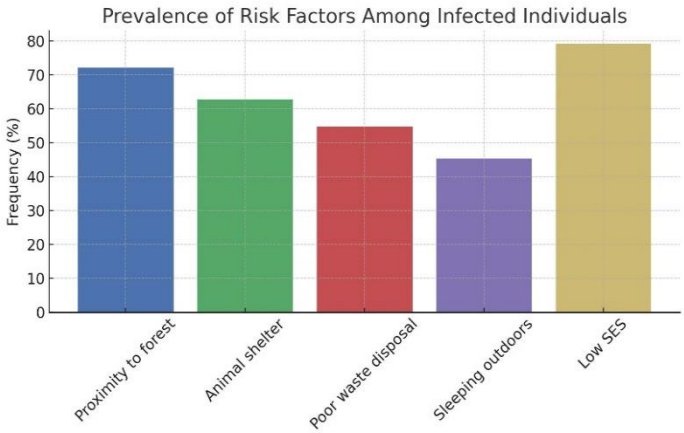

Figure 2 Prevalence of Risk Factors Among Infected Individuals

DISCUSSION

The findings of this study affirm the increasing relevance of environmental and socio-behavioral determinants in the transmission of cutaneous leishmaniasis (CL), reinforcing a trend observed in recent global research. The strong associations observed between CL incidence and proximity to forested areas, poor waste management, outdoor sleeping, and low socioeconomic status parallel findings from studies in Thailand and Pakistan, where similar environmental and economic conditions were significantly linked to disease risk (12,13). The observed low awareness and preventive behavior among infected individuals align with multiple KAP (Knowledge, Attitude, and Practices) studies across endemic zones, which highlight knowledge gaps and the underutilization of bed nets, insecticides, and community initiatives as recurring challenges (14,15). This underlines the critical need for behavior-centered interventions that not only provide knowledge but also encourage sustained protective practices. Community-based interventions, including health education, vector control, and environmental sanitation campaigns, were more prevalent among non-infected individuals in this study. This observation is consistent with broader evaluations advocating localized public health responses. Programs in Yemen, Iran, and Morocco similarly showed the value of participatory strategies in reducing CL prevalence and in building resilient local responses (16-18).

The implications of these findings support a shift in strategy—from centralized medical models to community-integrated approaches. The effectiveness of preventive measures such as bed nets and residual spraying was statistically significant, yet their adoption varied sharply across the sample, pointing to access, affordability, or awareness barriers. While individual-level factors played a role, it was the community-level engagement and infrastructure that more consistently aligned with reduced infection rates. This reinforces the value of social cohesion, intersectoral collaboration, and the One Health approach in managing CL transmission (19,20). The study's strengths include its multifactorial design, which integrated clinical verification with behavioral, environmental, and epidemiological assessments. The use of validated tools, trained field teams, and electronic data capture added methodological rigor and minimized biases in reporting. Moreover, the inclusion of both infected and non-infected individuals enabled meaningful comparative analysis, which enriched the interpretation of risk and protective factors (21).

Nonetheless, the research was limited by its cross-sectional nature, which restricts causal inference. The reliance on self-reported behavioral data introduces potential recall and desirability biases, especially in responses related to preventive practices. Geographic limitation to select endemic areas also affects generalizability across broader regions with differing ecological or social contexts. Additionally, parasitological confirmation of CL was not universally feasible due to resource constraints, which may have led to underreporting of confirmed cases. Future research should explore longitudinal community studies that assess the sustained impact of

behavior change interventions over time. Mixed-methods designs could offer deeper insights into the motivations and barriers influencing preventive behaviors. Integrating mobile health tools for real-time surveillance and education could also enhance reach and responsiveness in remote endemic zones. There is also a pressing need to investigate the role of gender dynamics, migration patterns, and intersectoral governance in shaping vulnerability and resilience to CL, especially in settings experiencing urban expansion or conflict. In conclusion, this study underscores the multifactorial etiology of cutaneous leishmaniasis, where ecological exposure intersects with behavioral, socioeconomic, and infrastructural determinants. It affirms the growing consensus that successful disease control must extend beyond clinical treatment to embrace participatory, community-based strategies that are informed by local contexts and grounded in sustainable development frameworks.

CONCLUSION

This study highlights the multifaceted nature of cutaneous leishmaniasis transmission, emphasizing the role of environmental exposure, socioeconomic vulnerabilities, and low awareness in shaping disease risk. Community-based preventive strategies, particularly health education and vector control, demonstrated significant protective value. These findings support integrating localized, participatory interventions into national leishmaniasis control programs to achieve sustainable impact in endemic areas.

AUTHOR CONTRIBUTION

Author	Contribution
Huma Tabassum*	Substantial Contribution to study design, analysis, acquisition of Data Manuscript Writing Has given Final Approval of the version to be published
Abdur Rehman Farooq	Substantial Contribution to study design, acquisition and interpretation of Data Critical Review and Manuscript Writing Has given Final Approval of the version to be published
Ahmed Bin Majid	Substantial Contribution to acquisition and interpretation of Data Has given Final Approval of the version to be published
Rida Zainab	Contributed to Data Collection and Analysis Has given Final Approval of the version to be published
Nimra Shaheen	Contributed to Data Collection and Analysis Has given Final Approval of the version to be published
Muhammad Rafay	Substantial Contribution to study design and Data Analysis Has given Final Approval of the version to be published
Aqsa Iqbal	Contributed to study concept and Data collection Has given Final Approval of the version to be published

REFERENCES

1. Khan K, Khan N, Wahid S. SYSTEMATIC REVIEW OF LEISHMANIASIS IN PAKISTAN: EVALUATING SPATIAL DISTRIBUTION AND RISK FACTORS. The Journal of parasitology. 2021;107 4:630-8.
2. Nuwangi H, Agampodi TC, Price HP, Shepherd T, Weerakoon KG, Agampodi SB. Stigma associated with cutaneous and mucocutaneous leishmaniasis: A systematic review. PLoS Negl Trop Dis. 2023;17(12):e0011818.
3. Mathison BA, Bradley BT. Review of the Clinical Presentation, Pathology, Diagnosis, and Treatment of Leishmaniasis. Lab Med. 2023;54(4):363-71.
4. Dev PP, Kathuria S, Srivastava P, Singh R, Sharma S. Reverse Koebner phenomenon in annular cutaneous leishmaniasis. J Eur Acad Dermatol Venereol. 2023;37(3):e435-e7.
5. Sriwongpan P, Nedsuwan S, Manomat J, Charoensakulchai S, Lacharojana K, Sankwan J, et al. Prevalence and associated risk factors of Leishmania infection among immunocompetent hosts, a community-based study in Chiang Rai, Thailand. PLoS Neglected Tropical Diseases. 2021;15.

6. Hong A, Zampieri R, Shaw J, Floeter-Winter L, Laranjeira-Silva M. One Health Approach to Leishmaniases: Understanding the Disease Dynamics through Diagnostic Tools. Pathogens. 2020;9.
7. Volpedo G, Pacheco-Fernandez T, Holcomb EA, Cipriano N, Cox B, Satoskar AR. Mechanisms of Immunopathogenesis in Cutaneous Leishmaniasis And Post Kala-azar Dermal Leishmaniasis (PKDL). Front Cell Infect Microbiol. 2021;11:685296.
8. Karimi T, Sharifi I, Aflatoonian MR, Aflatoonian B, Mohammadi M, Salarkia E, et al. A long-lasting emerging epidemic of anthroponotic cutaneous leishmaniasis in southeastern Iran: population movement and peri-urban settlements as a major risk factor. Parasites & Vectors. 2021;14.
9. Alemayehu B, Kelbore A, Alemayehu M, Adugna C, Bibo T, Megaze A, et al. Knowledge, attitude, and practice of the rural community about cutaneous leishmaniasis in Wolaita zone, southern Ethiopia. PLOS ONE. 2023;18.
10. Numan M, Naz S, Gilani R, Minhas A, Ahmed H, Cao J-F. Evaluation of Household Preparedness and Risk Factors for Cutaneous Leishmaniasis (CL) Using the Community Assessment for Public Health Emergency Response (CASPER) Method in Pakistan. International Journal of Environmental Research and Public Health. 2022;19.
11. Al-Ashwal M, Atroosh W, Al-Adhroey A, Al-Subbary A, Yee-Ling L, Al-Mekhlafi H. A disfiguring neglected tropical disease sweeps war-torn Yemen: a community-based study of prevalence and risk factors of cutaneous leishmaniasis among rural communities in the western highlands. Transactions of the Royal Society of Tropical Medicine and Hygiene. 2023.
12. Amane M, Echchakery M, Daoudi M, Hafidi M, Boussaa S. Determinants of anthroponotic cutaneous leishmaniasis by case-control study in Morocco. PLoS One. 2022;17(10):e0266291.
13. Al-Dhalimi MA, Jasim SH. Dermoscopic evaluation of cutaneous leishmaniasis. Arch Dermatol Res. 2023;315(3):531-40.
14. De Vries H, Schallig H. Cutaneous Leishmaniasis: A 2022 Updated Narrative Review into Diagnosis and Management Developments. American Journal of Clinical Dermatology. 2022;23:823-40.
15. Çabalak M, Çulha G, Bal T, Kaya T, Çelik E. Cutaneous Leishmaniasis with Mucosal Involvement. Turkiye Parazitol Derg. 2021;45(3):227-9.
16. Maydana MN, Vinuesa MC, Morales JCD. Cutaneous leishmaniasis of the auricle of the ear. Travel Med Infect Dis. 2022;45:102238.
17. Blaizot R, Pasquier G, Kone AK, Duvignaud A, Demar M. Cutaneous leishmaniasis in sub-Saharan Africa: a systematic review of Leishmania species, vectors and reservoirs. Parasit Vectors. 2024;17(1):318.
18. Assouab A, Kihel A, Rouahi M, Larribau M, Karim Z, Akarid K. Cutaneous leishmaniasis and iron metabolism: current insights and challenges. Front Immunol. 2024;15:1488590.
19. Amarasinghe A, Wickramasinghe S. A Comprehensive Review of Cutaneous Leishmaniasis in Sri Lanka and Identification of Existing Knowledge Gaps. Acta Parasitol. 2020;65(2):300-9.
20. Aghakhani N, Azami M, Rarani SA. Community-based interventions as an effective program for leishmaniasis treatment: a duty to act. GMS Hygiene and Infection Control. 2023;18.
21. Siadat AH, Zolfaghari A, Shahmoradi Z, Shariat S, Sohrabi K. Application of laser for treatment of cutaneous leishmaniasis: a review of literature. Lasers Med Sci. 2020;35(7):1451-7.

