Original Article https://doi.org/10.70084/mru/pmrcc/042.P22

Assessment of Knowledge and Awareness of Leishmaniasis Among Medical Students at the University of Kordofan

Randa Fadlallah Khaleel Hamoudah[1], Abubakar Alsiddig Habiballa[1], Nancy Aseel Mohammed Ahmed[1], Salahaldeen Ali Aldoma[1], Ahmed Widaa Ahmed Elteyb[1], Eman Abdelmutalab Omer[1], Malaz Mualla Abu Al-Noor[1], Amal Khalil Yousif Mohammed[2,3], Eldisugi Hassan Mohammed Humida [2,4,5,6]

Affiliations

[1]Department of Community Medicine, Faculty of Medicine, University of Kordofan, El-Obeid, Sudan. [2]Department of Medicine, Faculty of Medicine, University of Kordofan, El-Obeid, Sudan. [3]Aldaman International Hospital, El-Obeid, Sudan. [4]EL-Obeid Teaching Hospital, El-Obeid, Sudan. [5]Cardiac Catheterization Laboratory, EL-Obeid International Hospital, El-Obeid, Sudan. [6]Prof Medical Research Consultancy Center (MRCC), El-Obeid, Sudan.

Correspondence to: Eldisugi Hassan Mohammed Humida, Email: heldisugi@gmail.com

Cite: *Hamoudah*, et al Assessment of Knowledge and Awareness of Leishmaniasis Among Medical Students at the University of Kordofan. Medical Research Updates Journal 2026;4(2):21-32. https://doi.org/10.70084/mru/pmrcc/042.P22

ABSTRACT

Background: Leishmaniasis is among the most neglected tropical diseases. More than 90 countries are afflicted by this critical public health concern, predominantly impacting poor nations. Since it was first reported as endemic in Sudan, it still represents a public health concern. The purpose of this study was to evaluate the knowledge and awareness of medical students at the University of Kordofan towards the disease. **Methodology:** This study was a cross-sectional descriptive community-based investigation conducted at the Faculty of Medicine, University of Kordofan, in El-Obeid City, North Kordofan, Sudan, during the period from January 2026 to March 2026. **Results:** We included 323 participants in this study, aged 18-27 years, all of whom were medical students at the University of Kordofan. Males constitute 107/323 (33%), while 216/323 (67%) were females. Regarding the academic level of the participants in this investigation, the majority were at the initial university level, followed by the fourth year and sixth year, with proportions of 154/323 (47.67%), 26.9%, and 13%, respectively. Most of the candidates (63%) were unaware of leishmaniasis, of whom 48% were at an initial university level. About 42% of the participants were unaware of the types of leishmaniasis in Sudan; 77% of them belonged to the initial university level. Many subjects identified funding and the lack of awareness campaigns as the primary factors contributing to their insufficient knowledge and awareness of the disease. **Conclusion:** The awareness and knowledge levels of medical students at Kordofan University are generally low, with the most significant gaps observed among students at the initial university level. This investigation considers funding and the availability of awareness campaigns as crucial factors for improving knowledge and awareness about leishmaniasis.

Keywords: Leishmaniasis, Awareness, Medical students, Sudan, Kordofan

Introduction

Leishmaniasis is considered among the most common neglected tropical diseases globally. The disease is a major public health issue worldwide, with a predilection towards poor nations in over 90 countries. Low- and middle-income nations encountered the serious outcomes of the disease, where both the morbidity and mortality were higher than in developed countries. It is estimated to have 700,000 to 1 million new cases annually by the World Health Organization (WHO), with another

over 350 million persons at risk of the disease [1]. The protozoan parasite of the genus Leishmania causes the disease, which presents in three major forms: cutaneous, mucocutaneous, and visceral leishmaniasis. These forms are considered the most serious and pose a high burden to the health system and the community in endemic regions, particularly due to their potential to cause severe complications and long-term health issues if left untreated. The disease is a vector-borne disease that is transmitted through the bite of the infected sandfly of the genus Phlebotomus [2]. Multiple continents in tropical climates, including Africa, America, Asia, and Europe, are the primary habitats of the vector. The parasite replicates intracellularly in humans and manifests classically as visceral or cutaneous disease. The host's immune status is an important determinant of the manifestations and clinical forms of the disease, so co-infection with the human immunodeficiency virus (HIV) might lead to emerging cutaneous lesions like post-kala-azar dermal leishmaniasis (PKDL), an entity that is commonly linked to co-infection of visceral leishmaniasis with HIV [3–8].

Leishmaniasis is an endemic disease in Sudan, and reports indicate an increasing spread of the disease, besides numerous other neglected tropical diseases (NTDs). Several factors contributed to the spread of these NTDs since the explosion of the Sudan 2023-armed conflict, including the collapse in the country's health system [9]. Data regarding the assessment of awareness of leishmaniasis in Sudan is limited, so the purpose of the current study was to evaluate the knowledge and awareness of the medical students at the University of Kordofan towards this disease.

Materials and Methods

This study was a cross-sectional descriptive study conducted at the Faculty of Medicine, University of Kordofan, in El-Obeid city, North Kordofan, Sudan, spanning from January 2026 to March 2026. Medical students at the University of Kordofan were selected randomly, regardless of their study class or level, or any other demographic characteristics. Non-medical students and medical students from other universities were excluded. A purposeful self-administered questionnaire was designed and used for collecting the data.

Statistical analysis

We collected the data via a well-structured questionnaire, and we organized the data in a datasheet before entering them into the statistical software package for social science (SPSS), version 31, Chicago, USA. Frequencies, percentages, and cross-tabulations were computed.

Results

This study included 323 participants aged 18-27 years. Males constituted 107/323 (33%), while 216/323 (67%) were females. Regarding the participants' academic levels, most were at the initial education level, followed by those in the fourth and sixth years, which accounted for 154/323 (47.67%), 26.9%, and 13%, respectively. The majority of the study participants considered lectures to be the most suitable source of information about the disease, followed by the internet at 124/323 (38.4%) and 74/323(22.9%), respectively, while 28.4% were unaware of any suitable source for disease information. Most participants, 295/323 (91%), report living in an area not endemic with the disease, while the remaining 11% living in an endemic region with leishmaniasis. As indicated in Table 1, Fig. 1, most of the individuals in this survey, 205/323 (63%), reported ignorance about the disease and its consequences, while the remaining 37% reported familiarity with it and its complications.

Table 1: Distribution of the study participants based on their sex, academic level, and source of the disease information

Variable	Males n =107	Females n =216	Total n =323
Academic level			
Basic level	48	106	154
Fourth year	24	63	87
Fifth	16	24	40
Sixth	19	23	42
Total	107	216	323
Source of disease information			
Lectures	46	78	124
Internet	20	54	74
Colleges	8	25	33
Not heard	33	59	92
Total	107	216	323
Do you live in endemic region			
Yes	12	16	28
No	95	200	295
Total	107	216	323
Have you heard about the disease			
Yes	39	79	118
No	68	137	205
Total	107	216	323

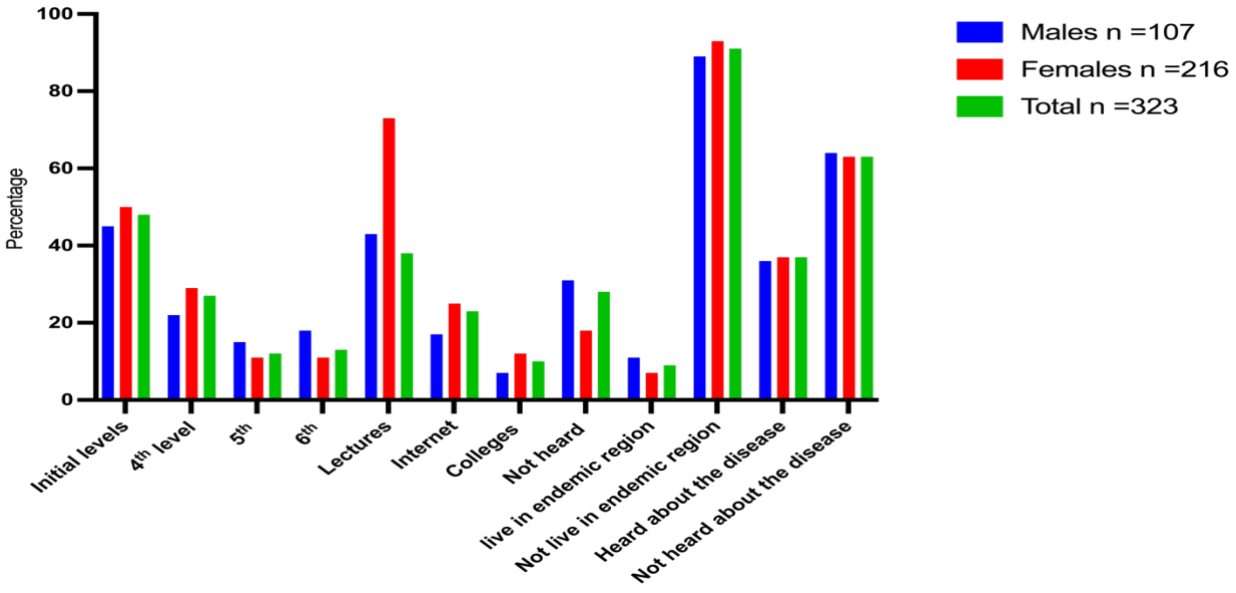

Figure 1: Description of the study participants based on their sex, academic level, and source of the disease information.

Most of the candidates, 135/323 (42%), were ignorant about the types of leishmaniases in Sudan; most of them, 104/135 (77%), belong to the initial university level, followed by the fourth year at 21%. Moreover, 98/323 (30%) reported visceral leishmaniasis as the most common form of the disease in Sudan, while 24% reported cutaneous leishmaniasis. Many of the participants, 208/323 (64%), did not study the disease, and the remaining 115/323 (36%) reported studying it, of whom 38% studied it in their fourth year. As indicated in Table 2 and Fig. 2, most participants, 259/323 (80%), expressed interest in acquiring information about the disease.

Table 2: shows the distribution of the students by university level and knowledge about the disease.

Variable	**Initial levels**	**4rth level**	**5th**	**6th**	**Total**
What is most common type of leishmaniasis					
Cutaneous	25	22	15	17	79
Visceral	21	34	19	24	98
Mucocutaneous	4	2	5	0	11
Don't know	104	29	1	1	135
Total	154	87	40	42	323
Heard of the disease					
NO	89	25	3	1	118
Yes	65	62	37	41	205
Total	154	87	40	42	323
Studied the disease					
Yes	5	44	38	28	115
No	149	43	2	14	208
Total	154	87	40	42	323
Interested to Know about the disease					
Yes	114	75	34	36	259
No	40	12	6	6	64
Total	154	87	40	42	323

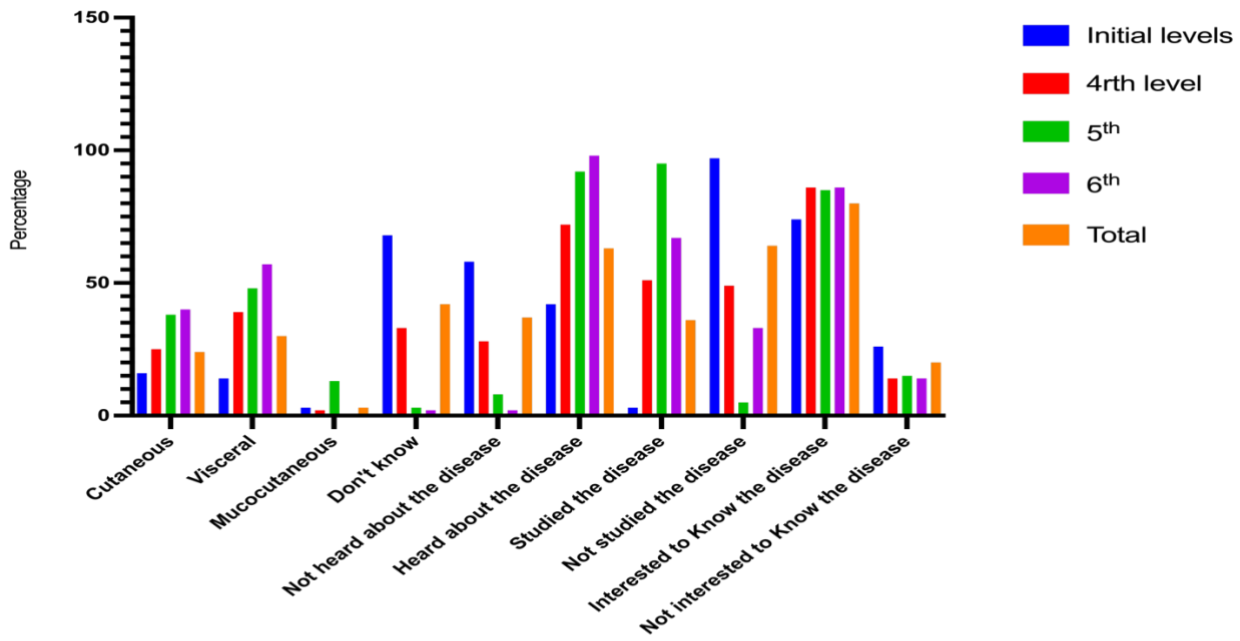

Figure 2: delineates the study population based on the academic level and participants' knowledge of the disease, as well as their eagerness to learn about it.

Concerning disease prevention, most participants were unfamiliar with the preventive measures (192/323, 59%); most of these individuals (124/192, 64.5%) possessed initial university levels, whereas the remaining 41% were knowledgeable with the preventative approaches. About 42 out of 131 students (32%) were in their fourth year, while 24.4% are in their fifth year. Most of the participants, 262 out of 323 (81%), indicate insufficient familiarity with clinical situations; the majority are at the initial university levels, followed by 4th level and 5th level, with incidence rates of 54.96%, 27.5%, and 12%, respectively. Many participants, 219 out of 323 (67.8%), deemed financing crucial for raising knowledge of the condition and its repercussions; most of them were at initial university levels, totalling 89 out of 219 (40.6%), followed by those in their fourth year at 31%, as indicated in Table 3 and Fig. 3.

Table 3: delineates the allocation of academic levels, preventive strategies, clinical situations, and financial support.

Variable	initial levels	4th level	5th	6th	Total
Preventions methods					
Familiar with preventions methods	30	42	32	27	131
Not familiar with preventions methods	124	45	8	15	192
Total	154	87	40	42	323
Cases of leishmaniasis					
Encounter cases of leishmaniasis	10	15	8	28	61
Not encounter cases of leishmaniasis	144	72	32	14	262
Total	154	87	40	42	323
Lack of funding					
affects awareness	89	68	30	32	219
Not affects awareness	65	19	10	10	104
Total	154	87	40	42	323

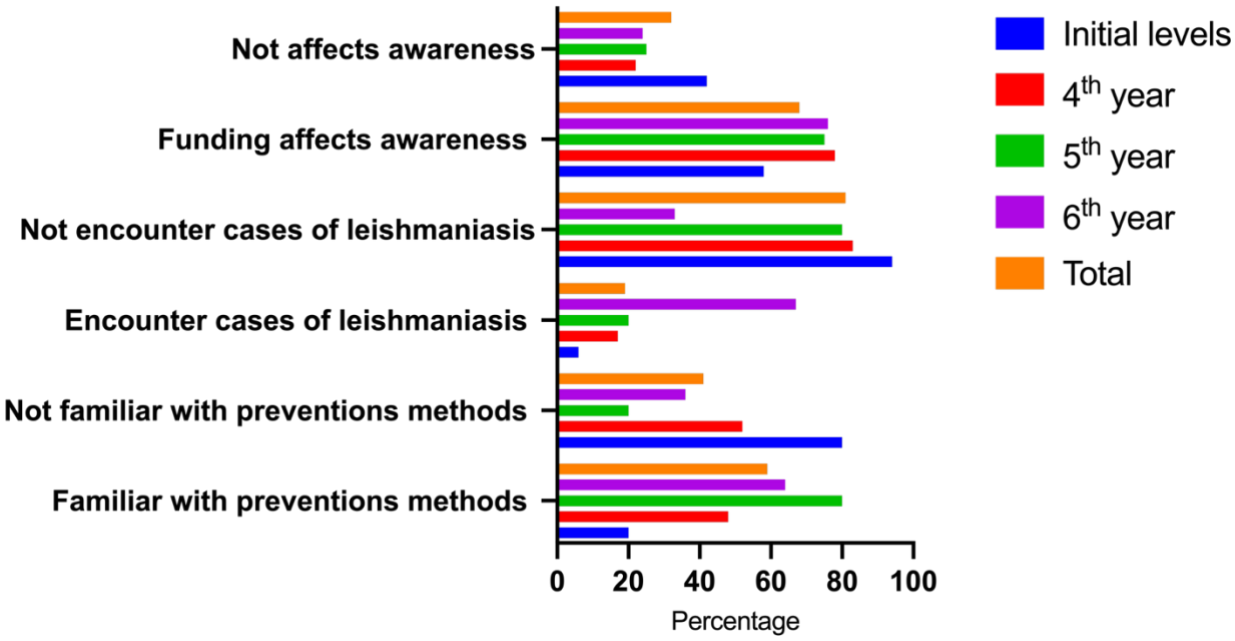

Figure 3: illustrates the distribution of academic level, prevention methods, clinical cases, and funding.

In this series, most candidates, 164 out of 323 (50.7%), identified leishmaniasis as the most serious health problem. Most of these candidates were in their fourth year of study, followed by those at the initial levels and fifth year, represented by 55 out of 164 (33.5%), 29.87%, and 19.5%, respectively. A significant portion of participants, 121 out of 323 (37.5%),

found the faculty curriculum to be unsatisfactory, while 113 out of 323 (34.9%) expressed uncertainty about it.

When it comes to the methods of leishmaniasis transmission, most participants reported sandfly transmission as the primary mode, followed by human-to-human transmission & contaminated water, with frequencies of 213 out of 323 (65.9%), 18.5%, and 15.5%, respectively. In terms of disease etiology, the organism most frequently identified was protozoa, reported by 174 out of 323 (53.86%) of participants, with the majority, 58 out of 174 (33%), being in their fourth year. The second most common cause was a lack of knowledge about the organism at 32.5% (with 86 out of 105, or 82%, of those in the basic level of education) and bacteria at 7.7%. This information is summarized in Table 4 and Figure 4.

Table 4: Population descriptions based on academic level and information regarding leishmaniasis.

Variable	Initial levels	4th level	5th	6th	Total
Major health problem					
Is a major health problem	49	55	32	28	164
Is not a major health problem	68	27	8	12	115
Not sure	37	5	0	2	44
Total	154	87	40	42	323
Curriculum					
Satisfying	17	29	17	26	89
Not satisfying	63	27	17	14	121
Not sure	74	31	6	2	113
Total	154	87	40	42	323
What is the mode of transmission					
Sandfly bite	76	65	39	33	213
Contaminated water	29	15	1	5	50
Human to human	49	7	0	4	60
Total	154	87	40	42	323
What is the etiology					
Viruses	15	3	0	1	19
Bacteria	14	7	0	4	25
Protozoa	39	58	40	37	174
Not familiar	86	19	0	0	105
Total	154	87	40	42	323

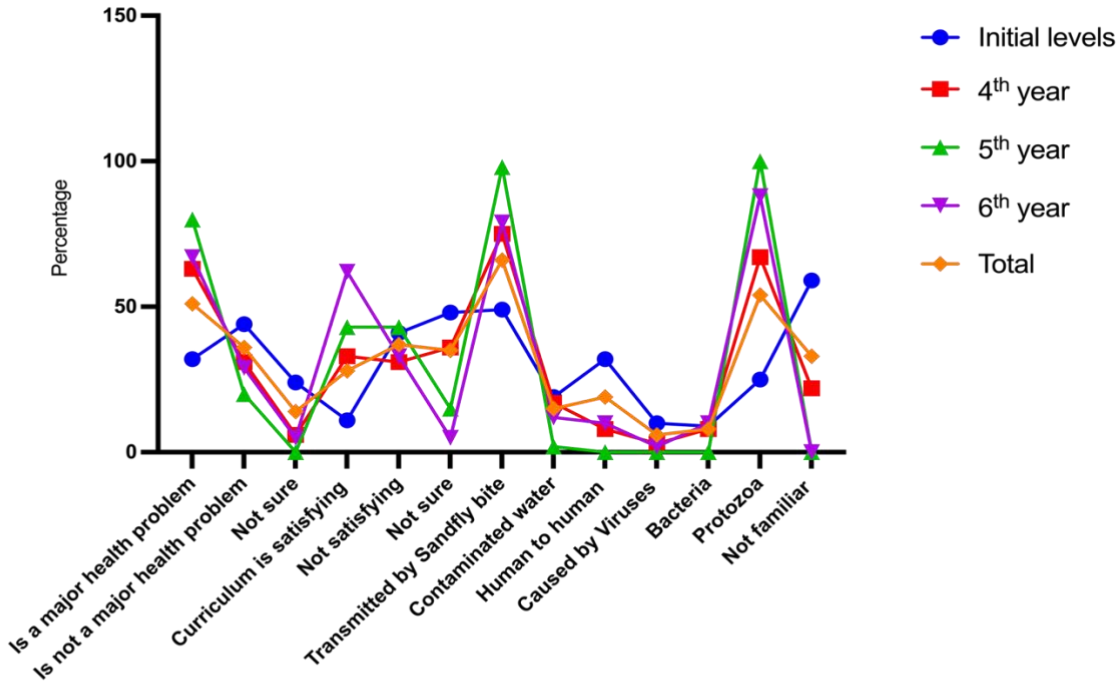

Figure 4: Description of the populations based on academic level and information about leishmaniasis

Table 5 and Fig. 5 showed that most of the participants considered lack of awareness campaigns to be the most common factor associated with low awareness about leishmaniasis, followed by inadequate training and curriculum shortage at 80/323 (24.76%), 22.6%, and 20%, respectively.

Table 5: Description of the academic level and the possible causes related to low awareness about leishmaniasis

Variable	Initial levels	4th year	5th year	6th year	Total
Possible causes of low awareness					
Inadequate curriculum	21	19	7	18	65
Inadequate training	30	16	15	12	73
Lack of awareness campaigns	39	24	10	7	80
limited literature	13	8	4	2	27
Limited research	9	4	0	1	14
Limited work shops	42	16	4	2	64
Total	154	87	40	42	323

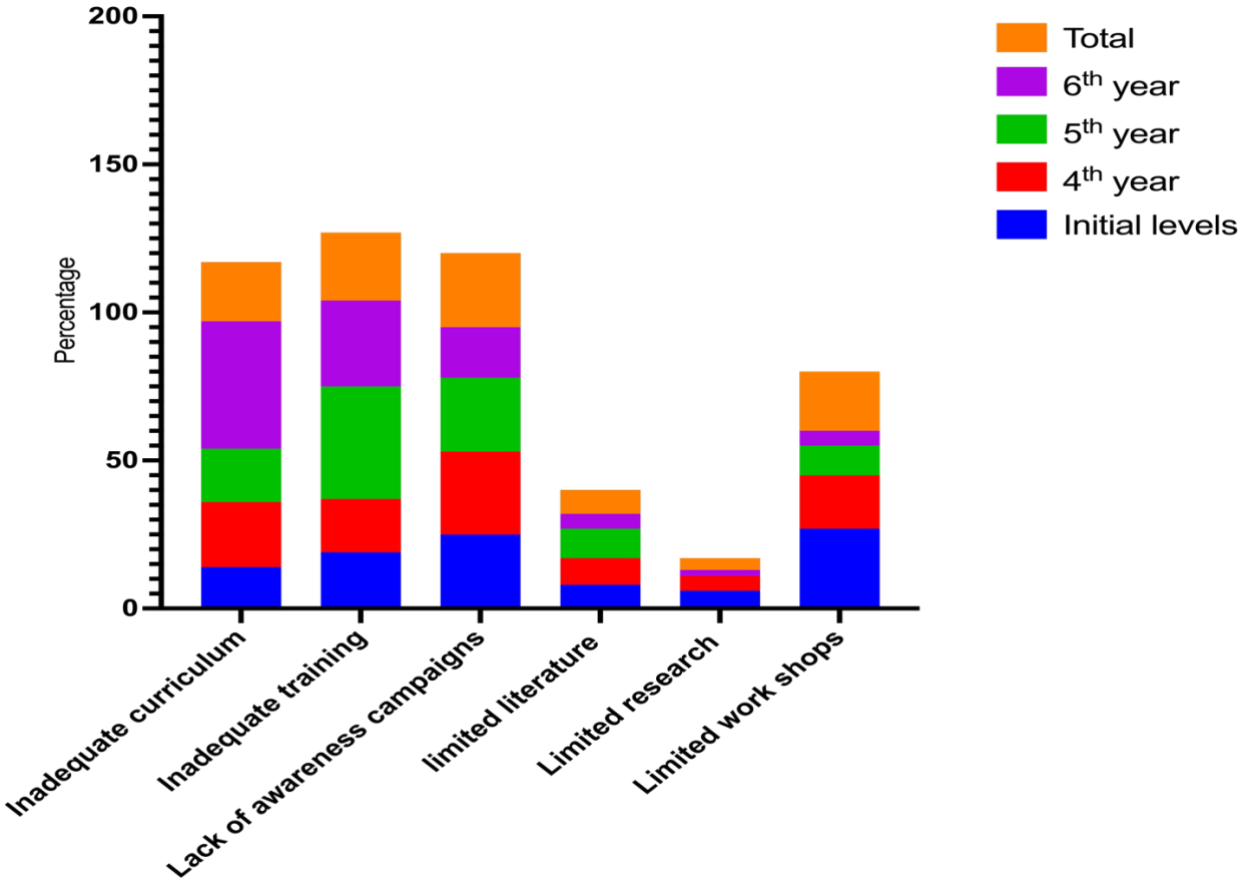

Figure 5: Depiction of the academic level and the possible causes related to unawareness of leishmaniasis

Discussion

Leishmaniasis represents a significant public health challenge, endemic to numerous areas within Sudan, thereby requiring a concerted effort among diverse humanitarian and governmental entities to alleviate the harmful impacts of this affliction. The persistent and distressing armed conflict of 2023 has significantly affected the community, especially regarding the health system's capacity for the prevention and detection of neglected tropical diseases, such as leishmaniasis. This turmoil has disrupted healthcare services and restricted access to essential resources required for effective disease management, including medications, diagnostic tools, and trained healthcare personnel necessary to combat leishmaniasis effectively. Comprehending the intricacies of disease pathophysiology, alongside the behavioral patterns of vectors, serves as the fundamental basis for mitigating the spread and transmission of the disease, which is crucial for developing effective prevention strategies and improving public health responses in conflict-affected areas. The research sought to evaluate the understanding and cognizance of Sudanese medical students regarding leishmaniasis.

In the present investigation, 63% of the participants exhibited a lack of awareness regarding leishmaniasis. The elevated percentage can be ascribed to the observation that a significant portion of participants (48%) were still at the initial university levels, representing the stage preceding the study of tropical pathology. Nonetheless, an increased awareness was observed in the later senior levels of training within this series, suggesting that as participants advanced in their educational process, their comprehension of

leishmaniasis markedly enhanced. A recent study conducted in Sudan indicates that approximately 30% of medical students lack awareness regarding neglected tropical diseases, such as leishmaniasis. Awareness among the community and healthcare workers is essential for the eradication of both visceral and cutaneous leishmaniasis. Since its identification in 1990 in Sudan, cutaneous leishmaniasis has consistently been the most widespread clinical manifestation of the disease, especially in low- and middle-income countries. At this time, there is no approved human vaccine, and the main way the immune system protects itself is through host T cells. Preventive measures are of paramount importance in understanding the natural history of the disease, particularly considering the absence of vaccines and the toxicity associated with existing therapeutic agents. These measures encompass community education, vector control, and personal protective practices aimed at minimizing transmission. Reports indicate that communication within the community plays a crucial role in preventing the spread of visceral leishmaniasis while also enhancing understanding and attitudes towards the disease [10-14].

Furthermore, 42% of the individuals involved in this study lacked awareness regarding the various forms of leishmaniasis present in Sudan. A significant majority of the participants, specifically 77%, were at the foundational level of education. Sudan bears the highest global burden of VL, with a significant prevalence of both cutaneous and visceral forms of the disease. Annually, there are between 2,000 and 7,000 new cases, accounting for 57% of the worldwide total, which ranges from 50,000 to 90,000 cases each year. The majority of these cases were documented in the rural areas of Gedaref and White Nile states. During the years 2019 and 2020, the disease resulted in the deaths of 52 and 46 individuals, respectively. The disease has persisted in Sudan since its initial documentation in 1990, with the inaugural outbreak occurring in 1976 within the Nile River states, specifically in the regions of Shendy, Atbara, and the northern areas of Khartoum.

In this series, 68% of the participants identified funding as the paramount factor contributing to the deficiency in knowledge and awareness. The advancement of a nation is fundamentally reliant on robust training and education. Insufficient funding and inadequate training will impede various facets of life, encompassing healthcare, economic growth, and social welfare. For many years, we have recognized the significance of financial support in advancing and sustaining educational initiatives. The primary objective of undergraduate medical education continues to be the cultivation of medical students who possess competencies across all disciplines, thereby addressing health needs effectively [17-19].

The predominant sentiment among the participants in the present study is that the absence of awareness campaigns is the primary factor contributing to prevailing unawareness. Awareness campaigns are pivotal in advancing the diagnosis of rare diseases and enhancing the competencies of healthcare professionals within the targeted system. The impact on the attitudes and behaviours of medical personnel during disease outbreaks was significant, as it played a crucial role in safeguarding and upholding the integrity of vulnerable health systems across numerous countries, particularly by bolstering their response capabilities and enhancing patient outcomes. The presence of these awareness campaigns offers various training tools and demonstrates the integrity and effectiveness of the training and development programs, highlighting the need for collaboration between governmental and non-governmental organizations [20-22]. This collaboration has the potential to yield more thorough training modules that cater to the distinct requirements of diverse health systems, which can include tailored strategies for disease prevention, management protocols, and resource allocation specific to each context. By ensuring that the training is customized to the particular challenges encountered by each system, it can ultimately enhance health outcomes, including the reduction of disease transmission rates and the improvement of patient care during health crises. Although the present study offers

significant insights into the understanding and awareness of leishmaniasis among undergraduates, it is important to acknowledge its limitations, particularly concerning its design and the generalizability of the findings.

In conclusion, the levels of awareness and knowledge among medical students at Kordofan University are notably deficient, particularly pronounced among those in the early stages of their studies. This inquiry examines the significance of funding and the accessibility of awareness campaigns as essential elements in enhancing understanding and consciousness regarding leishmaniasis.

Acknowledgment

The authors express their sincere appreciation to the medical students at the University of Kordofan for their invaluable participation in the study.

Ethical Approval

The Prof Medical Research Consultancy Center's Human Research Ethics Committee (HREC) has approved the study proposal. Approval #: HREC 0020/MRCC.7/25

Conflict of interest

The authors declare no conflict of interest.

Data availability

Data regarding this study are available from the corresponding author

Author contributions

All authors approved the final version of the publishable manuscript.

Hamoudah RFK: Concept and design, Acquisition, analysis, or interpretation of the data,

Drafting of the manuscript**.**

Habiballa AA: Concept and design, Acquisition, analysis, or interpretation of the data

Ahmed NAM: Acquisition, analysis, or interpretation of the data, Drafting of the manuscript.

Aldoma SA: Concept and design, Drafting of the manuscript.

Elteyb AWA: Concept and design, Acquisition, analysis, or interpretation of the data,

Drafting of the manuscript.

Omer EA: Concept and design, Acquisition, analysis, or interpretation of the data

Abu Al-Noor MM: Concept and design, Acquisition, analysis, or interpretation of the data

Mohammed AKY: Critical review of the manuscript for important intellectual content.

Humida EHM: Supervision**,** Concept and design, Drafting of the manuscript.

References

1. Li S, Qiu T, Zhao N, Liu M, He X, Wang X, Jiang S, Luo M, Wang S, Zhang L, Wang X. Global burden of leishmaniasis, 1990-2021: systematic analysis of the global burden of disease study. Int J Equity Health. 2025 Nov 25;24(1):329. doi: 10.1186/s12939-025-02691-0. PMID: 41291776; PMCID: PMC12648993.
2. Zhang SX, Yang GB, Sun JY, Li YJ, Yang J, Wang JC, Deng Y. Global, regional, and national burden of Visceral leishmaniasis, 1990-2021: findings from the global burden of disease study 2021. Parasit Vectors. 2025 Apr 26;18(1):157. doi: 10.1186/s13071-025-06796-x. PMID: 40287729; PMCID: PMC12032768.
3. Maxfield L, Crane JS. Leishmaniasis. 2023 Jun 28. In: StatPearls [Internet]. Treasure Island (FL): StatPearls Publishing; 2026 Jan–. PMID: 30285351.
4. Iniguez E, Tuluso M, Kiplagat S, Gebresilassie A, Aklilu E, Battistoni O, Ingonga J, Makwatta JM, Alamin M, Dakien O, Chebet A, Kaunda E, Huffcutt P, Doh S, Cecilio P, Bonaya G, Meneses C, Serafim TD, Pareyn M, Osman M, Khalil EAG, Osman OF, Younis BM, Dorjee S, Zhou G, Valenzuela JG, Masiga DK, Musa AM, Hailu A, Satoskar A, Kamhawi S, Matoke-Muhia D. Widespread transmission in diverse ecotypes challenges visceral leishmaniasis control in East Africa. medRxiv [Preprint]. 2025 Nov 24:2025.10.01.25337091. doi: 10.1101/2025.10.01.25337091. PMID: 41256117; PMCID: PMC12622091.
5. Zijlstra EE. Risk factors for post-kala-azar dermal leishmaniasis (PKDL): Challenges in understanding pathophysiology. PLoS Negl Trop Dis. 2026 Feb

23;20(2):e0013952. doi: 10.1371/journal.pntd.0013952. PMID: 41729910; PMCID: PMC12928490.

6. 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 Jun 8;11:685296. doi: 10.3389/fcimb.2021.685296. PMID: 34169006; PMCID: PMC8217655.
7. Elamin E, Mukhtar M, Kheir M. Visceral Leishmaniasis/HIV co-infection in Sudan: isolation of parasites from peripheral blood and documentation of 7 cases. Indian J Med Microbiol. 2025 May-Jun;55:100832. doi: 10.1016/j.ijmmb.2025.100832. Epub 2025 Apr 4. PMID: 40188878.
8. Osman OS, Hamid ME. Trends in Post-Kala-Azar Dermal Leishmaniasis in Sudan: Cases, Ethnic Distribution, and Recovery. Am J Trop Med Hyg. 2025 Mar 18;112(6):1196-1200. doi: 10.4269/ajtmh.24-0602. PMID: 40101288; PMCID: PMC12139568.
9. Alaa Abdelmonim Elsaeed Elhag, Iyas Dawood, Salma Ibrahim Mohammed Adam, Nusaiba A Y Ahmed, Rana Osman, Nayyrah Ahmed, Abdulhafiz Yaghoub Ali Abdulla, Rawa Badri, The Impact of Displacement on Skin-Related Neglected Tropical Diseases in Sudan, *Clinical and Experimental Dermatology*, 2025;, llaf392, https://doi.org/10.1093/ced/llaf392
10. Mohammed, F.E.A., Elgailani, U.S.A., Elgadi, A. et al. Knowledge, attitude and practice of medical students in Khartoum State, Sudan towards neglected tropical diseases 2023–2024 - a cross-sectional study. BMC Med Educ 25, 882 (2025). https://doi.org/10.1186/s12909-025-07558-0.
11. Positive Influence of Behavior Change Communication on Knowledge, Attitudes, and Practices for Visceral Leishmaniasis/Kala-azar inIndia.Raghavan Srinivasan, Tanwir Ahmad, Vidya R aghavan, Manisha Kaushik, Ramakant Pathak.Global Health: Science and Practice Mar 2018, 6 (1) 192-209; DOI: 10.9745/GHSP-D-17-00087.
12. de Vrij N, Pepermans E, Laurijssen L, Pham TT, Thijs L, Boonen K, Ramadan K, Maes I, Aleka Y, Kassa M, Mekonnen T, Asres MS, Woldetensay M, Hassen S, Bialfew F, Tilahun Zewdu F, Abdela SG, Domagalska MA, Cuypers B, van Henten S, van Griensven J, Meysman P, Baggerman G, Laukens K, Adriaensen W. Immunopeptidomics of cutaneous leishmaniasis patients reveals the natural antigenic landscape. Front Immunol. 2026 Feb 20;17:1765843. doi: 10.3389/fimmu.2026.1765843. PMID: 41798914; PMCID: PMC12963358.
13. Reis TC, Yagi ACL, Ramos ALD, Velásquez AMA, Coelho NCC, Graminha MAS. Surface molecules of Leishmania: From virulence determinants to therapeutic and vaccine targets. Mol Biochem Parasitol. 2025 Dec;264:111702. doi: 10.1016/j.molbiopara.2025.111702. Epub 2025 Sep 30. PMID: 41033399.
14. Community knowledge, attitudes, and practices toward cutaneous leishmaniasis in central Ethiopia
Yohannes T, Beyene G, Geltore TE, Geleta D, Mekonnen Z (2026) Community knowledge, attitudes, and practices toward cutaneous leishmaniasis in central Ethiopia. PLOS Neglected Tropical Diseases 20(1): e0013838. https://doi.org/10.1371/journal.pntd.0013838
15. Diagnostic performance of a novel point-of-care test for the diagnosis of visceral leishmaniasis in Sudan: A Comparative Accuracy Study Abass E, Mansour D, Abdalla Z, Altaher H, Sliman M, et al. (2025) Diagnostic performance of a novel point-of-care test for the diagnosis of visceral leishmaniasis in Sudan: A Comparative Accuracy Study. PLOS Neglected Tropical Diseases 19(4): e0012905. https://doi.org/10.1371/journal.pntd.0012905
16. Gumaa, S.A., Elaagip, A., Frah, E. and Abushama, H.M. (2025), An Update on the Sand Fly (Diptera: Psychodidae) in Khartoum, Sudan: Species Composition and Distribution in Areas Endemic for Cutaneous Leishmaniasis. Public Health Chall., 4: e70070. https://doi.org/10.1002/puh2.70070
17. Patel H. A Five-Year Budget Trend Analysis and Evaluation of Important Priority Areas for Education Financing in India (2020-2025. International Journal of Multidisciplinary Research and Growth Evaluation. 2026 Jan 1.
18. Npochinto Moumeni I (2026) From policy to practice: why the WHO's Africa rehabilitation strategy 2025–2035 risks failure without educational reform. Front. Med. 12:1716773. doi: 10.3389/fmed.2025.1716773
19. Hirsh DA, Ogur B, Thibault GE, Cox M. " Continuity" as an organizing principle for clinical education reform. New England Journal of Medicine. 2007 Feb 22;356(8):858.
20. Abdo AM. Health awareness campaigns and their role in promoting awareness of rare diseases. Journal of Design Sciences and Applied Arts. 2023 Jun 1;4(2):70-83.
21. Akdim K, Ez-Zetouni A, Zahid M. The influence of awareness campaigns on the spread of an infectious disease: a qualitative analysis of a fractional epidemic model. Modeling earth systems and environment. 2022 Mar;8(1):1311-9.
22. Seymour J. The impact of public health awareness campaigns on the awareness and quality of palliative care. Journal of Palliative Medicine. 2018 Jan 1;21(1_suppl):30-6