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Spatial and Temporal Distributions of Visceral Leishmaniasis (Kala-azar) in Selected Communities of Isiolo County, Kenya

Victor Mwiti Marangu [1], Prof. Eric M. Muchiri [2], Dr. Dorothy Kagendo [3]

Department of Public Health, Meru University of Science and Technology, Meru, Kenya [1,2]
Department of Medical Laboratory Sciences, Meru University of Science and Technology, Meru, Kenya [3]
Department of Nursing and Public Health, Chuka University, Chuka, Kenya [3]

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Abstract: **Visceral Leishmaniasis (VL), also known as Kala-azar is a neglected tropical disease (NTD) that is progressively emerging as a significant public health concern particularly in Kenya's arid and semi-arid lands (ASALs). There is inadequate information on the spatial distribution, burden, and prevalence of the disease. The aim of this study is to: determine spatial and temporal distributions of visceral leishmaniasis in selected communities of Isiolo County. Design: An observational study using participatory epidemiology (PE) methods was adapted. Setting: This study was conducted in two Sub-Counties of Isiolo County namely Merti and Garbatulla. The two study sites were selected on the basis of Kala-azar being identified as an important public health problem by communities living in the two areas, and recent Ministry of Health reports which indicated that the two sites had documented cases of Kala-azar. Sample: Purposive 18 study communities comprising of 433 households. Tools: Informal interviews using semi-structured questions were conducted with study participants to gather indigenous qualitative and quantitative data on the disease and its surveillance. Seasonal calendars were utilized to assess the frequency and magnitude of the disease across the two study areas. Results: Overall, 273 households (63%) reported Kala-azar cases with a total of 15 deaths resulting in a case fatality rate of 3.5%. Temporal analysis indicated that Kala-azar cases predominantly occurred during the dry seasons suggesting a seasonal variation in the disease's incidence. Conclusion: Merti and Garbatulla were identified as VL endemic clusters where communities demonstrated knowledge of VL high risk areas and recognized seasonal patterns of disease transmission. Recommendation: Understanding the VL spatial and temporal distribution in Kenya is crucial for effective control and elimination strategies.**

Keywords: **Endemic, Isiolo, Kala-azar, Kenya, Participatory Epidemiology, Seasonal Calendars, Spatial, Temporal, Visceral Leishmaniasis.**

1. INTRODUCTION

Visceral Leishmaniasis (Kala-azar) is a severe and potentially fatal parasitic disease caused by protozoa of *Leishmania species*. It affects humans and is transmitted through the bite of infected *Phlebotomus* sandflies. In more than 95% of cases, it can result in death if treatment is not received. It disproportionately affects the poorest and most marginalized populations. The disease is characterized by enlargement of the spleen and liver (splenomegaly and hepatomegaly), prolonged fever, weight loss, and anemia. Kenya is one of ten countries that collectively report more than 90% of new visceral leishmaniasis cases globally each year. The majority of visceral leishmaniasis (VL) cases in the country are concentrated in dry and semi-arid regions notably the Northeastern, Eastern, and the Rift Valley areas. The disease predominantly affects children aged under five years of age and young adults who represent the highest case burden. Eleven of the 47 counties in the country, including Isiolo are endemic for visceral leishmaniasis. The VL spread in these regions is driven by a complex interplay of socio-economic, human behaviour, and environmental factors **(World Health Organization, 2025).**

Climate change and population mobility has been attributed to the change in disease foci to previously unidentified endemic areas. The true prevalence of the disease in endemic regions remains poorly understood with the implementation of prevention and control measures in these areas constrained by the rural nature of the disease, high levels of poverty, inadequate infrastructure, recurring famine, and drought. Despite the availability of control and prevention strategies, the disease has persisted in these areas causing substantial morbidity and mortality **(Ouma & Mulambalah, 2021).**

Similar to other zoonotic diseases, visceral leishmaniasis has become a persistent public health concern in Kenya with an estimated 5 million individuals at risk of infection. Despite its growing impact, recent assessments reveal a significant gap in the documentation of the disease's prevalence, burden, and spatial distribution. This underscores the critical need to advance understanding of VL transmission dynamics and precise geographic distribution in Kenya **(Grifferty et al., 2023).**

Despite being a treatable condition, visceral leishmaniasis is associated with high morbidity and mortality due to a low index of suspicion among healthcare providers, delayed diagnosis, and complex case management. The toxic side effects of some therapeutic agents further deter patients from seeking timely treatment particularly in resource-limited settings. Moreover, the high cost and limited availability of anti-leishmanial drugs in many health facilities pose significant barriers to effective care. As a result, the true burden of the disease remains poorly defined largely due to diagnostic challenges and limited access to healthcare services which hinder disease detection and reporting **(Mewara et al., 2022).**

Kala-azar remains a significant public health concern in the country despite numerous prevention and control initiatives by the Ministry of Health. The country has experienced a significant increase in reported visceral leishmaniasis (VL) cases in recent years with outbreaks documented in Isiolo County. Notably, the disease is also emerging in regions that were previously unaffected. Comprehensive mapping of visceral leishmaniasis (VL) across all endemic counties in the country has not been conducted. Furthermore, only a limited number of health facilities possess the capacity to diagnose the disease. Surveillance remains largely passive with minimal active case finding resulting in delayed case detection and increasing the risk of outbreaks **(Ministry of Health, 2021).** These trends underscore the urgent need for a paradigm shift in the prevention and control strategies to effectively curb VL transmission in the country. Accordingly, this study aimed to explore potential approaches for strengthening surveillance and to identify common VL risk factors through community and people driven initiatives. Using participatory epidemiology (PE), the study determined the VL temporal and spatial distribution in a subset of Isiolo County communities while also examining its transmission dynamics and detection mechanisms. This study employed a participatory epidemiology (PE) approach drawing on participatory appraisal (PA) methodologies to generate context-specific insights in settings where conventional epidemiological methods fall short **(Alders et al., 2020)**. This approach is particularly valuable in resource-limited environments for informing the design of effective strategies for early warning and in the management of infectious diseases **(Catley & Mariner, 2002; Allepuz et al., 2017)**.

Overall, the study provides a comprehensive overview of the disease burden in the research area and highlights the value of participatory research approaches in the surveillance of chronic and neglected tropical diseases (NTDs) which are often prevalent in resource-limited settings. These approaches enhance community understanding of disease patterns within populations and promote sustained engagement in identifying local health challenges. By fostering shared learning, they enhance awareness of health risks and risk perceptions, support community-based surveillance and control efforts, and facilitate timely communication of critical information to those responsible for prevention and response. Moreover, this participatory approach encourages the active involvement of relevant stakeholders, fostering trust, mutual respect, acceptability, and a strong sense of community ownership **(Alders et al., 2020).**

Significance of the study

Isiolo County is a visceral leishmaniasis endemic area and significant transmission foci in Kenya. According to the **Division of Vector Borne & Neglected Tropical Diseases**, between 2017 and 2023, 425 VL cases were reported in the county with outbreaks documented during this period. Furthermore, the disease has spread into new areas within the county. According to a study done by **(van Dijk et al., 2024),** apart from the Kenyan Ministry of Health's VL surveillance, scientific studies could also provide insights on the geographic distribution of VL cases in the country. However, only a small number of studies have mapped visceral leishmaniasis in Kenya at the county level.

The first National Strategic Plan for Control of Leishmaniasis was launched by the Kenyan Ministry of Health (MoH) in 2021 in response to the rise in VL cases across the country. Its primary goals included mapping VL transmission foci, tracking epidemiological trends, establishing and strengthening surveillance systems for VL. Monthly reporting of diagnosed cases by VL treatment facilities currently serves as the primary method of VL surveillance in Kenya. The District Health Information System 2 (DHIS2) a nationally accessible platform collects reported VL cases data. However, detailed geographical information on VL spread remains limited due to the low number of healthcare facilities equipped with VL diagnostic facilities and trained healthcare personnel. This lack of detailed data hampers efforts to prioritize VL control measures and monitor the spread of the disease in previously unaffected areas **(Ministry of Health, 2021).**

To curb transmission and reduce mortality from VL, counties are forced to rely on early diagnosis and treatment in the absence of evidence-based, scalable and effective vector control strategies **(Ministry of Health, 2017).** This study aimed to address these knowledge gaps by leveraging existing information and promoting community engagement through a participatory epidemiology (PE) approach which integrates oral traditions and community-based observations. This methodology fosters a collaborative learning environment that enhances understanding of community health risks and creates opportunities for improved disease surveillance and control **(Toribio & Rushton, 2012)**.

This view is supported by **(Catley & Mariner, 2002)** experiences utilizing participatory approaches to understand diseases in pastoral areas where there is no data. Their experiences revealed that pastoral communities possess detailed and rich indigenous knowledge. Pastoralists utilize this knowledge to describe the epidemiology of diseases affecting them in their own language which closely corresponds to scientific terms and literature. Integrating local knowledge and experience is essential to effectively and sustainably address health issues that a given community faces. Therefore, by empowering communities to recognize and address their health needs, participatory epidemiology approach leads to the implementation of more sustainable disease surveillance, prevention, and control strategies. Application of participatory epidemiology approach in this study to determine VL transmission dynamics and detection of cases is among the first studies in Kenya to use the approach for an infectious human disease and particularly in Isiolo County.

Aim of the study

This study aims to determine spatial and temporal distributions of visceral leishmaniasis in selected communities of Isiolo County through the following participatory methods:

- Participatory mapping using indigenous knowledge to identify Kala-azar risk villages.
- Proportional piling to estimate the morbidity, mortality, and case fatality associated with Kala-azar.
- Seasonal calendars to collect information on disease patterns over time.
- Semi structured interviews (SSIs) to gather indigenous knowledge on the etiology, signs, symptoms, and diagnosis of Kala-azar in the community.
- Community conversations (CC) and dialogues to gather more information on Kala-azar especially from a community's perspective.

2. SUBJECTS AND METHODS

Research design:

An observational study employing participatory methods was conducted to engage communities and gather information on visceral leishmaniasis. Participatory epidemiology (PE) exercises were conducted in the study villages.

Selection of study communities:

The study was conducted in two Sub-Counties of Isiolo County namely Merti and Garbatulla. Selection of study areas based on information shared by healthcare workers and local administrators. Shared information and documentation of Kala-azar cases used to select study villages representative of the population.

Study population:

A total of 18 study communities (10 in Merti Sub-County and 8 in Garbatulla Sub-County) were chosen to participate in the research comprising of 433 households (265 in Merti Sub-County and 168 in Garbatulla Sub-County).

The informant groups sizes in the villages varied between 10 to 15 participants. The study communities were selected according to the following inclusion criteria:

1) Presence of established and functional Community Health Units (CHUs) with active Community Health Promoters (CHPs).
2) Study villages that had previously been reported to be Kala-azar hotspots.
3) Populations living in the study villages had identified Kala-azar as a major disease of concern and an important problem in the area.
4) Selected study areas similar in terms of environment, ecological conditions, and livelihoods.

Data collection methods:

Participatory epidemiology (PE) methods including participatory mapping, proportional piling, and seasonal calendars were used as tools to gather information on the community insights of the disease. Information obtained from other methods such as semi-structured interviews (SSIs), and community conversations (CC) was used to triangulate the findings from the participatory epidemiology (PE) exercises by community residents. The Investigator collected data with assistance from a trained team of Community Health Promoters (CHPs).

Training of the participatory epidemiology field teams:

The Researcher trained Community Health Promoters (CHPs) on the principles of participatory approach and specific methods utilized in data collection. The trainings were conducted in the CHPs respective areas of operation i.e., Community Health Units (CHUs). Participatory approach methods were practiced during the training and planning sessions over two days, and data recording formats designed. Content of the training included sessions on techniques to manage group dynamics, and communication skills to enable interactive and effective communication between the research team and study participants.

Piloting of the instruments:

Pilot phase of the study was conducted in Warbera Ward, Isiolo-Central Sub-County. Warbera Ward was not part of the study area. Characteristics in Warbera Ward similar to those of the study area. During pre-testing, the accuracy and comprehension of the questions were taken into consideration while assessing the suitability of the different data collection tools. The household survey questionnaire was piloted by the CHPs during the training practicum sessions in their respective community health units.

Data management and statistical analyses:

Data collected was entered into created computer databases using Excel for data management. All obtained information was coded into physical values and cross checked with original data form before entry into computer. Frequency distribution of variables was undertaken to check correctness of data values or codes prior to statistical analysis. SPSS Version 25 was used for data analysis and data visualization. Epi Info was used for data entry, data validation and data analysis. The information gathered was summarized using descriptive statistics and Chi-square tests used to evaluate how the variables related to one another. The level of agreement between the different community groups in each of the study villages was assessed using Kendall's Coefficient of Concordance (W).

Data integrity:

Information was collected only from those participants who had completed the informed consent procedure. All the CHPs recruited to support the study were trained to protect the rights of study participants and on confidentiality of the data. The Researcher used Global Positioning System (GPS) technology to geocode study villages and the locations of suspected Kala-azar cases enhancing the accuracy, reliability, and overall quality of the data.

Ethical considerations:

Scientific approval was sought from the School of Health Sciences Graduate Studies Committee, Meru University of Science and Technology (MUST) Institutional Research Ethics Review Committee (MIRERC)**,** National Commission for

Science, Technology, and Innovation (NACOSTI/P/23/29291), and County Department of Health. Further permission was sought from the local administration. All study participants approved their participation by signing consent forms without any form of coercion.

3. RESULTS

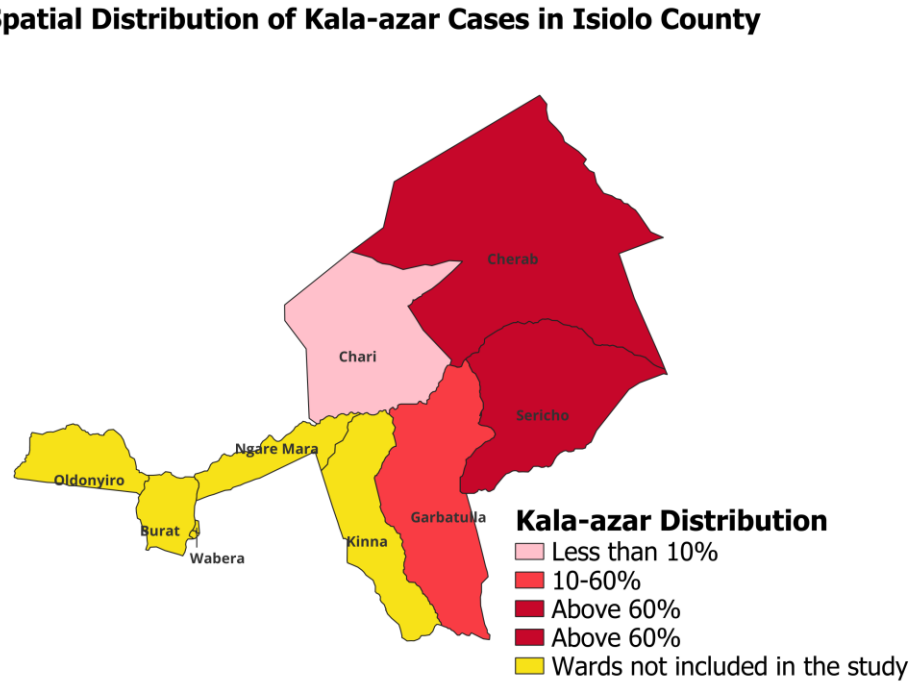

Figure (1): Spatial distribution of Kala-azar cases in Isiolo County

Figure (1): Shows that majority of VL cases were reported in Cherab Ward of Merti Sub-County (72.8%). While Sericho Ward of Garbatulla Sub-County reported (71.7%) of the cases.

Table (1): Kala-azar cases per Ward (n=433)

Ward	No. of participants/ households interviewed	No. of Kala-azar cases reported (%)	No. of deaths from Kala-azar reported (%)
Chari	19	1 (5.3%)	1 (100%)
Cherab	246	179 (72.8%)	6 (3.4%)
Garbatulla	48	7 (14.6%)	0 (0%)
Sericho	120	86 (71.7%)	8 (9.3%)
Total	433	273 (63%)	15 (3.5%)

Table (1): Shows that, only 1 household (5.3%, 1/19) in Chari Ward reported a Kala-azar case. Cherab Ward in Merti Sub-County had the highest number of Kala-azar with 179 households (72.8%, 179/246) reporting cases. Garbatulla Ward reported a 14.6% (7/48) prevalence of Kala-azar cases whereas Sericho Ward reported 86/120 (71.7%) prevalence of Kala-azar cases. Overall, a total of 273 households (63% prevalence) reported Kala-azar cases with 15 deaths recorded across the surveyed households resulting in a case fatality rate of 3.5%.

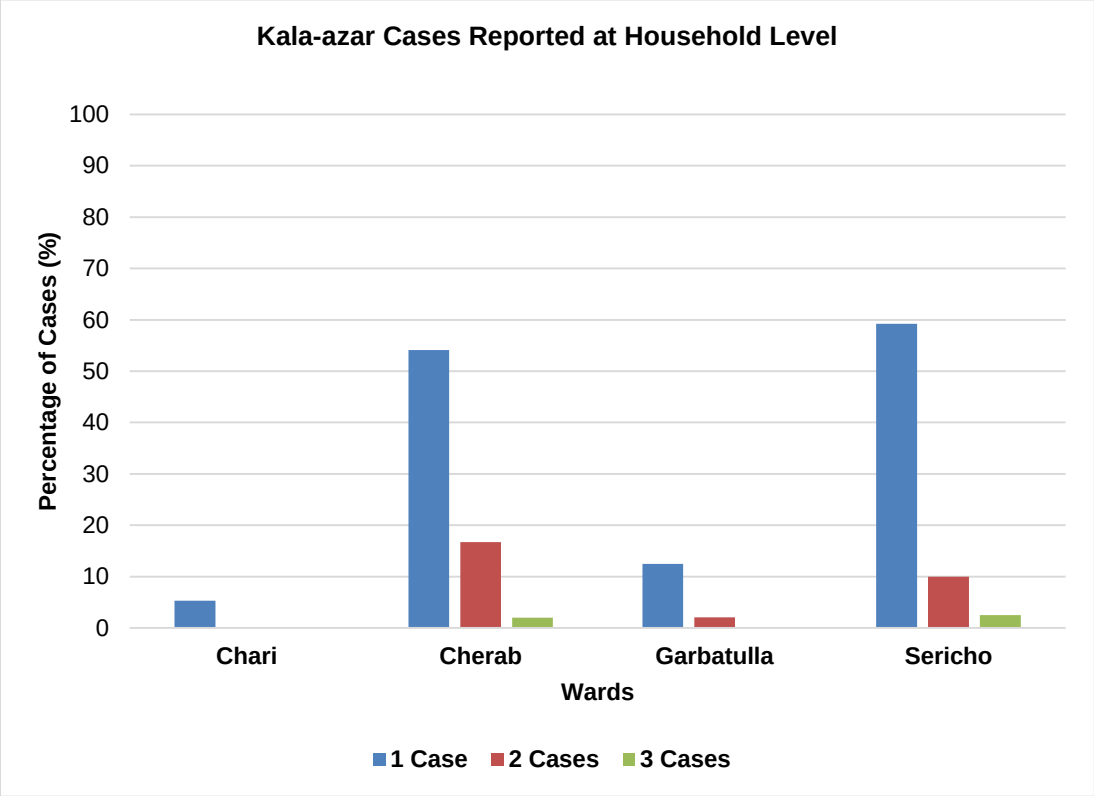

Figure (2): Number of Kala-azar cases reported by household across different Wards

Figure (2): Shows that, in Chari Ward, only one household reported a single Kala-azar case. In Cherab Ward, 133 households (54.1%) reported one case, 41 households (16.7%) reported two cases, and 5 households (2%) reported three cases. In Garbatulla Ward, 6 households (12.5%) reported one case, and 1 household (2.1%) reported two cases. In Sericho Ward, 71 households (59.2%) reported one case, 12 households (10%) reported two cases, and 3 households (2.5%) reported three cases.

Table (2): Temporal distribution of Visceral Leishmaniasis

Season Kala-azar is most prevalent (%)			
Dry season		**Wet season**	**Uncertain of season**
Ward			
Chari	8 (2.2%)	4 (6.3%)	7 (100%)
Cherab	210 (58.0%)	36 (56.3%)	0
Garbatulla	47 (13.0%)	1 (1.6%)	0
Sericho	97 (26.8%)	23 (35.9%)	0
Total	362 (83.6%)	64 (14.8%)	7 (1.6%)

Table (2): Shows that, that the disease was most common during the dry seasons accounting for 83.6% of reported cases while only 14.8% of cases occurred during the wet seasons. A significant majority of respondents from Cherab (210), Garbatulla (47), and Sericho (97) indicated that Kala-azar cases were predominantly reported during the dry seasons in their respective Wards. However, a small number of participants (7) were uncertain (not sure) about the specific season when majority of VL cases were reported across the study areas.

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Table (3): Seasonal variation in Kala-azar cases occurrence

Reports of Kala-azar cases by households	Yes	No	X^2	df	*P*_value
Season					
Beginning of Rainy Season	11 (30.6%)	25 (69.4%)	43.66	3	< 0.001
End of Rainy Season	10 (35.7%)	18 (64.3%)			
Dry Season	252 (69.6%)	110 (30.4%)			
***Unclear of Season**	0 (0.0%)	7 (100.0%)			
Total	273 (63.0%)	160 (37.0%)			

*Unclear of Season: Not sure of the season when Kala-azar cases are mostly reported.

Table (3): Shows that, majority of households surveyed (69.6%), indicated that dry seasons had the highest number of Kala-azar cases, followed by end of the rainy season (35.7%) and the beginning of the rainy season (30.6%). Only seven households, however, were unsure about the exact season during which Kala-azar infections were most commonly reported. Statistical analysis revealed a highly significant and strong link between seasons and the occurrence of Kala-azar, **X^2 = 43.66, *P* < 0.001.**

Garbatulla **Merti**

Figure (3): Seasonal Calendars for Garbatulla and Merti Sub-County

Figure (3): Highlighted the level of awareness by residents on several factors contributing to the incidence of Kala-azar across the study communities. Community members distributed counters to illustrate monthly variations in key indicators such as sandfly activity, migration patterns, drought, malnutrition, and water availability all which were associated with Kala-azar incidence. In Garbatulla Sub-County, strong evidence of sandfly activity was observed across most months with notable exceptions in January and May. Migration of both people and livestock was reported particularly during the drier seasons of February, March, April, July, August, and September. Drought and malnutrition was found to be an important influence in Garbatulla especially during the dry months of July to September. Water scarcity was another recurring issue predominantly reported during the drought periods of February, March, and July to September. The seasonal calendar for Garbatulla confirmed that malnutrition and water shortages coincided with the drier months and drought periods which also saw significant population mobility in search of pasture and water. Similarly, in Merti Sub-County sandfly activity was reported from across most months of the year apart from the months of April, May, November, and December. Population migrations were observed in the months of January, March, May, August and October. Drought conditions occurred in May, June, and September to October. Malnutrition was reported during the dry months of February, March, June to October. Water shortage was experienced in the months of January, February, September and October. In general, the seasonal

calendars revealed shared patterns across both study areas with similar timelines for sandfly activity, population migrations, and the occurrence of drought, malnutrition, and water shortages. These trends matched the seasons when Kala-azar cases were said to be most common, suggesting that the disease's occurrence varied seasonally throughout the research areas.

4. DISCUSSION

The spatial distribution data **(Figure 1)** illustrate the geographic locations of Kala-azar cases within households across the study area. The results demonstrated the utility of spatial statistical approaches in enhancing of the understanding of spatio-temporal dynamics and informing the control of visceral leishmaniasis. The Global Positioning System (GPS) employed by the Researcher illustrates the distribution of the disease across both study locations. The present study provides additional evidence to the county with respect to utilization of GPS depicting the ease to locate Kala-azar infected persons. **Table 1** presents results on Kala-azar cases and incidence across the Wards providing insights into the household level distribution of the disease. These findings deepen our comprehension of the disease prevalence in the areas which the study set out to determine and reports a prevalence rate of 63% and a case fatality rate of 3.5%.

Prevalence of Kala-azar in the study area matched with a study entitled as "Persistence and changing distribution of leishmaniasis in Kenya require a paradigm shift'' conducted by **Ouma & Mulambalah (2021)**, who stated that VL has remained persisted in the arid and semi-arid counties of Kenya located in North, Eastern, and Rift Valley regions of the country. From the present study results, each Ward had a different number of individuals who had experienced Kala-azar. Cherab Ward reported the highest number of cases with households reporting multiple cases. Similarly, Sericho Ward reported a number of multiple cases in the surveyed households. Fewer cases were reported in Garbatulla and Chari Wards respectively. From the researcher's point of view, the disparity in infrastructure development and socio-economic conditions could be attributed to these findings. However, the study's findings also highlight other potential reasons, such as environmental influences. These results agreed with earlier reports from the United Nations Office for Coordination of Humanitarian Affairs **(OCHA, 2009)** that reported visceral leishmaniasis cases in the drought-affected Merti and Sericho areas of Isiolo County.

As regard to occurrence of the disease, the results of the current study revealed that, Cherab Ward recorded the highest incidence rate of Kala-azar, with a relatively low mortality rate. According to the researcher, this outcome can be attributed to several factors. First, the presence of a medical facility **(Merti Health Centre)** within the Ward provides access to Kala-azar treatment. Second, the Department of Health with support from partners has implemented bi-weekly integrated community outreach activities in the area. These factors may explain the observed results as outreach activities in hard-to-reach areas have increased accessibility to primary healthcare services for the Ward populations. Sericho Ward recorded the highest number of reported deaths (8) from Kala-azar. From the researcher's perspectives, one possibility that could account for this, is challenges in accessing primary healthcare services especially during the rainy season when the whole area floods cutting off accessibility to the health facilities and other critical services. **World Health Organization (2010)** reported similar challenges resulting in increased incidence of Kala-azar in Sudan when access to treatment for this fatal disease was restricted by several elements like flooding, insecurity, and a lack of medical facilities over a large geographic area. These barriers must be addressed because they seriously imperil access to VL diagnosis and treatment in Isiolo County. So, decentralizing VL care to bring services closer to those who are afflicted is critical in strengthening healthcare delivery in endemic and at-risk areas **(Macharia et al., 2025).**

Concerning mortality from Kala-azar, the findings of this study revealed that the impact in terms of fatalities varied across the Wards. The actual number of deaths may be even higher as some community fatalities were not reported to the health facilities. These results provide further support for the Kenya's Ministry of Health efforts in addressing the high visceral leishmaniasis mortality rates in a report by **Scovian (2025)** of a similar Kala-azar endemic County in Kenya, Lodwar entitled "A promising fight against a silent killer". The report stated the Ministry's multi-sectoral efforts including implementing vector control measures, decentralizing services, and strengthening diagnosis and treatment. The report points out that by 2030, the Ministry alongside partners are working to eradicate Kala-azar as a public health concern through mapping the prevalence of the disease, deploying improved diagnostic tools, and improving public health education to ensure timely medical intervention.

This was in the same line with **Alvar et al., (2021)** health policy paper entitled "Towards the elimination of visceral leishmaniasis as a public health problem in East Africa: Reflections on an enhanced control strategy and a call for action" who stated that, effective progress towards visceral leishmaniasis elimination requires continuous surveillance of

populations at risk, morbidity, and mortality of the disease. The paper argues that to achieve the elimination target, there comes need to look into ways of reducing the evident underreporting bias and establish strategies to monitor and ascertain the disease control programs. In view of all that has been mentioned in the policy paper, proper epidemiological surveillance allows for the establishment of the past and present burden of the disease and guides the authorities to take appropriate and timely action on case detection, management of patients, control of vectors, and community awareness.

Regarding VL temporal distribution, analysis of Kala-azar cases across different seasons revealed significant seasonal variation highlighting the disease's dependence on environmental conditions. Temporal distribution demonstrated that Kala-azar is most prevalent during the dry seasons and less prevalent during the wet seasons. According to the researcher, during the dry season majority of the community members sleep outdoors due to the hot weather conditions. The researcher also observed that during this season, sandflies are also abundant breeding in the cracks and crevices on the ground increasing the exposure to the vector and transmission. This observation was in agreement with **Hassaballa et al., (2021)** who carried out a study entitled "Exploring the influence of different habitats and their volatile chemistry in modulating sandfly population structure in a leishmaniasis endemic foci, Kenya" who asserted that developing VL control strategies requires an understanding of sandfly ecology owing to the fact that sandflies selective selection of sites for breeding or resting is a significant ecological adaptation. This trend underscores the heightened vulnerability to Kala-azar during periods of dryness potentially due to favorable breeding conditions for sandflies. Conversely, during the beginning and end of the rainy seasons, lower percentages of households reported cases suggesting that Kala-azar transmission is not confined to one season but varies based on specific ecological and environmental factors.

Statistical analysis of Kala-azar cases and seasons revealed a very strong statistically significant relationship between seasons and the occurrence of Kala-azar cases, $\mathbf{X^2 = 43.66}$, $\boldsymbol{P < 0.001}$. These results emphasize the significance of understanding seasonal patterns and their impact on Kala-azar transmission dynamics, providing a basis for implementing targeted, time-specific public health measures to combat the disease effectively. The temporal distribution of Kala-azar cases as assessed through seasonal calendars indicated that community members had a clear understanding of key indicators of the disease and their typical timelines of occurrence throughout the year. Additionally, the analyzed data reflected the communities' knowledge of the monthly prevalence of various factors contributing to the incidence of Kala-azar in Isiolo County. This result is supported by **Faria et al., (2023),** who noted that social mobilization was among the strategies utilized by Bangladesh to become the first country in the world to be officially recognized as having eradicated Kala-azar as a public health problem. Therefore, it is advised to improve community awareness, attitudes, and practices regarding Kala-azar prevention and elimination.

In addition, the VL temporal distribution findings also align with research findings of a study conducted by **Abdullahi et al. (2022)** entitled "Climate change and environmental influence on prevalence of visceral leishmaniasis in West Pokot County, Kenya" which reported a surge of Kala-azar cases during the dry seasons and just after the rains when the region experienced high humidity. During these seasons, the study observed elevated vector populations and vector expansion to uncommon areas towards the end of dry seasons which are typically characterized by high humidity and wider temperature variations. Their findings suggest that prolonged drought conditions driven by climate change reduce pasture availability prompting increased migration of people and livestock into rangeland areas with high vector densities. This movement heightens human exposure to vector bites thereby increasing the risk of Kala-azar transmission. Furthermore, this result was in accordance with **El Omari et al. (2020),** who conducted a study in Morocco entitled "Impact of climatic factors on the seasonal fluctuation of leishmaniasis vectors in Central Morocco" who showed that variations in climatic conditions cause variations in the actions and population of sandflies. The study observed that biology and ecology of vectors, and consequently the likelihood of disease transmission, was impacted by variations in temperature, precipitation, and humidity.

This view is supported by **Patz et. al., (2000)** who indicated that to identify immediate actions that must be taken with reference to climatic and ecological changes, besides provide foundation for creation of prediction models, enhanced surveillance and monitoring is important. The results of the present study provide further support for these models which serve as valuable tools in developing interventions aimed at reducing parasitic diseases in the context of anticipated environmental changes. The models elucidate the relationships between ecological factors, entomological, genetic, and behavioral traits of parasites and vectors as well as human behavior, all of which are linked to disease transmission. Recent evidence indicates that communities residing in endemic areas face considerable risk due to environmental factors such as dry conditions, altered precipitation patterns, and ecological disturbances. These factors create favorable conditions for vector proliferation leading to increased disease transmission **(Kiptoo, 2024).**

5. CONCLUSION

The findings from this study contribute further evidence to the ongoing debate regarding the capacity of epidemiological methods to accurately describe and specify results that can be more effectively integrated into public health practice. To bridge the gap between description and action, participatory research approaches are recommended for use in epidemiology to facilitate the identification of diverse disease risk factors and to promote population health. The results of this study support the notion that communities possess the capacity to analyze and address their own health challenges. This implies that communities have the potential to make informed decisions about their own solutions and to implement actions aimed at improving their health. Effective local involvement is therefore crucial for developing community-sensitive, well-tailored and sustainable strategies for early disease detection, timely prevention, and control measures thereby minimizing the unintended consequences of disease transmission. In addition, the study confirms Cherab and Sericho Wards as visceral leishmaniasis endemic clusters within Isiolo County. This finding implies that a substantial number of cases may go undiagnosed due to a complex interplay of factors including weaknesses in the health system, limited diagnostic capacity, poor access to healthcare services, socio-cultural barriers, and inadequate surveillance collectively reinforcing the status of the disease as a significant public health threat. The results of this research support the idea that mapping Kala-azar cases to assess spatial distribution and temporal changes in transmission patterns highlights the value of spatial statistical methods in enhancing the understanding of the spatio-temporal dynamics and control of Kala-azar. Additionally, the evidence from this study demonstrates that the use of GIS and GIS-based spatial statistical methods provides a more precise approach to defining and measuring Kala-azar epidemic conditions in endemic areas as opposed to relying solely on cumulative incidence reports from health facilities collected monthly. Overall, the evidence from this study provides a deeper understanding of variations in disease transmission which is essential for guiding the implementation of effective visceral leishmaniasis management plans. Consequently, there is a clear need for management strategies to be grounded on early diagnosis, complete treatment, integrated vector management, behaviour change communication activities, capacity building, supervision, surveillance, and rigorous monitoring and evaluation. To keep Kala-azar elimination high on the national public health agenda, this study concludes that focused efforts at all levels of government supported by sustained political commitment are essential to maintaining momentum and achieving long-term success in the elimination drive. Strategic investment in both scientific research and community-based interventions positions Kenya to make meaningful progress toward the elimination of visceral leishmaniasis as a public health threat, while advancing health equity and safeguarding its most vulnerable populations.

6. RECOMMENDATIONS

Based on the results of the current study, the following recommendations are suggested.

- A clear understanding of the spatio-temporal distribution of diseases is essential for enhancing surveillance and optimizing the implementation of disease management plans.
- Participatory epidemiology (PE) is essential for effective disease surveillance as it actively engages communities in identifying, prioritizing, and developing solutions to health challenges.
- Community engagement and education in Kenya's endemic areas are vital for improving healthcare access and strengthening the response to visceral leishmaniasis.
- Promoting community-led health interventions in the fight against visceral leishmaniasis is crucial for fostering local ownership, enhancing participation, and ensuring sustainability of health programs.

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