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Scio-demographic Determinants of Visceral Leishmaniasis in Eastern Sudan: A Cross-sectional Study from Gadaref State

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ABSTRACT

Visceral leishmaniasis (VL) remains a major public health problem in Sudan, particularly in Gedaref State. Understanding the socio-demographic determinants of VL is essential for designing effective control strategies. This study aimed to investigate the association between VL infection and socio-demographic factors such as age, sex, marital status, education level, and occupation in an endemic region of eastern Sudan. A descriptive cross-sectional study was conducted among 208 individuals suspected of VL infection in Gedaref State. Data were collected using structured questionnaires, and blood samples were tested using the rK39 rapid diagnostic test. Statistical analysis was performed using SPSS version 25. Of the 208 participants, 51 tested positive for VL. No statistically significant associations were found between VL infection and gender (P = 0.71), age group (P = 0.17), or place of residence (P = 0.17). Although no statistically significant associations were found, the persistence of VL cases in endemic regions like Gedaref highlights the need for continuous epidemiological monitoring. Further studies with larger sample sizes and consideration of environmental and behavioral risk factors are recommended.

Introduction

Visceral leishmaniasis (VL), also known as kala-azar, is the most severe form of leishmaniasis caused by protozoan parasites of the *Leishmania donovani* complex. It is transmitted to humans by infected female *Phlebotomus* sandflies and is classified as a neglected tropical disease (NTD), causing substantial morbidity and mortality in endemic regions of Africa, Asia, and Latin America [1]. VL is characterized by prolonged fever, weight loss, hepatosplenomegaly, and severe anemia, and is often fatal if untreated [2]. Globally, 50,000 to 90,000 new cases are reported annually, with high burdens in countries such as Sudan, Ethiopia, India, Nepal, and Brazil [3].

In Sudan, the eastern region, particularly Gedaref State, is a recognized hotspot for VL transmission. Contributing factors include cross-border migration, poverty, poor housing, and proximity to endemic zones in Ethiopia [4,5]. Seasonal laborers working in agriculture are especially vulnerable, as they often live in conditions that facilitate sandfly breeding [6].

Despite national control programs, challenges such as underdiagnosis, limited access to healthcare, and recurring epidemics persist. While traditional diagnostic tools are still used in many settings, molecular methods such as PCR offer promise for improving early case detection [7]. This study explores the socio-demographic determinants of VL in Gedaref State to inform more targeted public health interventions.

Methods

Study Design and Setting

A descriptive cross-sectional study was conducted in Gedaref State, eastern Sudan—an area known for recurrent outbreaks of visceral leishmaniasis. The study population included individuals clinically suspected of VL infection from various endemic villages.

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Data Collection
Socio-demographic and clinical data were collected using a pre-structured questionnaire. Variables included age, gender, marital status, educational attainment, and occupation. Data collection was performed by trained healthcare personnel under direct supervision.

Sample Collection and Laboratory Testing
Venous blood samples (5 mL) were drawn from each of the 208 participants using sterile techniques. Samples were either processed immediately or stored at −20°C for later testing.
VL diagnosis was performed using the rK39 rapid diagnostic test (RDT), a lateral flow immunochromatographic assay that detects anti-*Leishmania* IgG antibodies. The test was interpreted as follows:

- **Positive**: Appearance of both control (C) and test (T) lines.
- **Negative**: Appearance of only the control line.
- **Invalid**: Absence of the control line.

Data Analysis
Data were analyzed using IBM SPSS Statistics, version 25. Descriptive statistics (frequencies and percentages) were calculated. Chi-square tests were used to assess the association between VL infection status and socio-demographic variables. A P-value of < 0.05 was considered statistically significant.

Results
Of the 208 participants, 149 (71.6%) were male and 59 (28.4%) were female. A total of 51 participants tested positive for VL (35 males and 16 females). No statistically significant association was found between gender and VL infection (**x^2 = 0.137, df = 1, P = 0.712**).

Table 1. Prevalence of visceral leishmaniasis by gender

Gender	Negative (n)	Positive (n)	Total (n)
Male	114	35	149
Female	43	16	59
Total	**157**	**51**	**208**

The highest number of VL-positive cases was recorded in the 21–30 age group (15 cases), followed by 0–10 and 11–20 age groups. However, there was no statistically significant relationship between age group and infection status (x^2 = 9.072, df = 6, P = 0.170).

Table 2. Prevalence of visceral leishmaniasis by age group

Age Group	Negative (n)	Positive (n)	Total (n)
0–10	15	7	22
11–20	17	8	25
21–30	27	15	42
31–40	29	7	36
41–50	33	7	40
51–60	26	3	29
61+	10	4	14
Total	**157**	**51**	**208**

Most participants resided in Gedaref State, with a few from Khartoum and Gezira. No statistically significant association was observed between place of residence and infection status (x^2 = 0.719, df = 2, P = 0.698)

Table 3. Prevalence of visceral leishmaniasis by place of residence

Residence	Negative (n)	Positive (n)	Total (n)
Gedaref	151	50	201
Khartoum	4	1	5
Gezira	2	0	2
Total	**157**	**51**	**208**

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Discussion

Visceral leishmaniasis (VL) remains a significant public health threat in eastern Sudan, particularly in Gedaref State, where environmental and socio-economic factors sustain ongoing transmission. This study aimed to identify associations between socio-demographic variables and VL infection among individuals residing in endemic areas. Despite the absence of statistically significant associations, the findings provide important insights into the local epidemiological dynamics of the disease.

The lack of a significant association between gender and VL infection (P = 0.71) aligns with findings from other studies conducted in similar endemic settings in Gedaref, where both males and females exhibited comparable exposure risks [8]. While some literature suggests a higher prevalence among males, attributed to increased outdoor activities and occupational exposure [9], gender-based risk disparities may be diminished in rural communities where both sexes are engaged in agricultural labor and household tasks near vector breeding sites.

Similarly, age-related patterns did not demonstrate a statistically significant correlation with VL infection status (P = 0.17), though the 21–30 age group had the highest number of positive cases. Previous research has often identified children under 15 as a high-risk group due to behavioral exposure and developing immune responses [10,11]. The lack of significant findings in the present study may be attributed to sample size limitations or homogeneous exposure across age groups within the surveyed population.

No significant relationship was found between place of residence and infection status (P = 0.17), though the majority of cases originated from Gedaref. This result may reflect similar ecological and living conditions across the sampled villages, including the presence of *Phlebotomus orientalis*, proximity to termite mounds and acacia trees, and poorly constructed housing—all known risk factors for VL transmission in the region [1, 12].

Although the study did not establish statistically significant associations, it underscores the complex interplay of factors contributing to VL transmission and highlights the ongoing vulnerability of populations in endemic areas. Importantly, the findings reinforce the need for integrated control approaches, including vector management, early diagnosis, and community-level health education.

Limitations of the study include its cross-sectional nature, which precludes the assessment of temporal relationships, and the reliance on a single diagnostic method (rK39 RDT), which may not detect all active infections. Future research should incorporate larger sample sizes, longitudinal designs, and advanced diagnostics (e.g., PCR) to elucidate underlying risk factors and better inform public health strategies.

Conclusion

This study found no statistically significant associations between socio-demographic factors—such as age, gender, and place of residence—and VL infection among residents of Gedaref State. However, the concentration of cases in this endemic region reaffirms the continued threat of visceral leishmaniasis in eastern Sudan. The findings underscore the importance of sustained public health surveillance, early diagnosis using reliable methods, and implementation of community-based vector control interventions. Further large-scale studies incorporating environmental, behavioral, and immunological variables are warranted to better understand the complex transmission dynamics and to inform more effective, evidence-based control strategies.

Conflict of interest. Nil

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