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Original Research Article

Risk factors of visceral leishmaniasis among residents of Baringo County, Kenya

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ABSTRACT

Background: Leishmaniasis is protozoan disease, transmitted by Sandflies. The annual incidence of visceral leishmaniasis in East Africa is between 29,400 and 56,700 cases, accounting for approximately 15% of the global cases. Visceral leishmaniasis is endemic in Baringo County yet the current report on risk factor burden of the disease has not been documented. Objective was to assess risk factors associated with visceral leishmaniasis among residents of Baringo County, Kenya.
Methods: Analytical cross sectional study design was conducted in Tiaty and Baringo south sub counties, Baringo County. The study population was 422 households selected through simple random sampling. The data collection tool were questionnaires. Data was analyzed using descriptive statistics, cross tabulations and chi square test of independence. Logistic regression was used to compute odds ratio. Variables with p value of less than 0.05 was considered statistically significant.
Results: Findings showed that uneducated were majority (68%), higher number of the population had more than 6 persons per household (70.6%). On occupation, pastoralists were more affected (62.2%), those living in mud and cracked house were more (61.8%) (63.0 %) respectively $p<0.01$. Daily activity 35.24, $p<0.01$), sleeping under acacia tree 53.42, $p<0.01$), sleeping outside the house 112.7, $p<0.01$), and presence of ant hills nearby homestead 32.42, $p<0.01$) were individual risk factors significantly associated visceral leishmaniasis.
Conclusions: The risk factors increased the exposure of the community to visceral leishmaniasis infection which needs to be addressed through control and prevention measures.

Keywords: Neglected tropical diseases, Risk factors, Visceral leishmaniasis

INTRODUCTION

Leishmaniasis is a parasitic disease caused by *Leishmania* species, transmitted by Leishmania parasites through the bites of infected female sand flies from the genera *Lutzomya* spp and *Phelebotomus* spp sand flies. There are types of leishmaniasis as follows; New World cutaneous leishmaniasis which is acquired from the bite of infected female sand flies. The skin lesions generally develop from papules, nodules and ulcers with elevated, indurated limits over weeks or months. The period between morsels and lesions varies between days and months. Apparently, the local trauma is a clinical characteristic linked with this illness, ulcerative skin lesion.[1] Visceral leishmaniasis which is considered the most severe form of leishmaniasis results in death if left untreated and may cause epidemic outbreaks with a high mortality rate.[2,3] Post-Kala-azar

dermal leishmaniasis (PKDL) is generally a sequel to visceral leishmaniasis, with clinical manifestation such as depigmentation, nodules and rash.[1]

Globally, the disease is reported to be responsible for approximately 20,000 and 40,000 deaths per year and majority of the cases remain asymptomatic. Depending on the eco-epidemiological environment the subclinical to clinical case ratio is 1:1 to 1:9. In Bangladesh, India, Nepal, Sudan, South Sudan, Ethiopia and Brazil, over 90 percent of the yearly incidence, 0.2 to 0.4 million new cases per year occur. Eastern Africa, after the Indian sub-continent, is the second biggest visceral leishmaniasis concentration with an additional 30,000-40,000 new cases a year, the largest contributors of which are Ethiopia, South Sudan and Sudan. The real burden of Leishmania remains mostly unseen, with many poor illnesses that lead to significant morbidity and death, partially because the most vulnerable reside in rural places.[4]

Visceral leishmaniasis predominantly occurs in East Africa and on the Indian Sub-Continent, which reported developing the disease in 5–10 percent of individuals with kala-azar. It generally emerges six months to one year or longer after kala-azar appears to have been healed, but this might happen faster. PKDL persons are considered a possible source of Leishmania infection1. Visceral leishmaniasis prevention strategies in most countries have been hindered by the lack of knowledge on visceral leishmaniasis risk factors. Studies by Kolaczinski showed that low socio-economic status and treating of livestock with insecticide as some of risk factors associated with visceral leishmaniasis.[5] Sleeping near animals, social cultural factors such as sleeping under an acacia tree during the day and sleeping outside at night time have also been identified to increase the exposure to visceral leishmaniasis. Other risk factors include, large family size and number of days spent in the farm.[6] A previous study done in India showed that some of the risk factors of visceral leishmaniasis include poor housing, ownership of goats, delay to seeking health care and poverty.[7] Other studies in Ethiopia has pointed out that the ecosystem and animal ownership are among the risks factors associated with visceral leishmaniasis.[4]

Studies in Kenya have shown that there is inadequate information on the prevalence and burden of the disease, which is distributed mainly in arid and semi-arid regions.[3] Other sources claim that in 14 of the 47 counties in the nation, visceral leishmaniasis is endemic. Almost 4,000 new cases occur annually in Kenya and in certain areas in northern Kenya, various outbreaks of VL have occurred during the past 10 years. In July 2006, more than 60 cases were registered as a VL epidemic in Isiolo County. In March 2018 there was a major fatality rate (CFR) in the Wajir County in which more than 180 patients were hospitalized. A VL epidemic in Marsabit County was recorded for the first time in 2014. The number of cases continued to increase in March 2017 and 104 were recorded with 3 fatalities as of June 2017.[8] In Kenya leishmaniasis is endemic including Baringo County.[9] In a study done in Baringo County between the years 2010 to 2016, findings indicated that the prevalence among the male and females was in the ratio of 1: 3 respectively and in addition, it affected majorly the young children <14 years of age.[10] Currently, there is no documented study done on risk factors of visceral leishmaniasis in Baringo County. Therefore, the present study has been conducted to establish the necessary evidence-base and to stimulate interest in supporting the control of this neglected tropical disease in the Baringo County.

METHODS

Study design and setting

Analytical cross sectional study design was used to assess risk factors associated with visceral leishmaniasis. The study was undertaken in Baringo County and the County is divided into 6 sub-counties however the study targeted Tiaty and Baringo South sub counties.

Study participants

Cochran (1977) formulae was used to obtain the 422 residents of Tiaty and Baringo South sub counties in Baringo County since these are endemic areas where the respondents interviewed were household heads. Community residents from Tiaty and Baringo south sub counties only who gave consent to participate in the study were interviewed.

Study period

The data collection period was from April to August 2019.

Inclusion criteria

Those residents from Tiaty and Baringo South Sub Counties who gave consent were included. Anyone above 18 years were eligible for the study.

Exclusion criteria

During the study, all non-residents of Tiaty and Baringo south sub counties were not interviewed. Residents who had not given consent to participate in the study and anyone who does not head any given household were excluded.

Sampling technique

Purposive sampling technique was used to select the two endemic sub counties in Baringo which were Tiaty and Baringo South.

Data collection tool and analysis

Validity and reliability

Pretest was done to ensure that the content was in line with the study objectives. To further check for construct validity

a pre-test was carried out in Baringo North (Barwessa and Bartabwa health facilities). Reliability of the study tools was checked using internal consistency techniques, specifically Cronbach, alpha which is a mean of all possible spilt halves. Therefore the study conducted a reliability analysis for the questionnaire's housing factors, animal factors, individual factors. Cronbach's alpha for the 18-items housing factors scale was α=0.701. Regarding the animal factors factors subscale, which had 3 items, Cronbach's alpha was α=0.702, while the individual risk factors subscale, which had a total of 5 questions, the Cronbach's alpha was α=0.840.

Data collection

Questionnaires were administered to the residents to assess the risk factors that expose them to visceral leishmaniasis.

Data analysis

Data was cleaned and exported to Statistical package for social sciences (SPSS) software (version 25.00) for analysis. Descriptive statistics, cross tabulations were done and chi square test of independence was used to test the association. Logistic regression was used to compute odds ratio which were used to test the strength of the association, statistically significant associations were tested at a $p<0.05$.

Ethics approval

The study was approved by Institutional review ethical board of Masinde Muliro University of Science and Technology. Ethical Review Committee and National Council for Science technology and innovation (NACOSTI) after explaining the objectives of the study, consent was sought from the participant and were assured that the study does not involve any risk nor lead to any form of harm. They were also informed that they shall have the freedom of withdrawal at any stage of the research without any consequence. Confidentiality was assured to each participants.

RESULTS

Socio-demographic characteristics of the respondents

Total of 422 participants, who consented to participate in the study was analyzed with response rate was 99%. The study findings showed that the gender distribution of the participants was (46.2%) females and (53.8%) males. Those between 18-30 years were more affected (44%). Majority of them were not educated (57.8%) while livestock farmers were the majority. Those with more than 6 members in their residence and infected with visceral leishmaniasis were the majority at (70.6%) of the study participants. (Table 1).

Demographic risk factors

There was and an association between visceral leishmaniasis and level of education (uneducated (68.0%), illiteracy (68.6%) and livestock farming as a form of occupation (62.2%) with a $p<0.01$ (Table 2).

Table 1: Social demographic characteristics of study participants.

Characteristic	N (%)
Gender	
Female	195 (46.2)
Male	227 (53.8)
Age	
18-30	186 (44)
31-43	140 (33)
44-56	65 (15.4)
57-69	28 (6.6)
70 and above	3 (0.7)
Level of education	
Primary	68 (16.1)
Secondary	86 (20.4)
Tertiary	24 (5.7)
Uneducated	244 (57.8)
Literacy level and VL infection	
Yes	167 (39.6)
No	255 (60.4)
Occupation	
Crop farming	60 (14.2)
Livestock farming	339 (80.3)
Professional	23 (5.5)
No of residents	
5 or less	124 (29.4)
6 or above	298 (70.6)
Land ownership	
Yes	400 (94.8)
No	22 (5.2)

Logistic regression of statistically significant demographic risk factors in bivariate analysis

Using multinomial logistic regression, the significant demographic risk factors in the table 2 were assessed to determine to what extent they predicted a family member having visceral leishmaniasis. Literacy level was a statistically significant independent predictor of a family member having visceral leishmaniasis; respondents who were able to read were 60% less likely to have a family member with visceral leishmaniasis than those who were not able to read OR (95% CI) = -1.430 (0.98-0.582).

Housing risk factors for visceral Leishmaniasis

To check for association, results revealed that most of the study participants with mud-walled houses 215 (61.8%) had suffered from visceral leishmaniasis compared to those with raised houses 15 (20.3 %.) $p<0.01$ while those with house roof thatched 221 (57.1%) reported to have suffered from the disease unlike those without thatched roof 9 (25.7%) $p<0.01$.

Table 2: Demographic risk factors for visceral Leishmaniasis indicating association with visceral leishmaniasis.

Demographic factors		Has any of your family member suffered from the visceral leishmaniasis disease?				
		Yes		No		
		N	%	N	%	P value
Level of education	Primary	31	45.6	37	54.4	<0.01*
	Secondary	27	31.4	59	68.6	
	Tertiary	6	25.0	18	75.0	
	Uneducated	166	68.0	78	32.0	
Literacy	Yes	55	32.9	112	67.1	<0.01*
	No	175	68.6	80	31.4	
Occupation	Crop farming	14	23.3	46	76.7	<0.01*
	Livestock farming	211	62.2	128	37.8	
	Professional	5	21.7	18	78.3	
Number of residents	5 or less	68	52.7	61	47.3	0.595
	6 or more	162	55.3	131	44.7	
	Yes	224	56.0	176	44.0	
	No	6	27.3	16	72.7	

Table 3: Housing modifiable risk factors for visceral leishmaniasis.

		Yes		No		P value
		N	%	N	%	
Housing structure	Mud-walled house	215	61.8	133	38.2	<0.01
	Raised house	15	20.3	59	79.7	
Thatched roof	Yes	221	57.1	166	42.9	<0.01
	No	9	25.7	26	74.3	
Presents of shed in the compound	Yes	224	56.3	174	43.7	<0.01
	No	6	25.0	18	75.0	
Sleep on bed	Yes	228	54.9	187	45.1	0.21
	No	2	28.6	5	71.4	
House with cracks	Yes	215	63.0	126	37.0	<0.01
	No	15	18.5	66	81.5	

Table 4: Animal modifiable risk factors for visceral leishmaniasis.

		Family member suffered from the visceral leishmaniasis disease				
		Yes		No		
		N	%	N	%	P value
Own cows	Yes	189	62.6	113	37.4	<0.01*
	No	41	34.2	79	65.8	
Own goats	Yes	219	57.9	159	42.1	<0.01*
	No	11	25.6	32	74.4	
Animal disposal Waste disposal site	In the compound	84	39.6	128	60.4	<0.01*
	In the farm	10	32.3	21	67.7	
	Not collected at all	136	76.0	43	24.0	
Spray animals with insecticides	Yes	220	56.6	169	43.4	0.01*
	No	10	30.3	23	69.7	

Table 5: Individual modifiable risk factors for visceral leishmaniasis.

		Family member suffered from the visceral leishmaniasis disease				
		Yes		No		
		N	%	N	%	P value
Activity involved during the day	Take care of the animals	206	48.8	142	33.6	<0.01*
	Cultivate crops in the farm	24	32.4	50	67.6	
Sleeping under acacia tree	Yes	40	58.0	29	42.0	<0.01*
	No	216	51.2	137	32.4	
Slept outside the house	Yes	14	20.3	55	79.7	<0.01*
	No	205	72.2	79	27.8	
Presence of ant hills nearby your homestead	Yes	25	18.1	113	81.9	<0.01*
	No	184	47.5	100	26.0	

Those who lived with animals within the compound and had been infected with visceral leishmaniasis were 224 (56.3%) compared with those without animals or cowsheds within the compound 6 (25.0%) p<0.01). The presence of cracks in the house and having been affected contributed to 215 (63.0%) more than those living in the houses without crack 15 (18.5%) p<0.01 (Table 3).

Using multinomial logistic regression, the significant housing risk factors were assessed to determine to what extent they predicted a family member having visceral leishmaniasis. Roof thatching was a statistically significant independent predictor of a family member having visceral leishmaniasis; respondents who had thatched roofs were 10% less likely to have a family member with visceral leishmaniasis than those who didn't have thatched roofs OR (95% CI) = -0.899 (1.123 - 5.38). Cracks in house was a statistically significant predictor of a family member having visceral leishmaniasis; respondents whose houses had cracks were 63% more likely to have a family member with visceral leishmaniasis than those whose houses dint have cracks OR (95% CI) = 1.635 (0.553-1.635).

Animal risk factors

The study found the following animal risk factors significantly associated with a member of the family having visceral leishmaniasis; ownership of cows p<0.01), ownership of goats p<0.01), place of disposing animal waste p<0.01), and spraying of animals with insecticide p<0.01). The summary of the results is as shown in Table 4.

Using multinomial logistic regression, the significant animal risk factors in Table 4 above were assessed to determine to what extent they predicted a family member having visceral leishmaniasis. Ownership of cows was a statistically significant independent predictor of a family member having visceral leishmaniasis; respondents who had cows were 17% more likely to have a family member with visceral leishmaniasis compare to those who did not have cows OR (95% CI) = 1.177 (1.961-5.371). Ownership of goats was also a statistically significant predictor of visceral leishmaniasis; respondents who owned goats had were 25% more likely to have a family member with visceral leishmaniasis than those whose did not own goats OR (95% CI) = 1.254 (1.464-8.395). In addition, disposing of waste in the compound was also a statistically significant predictor of visceral leishmaniasis; respondents who dumped animal waste in the compound were 56% more likely to have a family member with visceral leishmaniasis than those whose did not OR (95% CI) = 1.564 (.133-3.330).

Individual risk factors

The study also found the following individual risk factors significantly associated with a member of the family having visceral leishmaniasis; Daily activity 35.24, p<0.01), sleeping under acacia tree 53.42, p<0.01), sleeping outside the house 112.7, p<0.01), and presence of ant hills nearby homestead 32.42, p<0.01). The summary of the results is as shown in table 5.

Using multinomial logistic regression, the significant animal risk factors in Table 5 above were assessed to determine to what extent they predicted a family member having visceral leishmaniasis. Sleeping outside was a statistically significant independent predictor of a family member having visceral leishmaniasis; respondents who had slept outside were 2 times more likely to have a family member with visceral leishmaniasis compared to those who had not slept outside OR=2.118 (4.766-14.496). However, there was no significant statistical association between sleeping under acacia tree OR=0.094 (4.766-14.496) and visceral leishmaniasis.

DISCUSSION

Demographic risk factors

Results also showed that respondents who were able to read were 60% less likely to have a family member with visceral leishmaniasis than those who were not able to read. This is in agreement with findings reported in a prospective study done on the VL risk factors in India and Nepal, 2014 where results showed out that seroconversion and risk of VL were strongly associated with the illiteracy levels.[11]

Findings also showed that occupation had a significant association with likelihood of a family member in the household to suffer from visceral leishmaniasis. A similar study found that majority of the respondent's main source of income was livestock herding, and the majority of the participants housing conditions were hut/Manyatta with mud walls.[8]

Housing risk factors

The study found the following housing risk factors significantly associated with a member of the family having visceral leishmaniasis; type of house structure, those who lived in mud houses (61.8%) were more affected. Subsequently, those whose house roof was thatched and infected were 57.1%. The houses that were found to be cracked were at 63.03%. This is agreement with studies done in rural India that reported a significant association between housing characteristics (example-walls, roof, floors, or windows) and leishmaniasis infection.[12]

Presence of animals inside the compound also showed that there is a relationship with visceral leishmaniasis. This relates with study was carried out in Judean Desert and it showed that small numbers of larvae was recovered in animal burrows, termite mounds, domestic animal shelters, cracked walls.[13]

Animal risk factors

The study found the following animal risk factors significantly associated with a member of the family having visceral leishmaniasis; ownership of cows, ownership of goats, place of disposing animal waste, and spraying of animals with insecticide ($p<0.01$). Disposing of waste in the compound was also a statistically significant predictor of visceral leishmaniasis; respondents who dumped animal waste in the compound were 56% more likely to have a family member with visceral leishmaniasis. Similar studies done in Kenya found that the presence of domesticated animals at the household level could be associated with Visceral Leishmaniasis.[14]

Individual risk factors

Daily activity such as taking caking of animals or crop farming, sleeping under acacia tree, sleeping outside the house at night, and presence of ant hills nearby homestead is statistically associated with vl ($p<0.01$). Other similar studies have found that presence of active termite mounds and or playing or sleeping around the anti-hills and or termite mounds in the field or within the homestead could be associated with VL infection. The findings are compatible with the findings of a cross-sectional epidemiological study done in Gode and Adadle districts of Shebelle Zone, Somali region in 2016. It showed that there was association of vl presence of active termite hills [odds ratio (95% confidence interval): 12.58 (5.911–26.763).[15]

Study limitation

The study area is vast especially Tiaty and is prone to insecurity since time immemorial.

CONCLUSION

From the study, the following risk factors increased the likelihood of a family member getting visceral leishmaniasis infection; illiteracy level, livestock herding, presence of animals (cows and goats) within the compound. Also the issue of not collecting and disposing well animal waste, spraying of animals with insecticides increased the chances of infection. Individual risk factors such as sleeping outside during the night, sleeping under acacia tree and presence of anthills within the compound statistically increased the likelihood of vl infection. Visceral leishmaniasis infection is attributed to the knowledge gap on risk factors and prevention measures.

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