Original Research Article

Risk Factors Associated with Leishmaniasis among Residents of Rural Marigat Sub-County, Baringo County- Kenya.

ABSTRACT

Aim: Leishmaniasis is a parasitic and vector-borne disease existing in two main forms, Cutaneous Leishmaniasis and Visceral Leishmaniasis with an average global incidence of 0.95 and 0.3 million cases consecutively per annum. The study determined the prevalence and risk factors associated with Leishmaniasis in Baringo County-Kenya

Methods: Analytical cross-sectional study design that employed a mixed method was used. Study recruited 333 head of households in Marigat sub-County of Baringo County-Kenya. Purposive and multistage sampling techniques were used to recruit study participants. SPSS version 26 was used for analysis of quantitative data. Statistical test employed were X^2 test of independence and binary logistic regression. NVivo version 10 was used for analysis of qualitative data.

Results: Of 333 participants, 96 reported to have had Leishmaniasis translating to the prevalence of 28.8%. Increased odds of contracting Leishmaniasis were associated with living in a temporary house (OR = 5, 95% CI 2.64 – 9.44), Living below the poverty line **(**OR = 2.4, 95% CI 0.23 – 0.78), primary level of education (OR = 8.6, 95% CI 0.14 – 0.97), presence of termite hills (OR = 7.6, 95% CI 0.60 – 0.97) and presence of soil cracks (OR = 3.6, 95% CI 0.16 – 0.50). Having bed net (OR = 3.5, 95% CI 1.90 – 6.57), use of repellent (OR = 3.7, 95% CI 1.58 – 8.58), and wearing long sleeves after sunset (OR = 2.5, 95% CI 0.24 – 0.84) were associate with decreased odds of Leishmaniasis infection.

Conclusion: In the study area, Leishmaniasis was found to be aggravated by low level of education, living below the poverty line, living in a temporary house, presence of termite hills and soil cracks near the residential area. Government should network with development partners to improve the livelihood of people and people should destroy dormant termite hills around their area of residence.

Key words: Leishmaniasis, Risk factors, Prevalence, Baringo County, Kenya

1. INTRODUCTION

Leishmaniasis is a neglected tropical illness that primarily affects poor people who have little access to healthcare (1). Leishmaniasis is endemic in 97 nations around the world, including Kenya; 88 of these are CL hotspot regions, 78 are VL hotspot regions, and 69 are both CL and VL hotspot locations (1). Leishmaniasis exists mainly in two forms which are CL with an annual incidence of 0.7 to 1.2 million cases globally. Another form of Leishmaniasis is VL which is the most severe form, with estimated annual new cases of 0.2 to 0.4 million globally (2).

Worldwide, there are 20,000 to 40,000 deaths occur annually due to VL and making it to be the leading killer among neglected tropical diseases (3). Visceral Leishmaniasis is common in Africa and America, while Cutaneous Leishmaniasis is common in Asia and Europe. WHO 2020 report shows more than 90% of VL cases were from seven countries, namely Brazil, Ethiopia, India, Kenya, Somalia, South Sudan, and Sudan, and 95% of CL occurred in America, Mediterranean Basin, Middle East, and Central Asia (1). A retrospective study done in Ethiopia using the Hospital admission database from 2012 to 2017 found a rapid increase in Leishmaniasis mortality from 3.3% in 2012 to 5.4% in 2017% (4). This information signifies less public health attention toward Leishmaniasis.

In Kenya, the endemic areas for visceral Leishmaniasis are the arid regions of Rift Valley, Eastern, and North-Eastern regions. Of these regions, Baringo, Isiolo, Marsabit, Pokot, Turkana, and Wajir Counties are said to be the major transmission centres for Visceral Leishmaniasis in Kenya (5). The epidemiological survey conducted at Baringo County in 1999 and 2006 found 78/2,934 (2.7%) and 154/489 (31.5%) cases of Visceral Leishmaniasis and Cutaneous Leishmaniasis consecutively (6). Analysis of seven-years data (2010-2016) at Kimalel Health Centre, Baringo County, from a retrospective observational study found that males are predominantly affected compared to females with male-female ratio of 3:1. The 2nd Kenya National Strategic Plan for Control of Neglected Tropic Diseases (NSP-NTDs), 2016-2020, intends to reduce the morbidity of Leishmaniasis in Leishmaniasis endemic areas by reducing the number of the sandfly, improving early case detection and strengthening the surveillance system. NSP-NTDs also support the operational research in assessing predisposing environmental and behavioural factors to Leishmaniasis (6). The study determined the magnitude and risk factors associated with Leishmaniasis both, socio-economic, behavioural, and environmental risk factors in Marigat sub-County of Baringo County, Kenya. The study also proposed, the Government to network with development partners and NGOs to come up with poverty alleviation programmes for the sake of improving the livelihood of people who are living below the poverty line and increase the capability of the community to afford good housing. Residents should avoid misuse of bed nets and to effectively use them as it's protective and they should also destroy dormant termite hills around their residential area as they provide hiding and breeding sites for Leishmania vectors.

2. MATERIALS AND METHODS

2.1 Study design

Analytical cross-sectional study design was used which employed mixed method for the purpose of triangulation.

2.2 Study area

It was caried out in Marigat sub-County of Baringo County among the head of households in the rural Marigat sub-County of Baringo County. As of the 2019 census, the Marigat sub-County has a total population of 90,955 with a more male population (45,706) as compared to the female population (45,246) (7). Sub-County has a total of 27 health facilities, one level four hospital, three-level three hospitals, eighteen level two hospitals, and five level one facilities. Administratively the sub-County has three wards, eighteen locations, thirty-seven sub-locations, and three hundred and forty-eight villages.

2.3 Study population

The study recruited 333 head of households. In this case, the household head was the father, mother, or the older person in a family.

2.4 Sample size determination.

The sample size was determined from the prevalence of Leishmaniasis found in the previous study from another County. In the research done at Marsabit County Kenya from 2013 to 2014, of the 433 suspected Visceral Leishmaniasis cases, 136 cases were laboratory-confirmed to be positive cases that is 31.8% of all suspected cases (8).
From the Fisher's formula of sample size calculation using the prevalence from the previous study,

$$n = \frac{z^2 p\,(100-p)}{d^2}$$

Whereby

n is the sample size

z is the statistic corresponding to the decided level of confidence, in this case, 95% with a z value of 1.96

p is the prevalence obtained from the previous study

d is the amount of error that can be tolerated by the study, in this case, 5%.

So

$$n = \frac{1.96^2 * 31.8\,(100-31.8)}{5^2}$$

n = 333.26 ≈ 333

2.5 Sampling Techniques

Purposive sampling was used to select the study area from the County Level, Baring County to location level, Marigat location and to select the participants in the Focus Group Discussion (FGD) and Key Informants Interview (KII). Multistage sampling was used to select sub-locations and the study participants in quantitative approach. Marigat location has three sub-locations namely Perkerra, Endao, and Yatoi with 2300, 612, and 2943 households consecutively, where simple random sampling was used to select two sub-locations by lottery method in this case, Perkerra with 2300 households and Endao 612 households. The sample size of 333 was proportionally distributed to selected sub-locations, where the sample of 263 and 70 households were randomly drawn from Perkerra and Endo respectively. A systematic sampling technique was used to obtain the households from the selected sub-locations. In each sub-location, the sampling interval (k^{th} value) was determined by dividing the total number of households by proportionated sample size, in this case, the sampling interval of 8 was used in Perkerra and Endao as well. The first household was randomly selected by lottery method from the sampling interval of 8.

2.6 Quantitative data collection

Quantitative data was collected using a questionnaire with both open and close-ended questions and an observation checklist. The questionnaire had five sections with social demographic characteristics, Leishmaniasis status which was self-reported, behavioural factors related to Leishmaniasis, socioeconomic factors, and environmental factors associated with Leishmaniasis respectively. The observation checklist had two sections, socio-economic factors, and environmental risk factors.

2.7 Qualitative data collection

FGD and KII were used for qualitative data collection from the study participants. FGD extracted information from the participants by using a focus group discussion guide with pre-prepared questions. Participants were divided into three groups, a group of men, women, and a group of sub-location leaders with seven, six, and seven participants respectively. Moderator recorded the discussion by using a smartphone with flight mode on to avoid interruptions like calls. The Key Informants Interview guide was used to get details from experts in Kimalel Health Centre. Three Key Informants Interviews were conducted, with the clinical officer, nurse, and community health volunteer.

2.8 Quantitative and qualitative Data analysis

Statistical Package for the Social Sciences (SPSS) version 26. Categorical variables were summarised by frequency and percentage and the numerical variable was summarised by median and interquartile range. In bivariate analysis, Chi-square test of independence was run to assess the relationship between the dependent and independent variables where the significance level was set at a *P*-value of ≤ .05. Multivariate logistic regression, in this case, binomial logistic regression was carried out for the factors found to be significant in bivariate analysis. The findings were presented using text, tables, and figures.

Qualitative data was analysed by NVivo version 10. Recorded audios were transcribed to textual format objective-wise. Transcripts were then entered into NVivo software for analysis. Objectives were coded as parent codes and variables under each objective as child codes. Information regarding each variable was put in the respective codes as provided by the respondents

3. FINDINGS

3.1 Quantitative findings

3.1.1 Sociodemographic characteristics of the respondents

From (table 1), the study recruited 333 participants from Marigat location in Marigat sub-County of Baringo County, of which 263 (79.0%) of the respondents were from Perkerra sub-location and 70 (21%) were from Endao sub-location. The median age of participants was 35 years with an interquartile range (IQR) of 17. More than half of the respondents were female (194, 57.7%). Majority of them were spouses (158,47.4%) with relatives being the least respondents (3, 0.9%). More than three quarter of respondents were married (271, 81.1%), In terms of education status, Majority (205, 61.6%) were having a primary level of education.

Table 1: Summary of sociodemographic characteristics of the respondents (n =333)

Variable	Categories	Frequency(n)	Valid Percent (%)	Median	IQR
Gender	Male	141	42.3		
	Female	192	57.7		
	Total	333	100.0		
Relationship to household head	Household head	148	44.4		
	Spouse	158	47.4		
	Son	11	3.3		
	Daughter	13	3.9		
	Relative	3	.9		
Marital status	Single	51	15.3		
	Married	271	81.4		
	Widower	6	1.8		
	Widow	5	1.5		
Level of education	Never gone to school	43	12.9		
	Primary education	162	48.6		
	Secondary education	100	30.0		
	College+	28	8.4		
Sub-location of residence	Endao	70	21.0		
	Perkerra	263	79.0		
Age in years				35	17

3.1.2 Prevalence of Leishmaniasis among residents of rural Marigat Sub-County in Baringo County, Kenya

Ninety-six (96) respondents reported having ever contracted Leishmaniasis out of a random sample of 333 from two sub-locations of Endao and Perkerra. This translates to a prevalence rate of 28.8%. Of these, 23(6.9%) were from Endao sub-location and 73 (21.9%) were from Perkerra sub-location.

3.1.3 Socioeconomic factors associated with Leishmaniasis

Association between socioeconomic factors and the risk of contracting Leishmaniasis was established by chi-square test of independence and binary logistic regression for variables which were significant in bivariate analysis. In bivariate analysis the following variables showed a significant relationship with the dependent variable, level of education (X^2 =15.629, *df* =3, *P* =.001), average monthly income (X^2 =31.781, *df* =1, *P*<.001), type of the house (X^2 =60.655, *df* =2, *P*<.001), condition of the wall (X^2 =9.615, *df* =1, *P* =.002), and condition of the floor (X^2 =17.549, *df* =1, *P*<.001). While there was no significant association between the dependent variable Leishmaniasis status and occupation (X^2= 7.691, *df* =3, *P* =.053), keeping domestic animals (X^2 =1.081, *df* =1, *P* =.3), and source of fuel for cooking (X^2 =4.62, *df* =3, *P* =.2). Logistic regression (table 2) demonstrated that individuals living below the poverty line were 2.5 times more likely to contract Leishmaniasis. Those living in temporary houses were 5.7 times more likely to contract Leishmaniasis than those in semi-permanent houses. Furthermore, individuals who had never been to school and those with a primary level of education are 15 and 8.6 times more likely to contract Leishmaniasis than those with a college level of education.

Table 2: Multivariate Logistic regression for socioeconomic factors associated with Leishmaniasis.

Step 1[a]	B	df	Sig.	OR	95% CI for OR	
					Lower	Upper
Income groups (1)	-.867	1	.006	.420	.227	.778
House type		2	.000			
House type (1)	.276	1	.773	1.318	0.201	8.633
House type (2)	1.608	1	.000	4.994	2.641	9.440
Wall condition (1)	.302	1	.369	1.352	0.700	2.612
Floor condition (1)	-.360	1	.363	.698	0.321	1.515
Level of Education		3	.084			
Education level (1)	-2.703	1	.016	.067	0.007	0.602
Education level (2)	-2.153	1	.046	.116	0.14	0.966
Education level (3)	-2.018	1	.062	.133	0.016	1.105
Constant	2.538	1	.023	12.651		

3.1.4 Behavioural factors associated with Leishmaniasis

This study also sought to identify human behavioural factors associated with Leishmaniasis. A chi-square test of independence revealed the following variables had a significant relationship with the dependent variables, having bed net (X^2 =25.672, *df* =1, *P*<.001), using insect repellents (X^2 =19.018, *df* =1, *P*<.001), type of clothes after sunset (X^2 =16.664, *df* =2, *P*<.001), and spending time outdoor after sunset (X^2 =5.546, *df* =1, *P* =.02). On the other hand, chi-test did not show the association between the outcome variable Leishmaniasis status and spraying the house with insecticides (X^2 =3.097, *df* =1, *P* =.08), and installing a window screen mesh (X^2 =2.184, *df* =1, *P* =.17).

The variables with statistically significant association with the dependent variable were then modelled with the binary logistic regression (table 3) and individuals with bed nets were 3.5 less likely to contract Leishmaniasis, while those who are not using repellents were 3.7 times more likely to contract the disease. Besides, individuals putting on long-sleeved clothes after sunset were 2.2 times less likely to contract the disease than those putting on any other kind of clothes after sunset.

Table 3: Multivariate Logistic regression for behavioural risk factors associated with Leishmaniasis.

Step		B	df	Sig.	OR	95% CI for OR	
1[a]						Lower	Upper
	Bed net (1)	1.262	1	.000	3.533	1.899	6.572
	Repellent (1)	1.305	1	.002	3.686	1.583	8.584
	Type of clothes		2	.014			
	Type of clothes (1)	-.113	1	.727	0.893	0.594	2.109
	Type of clothes (2)	-.908	1	.009	.403	0.243	0.840
	Hours outdoor after sunset (1)	.596	1	.076	1.814	0.940	3.501
	Constant	-.141	1	.704	.868		

3.1.5 Environmental factors associated with Leishmaniasis

The last objective of this study was to determine the environmental factors associated with Leishmaniasis among residents of rural Marigat Sub-County in Baringo County, Kenya. A significant association was found between the presence of water-logging (X^2 =4.739, *df* =1, *P* =.03), presence of gorges around the residential area (X^2 =4.732, *df* =1, *P* =.03), presence of termite hill(s) around the residential area (X^2 =45.627, *df* =1, *P*<.001), presence of vegetation around the homestead (X^2 =16.394, *df* =1, *P*<.001), and presence of soil cracks and crevices in the area (X^2 =35.921, *df* =1, *P*<.001). While there was insignificant association between irrigation scheme in the area of residence (X^2 =1.1278, *df* =1, *P* =.26), distance between the household and animal shed (X^2 =0.888, *df* =1, *P* =.51), and cultivated farms near the household (X^2 =0.752, *df* =1, *P* =.39). In multivariate logistic regression (table 4), only two variables were found to be significant and individuals with no termites' hills around the residential area are 7.6 times less likely to contract Leishmaniasis than those with termites' hills around their residential area. Furthermore, presence of soil cracks and crevices in the area increased the odds of contracting Leishmaniasis by 3.6.

Table 4: Multivariate Logistic regression for environmental risk factors associated with Leishmaniasis.

		B	df	Sig.	OR	95% CI for OR	
						Lower	Upper
Step 1[a]	Waterlogging (1)	-.623	1	.057	.536	0.282	1.019
	Gorges/caves (1)	.335	1	.270	1.397	0.771	2.532
	Termite Hills (1)	-2.035	1	.000	.131	0.60	0.285
	Vegetation (1)	-.463	1	.213	.630	0.304	1.303
	Soil cracks (1)	-1.274	1	.000	.280	0.157	0.498
	Constant	3.628	1	.000	37.653		

3.2 Qualitative findings

Qualitative approaches used were Focus group discussion and key informants interview. Three themes on the risk factors associated with Leishmaniasis were generated, socioeconomic, behavioural and environmental factors associated with Leishmaniasis.

3.2.1 Theme 1: Socioeconomic factors associated with Leishmaniasis

From the focus group discussion and key informants interview the following sub themes were generated from the theme socioeconomic factors associated with Leishmaniasis; level of family income, type of house and occupation. Findings from FGD and KII showed people who are living under poverty are at higher risk of being infected as they are less likely to afford protective measures. Temporary type of house was reported to provide the hiding and breeding places of the vector and increase likelihood of being infected. Also, outdoor occupation like farming animal keeping, burning of charcoal and bee keeping were reported to increase the likelihood of being infected by Leishmaniasis;

"…. Economically, the reason actually is poverty as a person might go to the farm as a labour and get a little amount whereas a person cannot build a good house, buy a net or repellent, instead uses the little amount to cater for food……" (R3 FGD, women)

"……. The houses they live in, you cannot say they are permanent, also you cannot say even semi-permanent, they are temporary structures instead. So, flies can get access, and enters the house directly and bites a person…." (KII, nurse in-charge)

"……Farmers are at the risk especially when they go to the farm during the night for irrigation, for livestock keepers especially when they spend a night outdoor caring for their cattle. Also, bee keepers is another group at risk as the occupation involves forest visit and mostly is being done at night hours ……." (R4 FGD, 'Village leaders).

3.2.2 Theme 2: Behavioural risk factors associated with Leishmaniasis.

Under this theme, participants from FGD and KII reported that not using and misuse of bed nets, type of clothes being worn after sunset was another factor reported by the respondents as wearing long sleeves was reported to be protective and short-sleeves to increase the exposure. Furthermore, spending time outdoor after sunset was another factor that increases the risk of being infected;

"…… You know, most of our people we give them nets, but they are not using nets the way it is supposed to be used, you just find some people use the nets to fence the chicken shed, to fence the garden, they don't adhere to what we have told them to use the nets for…." (KII, nurse in charge)

"….. lack of nets, especially many people do not have the net, people are just sleeping without nets, so they get bitten by the vector and get infected. Some don't know the importance of the nets, like our parents used to say, even us we were born in the era where there were no nets and we survived and we have also seen those who are using it got infected as well……" (R1 FGD, women).

"……. During the night hours, maybe they don't even wear long sleeves to protect themselves from the bite especially during the summer season as the weather is very hot…." (KII, clinical officer in charge).

"…. You might find during the night people decide to sleep outdoors justifying it is hot indoors, without considering that you risk your life by exposing yourself to sandfly vector …." (KII, CHV).

3.2.3 Them 3: Environmental risk factors associated with Leishmaniasis

The findings under this theme showed presence of termite hills, vegetation, and irrigation scheme near the residential areas increase the likelihood of Leishmaniasis infection;

"…… I can liaise with the habitat of the sandfly, the site they live in because in most of our places we have the anthills, especially the dormant ones where this vector can hide, live in and breed…" (KII, clinical officer in charge).

"…. You see in our place here, presence of these trees also contributes, sometimes when it is sunny you look for a shed under these trees, you might find yourself bitten by these vectors this increases the transmission rate of Leishmaniasis…." (R4, FGD, Village leaders).

"…. Irrigation can be one of the reasons, we can say the time spent in the farm for irrigation, going to that farm for a very long duration, resting under those trees, you see, that is now the time they can interact with that bite. So, farming part of it and the way they do it can contribute to the risk of contracting Leishmaniasis ……. "(KII, clinical officer in charge).

"……. for us in our place we can even spend a whole night on the farm for irrigating our farms, especially if we are told that today is our turn. Everyone should fight to channel water to his or her own farm that day because if you miss, you will not get it unless you wait for the next round. So, it is must you go to the farm even until morning, now in the process of irrigation overnight, you might find you're being bitten by the vector mostly on the face, upper extremities, and lower extremities……" (R2 FGD, Women).

4. DISCUSSION

Leishmaniasis status was determined by the self-reporting method and prevalence was found to be 28.8%. This prevalence was lower as compared to the prevalence of 38.0% of Cutaneous Leishmaniasis reported from the study done in the endemic rural community of Tigray region, Ethiopia. This difference was attributed to the method of recruiting study participants, in this study only one person in the household was recruited to participate but the comparison study was focusing to find out the number of household members who had been infected by Cutaneous Leishmaniasis (9).It is almost the same as the prevalence of 31.4% from the retrospective study done in Marsabit County which enrolled 433 suspected cases of Visceral Leishmaniasis, after doing laboratory testing, 136 of them were laboratory confirmed to have Visceral Leishmaniasis. Though the study design and methods used were different, but prevalence was found to be almost the same (8).

There was a significant relationship between the level of education attained and the risk of contracting Leishmaniasis as individuals who had never been to school and those with a primary level of education are 15 and 8.6 times more likely to contract Leishmaniasis than those with a college level of education. In this case, education makes a person informed and easily adopt protective measures to cut the transmission cycle of the disease. The study done in the western part of Ethiopia by Yared *et al* (2014), reported the same findings that a lower level of education is associated with increased odds of being infected by Leishmaniasis. But these findings were contrary to the findings from a case-control study done in a peri-urban settlement in Kenya where most of the cases (94.8%) had a primary level of education and below but the level of education was not a risk factor for contracting Cutaneous Leishmaniasis (11).

In this study poverty line was set at 1.90$ a day as per the World Bank report of 2021, an individual earning less than 1.90$ a day was considered to be below the poverty line category. In this study, family income was associated with the risk of being infected by Leishmaniasis and participants who were living below the poverty line were 2.4 times more likely to contract Leishmaniasis as compared to those living at and above the poverty line. This might be because people who are earning more are likely to afford the cost of protective measures against the vector-like buying insect repellents, bed nets among others. These findings were consistent with the results obtained from the study done by (12) where monthly income was significantly associated with the risk of contracting the disease as living below the poverty line increases the likelihood of getting Leishmaniasis. Also consistent with findings from a study on socioeconomic, demographic, and landscape factors associated with Cutaneous Leishmaniasis carried out in Sri Lanka where the odds of being infected by Leishmaniasis increased with poverty as the participants earning below 56.76$ a month which is almost 1.90$ a day were 9.5 times higher likely to be infected as compared to those earning 170.27$ a month (13).

This study classified type of house as permanent, semi-permanent, and temporary house depending on the nature of the building materials. More than half of the participants living in temporary houses were infected with Leishmaniasis and around one sixth of those living in a semi-permanent type of house reported to have had the infection. Most likely it is because materials used in building the temporary type of house like thatch, timber, mud, poorly joined wall of iron sheets provide the breeding and hiding place for the Leishmaniasis vector. There was a significant association between the type of house a person was living in and the risk of being infected with Leishmaniasis and the odds of infection was found to increase with living in a temporary house as individuals living in a temporary house were 5 times higher likely to be infected as opposed to individuals living in a semi-permanent type of house. The findings were in agreement with the findings from the study done in Nepal, where living in the house made up of bamboo walls increases the odds of being infected 8.1times (14). These findings were also similar to the findings from a case-control study carried out in high endemic areas of Morang district in Nepal which recruited 310 participants where people living in a thatched house had 4.72 times likelihood of contracting Leishmaniasis as compared to people living in a brick house (15).

Having a bed net was found to be protective as participants who had bed nets were 3.5 times less likely to contract Leishmaniasis compared to those who did not have bed nets this could be because sleeping under bed net reduces a person-vector interaction and reduce the risk of being infected. Findings were in line with the findings from the study among the head of households in Sudan where a bed net was found to decrease the risk of Leishmaniasis infection (12). The findings were also similar to the findings from a

retrospective cohort study done in Bangladesh on the effectiveness of Long-Lasting Insecticide Treated Nets (LLITNs) where after three years of follow-up, a significant reduction in the incidence of Leishmaniasis cases in the intervention group was observed (16). This was in contrast with the findings from the study done among immunocompetent individuals in Thailand which reported that there was no significant relationship between having a bed net and the risk of getting Leishmaniasis (17).

Using insect repellent was found to be protective as this factor had 3.7 times reduced odds of being infected by Leishmaniasis. This is similar to the study done in Trang province, southern Thailand among HIV infected patients where 77.8% of the respondents were not using insect repellent and the risk of Leishmaniasis infection was found to be 3 times higher among respondents who were not using insect repellent (18). However, in the study carried out in Thailand, factors other than insects repellent were associated with Leishmaniasis infection (17).

Wearing short-sleeves after sunset was attributed to increased odds of Leishmaniasis infection due to the fact that; short sleeves expose the upper and lower extremities to an insect bite. Wearing long sleeves after sunset was found to be protective as people wearing long sleeves after sunset were 2.5 less likely to contract Leishmaniasis as compared to people wearing short-sleeves. These findings were in agreement with the findings from the study in Thailand where wearing long sleeves after sunset was reported to decrease the odds of infection by 4.0 times. (17)

Presence of termite hills around the homestead increases the likelihood of contracting Leishmaniasis by 7.6 times. This could be due to termite hills especially the dormant ones acting as a habitat, hiding place, and breeding sites for sand flies. This was in agreement with the findings from the study done in Kurunegala district in Sri Lanka where the presence of termite hills was reported to increase the odds of being infected by Leishmaniasis 2.4 times (13). But the proximity of termite hills to the household was not associated with an increased risk of contracting Leishmaniasis as reported by the study done in the Pokot territory in two East African Countries, Kenya and Uganda. This difference could be attributed to the difference in study design and the fact that termite hills were common to both case and control groups (19).

Almost half of the participants whose soil cracks were observed to be near their residential areas have had Leishmaniasis and only one sixth of those whose soil cracks were not observed to be near their residential area had Leishmaniasis. This could be because soil cracks hide and provide a breeding site for the Leishmaniasis vector. Presence of soil cracks near the residential area was found to increase the chances of being infected as respondents whose households were near the areas with soil cracks were 4.0 times more likely to be infected by Leishmaniasis compared to their counterparts. This is in agreement with the findings from the study done in the Tigray region where the presence of cracked black soil was reported to increase the likelihood of Leishmaniasis infection 6.0 times (10). But in contrast to the study on ecology and control of sandfly vector by (20) which ruled out soil crack as a risk factor for Leishmaniasis as collection of the vector from soil cracks did not provide consistent results.

CONCLUSION

Leishmaniasis is a tropical disease most common in arid and semi-arid regions. In this study, the prevalence of Leishmaniasis was found to be 28.8% as 96 respondents out of 333 reported to have had Leishmaniasis. Findings from this study showed the association between the level of education, family income, the type of house, wall condition, floor condition, having bed net, use of repellent, type of clothes worn after sunset, spending time outdoor after sunset, presence of termite hills, soil cracks, vegetation, gorges/caves, and waterlogging near the residential areas with the risk of contracting Leishmaniasis. The low level of education, living below the poverty line, living in a temporary house, presence of termite hills near the residential areas, and presence of soil cracks near the area of residence were found to increase the risk of being infected by Leishmaniasis. While having a bed net, the use of repellents, wearing long sleeves after sunset were found to be protective as they reduce the risk of being infected by Leishmaniasis.

ETHICAL APPROVAL AND CONSENT

The ethical clearance to do this study was obtained from Mount Kenya University Institutional Research Ethics and Review Committee. Permit to conduct the research was sought from National Commission for Science, Technology, and Innovation. Further legal documents to conduct this research in a given area were obtained from the County Department of Health Services, the County director of education, and the County Commissioner. Participation was voluntary, and the researcher obtained a written informed consent from the participants.

RECOMMENDATIONS

1. The County government through health officials should organise for health education and awareness programmes to emphasise the frequent use of bed nets as most of the infected respondents were having bed nets but they were rarely using it.
2. Government should network with development partners and NGOs to come up with poverty alleviation programmes to improve the livelihood of people who are living below the poverty line and increase the capability of the community to afford good housing.
3. Residents should avoid misuse of bed nets and to effectively use them as it's protective.
4. Residents should destroy dormant termite hills around their residential area as they provide hiding and breeding sites for Leishmania vectors.
5. People should immediately take to the hospital any suspected case of Leishmaniasis for diagnosis and treatment as it is one of the Government free Health services

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