

Factors associated with Visceral Leishmaniasis infection in Gode General Hospital, Gode, Somali Region, Eastern Ethiopia. A case control study

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Abstract

Background: Tropical diseases are global public health concern claiming millions of lives. Leishmaniasis is one of the neglected tropical diseases caused by intracellular protozoan parasite; visceral leishmaniasis (VL) is the most severe and fatal if left untreated. There is no published data on factors associated with VL in the study area.

Objective: To assess associated risk factors for Visceral Leishmaniasis in Gode General Hospital, Somali region, eastern Ethiopia.

Methods: An unmatched case-control study was conducted on 510 study participants (102 cases and 408 controls) using convenient sampling technique at Gode General Hospital from April 01 – June 30, 2024. Structured questionnaire was used to collect socio-demographic information and other risk factors. Retrospective record reviewing was carried out in the Hospital for the cases. 102 recent and accessible cases were selected. Data collectors went to three selected districts where cases are living. Controls were selected randomly from the houses near by the cases. VL was screened from the controls using rapid test (rk39). Data were entered into Epi-data 4.6, exported to and analyzed in SPSS version 25. Bivariate and multivariable logistic regression analysis was carried out to measure the strength of association between outcome and independent variables. In bivariate regression, variables with p -value ≤ 0.25 were set for multivariable regression analysis. P - Value <0.05 at 95% confidence interval was used as significance level.

Result: Male sex; AOR with 95%CI: 2.6(1.6 -4.3, $p=0.00$), type of house wall; AOR/95% CI 2.0(1.2 -3.4, $p=0.006$), presence of member with VL in the family; AOR/95% CI 2.7(1.6-4.4, $p=0.00$), outside sleeping habit; AOR/95% CI 1.7(1.0 -2.7, $p=0.04$), presence of termite hill near the home; AOR/95% CI 1.6(1 – 2.6, $p=0.047$) and mosquito net usage; AOR/95% CI 0.6(0.4 – 0.9, $p=0.039$) were found statistically associated with Visceral Leishmaniasis.

Conclusion: Male sex, presence of VL confirmed member in the household, presence of termite hill near the house, an outdoor sleeping habit and mud type of house wall were statistically associated with increased risk of acquiring VL. In contrast, possession and usage of mosquito net usage was statistically associated with reduced risk of VL. Housing conditions should be improved lowering mud wall, removing termite hills near households, personal habits should also be improved by creating awareness towards prevention and control of VL.

Keywords: Visceral Leishmaniasis, Risk Factors, Gode, Eastern Ethiopia, Infection

List of Abbreviations/Acronyms

AIDS Acquired Immunodeficiency Syndrome
AOR Adjusted Odds Ratio
COR Crude Odds Ratio
CI Confidence Interval
CL Cutaneous Leishmaniasis

HIV Human Immunodeficiency Virus
MCL Muco-cutaneous Leishmaniasis
TB Tuberculosis
VL Visceral Leishmaniasis

1. Introduction

Leishmaniasis is tropical disease caused by protozoan parasites which are transmitted by the bite of infected female phlebotomine sandflies [1]. Leishmaniasis is the second parasite-related cause of death after malaria and ranks third in disability-adjusted life years caused by neglected tropical diseases; however, despite its importance to health, it does not receive the attention and emphasis that it deserves for a variety of reasons. The main clinical forms of leishmaniasis are visceral leishmaniasis (VL), which has a dog as its zoonotic animal reservoir; cutaneous leishmaniasis (CL), which has rodents as its main animal reservoir in rural foci, and muco-cutaneous leishmaniasis (MCL), which has sylvatic mammals as its animal reservoir [2]. VL, also known as kala-azar, is fatal if left untreated in over 95% of cases. It is characterized by irregular bouts of fever, weight loss, enlargement of the spleen and liver, and anemia [1]. Most cases of VL occur in Brazil, east Africa and India [1]. An estimated 50 000 to 90 000 new cases of VL occur worldwide annually, With an estimated 30,000 cases annually, Eastern Africa is the second-largest VL foci in the world, after South-East Asian territory [1]. An estimated 4,000 people die from it each year in various regions of Ethiopia, Eritrea, Kenya, Somalia, Sudan, and Uganda [3]. Neglected tropical diseases are a significant public health problem in Ethiopia, which is experiencing a considerable burden compared to other sub-Saharan African countries [4]. Systematic review and meta-analysis on Leishmaniasis indicated that the pooled prevalence remains high (9.3%) with being male and presence of hyraxes near the house were the associated risk factors [5]. In Ethiopia, the disease (VL) is prevalent mostly in lowland, arid areas, and the parasite involved is mainly *Leishmania donovani*, with an estimated annual incidence of more than 4,000 cases. According to studies' reports, there are various risk factors associated with development of VL; such as poor housing, sanitation, presence of termite hills near home, sleeping/staying under acacia tree, younger age groups, and poor in waste management, family size >5 members, ownership of domestic animals' poverty, dog ownership, malnutrition and HIV co-morbidity [6-9]. There is limited published data nationally in the study area too as per the envistagor's knowledge. Therefore, this study was aimed to assess the associated risk factors of VL in Gode.

2. Materials and Methods

2.1. Study Setting and Period

The study was conducted at Godey General Hospital, Shabele zone, Somali region. Gode Hospital is located at Gode city the second city of Somali region and has total population of 579,782. The hospital has been established at the end of 1952 E.C. The Hospital is under regional health bureau and serves as referral center for all Shebelle zone and some part of Afder zone centers. During the last three years 128 cases of VL were reported from this Hospital. This Hospital consists of the following services Medical, Surgical, Gynecology & Obstetrics, laboratory, pharmacy, radiology, Emergency department, etc., and a total number of 194 beds. The study was carried out on April 01 – June 30, 2024

• Study Design

Retrospective unmatched case-control study design was deployed

• Population

• Source Population

Cases: All records of VL confirmed patients in Gode General Hospital from January 2021 – March 2024. Controls: All participants living at nearby or similar area with the potential cases who were negative for VL by rk39.

• Study Population

All most recent records of VL positive patients in the Hospital in the last one year and their respected and accessible patients at selected area during the study period; All voluntary VL negative participants living in similar location with the selected cases during the study period.

2.2. Inclusion and Exclusion Criteria

2.2.1. Inclusion Criteria

• Case

Voluntary recent VL confirmed patients and their respective records

• Control

Voluntary VL negative individuals living nearby the selected VL confirmed cases.

2.3. Exclusion Criteria

Patient's records whereby their respects patients are inaccessible during the study period and VL confirmed cases before 2 years.

2.4. Sample Size Determination

Sample Size was determined by two population proportion formula for unmatched case control study design as shown below using Epi- Info 7 statistical software by considering that the proportion of usual sleeping on ground near cattle (main exposure variable) 23.8 % among controls and 48.7 %, among cases, which is estimated from other similar study conducted north-western Ethiopia Ninety five percent confidence level, 80% power and case to control ratio of 1:4 to detect an odds ratio of 2.0 were used [10]. Accordingly, 102 cases and 408 controls were included in the study. To calculate sample size dog ownership, usually sleeping outside the house and usually sleeping near cattle on ground were considered to be main exposure variables. But to get maximum sample size usual sleeping near cattle on ground were taken as the main exposure variable. The final total sample size is 510.

$$\frac{[Z\alpha/2\sqrt{(1+1/r)p(1-p)} + Z\sqrt{p_1(1-p_1)+p_2(1-p_2)}]^2}{(p_1-p_2)^2}$$

Where:-

- α = the level of significance = 0.05
 - β = the power of the test = 80 %
 - r = Ratio of Controls to Cases = 4
 - p_1 = Hypothetical proportion of controls with exposure = 23.8%
 - p_2 = Hypothetical proportion of cases with exposure = 48.7%
 - P = pooled estimate of P_1 & $P_2 = (P_1 + rP_2)/(1+r)$
- Sampling technique

Convenient sampling technique was used.

2.5. Study Variables

2.5.1. Independent Variables

- Socio- demographic variables (Age, sex, occupation, family size, etc)
- Behavioral variables (sleeping habit, ownership of a mosquito net & usage etc)
- Environmental and household variables (termite hills near house, acacia trees near house, domestic animals ownership, sleeping area etc).
- Co-morbidity (HIV/AIDS, malaria) factors

Dependent Variable

Visceral Leishmaniasis infection.

2.6. Data Collection Process

Data collectors (experienced nurse and laboratory technologist) were identified, trained and informed to collect the data using pre-structured questionnaire developed for this study (Supplementary file). The purpose of the study as well as any related harm and benefit were explained to the study participants accordingly. Primarily, number of patients tested for VL and treated at Gode General Hospital from 2021 – 2024 were counted by reviewing their cards and data by the data collectors. Total of 502 VL confirmed cases were found in Godey Hospital where most of the patients were from Kalafo, Ber'ano, Adadle and Gode districts. The most recently VL diagnosed and accessible patients were selected as cases. Based on the recent in diagnosis, availability and nearby residency, 102 VL confirmed patients were selected from the hospital data base. Data collectors travelled to the site where VL patients living by calling their contact ensuring their presence. Face to face interview was carried using pre-structured questionnaires. For controls, data collectors selected households nearby the cases randomly considering similarity in sex and age with cases. Controls were primarily screened for VL using rK39 rapid test. Laboratory data collectors collected whole blood by finger prick for rk39 and tested at that time. VL negative individuals were included for interview. Malaria was also screened from both cases and controls using rapid test. Face to face interview was carried using pre-structured questionnaires.

2.7. Data Quality Management

Data collectors were primarily trained on proper data collection and supervised by the principal investigator. Data completeness was being checked daily by the principal investigator. Known VL confirmed and negative samples were used as quality control for the rK39 rapid test.

2.8. Operational Definitions

Visceral Leishmaniasis or Kala azar (KA): A case of visceral leishmaniasis is a person showing clinical signs (mainly prolonged irregular fever > two weeks, splenomegaly and weight loss) with serological and/or parasitological confirmation of the diagnosis Co-morbidity: VL Individuals suffering from one or more of (HIV, tuberculosis or malaria) at admission [11]. Termite hills: Raised soil structures with several ventilation shafts built over underground nest of the termites [12].

2.9. Data Processing and Analysis

After checking for completeness, data were coded and entered into Epi-data version 4.6, then exported to statistical package for social sciences (SPSS) version 25 for analysis. Descriptive statistics were employed. Bivariate and multivariable logistic regression analysis was deployed. Crude and adjusted odds ratio with 95% confidence interval were calculated to determine the strength of association between outcome variable and independent variables. Variables with p - value of less than or equals to 0.25 in bivariate analysis were considered candidates for multivariable logistic regression analysis. P-value less than 0.05 was considered as a level of statistical significance

3. Result

3.1. Descriptive Statistics of Socio-Demographic Characteristics of the Respondents

A total of 510 respondents, 102 (20%) cases and 408 (80%) controls were enrolled in this study. Majority of the cases; 61.8% (63) and controls, 79.4%(324) were males. Most of the study participants were under 15 years; 84.3% (86) and 82.6%(337) for cases and controls respectively. Most of the cases; 95.1%(97) and controls; 93.6%(382) were single. In addition, about 91.2% (93) and 84.6%(345) of the cases and controls had family size less than five individuals, respectively (Table 1).

Variable	Category	Cases	Controls
		Count (%)	Count (%)
Sex	Male	63 (61.8)	324 (79.4)
	Female	39 (38.2)	84 (20.6)
Age	<15	86 (84.3)	337 (82.6)
	>15	16 (15.7)	71 (17.4)
Marital status	Single	97(95.1)	382(93.6)
	Married	5(4.9)	26(6.4)
Family size	>5	9 (8.8)	63 (15.4)
	≤5	93 (91.2)	345 (84.6)

Table 1: Socio -Demographic Characteristics for Factors Associated with Visceral Leishmaniasis at Gode General Hospital, Eastern Ethiopia from April 01 – June 30, 2024

3.2. Descriptive Statistics of House Hold and Environmental Conditions

Majority 64(62.7%) of the cases and 301(73.8%) of the controls possessed houses made with mud walls. Most of study participants, 97(95.5%) of cases and 378(95.1%) of controls had earthen type of floor in their houses. Majority of the cases; 50%(51) and controls; 65.7%(233) reported

possession of thatched roof in their houses. About 52%(51) of the cases and 44.1%(180) of the controls had reported presence of termite hill near their houses. About half 51%(52) of the cases and 51.5%(268) of the controls had reported presence of acacia tree near their houses. Most of the cases, 67.6%(69) and controls, 75.5%(308) owned cattle (Table 2).

Variable	Category	Cases	Controls
		Count (%)	Count (%)
Type of wall	Mud	64(62.7)	301(73.8)
	Cemented	38(37.3)	107(26.2)
Type of floor	Cemented	5(4.9)	20(4.9)
	Earthen	97(95.1)	378 (95.1)
Type of roof	Thatched	51(50)	233(57.1)
	Cement	19(18.6)	68(16.7)
	Corrugated	32(31.4)	107(26.2)
Termite hills near house	Yes	52(51)	268(65.7)
	No	50(49)	140(34.3)
Acacia tree near house	Yes	52(51)	210(51.5)
	No	50(49)	198(48.5)
Cattle ownership	Yes	69(67.6)	308(75.5)
	No	33(32.4)	100(24.5)

Table 2: Household and Environmental Variables for Factors Associated with Visceral Leishmaniasis at Gode General Hospital, Eastern Ethiopia from April 01 – June 30, 2024

3.3. Descriptive Statistics of Individual Behavioral Variables of the Respondents

Majority of the cases, 66.7 % (68) and controls, 65.9%(269), had slept on the ground in their houses. Most, 62.7%(64) of the cases and 71.3%(291) of the controls reported habit of sleeping outside of their houses. Majority of the cases,

68.6%(70) and controls 74.8%(305) had reported sleeping near domestic animal. More than half of the study participants reported possession of mosquito bed net; 62.7%(64) in cases and 51.2%(209) in controls. An about 40.2% (41) and 61.5%(251) of the cases and controls respectively reported presence of VL diagnosed member in their family (Table 3).

Variable	Category	Cases	Controls
		Count (%)	Count (%)
Sleeping pattern in the house	On the bed	10(9.8)	40(9.8)
	On the ground	68(66.7)	269(65.9)
	Mixed	24(23.5)	99(24.3)
Outside Sleeping habit	Yes	64(62.7)	291(71.3)
	No	38(37.3)	117(28.7)
sleeping near domestic animal	Yes	70(68.6)	305(74.8)
	no	32(31.4)	103(25.2)
Mosquito net possession	Yes	64 (62.7)	209 (51.2)
	No	38 (37.3)	199 (48.8)
Had family member with VL	Yes	41(40.2)	251(61.5)
	No	62 (59.8)	157 (38.5)

Table 3: Individual Behavioral Variables for Factors Associated with Visceral Leishmaniasis at Gode General Hospital, Eastern Ethiopia from April 01 – June 30, 2024

3.4. Descriptive Statistics of Co-Morbid Variables of the Respondents

Co-infections with other diseases were investigated among the study participants. Malaria prevalence was slightly

higher, with 5.1% among cases and 4.4% among controls. Notably, no HIV co-infection was identified among the study population (Table 4).

Variable	Category	Cases	Controls
		Count (%)	Count (%)
Malaria	Yes	6 (5.1)	18 (4.4)
	No	96(94.5)	390 (95.6)
HIV	Yes	0 (0)	0 (0)
	No	102 (100)	408 (100)

Table 4: Co-Morbid Variables for Factors Associated with Visceral Leishmaniasis at Gode General Hospital, Eastern Ethiopia from April 01 – June 30, 2024

3.5. Bivariate and Multi-Variable Logistic Regression Analysis for Associated Factors

3.5.1. Bivariate Logistic Regression Analysis

Bivariate and multivariable logistic regression was used to assess if any association between the independent variables with the dependent variable. In bivariate logistic regression,

Sex, family size, type of wall, type of roof, presence of member with VL in the family, cattle ownership, presence of termite hill near the house, sleeping near domestic animal, an outside sleeping habit and mosquito net possession were found to be candidates for multivariable logistic regression analysis ($p \leq 0.25$) (Table 5).

Variable	Category	Cases	Controls	COR (95%CI)	P-value
		No (%)	No (%)		
Sex	Male	63 (61.8)	324 (79.4)	2.4(1.5-3.8)	0.00*
	Female	39 (38.2)	84 (20.6)	1(ref)	
Age	<15	86 (84.3)	337 (82.6)	0.9(0.5 – 1.6)	0.7
	>15	16 (15.7)	71 (17.4)	1(ref)	
Marital status	Single	97(95.1)	382(93.6)	0.8(0.3-2.0)	0.6
	Married	5(4.9)	26(6.4)	1(ref)	
Family size	>5	9 (8.8)	63 (15.4)	1.9(0.9 – 3.9)	0.09*
	≤5	93 (91.2)	345 (84.6)	1(ref)	
Type of wall	Mud	64(62.7)	301(73.8)	1.7(1.1 -2.6)	0.028*
	Cemented	38(37.3)	107(26.2)	1(ref)	
Type of floor	Cemented	5(4.9)	20(4.9)	1.0(0.4 -2.7)	1.0
	Earthen	97(95.1)	378 (95.1)	1(ref)	
Type of roof	Thatched	51(50)	233(57.1)	1.4(0.8– 2.2)	0.22*
	Cement	19(18.6)	68(16.7)	1.1(0.6 – 2.9)	0.84
	Corrugated	32(31.4)	107(26.2)	1(ref)	
Termite hills near house	Yes	52(51)	268(65.7)	1.8(1.2 – 2.85)	0.006*
	No	50(49)	140(34.3)	1(ref)	
Acacia tree near house	Yes	52(51)	210(51.5)	1.02(0.7 – 1.6)	0.93
	No	50(49)	198(48.5)	1(ref)	
Sleeping pattern in the house	On the bed	10(9.8)	40(9.8)	0.97(0.43 -2.2)	0.94
	On the ground	68(66.7)	269(65.9)	0.96(0.6 – 1.6)	0.87
	Mixed	24(23.5)	99(24.3)	1(ref)	
Outside Sleeping habit	Yes	64(62.7)	291(71.3)	1.5(0.9 – 2.3)	0.09*
	No	38(37.3)	117(28.7)	1(ref)	
Sleeping near domestic animal	Yes	70(68.6)	305(74.8)	1.4(0.8 – 2.2)	0.21*
	no	32(31.4)	103(25.2)	1(ref)	

Mosquito net possession	Yes	64 (62.7)	209 (51.2)	0.6(0.4 – 0.9)	0.04*
	No	38 (37.3)	199 (48.8)	1(ref)	
Had family member with VL	Yes	41(40.2)	251(61.5)	2.4(1.5 – 3.7)	0.00*
	No	62 (59.8)	157 (38.5)	1(ref)	
Cattle ownership	yes	69(67.6)	308(75.5)	1.5(0.9 – 2.4)	0.11*
	no	33(32.4)	100(24.5)	1(ref)	

Abbreviation *: p-value ≤ 0.25 , COR: Crude odds ratio, CI: Confidence interval

Table 5: Bivariate Logistic Regression Analysis for Factors Associated with Visceral Leishmaniasis at Gode General Hospital, Eastern Ethiopia from April 01 – June 30, 2024

3.6. Multivariable Logistic Regression Analysis

In multivariable logistic regression analysis, sex; AOR with 95%CI 2.6(1.6 -4.3, $p=0.00$), type of house wall; AOR with 95% CI 2.0(1.2 -3.4, $p=0.006$), presence of member with VL in the family; AOR with 95%CI 2.7(1.6-4.4, $p=0.00$), an outside sleeping habit; AOR with 95% CI 1.7(1.0 -2.7, $p=0.04$), presence of termite hill near the home; AOR with 95% CI 1.6(1 – 2.6, $p=0.047$) and mosquito net usage; AOR with 95%CI 0.6(0.4 – 0.9, $p=0.039$) were found statistically significance at $p \leq 0.05$. Male participants were 2.6 times more likely to develop VL than female study participants of this study. Study participants with mud wall in their houses were

2.0 times more likely to be infected with VL than those with cemented wall. Study participants from family where there was VL diagnosed individual were 2.7 times more likely to be infected with visceral leishmaniasis. Study participants with outside sleeping habit were 1.7 times more likely to develop visceral leishmaniasis than those sleeping in the houses. Study participants from homes where there is termite hills nearby were 1.6 time more likely to be infected with visceral leishmaniasis. Study participants with mosquito net were less likely (protected) to be infected with visceral leishmaniasis than those with no mosquito net (Table 6).

Variable	Category	Cases	Controls	COR (95% CI)	AOR (95%CI)	P-value
		No (%)	No (%)			
Sex	Male	63 (61.8)	324 (79.4)	2.4(1.5-3.8)	2.6(1.6 – 4.3)	0.00**
	Female	39 (38.2)	84 (20.6)	1(ref)	1(ref)	
Family Size	>5	9 (8.8)	63 (15.4)	1.9(0.9 – 3.9)	1.9(0.9 -4.1)	0.11
	≤ 5	93 (91.2)	345 (84.6)	1(ref)	1(ref)	
Type Of Wall	Mud	64(62.7)	301(73.8)	1.7(1.1 -2.6)	2.0(1.2-3.4)	0.006**
	Cemented	38(37.3)	107(26.2)	1(ref)	1(ref)	
Had family member with VL	Yes	41(40.2)	251(61.5)	2.4(1.5 – 3.7)	2.7(1.6 – 4.4)	0.00**
	No	62 (59.8)	157 (38.5)	1(ref)	1(ref)	
Outside Sleeping Habit	Yes	64(62.7)	291(71.3)	1.5(0.9 – 2.3)	1.7(1.0 – 2.7)	0.04**
	No	38(37.3)	117(28.7)	1(ref)	1(ref)	
Cattle ownership	yes	69(67.6)	308(75.5)	1.5(0.9 – 2.4)	1.6(0.9 – 2.6)	0.09
	no	33(32.4)	100(24.5)	1(ref)	1(ref)	
Mosquito net possession	Yes	64 (62.7)	209 (51.2)	0.6(0.4 – 0.9)	0.6(0.4 – 0.9)	0.039**
	No	38 (37.3)	199 (48.8)	1(ref)	1(ref)	
Sleeping near domestic animal	Yes	70(68.6)	305(74.8)	1.4(0.8 – 2.2)	1.02(0.6 – 1.7)	0.9
	no	32(31.4)	103(25.2)	1(ref)	1(ref)	
Termite hills near house	Yes	52(51)	268(65.7)	1.8(1.2 – 2.85)	1.6(1 -2.6)	0.047**
	No	50(49)	140(34.3)	1(ref)	1(ref)	
Type of roof	Thatched	51(50)	233(57.1)	1.4(0.8– 2.2)	1.3(0.7 – 2.1)	0.4
	Cement	19(18.6)	68(16.7)	1.1(0.6 – 2.9)	0.9(0.4 -1.7)	0.7
	Corrugated	32(31.4)	107(26.2)	1(ref)	1(ref)	

Abbreviation: **: P-value < 0.05 , AOR: Adjusted odds ratio, CI: Confidence interval, COR: Crude odds ratio

Table 6: Multivariate Logistic Regression Analysis for Factors Associated with Visceral Leishmaniasis at Gode General Hospital, Eastern Ethiopia from April 01 – June 30, 2024

4. Discussion

This study was conducted to assess risk factors for VL infection in Gode Hospital, Eastern Ethiopia. Since analytical method was employed in this study, it can provide better insight of the predictors and determinants of VL infection in the area. In the present study, factors found associated with VL infection were being male, type of house wall, an outside sleeping habit, presence of termite hill near the house, presence of family member with confirmed VL and mosquito net ownership and usage. In this study demonstrated significant association between gender and VL infection; in the current study, male participants were 2.6 times more likely to develop VL than female participants. This is in line with case control studies conducted in Gonder; Ethiopia, northern Ethiopia Bihar; India, Brazil and systematic review carried out in America [8,13-16]. This might be due to the predominance of male in outdoor activities increasing the contact with sand-fly [13]. In contrast, study carried out in Somali region, Ethiopia reported increased odds of acquiring VL among female sex than male. In the present study, study participants with mud wall in their houses were 2.0 times more likely to be infected with VL [17]. This finding is in agreement with case control studies done in Gonder, Tigray, Ethiopia, Borena, Oromia Ethiopia and in India reporting that mud/thatched wall was significantly associated with VL [8-19]. In addition, this report of the current study is in consistent with studies conducted in Shabele zone, Somali region, Ethiopia and in Nepal and India [17,20-22].

The possible reason for this could be due to the fact that thatched and mud walls are most likely to be cracked and favorable for entrance and breeding of the vector [13]. In the present study, study participants with an outside sleeping habit were 1.7 times more likely to develop VL. This finding is in agreement with studies conducted at Shabele zone, Somali region, and in northern Ethiopia [14,17]. In addition, case control studies performed in Ahmara region, Ethiopia and in Sudan reported elevated odds of outdoor sleeping habit with VL [9,13,27]. This could be that sleeping outside increases the likelihood of biting by the sand-fly (vector). In contrast, a case control study which was implemented in north-west Ethiopia reported reduced odds(protective) between outside sleeping habit and VL [10]. In addition, A case-control study conducted in Urban residents in Dharan Town of Eastern Nepal to investigate factors for VL showed that sleeping on bed was protective [13]. In the current study, study participants from family where there was VL confirmed individual were 2.7 times more likely to be infected. This finding is consistent with case control study conducted in Sudan reporting increased odds among patients with VL confirmed member in their household [23]. Likewise, our finding is in line with other studies done in India and in northern Ethiopia reporting increased risk of VL among patients living with VL confirmed case in the household [14,24,25]. In the present study, mosquito net ownership and usage indicated reduced odds of acquiring VL and this finding was in line with studies done in Tigray, Ethiopia, East Africa, and in Nepa [10,11,20,26]. In the current study, presence of termite hill near the house increased the odds of acquiring VL. This is in agreement with studies conducted in

Gonder, in Southern Ethiopia and in Borena Oromia region, Ethiopia [9,13,18,27].

5. Conclusion

Male sex, presence of VL confirmed member in the household, presence of termite hill near the house, an outdoor sleeping habit and mud type of house wall were statistically associated with increased risk of acquiring VL. In contrast, possession and usage of mosquito net usage was statistically associated with reduced risk of VL.

Availability of Data and Material

The datasets used and/or analyzed during the current study are available from the corresponding author on reasonable request.

Competing Interest

Authors declare no competing interest.

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