RISK FACTORS FOR VISCERAL LEISHMANIASIS IN TURKANA COUNTY: A CASE-CONTROL STUDY IN LOIMA AND TURKANA WEST SUB-COUNTIES, NORTHERN KENYA

BY

PETER LOMURUKAI

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DECLARATION

Declaration by Candidate

I hereby declare that this is my original work; it has never been submitted to Moi University or any other institution in whole, or part or any other form for the academic qualification or any other purpose.

Signature: _____ Date: _____

Peter Lomurukai

SPH/PGH/FE/16/16

Declaration by Supervisors

This Thesis has been submitted with our approval as Moi University Supervisors

Signature_____ Date_____

Prof Christina A Otieno (PhD)
Department of Environmental Health & disaster Risk management
School of Public Health
College of Health Sciences
Moi University
Eldoret- Kenya

Signature _____Date _____

Dr. Zeinab Gura Roka
Field Epidemiology and Laboratory Training Program,
Ministry of Health,
Nairobi, Kenya

DEDICATION

This work is dedicated to my children, Shelmith Kangiro, Cyprian Longoli, Sienna Nayoki, Cian Ekadeli, Sergio Adiaka and Praxedes Amana to whom I gather the ingenuity to achieve the best in the academic world, my wife Catherine Abei Ewoi for her moral and financial support during my study period and my late mother Maria Kang'iro for her parental guidance.

ABSTRACT

Background: Globally Visceral Leishmaniasis (VL) a neglected tropical disease caused by *Leishmania donovani*, transmitted by the sandfly vector *Phlebotomus martini*, is ranked number one in terms of disease burden. East Africa is the second-largest VL focus in the world. In Kenya, VL mainly affects the rural communities with the majority of cases found in children of the age group 2-15 years. Health facility records from Turkana County annual reports show a VL incidence of about 300 Cases. **Broad objective:** Was to identify the risk factors associated with VL, determine knowledge and assess practices among the study participants in Loima and Turkana West Sub Counties**. Methods**: A case-control study design where 267 (89 cases and 178 controls) were enrolled at a ratio of 1:2. Cases were recruited from the five active VL treatment facilities in Loima and Turkana West Sub-counties while controls were recruited from the villages where the cases came from and frequency-matched by age category. S**ample size:** was calculated using the Kelsey formula. **Data collection tools:** Pretested questionnaires, which tested variables, that included; Social-demographic, animal and human activities, Cultural/ behavioral, social economic, household and environmental, Co-morbidities and malnutrition assessment, knowledge and practices factors. Health facility VL registers, in and outpatient's cards accessed. **Data analysis**; data coded, cleaned, and entered for analysis using Microsoft Excel and Epi info 7.2. Descriptive statistics done where means, mediums, proportions/frequencies calculated, Bivariate and Multivariate analysis was undertaken and presented data by pros, tables, and graphs. **Results**: Descriptive statistics was undertaken. At the bivariate level, variables with a p= < 0.2 were entered into unconditional logistic regression backward stepwise elimination process for multivariable analysis. All factors with a p= (<0.05) at Multivariate level were considered statistically significant for VL. Significant factors independently associated with VL included; Presence of domesticated animals at the household level AOR 5.6(1.85-16.80), travel to VL endemic Counties or Countries AOR 4.9(1.95-12.25), playing or sleeping around the termite mounds while in the field or within the homestead 4.0(1.91-8.18). Majority of the participants 212 (79.4%) from which cases 58(27.4%) and 154 (72.6%) controls whereas 234 (87.6%) participants 75(32%) Cases and 159(68%) of controls reported VL being highly severe. Majority of the respondents 230(71.2%); from which 74(57.4%) cases and 156(80.4%) controls were not practicing any prevention and control measures towards VL, **Conclusion:** Presence of domesticated animals at the household level as a risk factor to VL was highly associated with VL. Majority of the respondents were aware of VL disease however were not aware of the cause but reported as highly severe. Two-thirds of the respondents were not practicing VL prevention and control measures. **Recommendations**: The study recommends the need for multi-sectoral approach through the key departments of health, Agriculture livestock and Fisheries and Education on need to develop contextualized health messages for facility and community health education and awareness on the risk factors associated with the disease. Community empowerment and participation should be emphasized as well as structural development plans that shall address causes, control and prevention measures towards Visceral.

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

DEFINITION OF TERMS

Case definition: Any patient diagnosed with VL using any approved serological or parasitological method and undergoing treatment at the VL treatment facilities within Loima and Turkana West Sub Counties in a person aged 6 months and above. Cases would be either a suspected or confirmed

Suspected case; Any person with fever or history of fever for more than two weeks and/or any of the two following symptoms, abdominal swelling, general weight loss, hepatomegaly and jaundice in whom any unknown fever condition has been ruled out or has not shown clinical response to effective drugs.

Confirmed Case: Any suspected case with positive VL diagnosis by either microscopy, Serology, or molecular technique, and would include patients who were on treatment both at the facilities and or at the community.

Control definition; Residents in the two Sub Counties who comes from the same village as the cases and is within the same age group as the case, with a negative VL test results after being tested with Rk39 antigen-based dipstick kit and with no prior history of treatment for VL. They were drawn from the same villages as the cases and interviewed at their household.

Formal education: Participant who has gone through the school system recognized by the ministry of education in Kenya and who can attempt or can read in English or Kiswahili words

Non-Formal education: Participants who have never gone through the education systems recognized in Kenya and who cannot attempt or read in English or Kiswahili words.

ABBREVIATIONS

DALYs	Disability Adjusted Life years
DNDi	Drug for Neglected Diseases Initiative
DSRU	Disease Surveillance and Response Unit
HIV	Human Immuno-deficiency Virus
IVM	Integrated Vector Control
MoH	Ministry of Health
MoPHS	Ministry of Public Health and Sanitation
NFGT	Napier's Formal Gel Test
NTDs	Neglected Tropical Diseases
PKDL	Post Kala-Azar Dermal Leishmaniasis
RK39	Immuno-Chromatographic Strip Test
TDR	Tropical Diseases and Research
VL	Visceral Leishmaniasis
WHO	World Health Organization

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CHAPTER ONE

INTRODUCTION

1.0 Background

Visceral Leishmaniasis (VL) is a zoonotic chronic vector-borne disease caused by obligate protozoa parasites of the Genus Leishmania (El-On *et al*., 2009). There are three forms of Leishmaniasis disease in mammalian tissues, namely visceral, cutaneous, and mucosal Leishmaniasis with the visceral Leishmaniasis being the most severe form (DebRoy, 2017a). The known infectious agents in Africa are *Leishmania donovani* and *Leishmania infantum.* The disease is transmitted through the infective bite of an insect vector, the *phlebotomine orientalis,*and *Phlebotomine martini* (Gebre-Michael *et al*, 2004). The main reservoir for the infectious agents is dogs for *L. infantum* and humans for *L. donovani* (Solano-Gallego *et al*, 2009).

The disease is characterized by fever, hepato-splenomegaly, lymphadenopathy, anemia, leukopenia, thrombocytopenia, and progressive emaciation and weakness, untreated clinically evident disease is usually fatal. Fever is of gradual or sudden onset, persistent and irregular, often with two daily peaks, alternating periods of pyrexia and low-grade fever (Desjeux, 2001). Post-VL dermal lesions may occur after the apparent cure of a systematic disease(van Griensven, 2012). The disease has an incubation period of 2-6 months with a range of 10 days to years and is self - curing within this period. The disease is an old but largely unknown disease that inflicts the world's poorest population (Marinho *et a*l, 2015).The global burden of Leishmaniasis has remained stable for some years, causing a morbidity and mortality loss of 2.4 million disability-adjusted life-years (DALYs) and approximately 70,000 deaths, significantly high rank among communicable diseases (Kimutai, 2010). There are two million new cases of

Leishmaniasis annually and 14 million infected people worldwide *(*Marinho *et al*, 2015).

In Kenya, VL mainly affects the rural communities with the majority of cases found in children of the age group 2-15 years (Debroy *et al*, 2017). In Kenya, an average of 600 -800 cases are expected to occur annually (Gebre-Michael*et al*, 2004) and the number of cases can rise to over 1000 in an epidemic year (Badaro*et al*, 1986) with Case fatality rate of up to 7% reported during an outbreak situation. The disease was first detected in Kenya in 1935 in the Northern frontier counties of Mandera and Wajir. Visceral Leishmaniasis seems to have been imported in Kenya by soldiers returning from Southern Ethiopia after the Second World War (Kassa *et al*,2007.,Piers,19) . The disease is now endemic in several counties in the country (Tinui, 2008).

In Kenya VL endemic Counties includes Mandera, Turkana, West Pokot, Baringo, Kitui, Machakos, and Wajir with Baringo and Pokot counties showing continuous high endemicity (Akutaa *et al*, 2017), which affects the very poor semi-nomadic population in this areas. In other areas, VL occurs in outbreaks that are associated with periods of drought, when the rate of malnutrition is high. The outbreaks are probably related to people's movement from high to low endemic areas due to the lack of food security (Ali & Awadalla, 2007).

Risk factors of VL include; lack of immunity against the parasite (Leishmania) in areas associated with low or debilitated herd immunity, increased exposure to infective sand-fly bites, and conducive environment to high contact human infective vector –reservoir (Diuk-Wasser, 2013). An increased number of cases of VL have been reported from northeastern Kenya since 2000. In July 2006, a VL outbreak was reported in Isiolo

where over 60 cases were admitted. Another outbreak was reported in Wajir in March 2008 resulting in more than 180 cases (WHO,2015).

1.1 Problem Statement

Visceral Leishmaniasis is a chronic Neglected Tropical Disease (NTD), in Kenya; it is endemic in arid and semi-arid areas characterized by high poverty index, marginalized and far remote communities with low access to affordable quality health care. The disease poses major public health concerns associated with; >85% fatalities in untreated cases and < 50% fatalities in treated cases, high morbidity adjusted life years (DALYs), marked economic impacts, social stigma, and psychological trauma and is also associated with 4^{th} stage in HIV/AIDS disease. The disease trends risks causing a health crisis as the disease is fatal, hence efforts are needed to avert the situation with appropriate control and prevention measures(Al-Salem et al., 2016., Hailu *et al.*, 2010).

In Kenya high morbidities and mortalities in arid and semi-arid regions are associated with a myriad of challenges that includes; Financial hardships due to high poverty levels in the County, VL diagnosis and treatment is not readily available in most facilities, VL drugs and other related logistics have not been included to the VL National drugs list, poorly skilled health care workers and lack of diagnostic machines to offer quality diagnostic health care services, negligible budgetary allocation by the National and County governments to sustain VL management, control, and prevention.(Kenya VL Health Care workers National Guideline., 2017).

Despite the minimal interventions by the local health partners to improve case detection, and management, there have been no efforts noted in VL prevention and Control interventions in the County. Nonetheless, there's more focus on treatment and diagnosis and little is being done on awareness and sensitization at the Community

level, So the need to determine the associated risk factors, determine knowledge and assess practices of the study population and possible determine scientific evidence-based intervention in the study area to reduce suffering, death and improve cost implications (http://www.health.go.ke/govt-steps-up-fight-against-leishmaniasis/,n.d).

1.2 Justification

There is a link between VL infection, malnutrition, and poverty. Turkana County is classified as the poorest leading County in Kenya with 79 in every 100 of its population living below the poverty line. Loima and Turkana west Sub Counties borders two of the six African high VL endemic counties that include, Uganda and South Sudan as well as West Pokot Sub County among the Six Kenya high VL burden Counties thus the need to control the spread of VL.

Visceral Leishmaniasis is age and gender cross-cutting infection affecting the immuno-compromised, adults in good health as well as the economically propagative group in our society. It primarily affects the locally remote populations characterized by a lack of or weaker health systems with low and or poor health-seeking behaviors.

Higher morbidities and mortalities have been reported because of delays in access or treatment services and or lack of diagnostic services to the populations in the reporting Counties. Control and prevention awareness creation and budgetary allocations are negligible and need to scale up for positive interventions.

Turkana County had experienced an increase in the number of cases of VL in the last 10 years. In the last one year, the County Government of Turkana through the department of health identified eight health facilities in the two Sub Counties as Visceral Leishmaniasis treatment centers. The objective of these centers were to offer timely diagnostic services, case management and provide health education and sensitize

their catchment populations on the risk factors of VL aimed at achieving targeted disease prevention and control measures to halt the trend and reduce morbidities and mortalities.

To achieve the objective of providing health education and sensitization of the population on the risk factors, there was a need to identify the specific risk factors for VL in the populations living in these two Sub-Counties and use this data to develop health messages that were relevant to the target population as little is known on VL risk factors, knowledge, and practices by the study participants. Our study was to provide the risk factor information aimed to generate prevention and control messages of VL in Loima and Turkana West sub-counties.

1.3 Research Question

What are the risk factors independently associated with Visceral Leishmaniasis in Loima and Turkana West Sub Counties?

1.4 Objectives

1.4.1 Broad Objective

The broad objective of the study was to identify the risk factors associated with VL and compare the knowledge and practices towards VL among the study participants in Loima and Turkana West Sub Counties.

1.4.2. Specific Objectives

1. Identify risk factors associated with *Visceral Leishmaniasis.*
2. Determine the knowledge of the study participants towards *Visceral Leishmaniasis.*
3. Assess the practices of the study participants towards *Visceral Leishmaniasis*

CHAPTER TWO

LITERATURE REVIEW

2.0 Background

Visceral Leishmaniasis (VL) is among the global neglected tropical diseases (NTDs) that are associated with poverty, war, and weaker health systems (Al-Salem *et al*, 2016).*Leishmania donovani* (LD) and *Leishmania Infatum* (LI) protozoans of the Genus *Leishmania (Kinetoplastida, Trypanosomatidae)* are the main causative agents of VL. The disease is transmitted through a bloody meal bite of the female phlebotomine sand flies *(*Kolaczinski *et al,* 2008). LD is associated with higher infections in the Northeast Indian sub-continent and East Africa with transmission being anthroponotic and in drier areas of Latin America and the Mediterranean region, LI is associate with VL infection (Ready, 2014).

VL is ranked number one NTD in terms of burden, marked economic impact, social stigma, and Psychological trauma (Al-Salem *et al*., 2016). The disease has been associated with high mortality and morbidity and is linked with poor nutritional status, remote locality of VL endemic areas as determinants of disease severity (Hailu *et al*, 2010). Globally 90% of VL cases occur in six countries: Bangladesh, Brazil, Ethiopia, India, South Sudan, and Sudan (Al-Salem *et al*, 2016). East Africa is the second-largest VL focus in the world affecting several communities in the following six endemic Countries in Sudan, South Sudan, Kenya, Uganda, Somalia, and Ethiopia(Al-Salem *et al*, 2016).

2.1 Epidemiology of Visceral Leishmaniasis

The epidemiology of Leishmaniasis is diverse with the Indian Sub-Continent, Brazil and East Africa having the highest prevalence, VL is a global infection affecting 88

Countries with 500,000 reported annually with 556 million people are at risk. Globally 90%of VL cases have been reported in Sudan, Brazil, India, Bangladesh, and Nepal (Hailu *et al*, 2010). Leishmania donovani (LD) and Leishmania infantum (LI) are the main causes of Infections. LDs are restricted to the (sub-) tropics of Asia and Africa while LI is restricted in the drier parts of Latin America as well as in the Mediterranean climate regions. Cutaneous Leishmaniasis (CL) causing organisms having been accounted for 73% of the CL infection globally with Afghanistan, Iran, and Syria (Ready, 2014).

In Africa, VL is endemic in West Africa, North, Central, East and the Horn of Africa. The presence of VL infection was first reported in Niger in 1911. Based on this information, VL is proposed to be endemic in a belt running from Mauritania, Gambia, and Senegal in the west to Nigeria and Cameroon in the east (Menkir & Tsion, 2015). East Africa is the second-largest VL focus in the world estimated at 30,000 and related deaths at 4000 especially in Sudan, Ethiopia, and Kenya, VL is associated with high mortality and morbidity, exacerbated by poor nutritional status and the remote location of VL endemic areas (Hailu *et al*., 2010), affecting several communities in the following endemic Countries; Sudan, South Sudan, Kenya, Uganda, Somalia and Ethiopia (Al-Salem *et al*, 2016).

The disease affects socially marginalized and poor communities in semi-arid and arid areas in Kenya and its 85% fatal if not treated(Kalan, 2013). Disease magnitude is expected to be about 4000 cases annually with a case fatality of about 7% in outbreak situations. VL is endemic in 30 Counties in Kenya with Seven counties endemic (Figure 2.1).

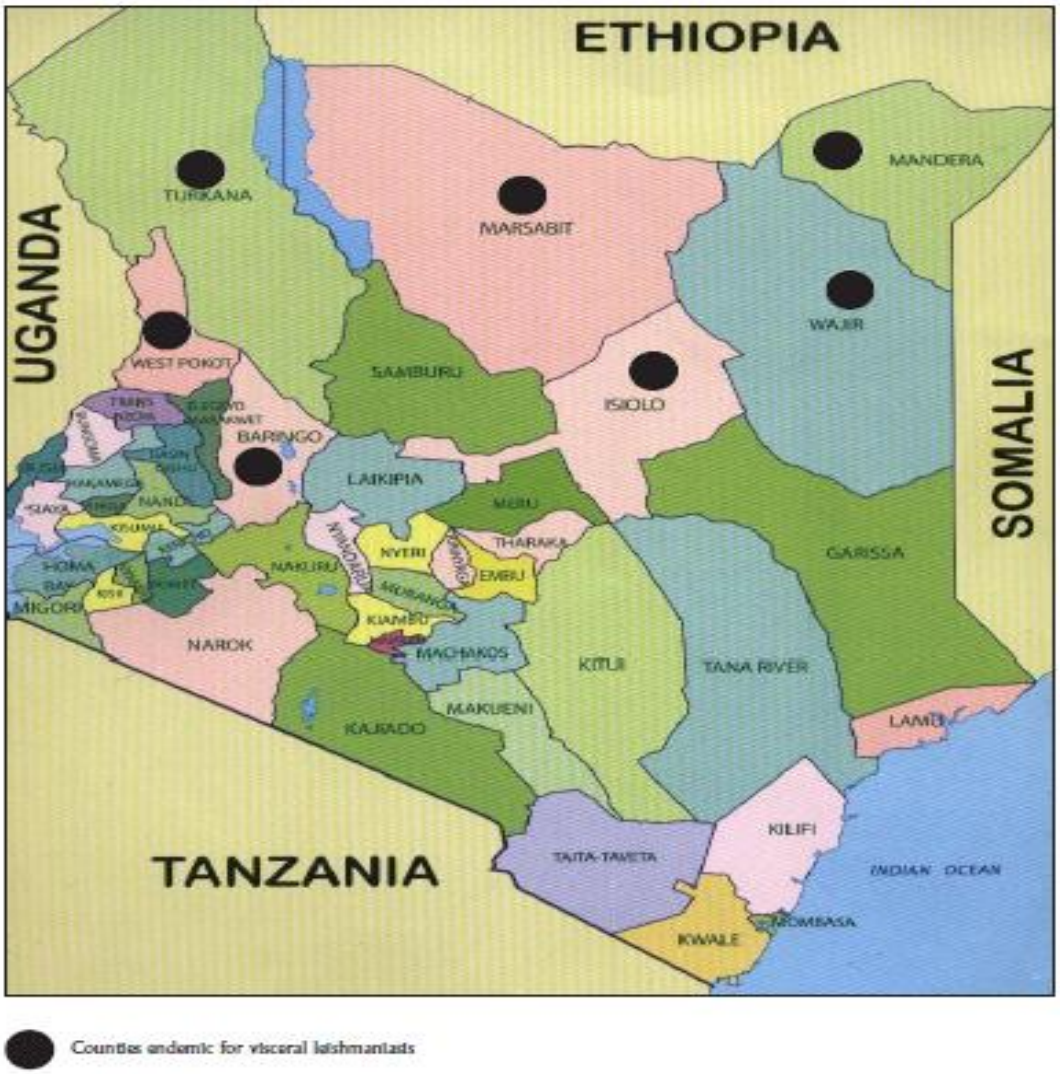

Figure 2.1: Map of Kenya showing the distribution of visceral Leishmaniasis endemic counties.
Adapted from the Kenya National Leishmaniasis Guideline for Health care workers 2017, Kenya

2.2 Transmission and Life cycle

The transmission starts when the female sand-fly vector *P. orientalis* or *P. Martin* injects the promastigotes into the susceptible host during a blood meal (Figure.2.1). The promastigotes multiply in the macrophages of the spleen, liver, bone marrow, lymph glands, mucosa of the small intestine, and other tissues of the reticuloendothelial system and forms amastigotes. Blood monocytes are also infected. The life cycle is continued

when the free amastigotes are ingested by a female sandfly during a bloody meal (Kolaczinski *et al*, 2008)

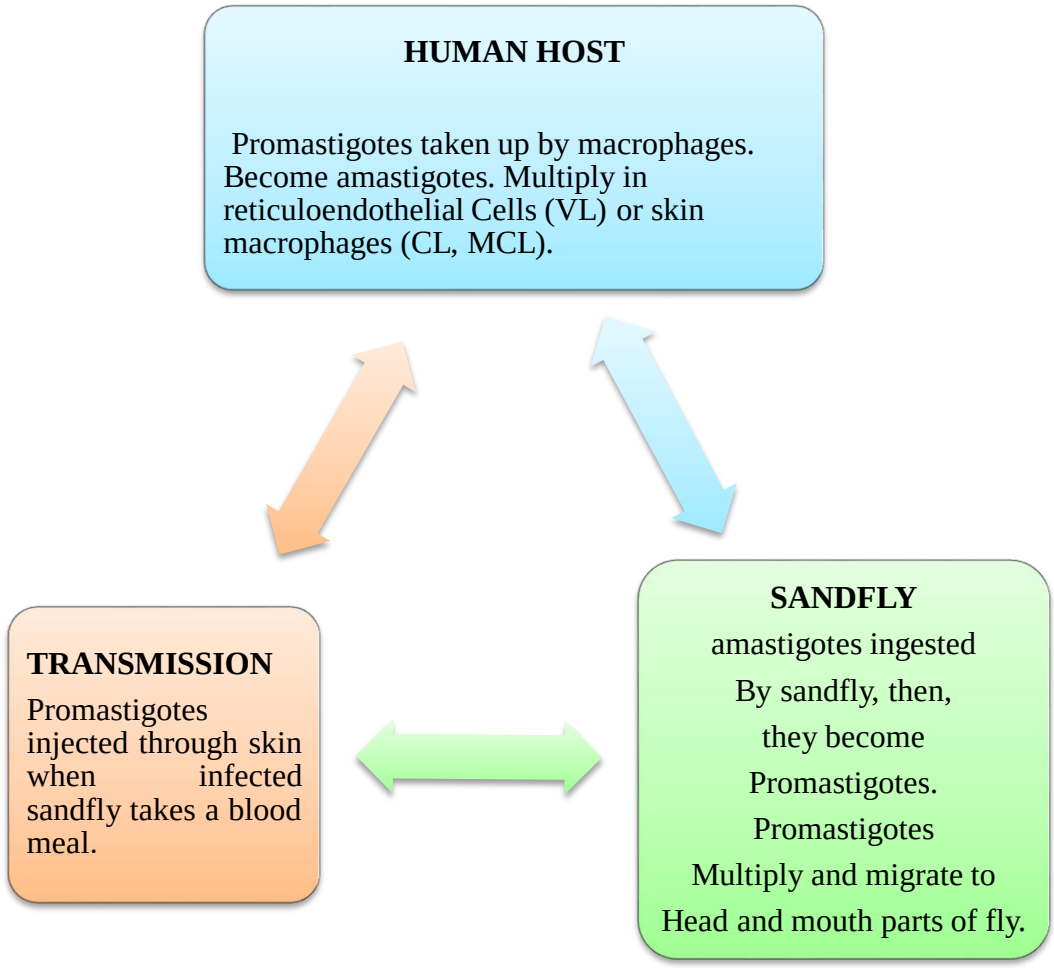

Figure.2.2: Showing the Life Cycle of Leishmania donovani
Adapted from the Kenya National Leishmaniasis Guideline for Health care workers 2017, Kenya.

2.3 Laboratory Diagnosis of Visceral Leishmaniasis

Diagnosis of VL can be made possible through the various methods, the most appropriate diagnostic method to detect infection and disease can vary (Anderson, 2009).

2.3.1 Parasitological /Microscopic Methods

The methods involve demonstration of the parasites in specific body tissues such as the spleen, bone marrow, lymph nodes, liver, or the buffy coat of peripheral blood. The most commonly used body tissues are the spleen and the bone marrow. Splenic aspirates are more sensitive (96%) than aspirates of bone marrow. Splenic and bone marrow aspirates are limited to the hospital settings or health facilities where there are adequate equipment and trained staff to manage complications appropriately. Parasites can be identified as either amastigote in smears from tissue aspirate stained by one of the Romansky stains or demonstration of the Promastigotes in the Culture samples.Examine at least 1,000 microscope fields for amastigotes using X100 oil immersion lens (Solano-Gallego *et al*, 2009.,WHO, 2015).

2.3.2 Serological Methods

The most commonly used methods including; DAT and rk39 dipstick test.

2.3.2.1 Rk39 dipstick test

Rapid based diagnostic tests (RDTs) are routinely used to start treatment if a strict VL suspect case definition is followed.Inbios® and Dia-Med – IT LEISH® tests are commonly used and recommended rapidly in Kenya. Allowing rapid diagnostic confirmation of Visceral Leishmaniasis at the peripheral health facilities with minimal Laboratory techniques and equipment hence leading to early treatment and better prognosis Kenya recent studies on rk39 dipstick test in collaboration with (KEMRI,

DND*i*, and FIND) and in conformity with other studies earlier done, showed a 97% sensitivity and 100% specificity. Serological test, cannot distinguish between active and past symptomatic or asymptomatic infections (Chappuis *et al*, 2005., Jha *et al*, 2000).

2.3.2.2 Direct agglutination Test (DAT)

The DAT employs a test antigen that is prepared from formalin-killed promastigotes stage of L.donovani cultures, which have been stained blue for visibility. The test is semi-quantitative and the antibody titers range from 1:100 up to 1: 51,200 with the Cut-off point for positive DAT being 1:3200 in endemic areas (Chappuis *et al*, 2005., Jha *et al*, 2000).

2.3.3 Others Diagnostic Methods includes

2.3.3.1 Western blotting technique

Western blotting technique is not commonly employed but it involves protein separation by sodium dodecylsulfate-polyacrylamide gel electrophoresis and then transferred to a nitro-cellulose or nylon membrane.(Reithinger & Dujardin, 2007).

2.3.3.2 Napier's Formal Gel Test (NFGT) or the Aldehyde test

Involves mixing a one-drop of sample serum or plasma with a drop of 37% formaldehyde solution. A positive reaction is shown by rapid coagulation or precipitate within 20-30 minutes.(Chappuis *et a*l, 2005), (Solano-Gallego *et a*l, 2009).

2.3.3.3 Leishmania skin test (Montenegro test)

The Montenegro skin test is a test for delayed-type hypersensitivity. Injection of 5 x 107 phenol-killed promastigotes into the forearm leads to the formation of an induration measurable after 48/72 hours. (ALI *et al*, 2006).

2.4 Treatment of Visceral Leishmaniasis

The Ministry of Health recommends sodium stibogluconate (SSG) and paromomycin (PM) combination therapy as the first-line treatment for primary VL in Kenya unless contraindicated otherwise. Primary visceral Leishmaniasis Combination therapy: sodium stibogluconate (pentavalent antimonial) /SSG at 20 mg/kg per day intramuscularly or intravenously plus paromomycin 15 mg [11 mg base] per kg body weight per day intramuscularly) for 17 days. For second-line treatment, Liposomal amphotericin B (AmBisome) is an efficacious treatment against visceral Leishmaniasis with a much-improved safety profile as compared to the amphotericin B deoxycholate formulation.

Mild infusion reactions (fever, chills, and rigor) and back pain may occur in some patients. Transient nephrotoxicity or thrombocytopenia is also occasionally seen. AmBisome comes in vials of 50 mg and needs to be reconstituted and diluted in 5% dextrose and given for 30–60 minutes as an intravenous infusion. The recommended dose in Kenya is 3–5mg/kg body weight per daily dose by infusion given over 6–10 days up to a total dose of 30 mg/kg (Solano-Gallego *et al*., 2009).

2.5 Potential Risk Factors to VL

2.5.1 Social-economic factors

Inequalities between the indigenous population and the mushrooming of the small centers or towns have led to the growth of bigger towns and or settlements leading to a close social interaction between Man, environment and the biological vectors in Turkana County s this, in turn, leads to poor social-economic factors to the inhabiting population predisposing them to poverty, poor housing conditions, poor sewerage and sanitary condition leading to ideal breeding and resting sites for VL and associated

vectors with ease in access of the susceptible population due to the associated overcrowding conditions in such settings ((Desjeux, 2001.,Hasker *et al*., 2012).

High Illiteracy has been associated with poor knowledge, attitude and, practices on the risk factors, control, and prevention strategies (DebRoy *et a*l.,2017). According to a prospective study done on the VL risk factors in India and Nepal, the results showed out that serocon version and risk of VL were strongly associated with the low economic and social-economic status noting that for those living in households with low socioeconomic status (OR=0.63 in households in the highest SES quintile (Picado *et al*, 2014)).

According to another study done in Bangladesh on the association of overcrowding, close stay, and association with previously infected VL patients it was found out that overcrowding (<50 meters household overcrowding) had a 3 fold higher risk intensity and pre-infection. There was a 26 times likelihood of developing an infection in the household with a previous case of VL(Bern C *et al*,2010).

2.5.2 Household and environmental factors

Household and environmental factors such as proximity to an active ant hill, acacia or availability of some bushes within the household, type of roof cover, house wall, presence of cracks in the house as well as the increase in the number of people in the household and Invasion of the agricultural farms and settlement into forested areas, domestication of the parasitic life cycle are among others proxy to sandfly exposure in Humans to and does affects the incidence of Leishmaniasis (Asfaram *et al*, 2017).

According to a systematic review of risk factors for VL in South Asia on the household and the environmental factors showed that poor housing conditions such as thatched, cracked houses were associated with the poor quintiles had a higher risk to VL and this

also included then on-use of IRS, non-Bed Net use and the presence of the positive persons in the household were found to be the VL risk factors and so is the vice-versa (Bern *et al*, 2010) .A similar finding was supported by in a similar case-control study that was done in Nepal to identify risk factors associated with VL at household level where it was found out that sleeping on a bed or cot, regular use of the mosquito nets, use of treated nets were found out be protective factors to VL, whereas; dumpy floors, mud floors, presence of the crevices and domestic animal ownership were found to the risky factors to VL (Jha *et al*, 2000).

2.5.3 Climatic change and Geographical factors

Leishmaniasis is climate-sensitive to rainfall, temperature and humidity change (Rodriguz *et al*, 2006) the changes in temperature, rainfall and humidity can have strong effects on vectors and reservoir hosts by altering their distribution and influencing their survival and population sizes; Slight fluctuations in temperature can have a significant effect on the Developmental cycle of *Leishmania* promastigotes in sandflies in areas with low transmission for the disease; Drought, famine and flood resulting from the global warming and land degradation causes population displacement and migration of the affected population to areas with high transmission of *VL*, and poor nutrition could in turn compromise immunity(Asfaram *et a*l, 2017).

According to the study on the geographical continuous area in Bihari, India in identifying the risk factors associated with incidence on the various climatic and geographical variation various were different locations was a protective factor (Hasker *et al*, 2012). In a research study on "Modeling the ecological niche " aim at assessing the environmental factors interdependence with VL spread in Bangladesh, the study

found out that high VL manifestations in warmer and low to moderate precipitations were agreeing with the disease distribution probability (Abdullah, *et al*,2017).

2.5.4 Malnutrition and Co-morbidity

Globally Malnutrition and the presence of the underlying opportunistic disease have been associated with disease severity (Desjeux *et al*,2004). According to the VL risk factors studies to assess on Hyponatremia and other risk factors for death in human visceral leishmaniasis: new insights from a cross-sectional study in Brazil showed that that most of the Non-survivor's had significant lower levels of albumin associated with protein-energy malnutrition among other protein malnutrition conditions, , energy malnutrition , lower levels of iron does iron deficiencies , vitamin A, hyponatremia among other electrolyte imbalances reported (Daher *et al*., 2017) Parasite proliferation and parasitemia was abundant in the spleen and the liver leading to hepatosplenomegaly in 75-90% of deaths ,bone marrow infections pancytopenia and generalized reduction in blood cell count resulted to superinfection and immunosuppression (Paul D Ready, 2014) According to a prospective study done in Northeast Brazil it was found out that a possible malnutrition was a possible risk factor to severe VL with coupled close association with debilitating disease (Cerf *et al*, 1987).

2.5.5 Human Behavioural factors

Human behavioral factors such as sleeping habits which includes sleeping outside the household or close to animal pen, not using the mosquito nets or sleeping near acacia tree among other sleeping habits are predisposing, others may include migratory or movement of people from low endemic VL areas to the endemic and the nature of the occupation or e.g. herding and farming has been associated with increased occupational exposures (Menkir & Tsion, 2015). According to a case-control study on the risk factors

to VL in Amudat in Uganda, the multivariate analysis identified low social economic status, sleeping near the animal pen, owing a mosquito net and the knowing the VL symptoms were associated with reduced risk of VL(Kolaczinski *et al*, 2008).

2.5.6 Animal and persons Seasonal migration / political factors

Seasonal migration and grazing patterns have been associated with an imbalance in the herd immunity (Sharma & Singh *et al.,* 2008) leading to the introduction of the non-immune persons into an area where there's enzootic or endemic transmission leading to a possible outbreak in such an area. Seasonal grazing and migratory movements may also spread the disease, with the return of migrants to non-endemic areas, as appears to have occurred in the highlands of Ethiopia in the 2000s. Herding activities that are being associated with migration and grazing predisposes the populations mostly the young youthful Men into sleeping outside under acacia trees and living in houses constructed of grassy material, appears to increase has been found to increase the risk for the disease (Gebremichael *et al.*,2018) European article review on the assessment of the emergency and the re-emergence of VL in Europe it was found out that human and domesticated animals movement from endemic Continents is responsible for the upsurge of VL cases in Europe (P D Ready, 2010).

2.6 Control and Prevention of VL

The control of VL can effectively be achieved through Man-Vector contact control measures methods (Sharma & Singh, 2008); some of these methods include; (1) the use of insecticide-impregnated bed nets to offer protective barrier, the most commonly used chemicals include; permethrin, lambda-cyhalothrin, alpha-cypermethrin and deltamethrin (Bongiorno *et al.,* 2005. Indoor residual spraying (IRS).This is normally a community participation process whereby internal walls of the community houses are

sprayed by the use of the appropriate insecticides at domestic and peridomestic situations. (3) Personal protection this includes; Indoor interventions may include the use of; fine-mesh screens on windows and doors, the use of insecticide-treated curtains, mosquito coils, and burning of traditional leaves known to be sandflies repellants at home.

Outdoor protective measures shall include; use of repellents, such as diethyltoluamide to the skin or clothing to reduce human–vector contact. Wearing of appropriate clothing this may include wearing long-sleeved shirts, long trousers, boots, and hats and may include tucking in shirts, tucking trousers into socks and closed shoes in VL endemic areas (Asfaram et al., 2017)(4) Adjustment and refinement of the physical environment to avoid the micro-environment that will aid in the effective breading and multiplication of the vector and the parasite. Moderation of the house structure by sealing open spaces on the roof, walls, floor, or within the house yard minimize the entry and resting sites for sandflies.

Effective bush and all level vegetation within the homesteads reduce or eliminate vector–human contact and disease transmission. Thirdly destruction of animal burrows and inactive termite mounds near households (Rodriguer *et al*, 2006) targeting is the health personnel in the local health facility, community health workers and through the health education (6) Leishmaniasis is primarily a zoonosis infection against the wild and domestic animal are the main reserve host which must regularly be vaccinated and routine examination done (Rodriguer *et al.*, 2006).

2.7 Conceptual Framework

The conceptual framework shows the interrelationship between Socio-economic factors, household and environmental factors, Social Cultural/Behavioural factors, and

Nutritional factors on visceral Leishmaniasis infection. The framework shows the steps that are involved in how variables operate to cause disease at distal and proximate levels: distal factors rarely have a direct effect on disease outcomes but operate through some interrelated steps leading to the infection. Social-economic factors do not affect directly the risk of VL but may affect VL indirectly through the other factors proximally and in turn, affects directly the risk of disease.

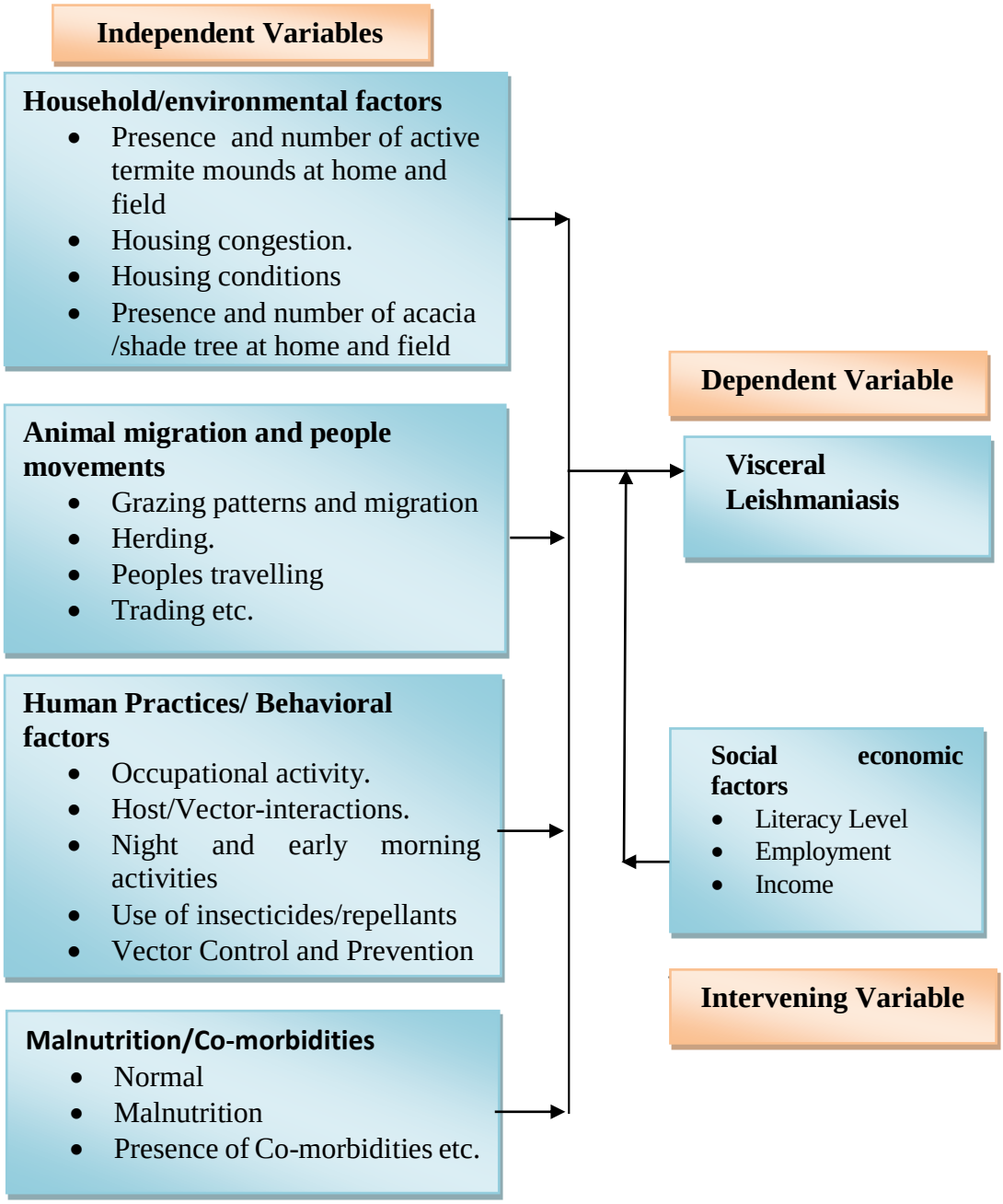

Figure 2.3: Conceptual Framework

Adapted and modified from the International journal of epidemiology 2008, on risk factors to Visceral Leishmaniasis in East Africa. (Author; Kolaczinski et al, 2008)

CHAPTER THREE

METHODS

3.0 Study Area

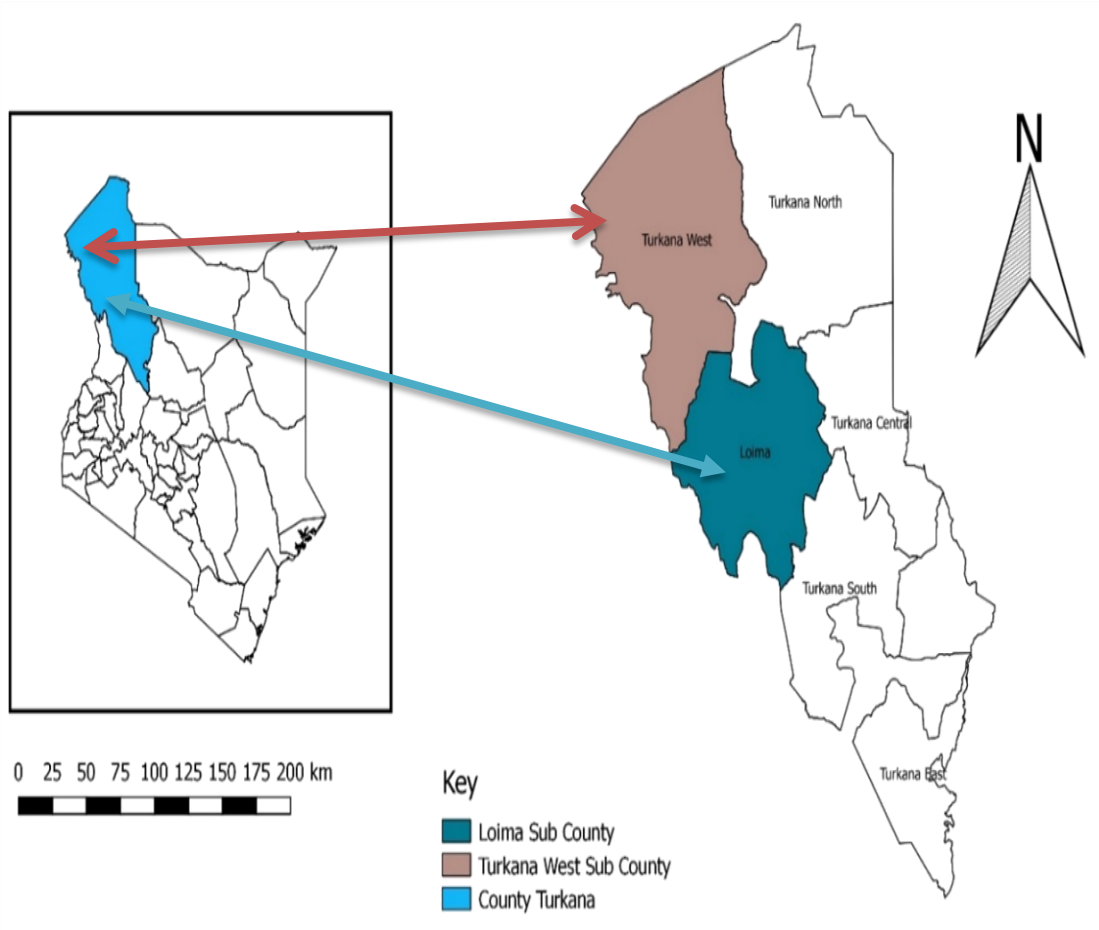

Figure 3.1: Map of Kenya and Turkana County showing Loima Sub County and Turkana West Sub study area
Source: Author, 2018

Turkana County is situated in North Western Kenya and it is bordering the following Counties; Marsabit to the east along the Lake Turkana gulf, West Pokot to the south, Baringo, and Samburu County to the southeast. Internationally it borders Uganda to the west, South Sudan to the North and Ethiopia to the northeast. The County covers an area of approximately 77,000 Km² and lies between Longitudes 340 30‘and 360 40‘East and between Latitudes 10 30‘and 50 30‘North. The physiographic features in the county

include low lying open plains, mountain ranges, and river drainage patterns(Johannes *et al*,2015).

The County is characterized by arid and semi-arid climatic conditions with unpredictable rainfall often in torrents with grassy and sparse thorny shrubs (Schilling *et al*., 2012). The current 2017/2018 Population projection is estimated to be about 1,427,797 (Johannes *et al*, 2015) with small Livestock stock population of about 3,517,151 sheep and 5,994,861 goats with approximately 70% of the population in Turkana are nomadic or semi-nomadic pastoralists (G, J, & G, 2014) deriving their livelihood from extensive livestock production.

The study was carried out in Loima and Turkana West Sub Counties being among the other seven Sub Counties in the County, the two-sub Counties international border Uganda to the West and South Sudan to the North. The study sites included the eight designated VL treatment and diagnostic facilities in the two Sub Counties and includes; Namoruputh health Centre, Urum health Centre, Lorugum Health Centre and Lorugum Sub County Hospital for Loima Sub County facilities and Kakuma Mission Hospital, Kakuma IRC refugee Hospital, Lokichoggio AIC Health Centre and Lopiding Sub County Hospital for Turkana West Sub County.

3.1 Study Design

A case-control study was used to determine if an exposure is associated with an outcome (VL infection). During the study, the cases (a group known to have VL infection) were identified from the VL treatment facilities in Loima and Turkana West Sub Counties while the controls (a group known to be free of VL infection) were identified from the communities.

The study utilized a case-control study design where cases were identified at the VL treatment health facilities were frequently matched with community controls to identify risk factors associated with Visceral Leishmaniasis infection in the study population.

3.2 Study Population

The Study populations were residents of Loima and Turkana West Sub counties where 267 participants (89 Cases and 178 Controls were enrolled).

3.3 Inclusion and Exclusion Criteria

3.3.1 Inclusion criteria

Persons who had been residents of Loima and Turkana West Sub Counties for more than one year for adults and more than six months for children under 10 years.

3.3.2 Exclusion criteria

Persons who were of unsound mind/ mentally sick. For controls, any person previously diagnosed and treated for VL was excluded.

3.4 Sample Size Determination

The sample size was calculated using the Kelsey formula (Charan& Biswas, 2013). A total of 267 participants (89 cases, 178 controls) were enrolled at a ratio of 1:2 (cases: controls), to detect an Odds Ratio (OR) of 2.1, at a significance level of 95% and power of 80%, where the proportion of exposure among controls was 43.5% where exposure is the presence of *Acacia Nilotica* in the house compound (Nackers *et al*, 2015).

$$P_0 = \frac{(OR)P_1}{(OR)P_1 + (1 - P_1)}$$

$$\mathbf{OR} = \frac{P_1(1 - P_0)}{P_0(1 - P_1)}$$

$$n_{cases-Kelsey} = \frac{\left(z_{\alpha/2} + z_{1-\beta}\right)^2 * p * (1-p) * (r+1)}{r * (p_0 - p_1)^2}$$

Variable Notations

- α - The probability of type I error (significance level) is the probability of rejecting the true null hypothesis
- β - The probability of type II error (1 - the power of the test) is the probability of failing to reject the false null hypothesis.
- P_0 - The proportion of cases
- P_1- The proportion for controls
- OR - The calculated odds ratio
- r - The ratio of case-control (1 case/r controls)
- $\mathbf{K_{elsey}}$- Required sample size for cases using Kelsey's formula

Assumptions:

Odds ratio = 2.1

Exposed controls = 43.5%

Alpha risk = 5%

Power = 80%

Controls / Case ratio = 2

Total exposed = 49.5952%

Based on Kelsey's formula estimated sample size was;

Number of cases = **89**

Number of controls = **178**

Total = **267**

3.5 Data Collection Tools

A semi structures Questionnaire was used, data was also abstracted using the data abstraction tool from the Visceral Leishmaniasis registers at the outpatient departments at the health facilities and from the VL outpatient cards and VL in patients files at the wards. Consent forms from adults and assent forms for children <10 years were administered, field notebooks we also used and use of photographs.

3.6 Methods

3.6.1 Method 1: Case selection at Health facility Level

Cases were selected from the consenting inpatients and outpatients units at the five (5) VL active treatment facilities at the time of study in Loima and Turkana West Sub Counties. From previous records, an average of 20 cases have been seen at the treatment facilities in these two sub-counties every month and this translated to 100 cases over the proposed five months of study duration. To achieve the sample size of 89 cases, we enrolled cases sequentially until the required sample size was achieved. Upon consenting of the Cases, a structured questionnaire was administered to the respondents.

3.6.2 Method 2: Control selection at the Village level

Controls were identified and followed from the same villages as cases and also frequently matched by the age categories **(<5, 5-14, 15-24, 25-34, 35-44,45-54, 55+ years**) to the case. For the selected village, the center was identified using a common landmark (office of the chief, house of the village elder or a local church). An empty bottle was tossed to identify the first household from the direction where the bottle head was pointing. The first household selected systematically by skipping the next household from the direction of the tossed bottle head until half of the households were selected. The investigation team then moved back to the center of the same village

where the bottle was first tossed and move in the opposite direction to select the remaining half of the controls.

Controls selections choice at the Community level than the health facility level was informed by the VL risk factors exposure assessment at the household level that involved physical observations of the following during the household and the nearby environmental factors; presence of the active termites and the acacia trees or shades trees at the household and or nearby households plus actual counting of the numbers, presence of the toilets/latrines at the household or community ones, use of mosquito nets, presence of the domesticated animals at household yards, sleep positions, presence of crevices and termite at the household level, housing condition among others.

3.6.3 Method 3: Control selection at the household level

The head of the household was requested for permission to conduct the selection in his/her household. List of individuals living in that household was drawn, the individuals in the age category of the case were identified, and if they were more than one, one was randomly selected through secret balloting by the use of papers marked yes or no.

Consenting individuals were asked screening questions to make sure they met the inclusion criteria and they were then tested using rk39 dipstick for VL. If the test was negative, the questionnaire was administered and if they turned positive, the patient was referred to the nearest treatment Centre for evaluations and treatment and another member of the same household (if more than one) was selected for the next test. In case of refusal of consent or absence of household occupants, the next household was selected. This was done until the required number of controls in each village was attained.

3.6.4 Method 4: A semi-structured questionnaire

A semi-structured questionnaire was developed and used during the study period (June 2018 to January 2019). Trained Laboratory Technologists who were recruited as research assistants in English or Kiswahili who came from the local community Nga'turkana" language proficiency as the additional language administered. The questionnaire had the following variables for the study; (a) Socio-demographics information age, sex, employment, illiteracy status, level of education and marital status among others (b) Household and environmental factors including; presence and number of active termite mounds, housing conditions, presence and the number of the acacia tree within the households, presence of animals at the household level, sleeping area and sleep proximity to the animal house, educational level, etc. (c)Social-cultural/ behavioral factors which include, occupation of the participant's, host-vector interactions at home and while in the field, night dance "Edonga", night and earlier morning activities, sleeping habits (Indoor or outdoor), use of insecticide-treated mosquito net among others. (d) Co-morbidity data was abstracted from the Case file records for inpatients and the outpatient treatment file, card during the treatment to the data abstraction tool (e) Case clinical information was also captured and this includes; date of disease onset, signs and symptoms presentation, the health-seeking behavior before seeking treatment, etc.

(f) Determination of the knowledge of the study participants was assessed by asking questions yes and No questions on disease awareness, causes of disease, severity, modes of treatment available among others.

(g) Assessment of the participant's practices on VL was also captured through practices on modes of control and prevention, health-seeking behaviors, and their willingness to receive information among others.

The interviewers were trained on the research objectives, study significance, consent administration, and delivery of the questionnaire content.

3.6.5 Pilot testing of the questionnaires

The questionnaires were pilot tested at the Lodwar County referral hospital, a facility that was not included in the study and was not part of the study area. The purpose was to validate the data collection tools and for quality assurance purposes.

3.6.6 Method 5: Visceral Leishmaniasis Diagnosis from Consenting Controls

3.6.6.1 Patient preparation

Upon consenting a trained Laboratory technologist recruited as the research, assistants prepare the patients for the test by describing the procedures of the test and also preparing the testing kits rk39 kit (VL Detect, Inbios, Seattle, USA or IT-LEISH, Switzerland 97% sensitivity and 100% specificity) before administering the test. Demographic variables such as name, age, sex, occupation, level of education, and the village of the participant were recorded during patient's preparation as well as labeling of the sample kits and devices using a special code identifier or use of a special marker.

3.6.6.2 Sample collection

Using the aseptic technique capillary blood was collected through the figure prick procedure where patients' blood was drawn into the provided Kit capillary tube up to the black mark (approximately 0.5 microliters) and was then directed into the sample well and immediately followed with proper mixing with the help of the tip of the pipette to lyze the blood cells

Drops of buffer were immediately added into the test device microwells (one drop to the sample well and four drops into the buffer well) for enhanced blood lateral flow. The test strip was then inserted into the sample well for 5 Minutes then into the buffer

well for another 10 minutes for enhanced capillary flow. The results were read after 15 minutes after color development.

3.7 Categorization of Results

Results were positive, negative, or invalid. Positive results were reported when both control and test lines appear as brightly red/pink or when a faint line for both the test lines and that the sample tested has antibodies against the recombinant Rk39 antigen of *Leishmania*. Negative results were reported when only the control line appears, while invalid results when no control line appears or both the control and test lines appear, even when repeat test is done with a different Kit device.

3.8 Data Management

3.8.1 Cleaning of Data

Data cleaning was done and it involves; deletion of all formatting, spell check, change of texts cases, identifying and correcting of errors, removal of duplicates, the conversation of numbers stored as texts into numbers, selecting and filling of the blank cells and getting rid of extra spaces among others was done.

3.8.2 Coding of data

Coding of variables was aimed in changing qualitative data into a quantitative format and was done by the lead researcher after data cleaning to facilitate ease in computer processing with statistical software's during data analysis.

3.8.3 Data entry

Coded data were entered into Epi info 7.2 and transferred into Microsoft Excel software's.

3.8.4 Data analysis

Descriptive statistics were performed using data analysis tool where means and medians were calculated for continuous variables and proportions/ frequency for categorical variables. Association between independent and dependent variables was evaluated using the Odds ratio (OR) and 95 % confidence interval (CI) as a measure of association and chi-square test as a test of significance. Bivariate analysis was undertaken and variables with a P-value of < 0.2were considered for Multivariate analysis.

Multivariate analysis was undertaken using unconditional logistic regression backward stepwise elimination process. All factors with a p-value of less than 0.05 were considered statistically significant. The final models presented the factors significantly associated with Visceral Leishmaniasis.

3.9 Ethical Considerations

This study was carried out after clearance from the supervisors' approval of my research topic and research proposal by the school of public health at Moi University. Institutional Ethics and Research Committee (IREC), Moi University and Moi Teaching and Referral hospital, IREC/2018/24-Approval number, granted study approval: 0003030 IREC 2088, National Commission for Science, Technology, and Innovations (NACOSTI) (Reference number: NACOSTI/P/18/36722/23791).

Permission to collect data at the County level facilities was granted by the County Management through the Director Medical Services (DMS). Written and verbal consent were sought from all study participants. The investigating teams explained the objectives of the study and intended use of the results in the prevention and control of VL before the participants gave their informed consent without any form of coercion.

3.10 Integrity of Data

Measures were sought to ensure that collected data was confidential, passwords were used for computers and the filled up manual questionnaires were put under lock and key with back up via cloud internet.

3.11 Dissemination of Data

The findings from the study were disseminated to the VL treatment and diagnostic facilities Sub-county health management of Loima and Turkana West Sub-Counties and other Sub-Counties. The County health management and Key stakeholders

CHAPTER FOUR

RESULTS

4.0 Introduction

In this section, the data analysis summary of the results related to the socio-demographic characteristics of the study participants, the clinical presentation of the cases, assessment of the risk factors associated with VL, determination of the knowledge and assessment of the practices of the study participants in Loima and Turkana Wets Sub-counties were analyzed and presented in form of figures and tables.

4.1 Socio-Demographic Characteristics of the Study Participants in Loima and Turkana West Sub Counties, as From June 2018 to January 2019

Of 267 participants interviewed, 89 (33.3%) were cases and 178 (66.7%) were controls. The overall age, median (IQR) years was, 11(9) for cases and 12(11.5) years for controls. (See appendix IIX).

4.1.1 Distribution of the study participants by Sex in Loima and Turkana West Sub Counties, as from June 2018 to January 2019

There were more male participants interviewed 173(64.8%) than female 94 (35.2%), from the male participants, 59 (34.1%) were Cases and 114 (65.9%) were Controls whereas, female were 30 (31.9%) and controls were 64 (68.1%) (See appendix IIX).

4.1.2 Distribution of the study participants by Age group in Loima and Turkana West Sub Counties, as from June 2018 to January 2019

Majority of the participants were in the age group 5-14 yrs 147 (55.1%), ages groups <5 yrs were 42 (15.7%), 15-24 yrs had 36(13.5%), 25-34 age groups were 24(9%), age groups 35-44 years were 9 (3.4 %), 55+ years were 6(2.3%) and the

age group with the lowest participants was 45-54 years which only had 3(1.1%) of the total participants (See appendix IIX).

4.1.3 Distribution of the study participants by place of residence in Loima and Turkana West Sub Counties, as from June 2018 to January 2019

The residence by sub-county of the participants was sought, wwere174 (65.2%) of the total participants were from Turkana West sub-county and 93(34.8%) from Loima sub-county Ward distribution of the study participants in Turkana West Sub County in decreasing order were as follows; Kakuma and Letia ward both had 42(15.7%), Nanam ward 30(11.2%), Lopur Ward 24(9%), Lokichoggio Ward 18(6.7%), Songot Ward 15(5.6%) and Kalobeyei Ward 3(1.1%). Nonetheless, the Loima Sub County ward distribution of the study participants in decreasing order showed Lokiriama/Lorengippi Ward 66(24.7%), Loima Ward 15(5.6%), and Lobei/Kotaruk ward 12(4.5) (See appendix IIX).

4.1.4 Characterization of the study participants by type of education in Loima and Turkana West Sub Counties, as from June 2018 to January 2019

The type of education of the respondents was aimed and the majority of the participants 178(66.7%) had non-formal education 60 (33.7%) were from Loima Sub County and 118(67.3%) from Turkana West Sub County. Eighty-nine (33.3%) had formal education with Loima 33(37%) and 56(63%) were from Turkana West Sub County. From the above, the respondents with non-formal education for the cases were 72(81%) cases and 106(59%) controls (See appendix IIX).

4.1.5 Characterization of the study participants by household income source in Loima and Turkana West Sub Counties, as from June 2018 to January 2019

The main household income activity for most participants was livestock keeping/herding, 126 (47.2%) followed by charcoal burning at 49(18.4%), trading was the third income 35(13.1%), Selling of the local alcoholic brews 30(11.2%) and finally 27(10.1%). farming 6(2.2%), Hunting/poaching 3(1.1%), and salaried employment 18(6.8%) (See appendix IIX).

4.1.6 Characterization of the study participants by housing type in Loima and Turkana West Sub Counties, as from June 2018 to January 2019

Majority of the respondents housing/sleeping conditions was determined where 108(40.45%) were living/sleeping in the Hut/Manyatta, 59(22.2%) were sleeping in open space, 53(19.9%) were sleeping near the animal pen, 29(10.9%) were living/sleeping in temporary shelter "Atabo", 9(3.4%) were living/sleeping in modern houses while 8(3.0%) of the total participants had varied residence/sleeping conditions according to weather. Only one (0.4%) was sleeping under a tree (See appendix IIX).

4.1.7 The conditions of the housing walls resided by the study participants in Loima and Turkana West Sub Counties, as from June 2018 to January 2019

The type of walls of the houses where the participants reside was analyzed and it was found that bulk of the participants 204(76.4%) had Grass/cane/wood/wood backs/polyester/Box covers walls with 77(86.0%) cases, and 127(71.3%) controls, followed by participants with mud/wood walls 51(19.1%) with 11(12.4%) cases and 40(22.5%) controls, and participants with cement/brick walls were third in distribution

at 11(4.1%), with 1(1.1%) cases, ad 10(5.6%) controls. Participants with cement/brick walls were 11(4.1%) with 1(1.1%) case and 10(5.6%) controls, and participants with iron sheet walls were 1(0.4%) with no cases and only one control (0.6%) **(**See appendix IIX**).**

4.1.8 The conditions of the housing floor resided by the study participants in Loima and Turkana West Sub Counties, as from June 2018 to January 2019

Most of the respondents 245(91.8%) had earth floors with 0(0%) cases having earth floors and only 1(0.6) control having earth floor. 14(5.2%) of the total respondents had cement floors with 3(3.4%) cases also having earth floors, and 11(6.2%) controls having cement floors. Participants with floors of made of mixed materials based on animal feces were two (0.7%), there were two (2.2%) cases with the same floor but there were no controls with floors with a mixture based on animal feces. The least number of participants (0.4%) had floors covered with gravel/rocks/stones (See appendix IIX).

4.1.9 The conditions of the housing floor resided by the study participants in Loima and Turkana West Sub Counties, as from June 2018 to January 2019

Most housing roofs where participants were residing in was pursued and the weighty participants 167(62.5%) had roofs covered with tree backs/polythenes/box where 99(55.6%) were controls and 68(76.4%) were Cases although, 52(19.5%) of the total participants had grass/wooden roofs where Controls 39 (21.9%) and Cases were 13 (14.6%). while only 48(18%) of the participants have iron sheet roofs with Controls 40(22.5%) and Cases 8(9%) (See appendix IIX).

4.1.10. Distribution of Cases as per the VL treatment facilities during the study period in Loima and Turkana West Sub Counties, as from June 2018 to January 2019

The Cases load distribution according to facilities in decreasing order were showed, Namoruputh Health Centre31 (34.8%), Kakuma Mission Hospital24 (27%), Lopiding Sub County Hospital 17(19.1%), Kakuma Sub County Hospital 13(14.6%) and Lokichoggio AIC Health Centre 4(4.5%) (See appendix IIX).

4.2 Description of the Cases clinical presentations in Loima and Turkana West Sub County as from June 2018 to January 2019

Description of the Cases clinical presentation, as well as the assessment of the signs and symptom experienced by the Cases during the time of treatment, was assessed

4.2.1 Clinical characterization of the study cases managed at the VL treatment facilities in Loima and Turkana West Sub County as from June 2018 to January 2019

The average mean days' duration from the time of contracting the disease to the time of seeking treatment by the cases was found out to be 51 (SD ± 48 days). About 1/3 of the Cases took 15-30 days while 21(23.6%) took more than 60 days. Of all the cases 44(49.4%) resided more than 50Kms away from the Health Facility (See table 4.1).

4.2.2 Case management at the facility level during the study period in Loima and Turkana West Sub Counties, as from June 2018 to January 2019

Case management at the health facility sought and was found out that 57(64%) of the participants were managed as inpatients, 32 (36%) as outpatients. On the treatment of

the Cases, 86(96.7%) were put on stibogluconate and paromomycin (SSG/PM) combination therapy whereas 3(3.3) on SSG alone (See table 4.1).

4.2.3 Nutritional and Co-morbidity assessment of the Cases at the facility level during the study period in Loima and Turkana West Sub Counties, as from June 2018 to January 2019

Nutritional and Co-morbidity assessment was also undertaken where 39(60.9%) of the cases were treated for Malaria, 15(23.4%) were treated for chest infections, and typhoid and brucellosis five (7.8%) cases were treated for each. Malnutrition was noted in 65 (73%) of the cases and 24(27%) were not malnourished in the Cases assessed (See table 4.1)

Table 4.1: Clinical characterization of the study Cases at the VL treatment facilities in Loima and Turkana West Sub Counties as from June 2018 to January 2019

Factor	Frequency	Cases n (%)
Length of stay of cases before seeking treatment in days	**N=89**	**n (%)**
<15 days	18	18(20.2%)
15-30 days	26	26(29.2)
>30-60days	24	24(27%)
60+	21	21(23.6%)
Facility distance in Kilometers	**N=89**	**n (%)**
>50 Kms	44	44(49.4)
< 50 Kms	45	45(50.6)
Some treatment is given before going to the Health facility	**N=89**	**n (%)**
Yes	56	56(63%)
No	33	33(37%)
Case treatment administered	**N=89**	**n (%)**
Sodium stibogluconate and paromomycin combination (SSG/PM)	86	86(96.7)
Sodium stibogluconate alone (SSG)	3	3(3.3)
Co-morbidities management	**N=89**	**n (%)**
Malaria	39	39(60.4)
Chest infection	15	15(23.4)
Typhoid	5	5 (7.8)
Brucellosis	5	5 (7.8)
Case patients management	**N=89**	**n (%)**
In patients	57	57(64)
Out of patients	32	32(36)
Nutritional status	**N=89**	**n (%)**
Malnourished	65	65 (73)
Normal	24	24 (27)
Type of treatment before going to the Health Facility	**N=89**	**n (%)**
Abdominal Burns	10	10(30.2)
Traditional Herbs	2	2(6.1%)
Traditional Healers- Cleansing	2	(6.1%)
Abdominal Tattooing marks	15	15(45.5%)
Use of Pain-relieving drugs	4	4(12.1)

4.3 Assessment of the Signs and Symptoms Experienced by the Case Participant

The study aimed to assess the common signs and symptoms from the Cases managed during the study period, fever was found to be the most common symptom reported by the cases 83(93.3%) with the others signs and symptoms in the decreasing others as; generalized body weakness 77(86.5%), abdominal distension 76(85.4%), weight loss 75(84.3%), loss of appetite 69(77.5%), joint pains 55(61.8%), fast breath 54(60.7%), abdominal pain 51(57.3%), yellow eyes 50(56.2%), swelling of legs 40(55.1%),swollen glands 34(38.2%),abdominal cramps 33(37.1%),nose bleeding 32(36%),vomiting 27(30.3%), 26 (29.2%), others(Nausea, sweating, yellow hair, yellow urination, and skin constituted 4(4.5%) (See table 4.2)

Table 4.2: Assessment of the presenting signs and symptoms for the Cases managed at the VL treatment facilities during the study period in Loima and Turkana West as from June 2018 to January 2019

Signs and Symptoms	Frequency	Percent (%)
Fever	83	93.3
Body weakness	77	86.5
Abdominal swelling	76	85.4
Weight loss	75	84.3
Loss of appetite	69	77.5
Joint Pains	55	61.8
Fast Breath	54	60.7
Abdominal pains	51	57.3
Yellow Eyes	50	56.2
Swollen Legs	40	55.1
Swollen glands	34	38.2
Abdominal cramps	33	37.1
Nose bleeding	32	36
Vomiting	27	30.3
**Others (Nausea, sweating and Yellow Air	26	29.2
Yellow urination	4	4.5

Objective 1: Analysis of Risk factors associated with Visceral Leishmaniasis

4.4 Bivariate Analysis of Risk Factors Associated with VL in Loima and Turkana West Sub Counties as from June 2018 to January 2019

Bivariate analysis was aimed at evaluating the interaction between dependent, independent, and intervening variables on Leishmaniasis infection. Association between independent and dependent variables was evaluated using the Odds ratio (OR)

and 95 % confidence interval (CI) as a measure of association and chi-square test as a test of significance.

The significance factors at bivariate level include; Non-formal education, the participant's history of animal movements/migration outside the area of residence in the past 6 months, the presence of acacia or shade trees in the homestead, nap under acacia and or any shade trees while in the field, presence, and the number of active termite mound's in the homestead and or field, sleep and or play around the termite mound's while in the homestead or field, not using household insecticides spray or repellants for both animals and humans for the last one year, not sleeping under the mosquito net, traveling in the VL endemic Counties or Countries in the past 6 Months, open (bush) defecation, presence of animals in the homestead**. (**See appendix VII).

4.5 Result of Multivariate Analysis on Factors Independently Associated with VL in Loima and Turkana West Sub Counties as from June 2018 to January 2019

Multivariate analysis was undertaken using unconditional logistic regression where all variables with a P-value of < 0.2 at the bivariate level were entered into the backward stepwise elimination process. All factors with a p-value of less than (<0.05) were considered statistically significant. The final models presented the factors independently associated with VL which included; the presence of domesticated animals at the household level, travel to VL endemic Counties or Countries in the past six months, playing or sleeping around the termite mounds in the field or within the homestead, animals migration history within the past six months in due to pasture or routine migratory pattern within the sub- County of residence, lack of formal education, >10 number of active termite mound's within the homestead and its surrounding and

not using the insecticides residual sprays at the household level in the past one years**.** (See table 4.3).

Table 4.3 Multivariate Analysis of Factors Independently associated with VL in Loima and Turkana West Sub Counties, Northern Kenya, 2018-2019

Variable	Category	Cases n=89 (%)	Controls n=178 (%)	AOR(95%CI)
Presence of domesticated animals at the homestead	Yes	84(94.4)	125(70.2)	5.6(1.85-16.80)
	No	5(5.6)	53(29.8)	
Travel to VL endemic Counties/ Border Countries in the past 6 Months	Yes	33(37.1)	21(11.8)	4.9(1.95-12.25)
	No	56(62.9)	157(88.2)	
Sleep/play around the termite mound in the field/homestead	Yes	72(80.9)	77(43.3)	4.0(1.91-8.18)
	No	17(19.1)	101(56.7)	
Animals migration History past 6 months within the Sub County of residence	Yes	52(58.4)	35(19.7)	2.8(1.34-5.67)
	No	37	143(80.3)	
Type of Education	No formal	72(80.9)	106(59.6)	3.4(1.54-7.54)
	Formal	17(19,1)	72(40.4)	
Number of active termite Mounds within the homestead /Surrounding	>10	53(59.6)	59(33.2)	3.3(1.65-6.41)
	≤10	36(40.4)	119(66.8)	
Non-use of Household insecticide use in the past 1 year	Yes	2(2.3)	32(18)	1.4(2.07-11.34)
	No	87(97.7)	146(82)	

4.6 Objective2: Determination of the participant's knowledge on Visceral Leishmaniasis infection in Turkana West and Loima Sub Counties Northern Kenya, as from June 2018 to January 2019.

To determine the participant's knowledge on the VL was assessed by use of a yes and no responses on their awareness of the disease, knew of somebody sick, on treatment or died of VL disease at household or community level, scaling of the participants responses by use of rating scales on disease severity, willingness to receiving VL information and their preferred methods of receiving VL information and Immediate participants responses on the course of the disease see figure 4.4). The majority of the participants 212 (79.4%) knew of the disease, they knew somebody who was sick and or on treatment or had died of the disease within their households or community level. From the above, cases 58(27.4%) and 154 (72.6%) of the controls reported this (See figure 4.4).

Scaling of the participants responses by use of rating scales on disease severity reported that it's highly severe234 (87.6%) in 75(32%) in the cases and 68% in the controls, while 30 (11.2%) reported that the disease was severe and 3(1.1%) could not rate the disease in terms of its severity (See figure 4.4).

Participant's knowledge of the VL modes of infection or transmission assessment was sought where the majority of the participants 222(83%) did know the modes of disease infection or transmission which includes; 157(70.7%) controls and 65(29.3%) of the cases. Sandflies as a vector were reported by 38(14.1%) which represented 17(44.7%) cases and 21(55.3 %%) of the controls. Cases 4 (4.5%) also reported mosquito as one of the causes of VL (See figure 4.4).

Participants were assessed on their willingness to receiving VL information and it was found out that 264(98.9%) were willing to receive the information from whom 88(33.3%) were Cases and 176 (66.7%) were controls (See figure 4.4).

During the research 335 study responses were received on the preferred methods of receiving VL information by the study participants where about half of the respondents 171(51%) preferred receiving VL information through the Chiefs Barraza's, from whom 32(18.7%) of the cases and 139(81.3%) were controls. Some preferred getting information through the health care workers 170(50.7%) where 27(15.9%) of the cases and 143(84.1%) of the controls, Participants preferring the use of the megaphones/public address system (PAS) 36(10.7%) from whom while 10(27.8%) of the cases and 26(72.2%) of the controls. The use of flyers and brochures was reported in 37(11%) from whom 8(21.6%) cases and 29(78.4%) were from Controls. Receiving VL information from their neighbor's was reported by 50 (14.9%) from whom 5 (10%) cases and 45(90%) were controls. Two (0.6%) of the participants did not know of their preferred method of receiving VL information from whom equal number 1 (50%) were reported by both the cases and controls and finally there were 1(100%) of the control who preferred through the church service 1(0.3%). (See figure 4.4).

Table 4.4: Determination of the participants knowledge on Visceral Leishmaniasis infection in Turkana West and Loima Sub Counties Northern Kenya, as from June 2018 to January 2019.

Variable	Cumulative (%)	Cases (%)	Controls (%)
Willingness to receive VL information	**N 267**		
Yes	264(98.8)	88(33%)	176(66.7%)
No	3(1.2)	1(33.3%)	2(66.7%)
Immediate response on causes of VL infections to humans	**N=267**		
Did not Know	222 (83)	65(29.3)	157(70.7)
Sandflies	38(14.1)	17(44.7)	21(55.3)
Mosquitos	8(2.9)	8(100)	
Knew somebody who was sick, on treatment or died of VL at household or neighbor	**N=267**		
Yes	212 (79.4)	58 (27.4)	154(72.6)
No	55 (20.6)	31(56.4)	113(43.6)
Degree of VL disease severity			
Very serious	234 (87.6)	75(32)	159(68)
Serious	30(11.2)	13(43.3)	17(56.7)
Do not know	3(1.2)	1(33.3)	2(66.7)
Preferred Methods of receiving VL information	**N335**		
Chiefs	171 (51)	32 (18.7)	139(81.3)
Health Care workers	170(50.7)	27 (15.9)	143 (84.1)
Public Address system	36(10.7)	10 (27.8)	26 (72.2)
Flyers and Brochures	37 (11)	8 (21.6)	29 (78.4)
Neighbors	50 (14.9)	5 (10)	45 (90)
Did not Know	2 (0.6)	1 (50)	1 (50)
Church service	1 (0.3)		1 (100)

4.7 Objective 3: Assessment of Participants Practices on VL in Turkana West and Loima Sub Counties Northern Kenya, as from June 2018 to January 2019

Assessment of the participant's practices on Visceral Leishmaniasis disease was sought by asking questions on where they seek treatment of VL, traditional methods of treatment in place, and their practices on VL control and prevention measures in place at individual and community level.

Participants practices on were they seek VL treatment found out that 126(47.2%) reported seeking on traditional methods with 44(34.9%) Cases and 82(65.1%) of the controls, treatment at health facility level were 121(45.3%) with Cases 50(41.3%) and Controls 71 (58.7%). Whereas 3(1.1 %) of the participants from which 3(100%) controls reported that VL has no treatment and 17(6.4%) of the participants from whom 10(58.8%) Cases and 7(41.2%) reported that they didn't know on the where they can seek VL treatment (See table 4.5).

Practices assessment for the study participants on some of the traditional methods for VL treatment found out where 220(82.4%) of the participants reported use of the abdominal burning of the skin using the animal dung where75 (34.1%) of the cases and 145(65.9%) of the controls were notified, on use traditional herbs 138(51.7%) from whom 56(40.6%) of the cases and 82(59.4%) of the controls reported. Whereas cleansing from traditional healer 71(26.6%) where 38(55.5%) of the cases and 33(46.5%) of the controls reported and the use of traditional abdominal tattooing marks 174 (65.2%) from whom 77(44.3%) of the cases and 97(55.7%) of the controls reported (See table 4.5).

Table 4.5: Assessment of participants practices on VL in Turkana West and Loima Sub Counties Northern Kenya, as from June 2018 to January 2019

Factor	Cumulative	Cases	Control
Place of seeking VL treatment			
Health facility	121(45.3)	50(41.3)	71(58.7)
Traditional Methods	126(47.2)	44(34.9)	82(65.1)
No cure of VL	3(1.1)	0(0)	3(100)
Don't know	17(6.4)	10(58.8)	7(41.2)
Traditional Methods of VL management	Cumulative number	Cases (%)	Control (%)
Abdominal Burns	220(82.4)	75(34.1)	145(65.9)
Traditional Herbs	138(51.7)	56(40.6)	82(59.4)
Traditional Healers- Cleansing	71(26.6)	38(55.5)	33(46.5)
Abdominal Tattooing marks	174(65.2)	77(44.3)	97(55.7)

4.7.1 Assessment of the participants practices on VL prevention and control strategies in Turkana West and Loima Sub Counties as from June 2018 to January 2019

Three hundred and twenty-three (323) responses from which 129 from the cases and 194 from the controls were captured from the study participants on their practices s towards VL control and prevention. Majority of the respondents230(71.2%);from which 74(57.4%) of the cases and 156(80.4%) of the controls were not practicing any prevention and control measures towards VL, On the use of insecticides treated nets 20(6.2%) were reported from which 12(9.3%) of the cases and eight(4.1%) of the controls reported. The use of insecticide's repellants 3(0.9%) was reported by2(1.6%) cases and 1(0.5%) control, the use of indoor insecticides sprays 6 (1.9%) were reported by 2(1.6%) cases and 4(2.1%) controls and killing of rodents at the household level and

nearby surroundings 8(2.5%) was also reported by 4(2.1%) cases and 4(3.1%) control(See Table 4.4)

Treatment at the health facilities 12(3.7%) was reported by 8(6.2%) of the cases and 4(2.5%) of the Control, filling of the crevices at the household and nearby environment 28(8.7%) was reported by cases 4(2.1%) and 19 (14.7) of the controls, destruction of the termite mounds 2(0.6%) by cases only and smoking to smoke of fresh tree branches of some trees "Emeyen and " Epuu" and or animal dung was reported by 14(4.3%) of which 6 (4.7) cases and 8 controls (8.1)**(**See table 4.4 **)**

Table 4.6: Assessment of the participants practices on VL prevention and control strategies in Turkana West and Loima Sub Counties as from June 2018 to January 2019

Variable	**Cumulative N=323**	**Cases n=129**	**Controls n=194**
	Frequency	**Cases Frequency**	**Control Frequency**
VL Control and prevention method	**N (%)**	**n (%)**	**n (%)**
Not practicing Control and prevention method	230 (71.2)	74(57.4)	156(80.4)
Use of Mosquito Insecticides treated Nets	20 (6.2)	12 (9.3)	8 (4.1)
Insecticides repellant use	3 (0.9)	2 (1.6)	1 (0.5)
Household insecticides residual spray	6 (1.9)	2 (1.6)	4 (2.1)
The killing of rodents at home	8 (2.5)	4 (3.1)	4(2.1)
Taking drugs from the health facilities	12 (3.7)	8 (6.2)	4(2.1)
Filling of the crevices at home and nearby homes	28(8.7)	19(14.7)	4(2.1)
Destruction of termite mounds	2 (0.6)	2 (1.6)	0 (0)
Burning to smoke =Fresh leaves /animal dungs at home	14(4.3)	6(4.7)	8(4.1)

CHAPTER FIVE

5.0 Discussion of the Social Demographics Characterization of the Study Participants

From the study we found out that males registered higher case notification than females; with a steady rise across the age groups observed from children and young adults to a pick at 5-14 years this could be due to the social predisposition and lifestyles of males that could be the risk factors for VL infection, including; herding, animal migration and long distance travels in search of food and animal raids, this finding is in agreement with conclusions of previous retrospective hospital based study in Humera, Western Tigray, 2018 where univariate analysis of the infection rate of Leishmaniasis was based on the potential risk factors and found higher male infection rates than female ($P < 0.05$) in all the study years (Gebremichael *et a*l, 2018) and were concordant to a study conducted in North-West Ethiopia, on the risk factors of visceral Leishmaniasis where in total of 1128 VL patients admitted and treated at Kahsay Abera Hospital from the period of July 2011 to August 2013 had three quarters of the admissions treated for VL as males, and most of the cases (825) were in the age group 15–39 years; the second affected age groups were 5–14 years (184 cases) followed by <5 years (66 cases) and > = 40 years (53 cases) (Yared *et al*, 2014).

Almost all the cases were treated as inpatients were on SSG/PM combinations. These findings were in agreement with multi-center, open-label randomized trials in assessing the patients response to paromomycin in East Africa, 2010 the overall cure rate with PM was significantly inferior to that of SSG (63.8% versus 92.2%; difference 28.5%,95% CI 18.8% to 39.8%,P <0.001) (Hailu et al., 2010). Apart from the VL treatment, the cases were also managed for other Co-morbities that includes; malaria, typhoid, brucellosis and chest infections;-these findings were in harmony with the case-

control study was carried out from June to December 2006 at Amudat hospital, Nakapiripirit district, Uganda where malaria co-infection was identified as a risk factor to VL OR(95%CI); 0.26(0.90-0.72 and a short report on rainfall pattern,EL-Nino malaria in south-west Uganda,1998 where malaria testing was used to rule out underlying VL disease (Kolaczinski *et al*, 2008).

Majority of the respondent's main source of income being livestock herding, and the majority of the participants housing conditions were hut/Manyatta whose walls were covered with grass/cane/wood/wood backs/polyester/box covers; the floor was earth and the rooftop covers made of tree backs/polythene/box covers. The findings are concordant with similar studies on the economic burden of VL for households in Nepal in 20006 and a study case-control study was carried out in from June to December 2006 at Amudat hospital, Nakapiripirit district, Uganda, the majority (56.3%) of adult cases (>15 years) were pastoralists with a history of animal migration, social-economic factors such as place of sleep or housing condition were negatively associated with VL risk and being a pastoralist was not a risk to VL with unadjusted OR at 95% CI of 1. (78.1%)(Kolaczinski *et al*., 2008)(der Stuyft, & Boelaert, 2006.,Rijal *et al*., 2006).

Malnutrition was reported in three-quarters of the cases during the period of treatment this was concordant with a cross-sectional study on the prevalence and the risk factors on Nutrition among VL patients in Ethiopia in 2014 found out that among 403 VL patients 385(95.5%) were malnourished (Mengesha *et al*., 2014) and this could be due to the high poverty levels in the County.

Low health-seeking behaviors were observed, three-quarters of the cases seeking traditional treatment before going to the health facilities for treatment as well the majority of the study participants were illiterate. Related findings were noted in the

community-based in Gedaref state, northern Sudan in 2006to evaluate the accessibility of visceral Leishmaniasis (VL) treatment where it was found out that factors barring access to treatment were due to failure to earlier treatment at health facilities due to lack of money for treatment and transport, impassability of roads, work priorities, seeking of local treatment first, cultural and distance to the next health center (Gerstl, Amsalu, & Ritmeijer, 2006)) (Gerstl *et al.*, 2006).

Cases managed presented with the following signs and symptoms of VL fever being the most common symptom reported by the cases, general body weakness, abdominal distension, weight loss, loss of appetite, joint pains, fast breath, abdominal pains, yellow eyes swelling of legs, swollen glands, abdominal cramps, nose bleeding and vomiting others(Nausea, sweating, yellow hair, yellow urination, and skin constituted). There were similarities findings with epidemiological and factors associated with Visceral Leishmaniasis in Marsabit, Kenya in 2018 (Dulacha *et al*., n.d.).

5.1 Discussion of the Risk Factors Independently Associated with VL

From the study we found out that the multivariate factors independently associated with VL as; the presence of domesticated animals at the household level and this could be due to the local community lifestyle structure as nomadic pastoralist's with animals being their source of livelihoods coupled by the porous border associated with free movement of mobile populations, insecurity and hence animals close association at the household level is part of lifestyle;- human Visceral Leishmaniasis caused by *Leishmania donovani* has been associated as an anthroponosis with animals in the VL endemic areas having VL infection and or antibodies, the animal reserver host role is still not clear in VL epidemiology hence the animals-vector and human close association could be responsible for VL disease. Sylvatic mammals such as wild canids

and dogs are the most important species among domesticated animals in the epidemiology being the primary reservoir hosts to VL(Dawit& Shishay, 2014) The findings are in harmony with the preliminary survey studies of domestic animals and risk factors in north-west Ethiopia, 2015, the study seropositivity rates in 203 sera samples analyzed were 41.9% in cattle, 40% in dogs, 33.3% in donkeys, 10% in goats and 4.8% in sheep. Dogs owned by households with history of VL treatment and humans sharing the house with cattle were more affected by visceral Leishmaniasis ($p < 0.05$)(Kenubih *et al.*, 2015).

Increased numbers 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 being the breeding sites of the sandflies vectors and their increased numbers of active termite mounds could be associated with increased chances and the odds of infection due to the vector-human close contacts as a result of human behavior's and activities that include; use of anti-hills or mounds as a source of building materials, playing around could also be associated with lack of knowledge on diseases transmission, anti-hills and or mounds are used to dry clothes after washing as a practice and sometimes especially during the rainy season the children collect termites as an alternative source of proteins around the termite mounds and this could all be risk to 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 where from a total of 361 participants, Increased VL risk was associated with the presence of active termite hills/molds [odds ratio (95% confidence interval): 12.58 (5.911–26.763) and the entomological survey collected sandflies in termite hills.(Alebie *et al.*, 2019) and in a descriptive cross-sectional study design done in Kacheliba district of West Pokot County, Kenya in December 2007 and February 2008

where the presence of a large number of termite mounds (p=0.001,df=8,x2=39.821) and resting or sitting near termite mounds (p=0.001,df=2,x2=17.67) was a risk to VL infection (Lotukoi, 2011).

Animal seasonal migration history in the last six months associated with animal and populations migration in search of water and animal pastures was also independently associated risk factor to VL and this could be a normal lifestyle of the nomad pastoralist's of the local community across sub counties and the border countries, seasonal migration could also predispose the animals to close contacts with the vectors due to the long hours in the field increasing VL risk of exposure;- Seasonal migration and grazing patterns are associated with an imbalance in the herd immunity leading to the introduction of the non- immune animals into an area where there's enzootic or endemic transmission leading to a possible outbreak in such an area (Sharma & Singh, 2008)., The findings are concordant with a similar case-control study carried out from June to December 2006 at Amudat hospital, Nakapiripirit district, Uganda, the majority (56.3%) of adult cases (>15 years) were pastoralists with history of animal migration and were mostly Pokot and Turkana communities from Kenya (75.0%) and had lived in their community for 2 years or more (78.1%) (Kolaczinski *et al.*, 2008).

Low illiteracy level or lack of formal education was also independently associated with VL and this could impact negatively deciding on matters of disease transmission, prevention, and control strategies and does increasing the chances of transmission. Visceral Leishmaniasis has also been associated with low social economic status; unemployment, poor housing condition, poor sewerage and overcrowding among others and in turn increases the risk to VL transmission; similar findings were reported in a prospective study done on the VL risk factors in India and Nepal,2014 the results

showed out that seroconversion and risk of VL were strongly associated with the illiteracy levels and low social-economic status noting living in households with low socioeconomic status (OR=0.63 in households in the highest SES quintile (Picado *et al.*, 2014).

Non-use of insecticides at the household level were also reported as an independently associated risk factor and this could due to the community lack of empowerment and or ignorance of the use of insecticides as a prevention and control strategy in VL infection. On-Insecticides use at the household level for both animals and humans as a public health intervention to prevent human cases of zoonotic Visceral Leishmaniasis could be a risk to VL transmission. This finding were incompatible with conclusions derived from the optimization of the insecticides use based on the household and animal shades for VL control intervention in Bihar, India 2015 where there was optimal effectiveness of insecticides use as a prevention and control strategy towards VL at the household use (Gorahava *et al.*, 2015).

Travel to VL endemic Counties or Countries in the past six months was also independently associated as a risk factor to VL transmission. This could be a normal lifestyle of the nomad pastoralists of the local community across sub-counties and the border countries, seasonal migration could predispose the populations mostly the young youthful to close contacts to the vector due to the long hours in the field increasing VL risk of exposure. Population movement in such areas could be associated with an imbalance in the herd immunity leading to the introduction of the non- immune persons into an area where there is enzootic or endemic transmission leading to a possible outbreak and this could be a possible risk to VL transmission. The finding was in consistence with the conclusion of a case-control study that was conducted to assess the risk factors associated with VL in 5 endemic areas of Morang district from September

to November 2013, Nepal;- the study revealed, history of migration to India (Bihar and Jharkhand) which are the leading global regions for VL burden showing a strong risk factor association (Mandal, *et al*., 2019) and the European article review,2009 on the assessment of the emergency and the re-emergence of VL in Europe were strongly associated with the following three factors;- global travels, domestic dogs, natural spread from the endemic Mediterranean region of Europe and upsurge of immunosuppression or debilitated populations(Ready, 2010).

5.2 Discussion of the Participants Knowledge on VL

On the assessment of the participant's knowledge about VL, the majority of them were aware of VL and had knowledge of somebody on treatment, sick or died of VL within the community, and reported that the disease is severe. The findings were consistent with the findings of a case-control study in north-western Ethiopia,2014 that reported in 283 participants interviewed 94% had previously heard of VL and 64.3% considered VL as highly severe than malaria(Yared *et al*., 2014).

About three-quarters of them reported that they did not know on the mode of VL transmission and were willing to receive more information about VL. These findings were reconcilable with the interpretation of a similar case-control study carried out from June to December 2006 at Amudat hospital, Nakapiripirit district, Uganda, knowing about VL transmission modes and or knowledge of VL disease or its presentation had reduced risk of disease with an adjusted OR(95%CI)0.5(0.11-2.36) and 0.41(0.19-0.86) respectively(Kolaczinski et al., 2008).

5.3 Discussion of the Participant's Practices towards VL

On the assessment of the participant's practices towards VL place of seeking treatment, reported seeking VL treatment at the health facilities, traditional methods, has no

treatment and some participants did not know where they seek VL treatment. Related findings were noted in a community-based in Gedaref state, northern Sudan in 2006 to evaluate the accessibility of visceral Leishmaniasis (VL) treatment where it was found out that factors barring access to treatment were due to failure to earlier treatment at health facilities due to lack of money for treatment and transport, impassability of roads, work priorities, seeking of local treatment first, cultural and distance to the next health center (Gerstl et al., 2006).

Assessment of the available traditional methods of VL treatment reported use of abdominal burning, abdominal cuts, use of traditional herbs and cleansing by the traditional healer among others, the above findings were similar to a descriptive cross-sectional study done in Loima sub-county in October 2015 to June 2016 which reported the use of traditional methods is historical and still being practiced (Akutaa Lotukoi, 2017).

Three-quarters of the participants were not practicing VL prevention and control interventions. The above findings were at odds with the findings on the risk factors of visceral Leishmaniasis: a case-control study in north-western Ethiopia, 2014 where from 283 participants interviewed on the participants VL practices;- 94.7% reported VL can be treated from the health facilities while,1.4% reported the use of the traditional methods and 7% reported not using any control and prevention measures towards VL towards VL reported (Yared et al., 2014).

5.4 Study Limitations

The language barrier were encountered due to the minimal mixed population of the two Sub Counties during the study period, however; the researcher, therefore, hired a translator who helped to overcome the problem. The research culture of suspicion

among community members in need to be paid for the activity was also encountered, nonetheless; the research teams were able to involve the local community leaders and opinion leaders in explaining the study objectives and the intended purpose of the research. The minimal limitations did not affect the generalizability of our result findings.

CHAPTER SIX

CONCLUSION

6.0 Summary

Socio-demographic characteristics assessment of the study participants reported higher Male caseload notification than females with a steady increase in case numbers across the age groups observed from children and young adults to a pick at 5-14 years. The majority of all the cases were treated with SSG/PM combinations and were managed as inpatients. Cases were also managed for other Co-morbities that include; malaria, typhoid, brucellosis and chest infections, and malnutrition. Participants Respondent's main source of income was livestock and were residing in traditional Hut/Manyatta.

Majority of the participants were illiterate, with low health-seeking behaviors, however, the majority of the cases would seek traditional treatment before going to the health facilities .The majority of the Cases managed were asymptotic and presented with the following major signs and symptoms fever, generalized body weakness, abdominal distension, weight loss, loss of appetite, joint pains, fast breath, abdominal pain among others.

From the study multivariate analysis identified factors independently associated with VL as; the presence of domesticated animals at the household level, travel to VL endemic Counties or Countries in the past six months, playing or sleeping around the anti-hills and or termite mounds in the field or within the homestead, animals migration history within the sub- County of residence, lack of formal education, >10 number of active termite anthill's and or mound's within the homestead, Non-use of insecticides at the household level.

On the assessment of the participants, knowledge about VL majority of them was aware of and had knowledge of somebody on treatment, sick or died of VL within the community, and reported that the disease is severe. However, the majority of them reported that they did not know the mode of VL transmission and were willing to receive more information about VL.

On the assessment of the participant's practices towards VL place of seeking treatment, the majority reported seeking VL treatment at the health facilities, traditional methods, has no treatment and some participants did not know where they seek VL treatment. Traditional methods of VL treatment reported the use of abdominal burning, abdominal cuts, use of traditional herbs, and cleansing by the traditional healer. Three-quarters of the participants were not practicing VL prevention and control interventions.

6.1 Public Health Importance of the Findings

Dissemination of the study findings was done at the facility level management, the County /Sub County health management of the department of health services and sanitation, the department of education, and the Department of Livestock and Fisheries of Turkana County government and the Local partners for all the above ministries. Professional publications through Manuscript, article, or book form will be an important channel of communication.

The VL treatment centers and county health team to develop specific messages on prevention and control of VL and sensitize the community in Loima and Turkana West on possible risk factors and how to avoid exposure will use the finding on risk factors from this study. These messages could also be used during daily health talks for patients at the health facilities within Turkana County, and be incorporated in continuous medical education for health workers.

The results will also be useful at the County and the national level for policy formulation and designing goals and interventions at the programmatic that includes; development of prevention and control strategies, development of the information educational communication (IECs) materials that can be customized to the local language

CHAPTER SEVEN

RECOMMENDATIONS

7.0 Recommendations on the Socio-Demographic Characteristics of the Study Participants

Management of VL requires a multisectoral approach for all the policymakers likely to have a positive impact towards control and prevention of VL through partnership and resources allocations aimed in reversing the trend of diseases and key partners include; the department of health, Agriculture, Livestock and fisheries, Ministry of Education among their specific partners with specific need support.

The Ministry of Health (MOH) at National and the County level should develop targeted interventions on disease prevention and control measures for male gender population, children and young adults at the age group 5-14 years and the general population, through the development of localized contextualized messages to address the high illiteracy levels, poor health-seeking behaviors, the use of traditional treatment methods in the management of VL. The messages will be incorporated into continuous medical education at the facility and community level. There's need to strengthen and increase the number of VL treatment facilities with inpatients units to address the VL case management at the ward level with the need to strengthen the detection of malnutrition and co-morbidity case management for VL cases. The need to disseminate the findings of the above study to the policymakers under the MOH support. The department of health can create awareness at the community level through the Community health workers at their community Units through health education on prevention and control of VL.

The Departments of Agriculture, Livestock, and fisheries to offer Community sensitization and advocacy on VL anthroponosis and dangers posed in transmission, personal protection, and vector control measures at the individual, community, and household level. Training and campaigns are key as awareness mechanisms for the livestock keeping community with high illiteracy levels.

The department of education through formal education should aim at educating school children and students about VL infection empowering them in making choices on disease prevention and control measures.

7.1 Independently Associated Risk Factors of the Study Participants on VL

The departments of Livestock and fisheries and their local partners should come up with effective measures addressing the seasonal animal and people migration across the sub-counties and border counties for early disease and vector detection and notification, vaccination practices plans, quarantine practices among others for the nomadic populations this is aimed in addressing the identified independently associated factors on VL including the presence of domesticated animals at the household level, travel to VL endemic Counties or Countries in the past six months and animals migration history within the sub- County of residence.

The creation of Community awareness by the department of health and her support partners through at facility level through the health care works and community level through community health strategy mechanism is key in educating the populations through training, health care campaigns, radio, and other social media. This will empower the communities in making informed choices in VL transmission, prevention, and control measures. This is key in addressing identified independently associated factors to VL that includes; playing or sleeping around the anti-hills and or termite

mounds in the field or within the homestead, lack of formal education, >10 number of active termite anthill's and or mound's within the homestead, Non-use of insecticides at the household level.

7.2 Determination of Knowledge of the Study Participants on VL

Visceral Leishmaniasis is prevalent in the area and although the community is aware of its existence, the study participants have varied beliefs about the causes and disease transmission modes. The study recommends the need for enhanced general health education, awareness on the causes of the disease, the VL transmission cycle does the need for should be emphasized on management strategies, and control through the intersectoral approach.

7.3 Assessment of the practices of the Study Participants on VL

The county health department of health and her support partners should develop a comprehensive communication strategy taking into consideration the preferred methods of receiving information, diversity of the local languages, and communities residing in the County and this will include specific messages on prevention and control of VL. This can be done through community empowerment and participation.

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APPENDICES

Appendix I: Informed Assent/ Consent form in English

Introduction:

I'm Mr/Mrs/Miss _____, we are research assistants working for Moi University School of Public Health in the Department of Epidemiology and Field Epidemiology and Laboratory Training Programme (FELTP), Kenya. We are doing a research on the assessment of the risk factors to Visceral Leishmaniasis, which is one of the very common neglected tropical diseases in your Sub County. I am going to give you information and invite you to be part of this research, you are free to consult further in taking part or withdrawal from the study now and whenever you want, there will be no penalty. There may be some words that may seem unfamiliar during the interview or you do not understand. Please ask me to stop as we go through the information and I will take time to explain. If you have any questions, concerns or complaints about the study laiter, you can ask them for me by calling the principal researcher, Peter Lomurukai through this number **(+254) 729 388699 or 0792325944.**

Purpose of the research

Visceral Leishmaniasis (VL) cases occur in Kenya mainly in semi-arid and arid Counties of Northern Kenya. Turkana County is one of these counties and has experienced an increase in the number of cases of VL in Loima and Turkana West Sub Counties in the last 10 years. In the last one year the County Government of Turkana through the department of health, identified 14 health facilities in the two Sub Counties as Visceral Leishmaniasis treatment centres. The objective of these centres ws to offer timely diagnostic services, case management, provide health education, sensitize their catchment populations on the risk factors for VL with an aim of offering

targeted prevention, and control measures geared towards halting the trend and reducing morbidities and mortalities.

In-order to achieve the objective of providing health education and sensitization of the population on the risk factors, there is need to identify the specific risk factors for VL in the populations living in these two sub-counties and use this data to develop health messages that are relevant to the target population. On literature review, we did not find any study on risk factors undertaken in the study areas. Our study will provide the risk factor information that will be used to generate messages for prevention and control of VL in Loima and Turkana west sub-counties

Participant's selection:

Cases will be enrolled from the wards for the in-patients and during diagnostic or treatment visits at outpatient clinic at the VL treatment facilities in Loima and Turkana West Sub Counties. From previous records, an average of 30 cases are seen at the treatment facilities in these two sub-counties every month and this translates to 90 cases over the three months of study duration. To achieve the sample size of 76 cases, we will enroll cases sequentially until the required sample size is achieved. Upon consenting of the Cases a structured questionnaire will be administered to or their respective guardians.

Controls will be identified from the same villages as cases, and also frequency matched by the age categories (<5, 5-14, 15-24, 25-34, 35-44,45-54, 55+) to the case. Controls will be identified through a simple random sampling by identifying the villages where the cases resided. For each selected village, the center will be identified using a common Landmark (office of the chief, house of the village elder or a local church). An empty bottle will be tossed to identify the first household from the direction where the bottle

will be pointing. Subsequently, households will be randomly sampled in one direction until half of the controls are achieved in that village. The investigation team will then move back to the center of the same village where the bottle was first tossed and move in the opposite direction to select the remaining half of the controls. The heads of the households will be requested for permission to conduct the selection in his/her household. List of individuals living in that household will be drawn, the individuals in the age category of the case will be identified, and if they are more than one, one will be randomly selected through balloting. The individual will be asked screening questions to make sure they meet the inclusion criteria and will then be tested using rk39 dipstick for VL. If the test is negative, the questionnaire will be administered. If they turn positive, the patient will be referred to the nearest treatment Centre for evaluations and treatment and another member of the same household if more than one will be selected for the next test.

In case of refusal of consent or absence of household's occupants, the next household will be selected. This will be done until the required number of controls in each village is attained

Risks and benefits: There will be no known risks and or benefits to you as a person participating in this study research. However, the overall impact to your community may be great because the risks associated with VL among other tested objectives may be crucial in addressing the health problems associated with this infection.

Confidentiality: Any information you will provide will be maintained in a secure manner. No one but the interviewer will know how you answered the questions. The interviewer shall keep all the information about your privacy and confidentiality. Your

name will be removed from all records involved in the survey. A number will be assigned to the survey questionnaire instead.

Consent: You are free to take part or to withdraw from the study now and whenever you want, there will be no penalty.

Questions: If you have any questions, concerns or complaints about the study, please call Peter Lomurukai **(+254) 729 388699 or 0792325944**

Signatures: Your signature below indicates that you agree to participate in this study. You will receive a copy of this signed document if you want.

_____ _____

Signature of participant or Guardian Date

_____ _____

Signature of interviewer Date

_____ _____

Signature of investigator Date

Appendix II: Translated Informed Consent

Bw/Bi_____ Daktari Peter Lomurukai, Mimi ni mwanafunzi kutoka chuo Kikuu cha Moi nikifanya Shahada ya uzamili yasomo la Uwanja wa Epidemiologia na Mafunzo ya Mahabara Field Epidemiology and Laboratory Management'.Ninafanya utafiti juu ya hatari na sababu ambazo zinaweza kuwa zinachangia kueneza kwa ugwonjwa wa "Visceral Leishmaniasis" katiku Sub Kauntihi ya Loima na Turkana ya Magharibi.

Lengo la Utafuti: Sababu ya utafuti huu ni kuweza kuangalia hatari na visababu ambazo zinachangia kueeneza kwa ugwonja wa "Visceral Leishmaniasis" katika Kaunti ya Turkana hasa Sub Kaunti ya Loima na Sub Kaunti ya Turkana ya Magharibi, Kaskazini mwa Kenya. Utafiti huu utafanywa kwa watu wanaoish ikatiku Sub Kaunti hizi mbili kulingana na mikakati ambazo zimewekwa juu ya uteuzi kwa wanao kubali kushiriki kwenye utafiti huu.

Utafiti huu unalenga kutafuta sababu za kueneza kwa ugonjwa huu na pia kuweza kuona madahra ya ugonjwa huu kwa wanao adhirika na pia kwa jamii kwa minajili ya kusaidiana na serikali na washirikadau waa fya haza wanaousika na ugonjwa huu ili wapate njia mwafaka wa kusuia na kuepukana na maradhii hayo.

Utafiti huu pia unalenga kuwauzisha watu miambili sitini na saba(267) kwa muda wa utafiti huu.Mahojiano yatahudumiwa kwa watakaohojiwa kwa muda wa dakika arubaini na tano wakitumia muundo dodoso wakilenga kuuliza mambo ya idadi ya watu haza umri, jinziana zinginezona pia hatari za kueneza kwa ugonjwa wa 'Visceral Leishmaniasis'. Kutakuwa na kupimwa damu pia kwa bahadhi ya wahojiwa.

Hatari na Faida: Utafiti huu hauna kusidio ya hatari yeyote ambayo tunajua na pia utafanywa na madaktari walioitimu. Utafiti huu niwa kitaalamu na haina faida ya ubinafsi kwa wale watashiriki kweye mahojiano, bali matokeo yake yanaweza kuwa ya

faida muda mrefu kwa kuweza kukabiliana na changemoto za afya katika Jamii haza kwa hatari zinazo ambatana na ugonjwa huu wa 'Visceral Leishmaniasis'.

Usiri: Habari zozote ambazo utapeana yatakuwa ya faraghana siri kati yako na muhoji. Kumbukumbu zote zitafichwa kwa upatikanaji kwa watuambao hawaitaji kikuliangalia bila idhini yako, nambari zitapewa badalaya majina kamili kwenye muundo dodoso kwa usalama ya habariyako

Ridhaa: Unaruhusiwa kukubali kushiriki au kukata kushiriki utafiti huu kwa sasa na kwawakati wowote upendavyo bila tisho la tashushi au adhabu.

Mawasiliano: Ukiwa na swali lolote, tashushi au lalamishi kuusu utafiti huu, unaruhusiwa kupigasimu kwa Peter Lomurukai nambari ya simu; (+254) 729 388699 or 0792325944, Barua pepe; peterlomurukai2014@gmail.com

_____ _____

Sahii ya Muhusika Tarehe

Alama ya kidole

_____ _____

Sahii ya Muhoji Tarehe

_____ _____

Sahii ya Mtafiti Mkuu Tarehe

Appendix III: Study Questionnaire

Study Title: 'Risk factors of Visceral Leishmaniasis in Turkana County: A Case-Control study of Loima and Turkana West Sub Counties, Northern Kenya, 2018'**.**

Questionnaire number…….....Date of interview (**dd/mm/yyyy**)

Type of participant: Case □ Control □

Instructions: This questionnaire is to be administered in an environment, which ensures privacy, and confidentiality is strictly adhered.

Consent permitted □ **Consent denied** □

1. Sub County: _____ Facility Name _____

2. Name of interviewer: _____

3. Interviewee □ Self-□ Proxy (Parent/Legal Guardian)

4. How long have you lived in the area □ More than 1 year □ Less than 1 year?

Part 1 – Demographic and Social information

5. Age _____years

6. Gender; 1.Male 2.Female

7. Ethnicity/Nationality

   1. Turkana 2. Sudanese refuge 3. Ugandan Refugee 4. Ethiopian Refugees

   5. Somali refugee

   6. Karamojong 7. Toposa 8.Somali 9. Others, specify_____

8. What is the religion of the Main respondent?

1. Christian 2. Non practicing 3. Muslim 4.Hinduism 5. Others, specify_____

9. How many people live in this household? Including the participant._____

10. What is the education level of the participant**?** 0. Too young to school □ None/Madrasa □Lower primary □Upper primary □Secondary □Tertiary

11. What is the main income activity in this household**?** 1. Farming (own the land, rent the land)2. Livestock keeping/Herding 3. Trading 4. Poaching and Hunting 5. Salaried Employment 6.Too young 7. Charcoal burning 8. Selling of the local brews "Busaa and Changaa" 7. Others, specify_____

Part II: Clinical information and treatment (For Cases only)

12**.** Date of onset of illness (dd/mm/yyyy): _____

13. How long did it take from first symptom to seeking treatment (In days): _____

14**.** Did you experience any of the following signs and symptoms during your illness?□ swelling of the legs □ Nose bleeding □. Fast breathing □ Abdominal pains □ Joint pains □. Weight loss □Swelling of glands □Yellowness of the eyes □.Loss of the appetite □ abdominal distension □ Generalized body weakness □ Hotness of body □Vomiting □ abdominal cramps □Nausea □Leg/arm cramps

15. Was any treatment given before going to the hospital? □Yes □No

16. What type of treatment was given before going to the hospital?

□Traditional medicines □ Local cuttings made on the abdominal area □ burning of the abdominal skin by use of donkey dang □ cleansing from traditional healer □Others (Specify) _____

17. What treatment were you given at the health facility? □ SSG/ PM Combination □ SSG alone □ AmBisome

18. Were you treated as an outpatient or hospitalized? □Treated as outpatient □Admitted to hospital □Referred to another health facility

Part III. Risk factors /Exposure History assessment

19. Between the sunset and the time (s) he goes to sleep, where does the participant usually stays when in the usual homestead? 1.Indoor 2.Outdoor 3.Both indoor and outdoor

20. Between the sunset and the time (s) he goes to sleep, what is his/her main activity when he/she is outdoor (open area)? 1. Attending to animals 2. Playing; too young to have specific activities 3. Traditional Dancing ‘’**Edonga**” 4.Watching TV or listening to radio 5. Taking the Local brews 6. Discussing-relaxing 7. Hunting 8.Cooking or other house activities 9.Attending to school assignments 10.Others, Specify_____

21. When in usual homestead, where does the participants usually sleep at night? 1. In a modern house 2. In a hut /Manyatta 3.Under temporary sleeping shelter “Atabo” 4. In an open space. 5. Under a tree 6. Near the animal Pens 7. Variable according to the weather 8. .Others, Specify_____

22. When in the usual homestead, before sunrise, does the participant usually go outdoor early morning? 1. Daily

2. Frequently 3. Sometimes 4. Rarely 5. Never

23. In your usual homestead, are there acacia trees in your homestead or surrounding homesteads? No 1 Yes 2

If no go to Qs 25

24. Estimate number of acacia trees in your homestead and neighboring homesteads?

1. 1-10 2. >10

25. Do you have termite mounds around your homestead and in the surrounding homesteads? Yes/No

If no go to Qs 27

26. Estimate the number of active termite mounds in your homestead and the neighboring homesteads? 1. 1-10 2. >10

27. In usual homestead, where does the participant usually go for toilet purpose? 1. Personal Latrine/Toilet 2. In the Neighbor's Latrine 3. In the bush/open field 4. Not, relevant for the child

Observation : Ask the participants or the care taker to show you the room where the participant sleeps when he/she is in this house (if several rooms, ask for the main room)

28. What is the type of walls in the room where the participant usually sleeps in usual homes 1Cement/Brick-walled 2.Mud and wood walled 3? Mud and stone 4. Walled Grass/cane/wood/Woodbacks/polyester/box covers 5. Others, specify_____

29. Are the walls cracked? No 1 Yes 2

30. What is the type of roof in the room he/she is used to sleep? 1. Grass and wood 2. Iron sheets 3. Tree backs/Polythene or Box cover 4. Others, specify_____

31. What is the type of floor in the room he/she is used to sleeps? 1. Earth 2. Earthen covered with gravel 3.Sand soil 4.Rock, stone and gravel soil 6. Cemented 7. Mixture based of animal faces/dung 8. Others, specify__

32. Are there termites in the room he/she is used to sleep? No 1. Yes 2.

33. What does the participant usually sleeps on? 1. On the floor 2. On a bed 3. On a sheet 4. On a mat or mattress 5. Others, specify

34. Was the room sprayed inside in the last year? No 1 Yes 2

35. Does the participant usually sleep covered home and while in the field? No 1 Yes

36' Does the participant sleep under a mosquito net at home and while in the field (before hospitalization for cases)? No 1 Yes 2 **If no go to Qs 38**

37. How frequently does (s) he sleep under the mosquito net? 1. Daily 2. Frequently, often 3. Sometimes, occasionally 4. Rarely

38. Are domestic animals available in this home? No 1 Yes 2 **If no go to Qs 40**

39. Are there usually animals at night in this house yard where (s) he is used to sleep? (including animals located outside in animal accommodation pens) No 1 Yes 2

40. During the last 6 Months did the participants move with animals to VL endemic area away from the usual areas of residence in search of pastures and water within the Sub County of residence? No 1 Yes 2 **If no go to Qs 43**

41. Did any Child or house hold member travelled or returned from travel within 30 days prior to onset of the infection? (**For Cases Only)** No 1 Yes 2 **If yes go to Qs 4**

42. Did you travel in any of the following VL endemic areas outside the Sub County of residence in the last 6 Months? □ Turkana West Sub County □Turkana Central Sub County□ Kibish Sub County □ Turkana South Sub County □ Turkana East Sub County □ Uganda □ Sudan □ Ethiopia □ West Pokot Sub County □ Samburu Sub County □ Others, specify_____

43. When in the grazing field or home do you play or sleep around the termite's mounds? No 1 Yes 2

44. When in the field, do the participants usually nap under acacia trees? No 1 Yes 2

45. Do you use any insect repellants to prevent insect bite in your household for you and or the animals? No 1 Yes 2

If no go to Qs 46

46. If yes, which type of repellants do you use for both? 1. Cream 2. Spray 3. Coil 4. Traditional weeds/woods

Part IV: Knowledge and practices about VL

47. Are you aware of the disease VL? No 1 Yes 2 (**Before illness for cases**)

48. How can one get VL (**Do not read**) 1.Sandflies 2. Mosquito 3. Don't Know 4. Others, specify_____

49. What are the signs and symptoms of VL? (**Do not read**) 1. Fever 2. Loss of appetite 3. Enlargement of the spleen/Liver 4. Body weakness 5. Headache 6. Pain in the lower abdomen 7.Don't know 8. Others, List_____

50. How can someone with VL be cured? (**Do not read)** 1. Drugs from health facility 2. Traditional medicine 3. No, cure 4. Do not Know 5. Others, specify

51. Traditional methods for treatment of VL? 1. Traditional herbs 2. Burning of the swollen abdomen 3. Incision of the swollen abdomen 4. Others, specify_____

52. Do you know of anyone who got sick or has been treated or hospitalized or on medication or died because of VL? No 1 Yes 2

53. Do you think VL is a serious problem in your community? 1. Very serious 2. Serious 3. Not serious 4. Don't know

54. Have you received any information about Kala-azar in the last 6 Months? No1 Yes 2

55. Sources of the information on VL? 1. Radio 2.Health care worker 3.Flyers/Brochure's 4. Neighbor's 5. Chief barazas6. Television 7. Mega phone/Public address systems 8.Others, specify----------

56. Do you practice any of the following VL prevention and control measures? (Read and allow the participant to name others not listed?)

□Use of bed nets □Use of insect repellants for humans □Use of insect repellants for animals □Indoor spraying with insecticide □Filling cracks on walls □Fighting rodents □Cutting trees □Killing dogs □ Others specify_____□ I don't practice any

---

57. Would you wish to receive more information on VL? No1 Yes 2

58. What will be the preferred sources of receiving more information about VL? Radio 2. Health care worker 3. Flyers/Brochure's 4. Neighbor's 5. Chief Barraza's 6. Television 7.Mega phone/Public address systems 8. Others (Specify)_____

59. Rk39 Results **(for tested Controls only).** □ Negative □ Positive □ Invalid

Appendix IV: IREC Approval

MU/MTRH-INSTITUTIONAL RESEARCH AND ETHICS COMMITTEE (IREC)

MOI TEACHING AND REFERRAL HOSPITAL
P.O. BOX 3
ELDORET
Tel: 33471/2/3

MOI UNIVERSITY
COLLEGE OF HEALTH SCIENCES
P.O. BOX 4606
ELDORET

Reference: IREC/2018/24
Approval Number: 0003030

31st May, 2018

Mr. Peter Lomurukai,
Moi University,
School of Public Health,
P.O. Box 4606-30100,
ELDORET-KENYA.

INSTITUTIONAL RESEARCH & ETHICS COMMITTEE
31 MAY 2018
APPROVED
P.O. Box 4606-30100 ELDORET

Dear Mr. Lomurukai,

RE: FORMAL APPROVAL

The MU/MTRH- Institutional Research and Ethics Committee has reviewed your research proposal titled:-

"Risk Factors of Visceral Leishmaniasis in Turkana County: A Case -Control Study of Loima and Turkana West Sub Counties, Northern Kenya,2018".

Your proposal has been granted a Formal Approval Number: ***FAN: IREC 3030*** on 31st May, 2018. You are therefore permitted to begin your investigations.

Note that this approval is for 1 year; hence will expire on 30th May, 2019. If it is necessary to continue with this research beyond the expiry date, a request for continuation should be made in writing to IREC Secretariat two months prior to the expiry date. You will be required to submit progress report(s) on application for continuation, at the end of the study and any other times as may be recommended by the Committee.

Furthermore, you must notify the Committee of any proposal change (s) or amendment (s), serious or unexpected outcomes related to the conduct of the study, or study termination for any reason. You will also be required to seek further clearance from any other regulatory body/authority that may be appropriate and applicable to the conduct of this study.

Sincerely,

DR. S. NYABERA
DEPUTY-CHAIRMAN
INSTITUTIONAL RESEARCH AND ETHICS COMMITTEE

cc CEO - MTRH Dean - SOP Dean - SOM
Principal - CHS Dean - SON Dean - SOD

Appendix V: NACOSTI Approval

NATIONAL COMMISSION FOR SCIENCE, TECHNOLOGY AND INNOVATION

Telephone:+254-20-2213471,
2241349,3310571,2219420
Fax:+254-20-318245,318249
Email: dg@nacosti.go.ke
Website : www.nacosti.go.ke
When replying please quote

NACOSTI, Upper Kabete
Off Waiyaki Way
P.O. Box 30623-00100
NAIROBI-KENYA

Ref: No. **NACOSTI/P/18/36722/23791**

Date: **1st August, 2018**

Lomurukai L. Peter
Moi University
P.O Box 3900-30100
ELDORET

RE: RESEARCH AUTHORIZATION

Following your application for authority to carry out research on ***"Risk factors of visceral leishmaniasis in Turkana County: A case-control study of Loima and Turkana West Sub Counties , Northern Kenya, 2018"*** I am pleased to inform you that you have been authorized to undertake research in **Turkana County** for the period ending **30th July, 2019.**

You are advised to report to **the County Commissioner and the County Director of Education, Turkana County** before embarking on the research project.

Kindly note that, as an applicant who has been licensed under the Science, Technology and Innovation Act, 2013 to conduct research in Kenya, you shall deposit **a copy** of the final research report to the Commission within **one year** of completion. The soft copy of the same should be submitted through the Online Research Information System.

BONIFACE WANYAMA
FOR: DIRECTOR-GENERAL/CEO

Copy to:

The County Commissioner
Turkana County.

The County Director of Education
Turkana County.

Appendix VI: County Health department Authorization

MINISTRY OF HEALTH AND SANITATION

Telegrams: "MEDICAL" Lodwar
Telephone: 054-21073, 21087
Fax: 054-21073

OFFICE OF THE DIRECTOR MEDICAL SERVICES
TURKANA COUNTY GOVERNMENT
P.O. BOX 11-30500
LODWAR

26/06/2018

To the Sub County Medical officers of Health
Loima and Turkana West Sub Counties
P.O Box 11-30500
LODWAR-KENYA

Through,
Facility In-charges

Dear Sir/Madam;

RE: PERMISSION TO COLLECT RESEARCH DATA FROM LOIMA/ TURKANA WEST HEALTH FACILITIES:

I hereby permit Mr. Peter Lomurukai of **ID NO 21301772** and College admission number **SPH/PGH/FE/16/16** from Moi University School of Public Health who is undertaking a post graduate degree in Field Epidemiology to collect data on Visceral Leishmaniasis from your facilities, having received a formal approval from the Moi University/ Moi teaching and Referral Hospital –Institutional Research and Ethics Committee (IREC) formal approval **NO FAN: IREC 3030** on proposal entitled;

"Risk factors of Visceral Leishmaniasis in Turkana County: A case-Control study of Loima and Turkana West Sub Counties, Northern Kenya, 2018"

Accord him all the necessary support he may require.

Regards,

DIRECTOR HEALTH SERVICES
26 JUN 2018
TURKANA COUNTY GOVERNMENT

Dr. Gilchrist Lokoel
County Director of Medical Services
TURKANA COUNTY GOVERNMENT

CC- Chief Officer –Department of Health Services and Sanitation
- Director Public Health and Sanitation

Appendix VII: Bivariate analysis of factors associated with VL outbreak in Loima and Turkana West Sub Counties, Northern Kenya, 2018-2019.

Variable	Category	Cases n=89 (%)	Controls n=178 (%)	OR (95% CI)	P-value
Gender	Male	59(66.3)	114(64)	1.1(0.64-1.89)	0.82
	Female	30(33.7)	64(36)	Ref	
Education status	No-Formal education	72(80.9)	106(59.6)	2.9(1.57-5.28)	<0.001
	Formal education	17(19.1)	72(40.4)	Ref	
Animal migration History past 6 Months within the Sub County	Yes	52(58.4)	35(19.7)	5.7(3.28-10.06)	<0.001
	No	37(41.6)	143(80.3)	Ref	
Presence of acacia/shade trees at homestead	Yes	85(95.5)	145(81.5)	4.8(1.66-14.12)	<0.003
	No	4(4.5)	33(18.5)	Ref	
Number of acacia/shade trees at homestead	>10	49(55.1)	75(42.1)	1.7(1.01-2.81)	0.062
	<10	40(44.9)	103(57.9)	Ref	
Number of active termite mounds within the homestead	>10	53(59.6)	59(33.2)	3.0(1.76-5.02)	<0.001
	<10	36(40.4)	119(66.7)	Ref	
Presence of Mounds in homestead	Yes	78(86.6)	128(72)	3.0(1.46-6.35)	0.002
	No	10(11.4)	50(28)		
Household insecticide use in the last 1year	Yes	2(2.3)	32(18)	0.1(0.02-0.45)	<0.001
	No	87(97.7)	146(82)	Ref	
Sleep under mosquito net	Yes	15(16.9)	72(40.5)	0.3(0.16-0.56)	<0.001
	No	74(83.1)	106(59.5)	Ref	
Presence of termites in the sleeping room	Yes	77(86.5)	149(83.7)	1.2(0.60-2.58)	0.67
	No	12(13.5)	29(16.3)	Ref	
Sleep under Acacia/shade tree in the field	Yes	80 (89.9)	116(65.2)	4.8(2.23-10.12)	<0.001
	No	9(10.1)	62(34.8)	Ref	

Sleep/play around the termite mound at homestead/Field	Yes	72(80.9)	77(43.3)	5.6(3.03-10.18)	<0.001
	No	17(19.1)	101(56.7)	Ref	
History of past 6 Months travel to VL endemic Counties and or Countries	Yes	33(37.1)	21(11.8)	4.4(2.35-8.24)	<0.001
	No	56(62.9)	157(88.2)	Ref	
Participants regular place of defecation	Toilet/Latrine	7(7.9)	36(20.2)	0.3(0.14-0.79	0.016
	Bush/Open field	82(92.1)	142(79.8)		
Presence of domesticated animals at homestead	Yes	84(94.4)	125(70.2)	7.1(2.73-18.56)	<0.0001
	No	5(5.6)	53(29.8)	Ref	
Insecticide repellants use for both animals and humans	Yes	4(4.5)	19(10.7)	0.4(0.13-1.19)	0.14
	No	85(95.5)	159(89.3)		

Appendix VIII: Socio-demographic characteristics of the study participants in Loima and Turkana West Sub Counties, as from June 2080 to January 2019

Factor/ Variable	Cumulative % Overall N (%)	Cases n (%)	Control n (%)
Age			
<5yrs	42(15.7)	14 (33.3)	28 (66.7)
5-14	147 (55.1)	49 (33.3)	98(66.7)
15-24	36 (13.5)	12(33.3)	24(66.7)
25-34	24 (9)	8 (33.3)	16 (66.7)
35-44	9 (3.4)	3(33.3)	6 (66.7)
45-54	3 (1.1)	1 (33.3)	2 (66.7)
>55yrs	6 (2.2)	2 (33.3)	3 (66.7)
Gender			
Male	173 (64.8)	59 (34.1)	114 (65.9)
Female	94 (35.2)	30 (31.9)	64 (68.1)
Educational Status			
Formal Education	89 (33.3)	17 (19.1)	72 (80.9)
Non formal education	178 (66.7)	72 (40.4)	106 (59.6)
Residence Sub County			
Loima	93 (34.8)	31 (33.3)	62 (66.7)
Turkana west	174 (65.2)	58 (33.3)	116 (33.3)
Loima Sub County Participants Ward Distribution			
Loima	15 (15.7)	5 (33.3)	10 (66.7)
Lokiriama-Lorengippi	66 (24.7)	22 (33.3)	44 (66.7)
Lobei Kotaruk	12 (4.5)	4 (33.3)	8 (66.7)
Turkana West Sub County Participants Ward Distribution			
Kakuma	42 (15.7)	14 (33.3)	28 (66.7)
Kalobeyei	3 (1.1)	1 (33.3)	2 (66.7)
Letia	42 (15.7)	14 (33.3)	28 (66.7)
Lokichoggio	18 (6.7)	6 (33.3)	12 (66.7)
Lopur	24 (9)	8 (33.3)	16 (66.7)
Nanam	30 (11.2)	10 (33.3)	20 (66.7)

Songot	15 (5.6)	5 (33.3)	10 (66.7)
Period of stay			
6-12 Months	193 (72.3)	69 (35.8)	124 (64,2)
> 12 months	74 (27.7)	20 (27.0)	54 (73)
Housing/sleeping place			
Hat/Manyatta	108 (40.4)	37 (34.3)	71 (65.7)
Open space	59 (22.1)	19 (32.2)	40 (67.8)
Near animal Pen	53 (19.9)	18 (34)	35 (66)
Temporary shelter ‘Atabo”	29 (10.9)	6 (20.7)	23 (79.3)
Modern House	9 (3.4)	2 (22.2)	7 (77.8)
Varied according to weather	8 (3)	6 (75)	2 (25)
Roof type			
Tree backs/ Box covers	167 (62.5)	68 (40.7)	99 (59.3)
Grass/wood covers	52 (19.5)	13 (25)	39 (75)
Iron sheets	48 (18)	8 (16.7)	40 (83.3)
Floor type			
Earth	245 (91.8)	79 ()	166 ()
Cement	14 ()	3 ()	11 ()
Sandy soil	4 ()	4 ()	0 ()
Animal dung mixture	2 ()	2 ()	0 ()
Earth /gravel mixture	1 ()	0 ()	1 ()
Rocks/stones/gravel mixture	1 ()	1 ()	0 ()
Wall type			
Grass/cane/wood/backs/polyster/box covers wall	204 (76.4)	77 (37.7)	127 (62.3)
Mud/ wood walled	51 (19.1)	11 (21.6)	40 (78.4)
Cement/brick	11 (4.1)	1 (9.1)	10 (90.9)
Iron sheets	1 (0.4)	0 (0)	1 (100)
Household income Sources			
Livestock keeping	126 (47.2)	53 (42.1)	73 (57.9)
Charcoal Burning	49 (18.4)	11 (22.4)	38 (77.6)
Trading	35 (13.1)	8 (22.9)	27 (77.1)
Sale of local beer	30 (11.2)	10 (33.3)	20 (66.7)
Salaried employment	18 (6.7)	0 (0)	18 (100)
Farming	6 (2.2)	6 (100)	0 (0)
Hunting /poaching	3 (1.1)	1 (33.3)	2 (67)

Facility Case Load			
Namoruputh Health Centre	89	31 (34.8)	
Kakuma Mission Hospital	89	24 (27)	
Lopiding Sub County Hospital	89	17 (19.1)	
Kakuma Sub County Hospital	89	13 (14.6)	
Lokichoggio AIC hospital	89	4 (4.5)	
Case treatment administered			
Sodium stibogluconate and paromomycin combination (SSG/PM)	89	86(96.7)	
Sodium stibogluconate alone (SSG)	89	3(3.3)	
Co-morbidities management			
Malaria	89	39(60.4)	
Chest infection	89	15(23.4)	
Typhoid	89	5 (7.8)	
Brucellosis	89	5 (7.8)	
Case patients management			
In patients	89	57(64)	
Out patients	89	32(36)	
Nutritional status			
Malnourished	89	65 (73)	
Normal	89	24 (27)	
Traditional Methods of VL management			
Abdominal Burns	220(82.4)	75(34.1)	145(65.9)
Traditional Herbs	138(51.7)	56(40.6)	82(59.4)
Traditional Healers- Cleansing	71(26.6)	38(55.5)	33(46.5)
Abdominal Tattooing marks	174(65.2)	77(44.3)	97(55.7)
Place of seeking VL treatment treatment			
Health facility	121(45.3)	50(41.3)	71(58.7)
Traditional Methods	126(47.2)	44(34.9)	82(65.1)
No cure of VL	3(1.1)	0(0)	3(100)
Don’t know	17(6.4)	10(58.8)	7(41.2)