

**FACTORS PREDISPOSING THE COMMUNITY TO VISCERAL
LEISHMANIASIS IN KACHELIBA DIVISION OF WEST POKOT
DISTRICT, KENYA.**

BY

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DECLARATION



This thesis is my original work and has not been presented for a degree in any other University

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DEDICATION

I would like to dedicate my sincere thanks to my wife Philomena, Mother Regina son Abraham and daughter Dorcas and other family members for their co-operation, patience, social, spiritual, emotional and financial support during my studies.

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ABBREVIATIONS AND ACRONYMS

- AIDS-** Acquired Immune Deficiency Syndrome
- AMREF-** Africa Medical Research Institute
- BMA-** Bone Marrow Aspirate
- CBS-** Central Bureau of Statistics
- DALYS-** Disability Adjusted Life Years.
- DAT-** Direct Agglutination Test
- DNDI-** Drugs for Neglected Diseases Initiative
- ELISA-**Enzyme Linked Immuno-Sorbent Assay
- GIS-** Computerized Geographic Information System
- HIV-**Human Immune Deficiency Virus
- Kala-azar-** Synonym for visceral leishmaniasis
- KA-** Kala-azar
- KABP-** Knowledge, Attitude, Behavior and Perception
- KEMRI-** Kenya Medical Research Institute
- LST-** Leishman Skin Test.
- MSF-** Medicins sans Frontiers
- NCPD-** National Council for Population and Development
- PCR-** Polymerase Chain Reaction.
- SPSS-** Statistical Package for Social Sciences
- UNAIDS-** United Nations Programme on HIV/AIDS
- WHO** -World Health Organization

DEFINITION OF TERMS

Case fatality rate- Proportion of persons diagnosed as having a specific disease who die as a result of that illness within a defined period.

Endemic- The constant presence of a disease or non infectious agent within a given geographic area.

Epidemic- The occurrence of illness cases in a population or a district in excess of the normally expected

Hepatomegally- Enlargement of the liver.

Host- Animal including human that gives support to and provides a living environment for an infectious agent

Immunity--Resistance associated with the presence of antibodies or cells having a specific action on the micro-organism concerned with a particular disease or its toxin

Incubation Period - Time between the initial parasite invasion and the first appearance of symptoms

Infectious disease- A clinically manifest disease of humans or animals resulting from an infection

Insecticide- Chemical substance used for the destruction of insects (larvicide's: same for the larval stage) and spiders

Morbidity rate- Frequency of disease

Mortality rate- Frequency of deaths

Parasite- Organism living on or in another living organism (host)

Prevalence rate- Number of persons sick in a stated population at a given time.

Opportunistic disease- That which takes advantage of weakness in the immune defense

Reservoir- Any individual animal or plant, soil or substance in which infectious agent normally lives and multiplies and from which it can be transmitted to susceptible hosts

Splenomegally- Enlargement of the spleen.

Source of infection- Human, animal object or substance from which an infectious agent passes a host.

Susceptibility- Insufficient resistance against a particular infectious agent to prevent infection or disease

Surveillance of disease- Continuing scrutiny of all aspects of occurrence and spread of a disease those are pertinent to effective control (i.e. morbidity reports, field investigations, laboratory results, immunizations)

Transmission-The transfer of disease from one person or organism to another

Vector-Animal or organism that carries a disease agent either mechanically (on its feet or other parts of its body) or within its body so that the agent is transmitted to the person being infected

Zoonotic disease - Communicable disease which can be transmitted from vertebrate animals to humans.

ABSTRACT

Visceral Leishmaniasis (Kala-azar) is a vector borne disease caused by obligate intramacrophage protozoan parasites. It is an old, largely unknown, a forgotten and neglected disease yet is a public health problem, a debilitating disease causing an estimated 500,000 new cases each year, and a tenth of these patients will die in the predisposed areas. The actual toll death from the disease may be higher than this estimate considering the existence of its unidentified foci. Since 1993, the regions that are Kala-azar endemic have expanded significantly, accompanied by a sharp increase in the number of recorded cases. The increasing number of people infected with the disease, poses a major health challenge because it is a silent killer, invariably killing almost all untreated patients. Currently, estimates also suggest an overall prevalence of 12 million people infected with Kala-azar in an at risk population of 350 million, suggesting more than 2 million new infectious each year with the figures including only cases with the overt disease. The new trend risks causing a public health crisis in weak Africa economies like Kenya since the vaccine for the disease is non existent. In Kenya it is common in arid and semi – arid regions of North Eastern and Rift valley provinces, especially the Kacheliba Division of West Pokot District that has a prevalence of 30% amongst other areas of Turkana District, Machakos, North Eastern, Marigat and Baringo East. The study was conducted between December, 2007 and February, 2008. Descriptive cross- sectional research design was used to determine socio demographic characteristics, economic and cultural factors, health seeking behaviour, the disease morbidity and mortality, local peoples knowledge, perception and behaviour towards the existence of Kala-azar in the area. Simple random sampling technique was used to identify study subjects in the purposively selected Kacheliba Division. A sample size of 323 respondents who were household heads or adult members and the health facility workers were randomly sampled. The data collected were processed and analyzed using the Statistical Package for Social Sciences (SPSS). The chi – square test was used to compare the relationship between variables. The key factors associated with the community being predisposed to Kala-azar include: Age, gender, educational level, presence of large number of termite mounds all over the area (76.4%), low usage of bed nets (25%), inaccessibility to health services and lack of proper knowledge on transmission of the disease. Also, human activities such as hunting and deforestation (53.3%), resting or sitting near termite mounds (80.2%) and dancing at night -Adong,o (62.5%), when the sand flies are active. There was a significant association between age ($P= 0.001$, $df=2$, $x^2=14.462$) and being predisposed to Kala-azar, gender ($p= 0.001$, $df=4$, $x^2=61.04$), educational level ($p=0.001,df=9,x^2=149.55$), presence of large number of termite mounds ($p=0.001,df=8,x^2=39.821$) and resting or sitting near termite mounds ($p=0.001,df=2,x^2=17.67$). The study concludes that Kala-azar is still prevalent in the area, low economic status, inaccessibility to health services, abundant presence of termite mounds that harbour sand flies and the community's different beliefs about transmission are risk factors. The study recommends the need for enhanced general health education and awareness on the transmission cycle of Kala- azar. Community participation as well as culturally appropriate behaviour change communication activities should be emphasized to enhance strategies targeting vector control. In addition, integrated disease surveillance response to be implemented to avert the disease situation.

CHAPTER ONE: INTRODUCTION

1.1 Background information

From the early 1900s, visceral leishmaniasis has been among the most important health problems in Sub-Saharan Africa (SSA) especially Kenya and Sudan where major upsurges in the number of cases were and still are noted in the endemic areas (MOH, 2007). Though a forgotten tropical parasitic disease, it causes an estimated 500,000 new cases yearly and a tenth of these patients die; and that it is almost always fatal with a mortality rate of almost 100%, if the cause is not identified or if left untreated (WHO, 2007; Boelaert 2000; Schenkel 2006; Benenson, 1995). The actual death toll of the disease may be higher than this estimate, considering the existence of its unidentified foci. Since 1993, the regions that are kala-azar endemic have expanded significantly, accompanied by a sharp increase in the number of recorded cases of the disease. Current estimates suggest an overall prevalence of 12 million people infected with Kala-azar in an at-risk population of 350 million, suggesting more than 2 million new infections each year with the figures including only cases with the overt disease. In terms of Disability-Adjusted Life Years (DALYS), the disease is responsible for a loss of 34 DALYS (Webber, 1996; WHO 2005; Davies *et al.*, 2003).

The geographical distribution of Kala-azar in the predisposed areas is limited by the spread of the sand fly, its susceptibility to cold climates, its tendency to take blood from humans or animals only and its capacity to support the internal development of specific species of *Leishmania* (Desjuex 1996; Mandell *et al.*; 1995; Desjuex, 2004).

Globally, kala-azar is common in Bangladesh, Brazil, India, Nepal, Ethiopia and Somalia; and has re-emerged from near eradication, largely due to extensive population movements following civil unrest and to human encroachment on the sand flies natural environment through agricultural and development projects. The disease had been declared an occupational disease affecting men because of its association with the building of roads and railways, oil and gold extraction, deforestation, farming, hunting and military service (WHO, 2007, Mandell *et al.*, 1995; Elnaiem *et al.*; 2003).

In Africa, Kala-azar is prevalent in Sudan, Somalia, Niger, Uganda, Ethiopia and Kenya. In 2001, the disease killed 51,000 people including 40,000 in South Asia and 8,000 in SSA, representing 0.3% and 0.1%, respectively of all deaths with nearly all cases occurring at the ages of 5-29. Males were more affected than the females in SSA where the ratio is more than 3:1 (WHO 1996; Webber, 1996; Desjeux, 2001). The geographical distribution of Kala-azar in Africa is due to factors related to development including poverty, massive rural-urban migration and agro-industrial projects that bring non-immune urban dwellers into endemic rural areas. Man made projects with environmental impact such as dams, irrigation systems as well as deforestation, also contribute to the spread of leishmaniasis (Anderson *et al.*, 1992; Last 1988; Hassan *et al.*, 2004).

In Kenya, the disease has been reported in Baringo, Kitui, Machakos and West Pokot where the prevalence is high especially in Kacheliba Division. More recently, Kala-azar has been reported in Kerio Valley, North Baringo, East Pokot, Turkana, Wajir and

Mandera Districts in North Eastern Province (Fendal 1993; Marlet *et al.*, 2003). In Pokot area, Kala-azar has existed for at least 40 years.

1.2 Problem statement

The increasing number of people infected with kala-azar in Kenya and other countries poses a major public health problem, mostly in arid and semi arid areas such as West Pokot. Kacheliba one of the ten divisions of West Pokot district, has a kala-azar prevalence of 30% against a population of 20,151 people, with 15% of the people in the entire district being at risk (WHO 2006; De clichés *et al.*; 1974; Hailu *et al.*; 2005). This trend risks causing a health crisis as the disease is becoming a lethal cocktail, hence efforts need to be taken to avert the situation. The disease is fatal such that if not detected early, can result into deaths within a short period and that its mortality rate is almost 100% and it can result into epidemic outbreaks. The case fatality rate associated with the disease range from 0-50% of treated cases to 85- 90% of untreated cases. The disease is a silent killer, invariably killing almost all untreated patients (Boelaert, 2000; Hotez, 2004).

Kala -azar affects not only the most vulnerable in the community such as children and those weakened by HIV and tuberculosis, but also healthy adults and economically productive social groups (Boelaert *et al.*, 2000; Khalil *et al.*, 2002). Most Kala-azar infections occur in remote geographical areas where health facilities are not well established and often co-exist with malaria and other debilitating parasitic infections. In addition, untreated Kala-azar is usually fatal in that even after recovery; patients may develop the chronic form that requires prolonged and expensive therapy (WHO 1990; Griekspoor *et al.*, 1999; MSF 2006).

1.3 Justification and the significance of the study

Kala-azar is one of the 3 world's most neglected and forgotten tropical diseases, (including Buruli cancer and Chagas diseases), yet it has devastating effects on patients. Furthermore, it is recognized by WHO as endemic and a public health threat in the study area, nationally and globally, for it lacks effective control measures (Bres 1986; WHO, 1996; Marlet *et al*; 2003). It is prevalent in many tropical and sub-tropical regions of the world, where it is transmitted via the bite of an infected sand fly and its impact on humans is enormous. It leaves disfiguring scars, has numerous diffuse lesions that do not heal spontaneously, has severe and emotional consequences; and can have associated stigma that may affect marriage prospects. When the disease becomes chronic, it incapacitates patients and makes them unable to work, vulnerable to poverty, malnutrition and secondary infections (WHO, 2006; Lukes *et al*; 2007).

There is lack of sufficient data that can clearly help in the management policy and control strategies for Kala-azar in the affected communities and the entire country, since little has been researched on the risk factors but more on the validation of the diagnostic tests. Kala-azar often exists in areas that are either remote or not easily accessible and where health facilities are barely available or inadequate, like the study area. Those most likely to be infected are people who are poor, living in villages far from roads and health care centres. Patients from such remote communities often die in the villages without seeking treatment. Some may attempt to report to distant health care centres, but in many cases it is usually too late. Even if they can make the journey to a hospital, they would

still succumb to the illness because of the absence of anti leishmanial drugs (WHO, 2005; Aliluwalia, 2003; Alvar *et al*; 2004).

Clear understanding of the factors that predispose the community to Kala-azar in Kacheliba Division of West Pokot District, Kenya can result in giving recommendations on the probable intervention measures for the prevention, control and management of the disease in the affected area(s), through adequate diagnosis, treatment and follow-up of patients. This is so as to reduce the morbidity and mortality attributable to the disease. The results of the study shall help sensitize and inform about this forgotten disease, yet it is becoming a serious public health threat; thus much effort needs to be taken for control and prevention through advocacy, health education and capacity building of the community. The findings of this study will also be invaluable to health care providers, policy makers such as the Ministries of Medical Services and Public Health.

1.4 Research questions

- i) What social demographic and socio-economic factors predispose the community to Kala-azar?
- ii) What socio- cultural factors predispose the community to Kala-azar and influence the health seeking behavior in Kacheliba Division of West Pokot District?
- iii) What is the community's Perception, Knowledge, and Behavior about the disease with regard to its causes, transmission, symptoms, treatment and prevention measures?

iv) What intervention or control measures are employed by the community and the health facilities in order to reduce the morbidity and mortality attributable to Kala-azar?

1.5 Null hypotheses

- i) Social demographic, socio- economic and socio- cultural are not the main factors that predispose the community to Kala-azar in Kacheliba Division of West Pokot District, Kenya.
- ii) The community's Knowledge, Behavior and Perception about Kala-azar do not influence vulnerability to Kala-azar.

1.6. Objectives

1.6.1 Main objective

To determine the main factors predisposing the community to Kala-azar in Kacheliba Division of West Pokot District, Kenya.

1.6.2 Specific objectives

- i).To determine the socio-economic factors predisposing the community to Kala-azar in Kacheliba Division of West Pokot District, Kenya
- ii) To determine the socio- cultural factors that predispose the community to Kala-azar and influences the health seeking behavior in Kacheliba Division of West Pokot District.
- iii) To asses the community's Knowledge, Behavior and Perception about Kala-azar with regard to its transmission, symptoms, treatment and prevention measures.
- iv) To asses the intervention or control measures employed by the community and the health facilities in order to reduce the morbidity and mortality attributable to the disease in the area.

CHAPTER TWO: LITERATURE REVIEW

2.1 Leishmaniasis and its causative agents

Leishmaniasis is a vector borne disease caused by obligate intra-macrophage protozoan parasites of the genus *Leishmania* and is endemic in large areas of the tropics, subtropics and the Mediterranean basin. Poor and neglected populations in East Africa and the Indian subcontinent are particularly affected by visceral leishmaniasis (Kala-azar) (MSF, 2006). The disease is characterized by both diversity and complexity in that it is caused by more than 20 *leishmanial* species pathogenic to humans. It is transmitted by bites of different species of female phlebotomine sand flies, and the disease is focal in distribution (Pearson & Sousa, 1996., Herdwaltd, 1999; MSF, 2006).

Kala-azar has 30 synonyms in vernacular languages. It means “black sickness” and hyperpigmentation of the skin of the face, feet and abdomen as indeed observed in Indian cases. ‘Kala’ might however refer as well to “Kal” and reflect the terrifying effects the disease has on the affected persons. The affected communities therefore perceive Kala-azar usually as very threatening and their demand for treatment is high (Boelaert, 2000).

Leishmaniasis consists of the four main clinical syndromes: cutaneous leishmaniasis (CL); muco-cutaneous leishmaniasis (MCL, also known as espundia); visceral leishmaniasis (VL, also known as kala-azar); and post kala-azar dermal leishmaniasis (PKDL). Each of these produce clinical syndromes depending on the virulence or tropism of the parasite and differential host immune responses. In CL, the patient generally presents with one or several ulcer (s) or nodules in the skin. Different species of

Leishmania can infect the macrophages in the dermis with variable clinical presentations and prognosis (Arevalo, 2007, Dedet *et al.*, 2003 Anderson *et al.*; 1992). Although the ulcers heal spontaneously, shortly in immunocompetent individuals it causes disfiguring scars. In MCL, patients suffer from progressively destructive ulcerations of the mucosa extending from the nose and mouth to the pharynx and larynx. These lesions are not self-healing and are usually seen months or years after a first episode of the disease when the macrophages of the naso-oropharyngeal mucosa become colonized. *Leishmania braziliensis* is responsible for most cases of muco-cutaneous leishmaniasis (Arevalo, 2007).

Visceral leishmaniasis, the subject of this study is the most severe form of Kala-azar. It is a systemic disease that is both acute and chronic, characterized by irregular bouts of fever, substantial weight loss, swelling of the spleen and liver as well as anemia and is fatal if left untreated with a mortality rate of almost 100%. It is caused by the *Leishmania donovani* complex.- *L. donovani* sense stricto in East Africa and the Indian subcontinent, and *Leishmania infantum* in Europe, North Africa and Latin America and *L.chagasi* that occurs in South and Central Africa (Lukes *et al.*, 2007; Muricio *et al.*,2000;Davies *et al.*;2003).

There are two types of visceral leishmaniasis, which differ in their transmission characteristics zoonotic, transmitted from animals to vector to human and anthroponotic visceral leishmaniasis transmitted from humans to vector to human and that its transmission affects people's behavior as well as sand fly and reservoir activity. In the

zoonotic type, humans are occasional hosts and animals, mainly dogs are reservoir of the parasite (Davies *et al.*, 2003, Alvar *et al.*, 2004). Zoonotic visceral leishmaniasis is found in areas of *L.infantum* transmission whereas anthroponotic type is found in areas of *L. donovani* transmission with the vector being *Phlebotomus martini* (Alvar *et al.*, 2004)

Post-Kala-azar dermal leishmaniasis is characterized by a macular, maculo-papular or nodular rash and is a complication of visceral leishmaniasis that is frequently observed after treatment in Sudan and more rarely in other East African countries as well as in the Indian subcontinents (Zijlstra *et al.*, 2003). It can also occur in immunosuppressed individuals in *L.infantum* endemic areas. The interval between treated visceral leishmaniasis (VL) and PKDL is 0-6 months in Sudan and Kenya while 6 months to 3 years in India. PKDL cases are highly infectious because the nodular lesion contain many parasites which are putative reservoirs for anthroponotic VL between epidemic cycles (WHO, 2007., Addy & Nandy 1992).

The impact of leishmaniasis in humans is enormous. One tenth of the worlds population is at risk and 2 million new cases are reported each year (WHO,2006; MSF, 2007).Kala-azar has continued to have increased incidence globally, in Africa especially the SSA due to several reasons, including influx of non-immune population into natural foci of transmission, changes in ecology of vectors and reservoir hosts reduction in the use of residual insecticides for the control of malaria as well as improvements in diagnosis and reporting cases that were more disproportionately effected (WHO 2006; Neumine 2007).

2.2 Distribution of Kala-azar

2.2.1 World wide distribution of Kala-azar

Kala-azar occurs in 62 of those countries (WHO, 2005; Last 1988). There are an estimated 500,000 new cases of Kala-azar and more than 50,000 deaths from the disease each year, a death toll that is surpassed among the parasitic diseases only by malaria (Desjeux, 2004). Both figures are only approximations as kala-azar is frequently not recognized or not reported (Collins *et al.*, 2006; Rijal *et al.*; 2006). Over 90% of cases occur in just six countries of Bangladesh, India, Nepal, Ethiopia, Brazil and Sudan that is bordering Kenya.

It has been documented that worldwide 12 million people are affected by leishmaniasis; this figure includes cases with overt disease and those with no apparent symptoms. Of the 1.5-2 million new cases of the leishmaniasis estimated to occur annually, only 600,000 are officially declared (WHO, 2006; MSF, 2007). It is reported that AIDS and other immunosuppressive conditions increase the risk of Kala-azar infected people developing visceral illness. In certain areas of the world, the risk of co-infection with HIV is rising due to epidemiological changes (Desjeux and Alvar, 2003).

The distribution of Kala-azar in the tropical and sub-tropical regions of Africa, Asia, the Mediterranean, Southern Europe, South and Central America where it is endemic, is not uniform, but is patchy and often associated with areas of drought, famine and densely populated villages with little or no sanitation (WHO, 1996; MSF, 2006). Kala-azar has

been known to exist in the Himalayas in Pakistan for over three decades. Between 1985 and 1995 in Pakistan, 239 cases of the disease due to *L. d infantum* were reported, of these 52% were children below the age of 2 years, 48% were children below the age of 5 years, this represented an increase of ten fold in infantile Kala-azar cases over the 10 years period from 0.2 to 2 per 100,000 population and male cases out numbered female cases by three times (WHO, 2005). Recently sporadic cases are beginning to appear in the North West Frontier Province (NWFP), Punjab and certain large farming communities.

In neighbouring India, Kala-azar is endemic in the states of Bihar, Utta Pradesh and West Bengal. One of the largest epidemic occurred in 1978 in North Bihar where over half a million people fell victim to Kala-azar. In the first eight months of 1987 and 1988, 22000 cases of Kala-azar were registered (WHO, 2005). In Bangladesh, cases of Kala-azar greatly declined between 1953-1970, probably as a result of mass chemotherapy with pentavalent antimonials and wide- spread spraying with DDT to control malaria. Following the end of malaria control programme in 1970, sand fly vector population increased and so did the cases of Kala-azar and currently appears at a rate in excess of 1500 per year (Screenivas, 2002, WHO, 2005).

In Brazil, Kala-azar is distributed widely in the east and the central regions of the country. Kala-azar commonly affects poor and malnourished children below the age of 15 years (WHO 2005). The disease is highly endemic in the states of Bahia and Ceava which together account for 70% of the total cases of Kala-azar in Brazil (Schalling *et al.*,

2001). Up to 1989, 1500 cases of Kala-azar had been recorded in the states of Alagoas, Espirito Santo, Gias, Mato Grossodosul, Minas Geais, Para, Padiba, Pernambuco, Pravi, Rio Grande Norte and Sergipe including Bahia and Ceava (Yamey and Torreele 2002). Recently, the foci of Kala-azar has shifted from rural villages to large cities creating densely populated ghettos living sub-standard housing with improper sanitation and keeping farm animals in their gardens.

In Central America, where previously only isolated cases of Kala-azar were recorded, the disease is on the increase especially Casta Puca, Hondarum and Nicaraghua. This is most probably due to an increase in the human population and their movements in and out of these areas. As in most countries males are almost twice as likely to be affected by Kala-azar than female with young children being at the highest risk (WHO, 2006; WHO, 2007).

Table 1.1 Spectrum of leishmaniasis, aetiological agents and worldwide distribution

Type of leishmaniasis	Causative agent	Worldwide distribution
Visceral	L. donovani	China, India, Iran, Sudan, Kenya
	L.infantum	Ethiopia, Kenya Mediterranean basin, Brazil
	L. chagasi	Colombia, Venezuela, Argentina
Cutaneous	L.tropica	Mediterranean basin, Afghanistan
	L.major	Middle East,
	L. aethiopica L. Mexica	Ethiopia, Central America And Amazon basin
Muco-	L. braziliensis Complex	Brazil, Peru, Ecuador, Colombia, Venezuela.

Sources: African Journal of Health sciences, Volume 13, Number 1-2, January-June 2006.

2.2.2 Geographical distribution and Epidemiology in Africa

In Sudan since the first Kala-azar case was reported in 1938, the disease has become wide spread and is endemic in south and eastern parts of the White Nile and Upper Nile states. Other areas affected include the provinces of Kasala, Joglei and Kapoeta in the south, El Fasher and El Nahud in the West and also North of Khartoum (WHO, 2006).

In Ethiopia, the first case of Kala-azar was documented in 1942 in the Southern Parts of the country. Since then the disease has spread to become endemic in the Segen, Woito and Galana river valleys. The highest incidence has been recorded in the Aba Roba area. During an 8 year study leading up to 1990, 142 cases of Kala-azar were reported in the villages close to the Segen river valley. It was found that 58% of the people affected were children below the ages of 15 years with the lowest risk groups being males above the age of 39 years and females above 24 years, also surprisingly, children below the age of 5 years (WHO 1998, 2006).

In Somalia sporadic cases of Kala-azar first appeared in 1934, mainly in the Middle Shabelle and Lower Juba areas. A recent retrospective study has shown that Kala-azar is endemic in these areas. Children below the age of 15 years were at the highest risk and males were three times more susceptible than females (Yamey & Torrele, 2002).

In Israel Kala-azar is rare and the few cases that have been reported are largely confined to the run down Arab village in Western Galilee, proving that the disease is linked to poverty, poor sanitation and sub-standard housing. Between 1960 and 1989, 62 cases of

the disease were recorded with only 18 cases in the past 13 years and 6 cases of infertile Kala-azar between 1992 and 1994. The fall in the incidence rate is most probably due to improved standards of living, diet and the use of insecticides (WHO, 2006).

2.2.3 Epidemiology of kala-azar in Kenya

Leishmaniasis has been known to be endemic in parts of Kenya from as far as early in the 20TH century (Fendall, 1963; Alvar *et al.*, 2004). An outbreak of Kala-azar in the King's Africa Rifles troops encamped north of Lake Turkana in Southwest of Ethiopia was reported in the 1940s (Cole *et al.*, 1942, WHO, 2005). Since then Turkana, Baringo, Kitui, Machakos, Meru, West Pokot and Elgeyo Marakwet districts have been considered to be endemic for Kala-azar (Fendal, 1963; WHO, 2005).

There are three endemic foci of Kala-azar in the country: northwest Kenya including West Pokot, Baringo and Turkana districts in Rift Valley Province, Eastern Province mainly around the town of Machakos; and Northeastern Province along the Somali border, which had the epidemic of the disease in 2000 (WHO, 2006). Three independent studies showed that PKDL occurred in 1%, 6% and 30% of the Kala-azar patients respectively (Zijlstra *et al.*, 1995). Another study carried out over a period of 2 years between 1991 and 1992 showed that 56% of the Kala-azar patients develop PKDL (Zijlstra *et al.*, 1994). The highest prevalence of PKDL is believed to be in the 20-40 years age group with children below the age of 10 years and adults above the age of 40 years at low risk with males and females being equally affected or perhaps females slightly less than males (Rijal *et al.*, 2006; Yamey & Torreele, 2002).

2.3 Reservoir and vectors of Kala-azar

Sand fly is the vector for leishmaniasis. Investigations on vectors of leishmaniasis in Kenya started only in the early 1950s when the Kala-azar assumed importance as a result of major disease epidemic outbreak. The causative agent of Kala-azar cases in Iraq, India, China, Sudan and Kenya is *Leishmania infantum*. In the anthroponotic transmission cycle, humans are the sole reservoir or source of infection for the vector while in the zoonotic transmission cycle; animals are the main reservoir hosts: dogs for Kala-azar (VL) and several species of mammals such as rodents, jackals, and foxes for other forms of leishmaniasis (MSF, 2005).

Species of the sand flies belong to the genera *Lutzomyia* in Latin America and *phlebotomus* in Kenya and the rest of the world. There are over 300 different subspecies of sand fly, but only around 30 are involved in the transmission of *Leishmania* (Johnson *et al.*, 1999; WHO, 1996). *P.orientalis* has been identified in the West Upper Nile district (WUN) Sudan as the vector of *Leishmania donovani* which causes Kala-azar (Herwaldt 1999); where up to 10% of the dissected flies had been infected at the height of an epidemic. *P.orientalis* has been identified as the vector in the Gedaref focus (Sudan) and is highly suspected to be the vector in the Humera focus (North-West Ethiopia). *P.martini* is the suspected vector for Kala-azar in northern Kenya. The Kapoeta focus in South East Sudan / Ethiopia and Southern Ethiopia (Zijlstra *et al.*, 2003; Gebre *et al.*; 2004).

In Kenya, apart from *P. martini* commonly being the vector for Kala-azar *p. orientalis* has also been reported and occurs in the Kajiado district (Johnson *et al.*, 1999) The aetiological agents for cutaneous leishmaniasis which include *L. major* has been reported in Baringo; *L. tropica* in Laikipia, Samburu, Isiolo, Nakuru and Nyandarua districts while *L. aethiopica* has been reported in the Mt. Elgon area. *P. suboscqii*, *P. guggisbergi* are the vectors of *L. major* and *L. tropica* respectively, while *P. pediffer*, *p. logipes* and *p. elgonensis* are the vectors of *L. aethiopica* (Sang and Chunce, 1993; WHO 2006, Heisch, 1957). The sand fly species present in Kenya rests and breeds in termite hill, animal burrows, trees holes and house walls. It feeds mainly on goats, rabbits and humans, and to a lesser extent on dogs, cattle and other hosts (Southgate, 1964; MSF, 2005).

The vector of Kala-azar in West Pokot is the sand fly *P. martini*. The female alone requires a blood meal for maturation of the eggs and they are then laid in organic natural detritus. Specific temperature and humidity is required for the development of the immature stage and studies have shown that termite mounds and animal burrows may be locations where juvenile stages develop and where the adults breed and rest during the day (MSF, 2005). Manteufel was the first to report on sand fly collected on the Kenyan Coast in 1932 (Fendal, 1963). Thirty sand fly species were identified in the country and distributed in various biotypes and sand flies were then found to be present in dry desert like lands and forests such as Mt.Elgon. Early studies dealt with sand fly species distribution and composition in leishmaniasis affected areas such as Machakos (Wijers and Kiilu 1984; Matunda and Ngoka 1984 ;) Kitui (Heish 1956; Southgate, 1964), Baringo (Mekianon and Fendall 1956.) and West Pokot (Stephen, 2006). The active

cases of Kala-azar originating from the area are unlikely to transmit the disease unless the specific vectors are present (MSF, 2007).

2.4 Vulnerable groups and socio-economic impact of Kala-azar

Kala-azar affects poor communities, generally in remote rural areas. The disease is mostly endemic in countries that are among the least developed in the world such as Nepal or in the poorest regions of so called middle income countries such as Kenya and Bihar State in India. Patients and families affected by Kala-azar in such countries become poorer because of the high indirect costs (for example, the costs of Kala-azar diagnosis and treatment) and indirect costs (for example loss of household income) of the disease.

India, Nepal and Bangladesh harbour an estimated 67% of the global Kala-azar disease burden (Seaman *et al*; 1996; Alvar *et al*; 2006; Aliluwalia, 2003; Rijal *et al*; 2006). In endemic areas children below the age of 15 years are commonly affected in sporadic and epidemic cases of Kala-azar, people of all ages are susceptible with males at least twice more likely to contract the disease than females, except those who have conferred immunity due to past infection (WHO, 2006).

The poorest segments of rural populations in Southern Asia, Eastern Africa and Brazil are also mostly affected in that access to appropriate diagnosis and treatment is difficult. There is scanty investment in the development of new drugs for the disease. The most effective treatments are often unavailable and unaffordable for the patients in endemic or predisposed areas. Malnutrition is a predisposing factor for progression from leishmanial infection to disease and delays in diagnosis and treatment hence increases the risk of severe morbidity and mortality (Hotez, 2004).

The disease exists in areas not easily accessible and not only remote but also where health facilities are barely available or inadequate. Those most likely affected or infected are the poor living in villages without seeking treatment. It has been demonstrated that many may decide to stay at home due to anticipated lack of drugs hence acting as reservoir of infections passing on the parasites to family and neighbours through the bite of sand flies (Hailu *et al.*, 2005, Alvar *et al.*, 2004).

2.5 Factors predisposing or affecting the transmission of Kala-azar

Leishmaniasis transmission is increasing in several areas, at a rate of more than 50% in 1998-2002 even up to date, reflecting the environmental /and use of behavioral changes that increase exposure to sand flies (Desjeux 2001; Davies *et al.*, 2003). Contribution to the prevalence or transmission of Kala-azar include the following factors.,-

2.5.1 Migration

Rural –urban migration seems to have contributed to urbanizing Kala-azar in Brazil, whereas in East Africa, the disease is more closely associated with migrating seasonal workers and refugees (Davies *et al.*, 2003). Trans-border migrations between Bangladesh India and Nepal are also a risk factor to the disease; settlements in high – risk endemic areas such as those established by people migrating from high plateaus to tropical plains and the migrations increase their exposure to vectors (Desjeux 2001)

In America, there is evidence that Kala-azar like the Chagas disease transmission rates are strongly linked to types of housing, mobility patterns and the process of animal domestication. Domiciliary transmission of the Chagas disease has decreased due to the

elimination of the main vector manifestation from the interior of the infected homes and such transmission has been affected by residual spraying in about 25% of the area under risk. Favourable conditions for the increased number of anthroponotic leishmaniasis can be found in overcrowded cities due to massive rural –to-urban migration e.g. in Kabul or Aleppo (Ashford, 1993). A broad description of the epidemiological dynamics of the infection in Kabul showed that it had retained the characteristics of a newly arrived epidemic over a period of almost 20 years. The age distribution of infection did not change and an increase in the number of cases was observed despite insecticide application in houses and intensive detection and treatment of cases. It is suggested that the epidemic of anthroponotic leishmaniasis in Kabul persisted because of rapid turnover of people in the city (Kadaro, 1993., WHO ,1998).

2.5.2 Environmental Modification

Environmental modifications such as construction of dams can change the temperature and humidity of the soil and vegetation, which may result in changes in the composition and density of sand fly species as well as changes in populations of rodent species (WHO 2005). The formation of new settlement with non –immune populations, facilitate the outbreak of leishmaniasis. For example, the outbreak of zoonotic leishmaniasis in the central and southern parts of Tunisia in 1982-83 occurred following the construction of the Sidi saad Dam (Bern, 2005). The increase in the incidence of leishmaniasis among non – immune settlers was observed in water irrigation schemes in the Libyan Arab, Jamahiriya, Saudi Arabia, the Syrian Arab Republic and other countries (WHO, 2006).

An outbreak of zoonotic cutaneous leishmaniasis as a result of man-made changes to the environment has been observed since 1994 in the Kasha region, north of Lafahan in the Islamic Republic of Iran. An incidence of 8-15% was reported among local inhabitants. Available data indicate that the epidemic started after an increase in the number of *Rhombomys opimus* – a rodent reservoir of economic cutaneous leishmaniasis in the area – as a result of planting trees in the region to prevent soil erosion. Since sand fly vectors are present in the area, the active transmission of the leishmania parasite has been formed, thus resulting in an increase of human incidence of leishmaniasis in humans (Dowlati 1996; Davies *et al.*, 2003)

Outbreaks of leishmaniasis are often associated with the movement of people into foci of infection. For example, during the war between the Islamic Republic of Iraq, numerous leishmaniasis cases were observed among soldiers stationed in active foci of infection. The outbreak of the disease provoked the Iranians to start mass leishmanization of military personnel as a prophylactic operation. The displaced population of the Southern region of Sudan experienced a severe outbreak of Kala-azar in Pakistan; an outbreak of the disease among soldiers was recorded after military exercises in some endemic foci of Islachistan. A rise in the incidence was recorded among personnel of the United Nations, peace – keeping forces in East Sinai (Mansour, 1989)

The role of the climate in the emergence and re-emergence of the infectious disease and particularly vector borne disease is well recognized (Patz, 1996). Some outbreaks of Kala-azar in the endemic countries have been linked to climatic changes for example, it is

believed that heavy rains in Sudan in 1985 and 1986 created ideal breeding conditions for the sand fly and resulted in an outbreak of the disease in Khartoum with more than 10,000 cases. Furthermore, there was a massive migration of population from endemic Nile region north of Khartoum in 1984-85 following the drought in the West during the period (Desjeux, 2004; Neumine, 2007).

2.5.3 Inaccessibility to health care services

Visceral leishmaniasis (Kala-azar) occurs in immunologically naive populations without any access to treatment. A follow up study after an outbreak of the disease in South Sudan, document Kala-azar impact in a community with a fair access to primary health care (Hailu *et al.*, 2005). Kala-azar is becoming an emergency health problem in Eritrea, Ethiopia, Sudan and even Kenya where it has been endemic for years. The high mortality rate in its outbreaks is mainly due to the absence of diagnostic facilities and the non-availability of the first line drugs at the local level. In the absence of treatment, the mortality rate is close to 100% from the disease in these areas, where no treatment exists. Above 65% Kala-azar cases are found in many countries in children below 5, and 2006 study in India on knowledge, attitude and perception and 55.9% believed that the facilities at the health centers did not have the adequate treatment.

A shortage of specific drugs for the treatment of leishmaniasis can potentially contribute to the intensity of transmission in the foci in the anthroponotic forms of the disease and subsequently to an increase in the morbidity and even mortality among populations at risk of infection. Generally all humans serve as a reservoir host during endemics of anthroponotic forms of infection and if untreated, the severity of the disease will increase

and prove fatal in the case of Kala-azar outbreak (WHO, 2006., Davies *et al.*, 2003). The lack of diagnostic facilities and drugs for treatment has been among the possible contributing factors to the subsequent economic embargo imposed in 1991. A fourfold to six fold rise in the number of cases have since been observed due to other factors like population movement and the destruction of health and vector control facilities during the war in Iraq and the Islamic Republic of Iran (WHO, 2006). From 2000 through 2006, a total of 3,645 patients suspected of Kala-azar were screened in Amudat Health centre in Uganda. A total of 2088 patients confirmed with the disease were treated. Most of the patients (80%) were under 15 years of age and 75% were male and 70% were from Kenya. The increase of the number of the patients in that 2000-2005 period, was partly due to case detection and the availability of treatment (MSF, 2005; WHO, 2007).

In Kenya, most of those affected with kala-azar are livestock herders. The risk of infection with the disease under the age of seven years appears to be independent of sex, but males seem to report higher rates than women as they get older (Herwaldt, 1999). Ratios of up to five times more in men than in women seems to be evident from hospital morbidity figures (Webber, 1996), and which may also be a reflection of the higher likelihood of reporting and treatment for males. Community surveys however reveal much higher rates among women than is evident from hospital records, indicating that kala-azar and post-kala-azar dermal lesions remain under-reported by the community, due to the prevailing social-cultural and economic circumstances that hinder women's presentation in hospital. The extent to which the differences between men and women occur, are due to exposure or that under-reporting is unclear, though there is some

indication that part of the difference may be attributable to limited access to services, hormonal influences, response to treatment and differences in immune response (Davies *et al.*, 2003, Mandell *et al.*; 1995).

Kala-azar is predisposed to more people in West Pokot District, especially the Kacheliba Division, where the prevalence is 30% according to reports by MSF (2004) and Mutero *et al.*, 1992. The disease is also endemic in Pokot county, Nakapipirit Uganda that borders West Pokot, Kenya from Kacheliba. These two regions are single endemic focus. Also, the latest cases of Kala-azar have occurred even in the non-endemic areas of North Eastern where accessibility to health care is inadequate. During the period, 42 cases and 15 deaths were reported (Neumine, 2007). It is estimated that 15% of the total population of 391, 211, is at risk of contracting the disease in the West and North Pokot districts which have a prevalence of 15% and 17%, with 70% of the cases reported in the facilities coming from the study area (MOH, 2007). Kala-azar exists in areas that are either remote or not easily accessible and where health facilities are barely available or inadequate. In remote villages far from health care centers, the patients from such communities often die without seeking treatment (Hailu *et al.*, 2005).

2.5.4 Knowledge, Attitude, Perception and Behavior (KAPB)

In most countries, Kala-azar affects the poorest among the poor. The very poor have little knowledge about the disease and hence they are unlikely to seek early treatment and most of those who start treatment cannot afford to complete it. The occurrence of the diseases drags them further into the downward spirit of poverty from which they are unable to recover (WHO, 2007).

In a study in Pacific Ocean on knowledge, attitude and practice by gender on Kala-azar, 94% of the population believed that the disease appears as a skin disease; more men affected and more women did not know the mode of its transmission and 35% of the respondents connected the disease to the bite of an insect but did not know what the aetiologic agent was; and thought that the bite was infected by a worm that lives in the mountains. Great variety of treatment used to cure the disease was also based on plants, chemical substances, burning the lesion and to a lesser degree drugs. About 45% did not know how to prevent the disease. This in essence calls for an extensive study on knowledge and practices in the community that can help in identification and quantification of the local factors contributing to the disease, so as to institute preventive and control measures (MSF, 2007). The biting time of the sand flies lie between 6.30 p.m and 7.00 p.m at dusk. At this time people sit outside their homesteads at night. Children play on termite hills during the day and possibly early morning, between 6.00 a.m to 10.00 a.m that is the biting period of the sand flies at dawn (WHO, 2006, Stephen, 2006).

A study carried out in Kitui revealed a significant correlation between Kala-azar incidence and the presence of termite hills within 100 yards from homesteads. Of those with Kala-azar, 30 had a termite hill present while 116 did not. Latter studies by Southgate found that 70% of homesteads close to termite hills were infected compared to only 20% of those without (WHO, 2007). A pilot entomologic study conducted in 2004 in Uganda demonstrated that termite mounds are important for vector breeding and

resting sites and that sitting on termite mounds increases the risk of infection (MSF, 2005).

2.5.5 Cultural, Social beliefs and practices

Many communities like America, Nepal, Bangladesh, Sudan and Kenya; especially the areas of Kitui, Machakos, North Eastern, East Baringo and West Pokot, have multifactorial explanation of ill health due to Kala-azar. They believe variables such as social class, economic position, religion, gender, life events can be correlated with the incidence and distribution of the disease. Many associate Kala-azar ill health with misfortune that is believed to result from supernatural forces like sorcery, witchcraft, breaking of taboos, curses and spirit disturbances. Sudden changes of weather from wet to dry, exposure to dry air during hot seasons are also believed to cause the disease (Manderson 1998; Marmot *et al.*, 1981). Arrangement of living space and type of house, social isolation of certain sub-groups such as within a rigid caste system, population movements such nomadic life style are also believed to cause the disease.

2.5.6 Constraints to the provision of control

The re-emergence of leishmaniasis in most foci may be the result of interruption of previously applied methods of control, e.g. Insecticide spraying or early diagnosis and treatment of positive cases. It is reported that reduction in the use of insecticides for malaria control contribute to the increase in the population of synanthropic sand flies and results in the outbreak of the disease in some endemic foci of Kala-azar (WHO, 1998). The success of the control measures depend on a basic understanding of the epidemiology of different forms of leishmaniasis and the cultural / social customs of the population for example, indoor insecticide spraying will not be effective in areas with

exophagic vector species nor will treatment of burrows of *Psammonys obesus* with grain treated with zinc phosphate. If the vector is exophagic and people in the foci prefer to sleep outside without mosquito nets during the transmission season, then the use of insecticide- impregnated materials will not affect the transmission (Ben, 1994, WHO, 2006).

The control of vectors through residual insecticide, house – spraying plays a significant role in the reduction of transmission, particularly in foci of anthroponotic form of leishmaniasis. However, the high cost of modern insecticide and increasing concern about their impact on the environment have resulted in a significant reduction in their use by national programmes (Desjeux, 2004; WHO,1996). Humans may be protected from Kala-azar when in close proximity to livestock (because of the diversion of sand flies to alternating hosts) or when lighting fire indoors. Smoke act as a repellent to most biting flies. Ownership of insecticide- treated bed nets, which could protect persons from sand fly bites and reduce Kala-azar transmission is low in many communities and although most of the local population have heard of Kala-azar few are aware of how it is transmitted (MOH , 2007).

2.5.7 Health surveillance systems

Diagnosis of leishmaniasis is based on clinical, serological and parasitological identifications. However, difficulties in clinical and parasitological diagnosis of Kala-azar still exist. The signs and symptoms of the disease in areas with multiple morbidity may not be sufficiently or specific to differentiate. Kala-azar in mid 1988 was, by mistake, recognized as an outbreak of typhoid fever (WHO, 2005). Comprehensive

information about the distribution of different forms of leishmaniasis in many countries is incomplete and needs further studies. However, during an epidemic that happened in Sudan, the number of Kala-azar cases can considerably increase (WHO, 1998; 2005; Guerin *et al.*, 2002)

2.5.8 Co – infections

Kala-azar can be an opportunistic infection in people with HIV/AIDS and both are expanding. Due to the increasing overlapping geographical distribution of the two pathogens as reported in 34 countries especially in Asia, East Africa, South America and South Europe, the number of cases with co –infection is expected to rise Kala-azar stimulates replication of the HIV (Davidson 1997; Desjeux and Alvar, 2003.). More than 90% of the co- infected patients have less than 200 CD4 cells/ cubic mm (WHO, 1998, 2005). Kala-azar/ HIV co-infection is emerging as an extremely serious new disease and is increasingly frequent (Desjeux and Alvar, 2003).

2.6 The clinical presentation of Kala-azar

The incubation period of Kala –azar generally lasts between 2 and 6 months or longer. Patients present symptoms and signs of persistent systematic infection including fever, fatigue, weakness, loss of appetite and weight loss. There is parasitic invasion of the blood and reticulo –endothelial system that is the general phagocytic system such as enlarged lymph nodes, spleen and liver. Fever is usually associated with rigor and by anaemia, which is caused by the persistent inflammatory state, hemolysis, hypersplenism (the peripheral destruction of one of erythrocytes in the enlarged spleen) bone marrow destruction and sometimes bleeding (Macleod *et al.*, 1987; AMREF 1999).

2.7 Diagnosis of Kala-azar

A combination of clinical signs or symptoms and laboratory tests are used. As the clinical presentation of Kala-azar lacks specificity, confirmatory tests are required to decide which patients should be treated. Such tests should be highly sensitive (95%), specific, reproducible, feasible and cheap as Kala-azar is a fatal condition and that the drugs currently used are toxic. Ideally, a test should be able to make the distinction between acute disease and asymptomatic infection, because none of the drugs currently available is safe enough to treat asymptomatic infections. The commonly used tests are microscopy, antibody detection tests such as ELISA DAT and opti-leish ; antigen detection tests, non-leishmanial tests, polymerase chain reaction, leishman skin test and the immunological studies. Traditional methods used by communities include touching the abdomen or stomach of the sick in order to find out if the spleen is enlarged, looking at the paleness or yellowing of eyes to diagnose anaemia; vomiting and body weakness (WHO, 2005).

2.8 Prevention and control measures of Kala-azar

As outlined below, a combination of approaches is used to control the disease such as early recognition and treatment of cases, control of vectors and reservoir hosts, health education of the population in the endemic foci which is the most important element of the control strategy as well as passive active case detection followed by treatment and case reporting use of insecticide (Davies *et al.*, 2003).

2.8.1 Reservoir control

Dogs are the main reservoir of *L. Infantum* in zoonotic Kala-azar. Despite evidence from experimental studies showing a decreased incidence of Kala-azar in both dogs and children following serological screening of dogs and killing of sero-positive animals (Ashford , 1998., Palatruk 2001) , the efficiency and acceptability of this control strategy is increasingly being debated (Alvar *et al.*,2006, Davies *et al.*, 2003;Tesh ,1995). Treating infected dogs is not an effective control strategy as relapses are frequent and dogs can regain infectivity weeks after treatment, despite being clinically cured (Alvar, 1994., Bhattarya, 2007).

2.8.2 Vector Control

Sand flies are susceptible to the same insecticides as Anopheles mosquitoes, the malaria vector. Residual insecticide spraying of houses and animal shelters was shown to be efficacious in India (Kaul *et al.*, 1994) where the vector *Phlebotomus argentipes* is restricted to areas in and out around the home, following the large scale antimalarial insecticide such as dichloro-diphyl-trichloroethane (DDT) spraying campaigns that were implemented in the 1950s (Singh *et al.*, 2006).

2.8.3 Insecticide – impregnated nets

The use of the insecticide treated bed nets (ITNs) can concomitantly prevent Kala-azar and other vector-borne diseases such as malaria and Japanese encephalitis. There is limited evidence that bed nets provide protection against Kala-azar. Case control studies conducted in Bangladesh and Nepal showed that sleeping under a non- impregnated bed net during the warm months was a protective factor against Kala-azar (odds ratio = 0.20,

$P=0.001$; odds ratio = 0.69, $P=0.01$, respectively (Bern, 2005; Ritmeijer, 2007). Despite low usage, the mass distribution of ITNs in Sudan was accompanied by a 27% reduction in the incidence of Kala-azar in an observational study (Ritmeijer, 2007). A large prospective randomized controlled trial testing the efficacy of long – lasting ITNs to prevent *L donovani* infection and Kala-azar is underway in many countries especially in Nepal and India. Depending on the sleeping traditions of the population and the biting habits of the local vector other insecticide impregnated materials such as curtains and blankets should be evaluated for use in Kala-azar prevention, as some have been shown to provide efficient protection against cutaneous Leishmaniasis (Reyburn *et al.*, 2000 ; Kroeger *et al.*, 2002)

2.8.4 Early diagnosis and treatment

Early diagnosis and treatment are essential for both individual patients and for the community treatment outcome is worse in Kala-azar patients in bad general health. Adult patients in Sudan with severe anaemia, malnutrition and long duration of illness have shown to be at an increased risk of death (Collins *et al.*, 2006) . Untreated Kala-azar patients act as a reservoir for parasites and therefore contribute to disease transmission in anthroponotic Kala – azar areas. Early case finding and treatment is therefore considered an essential component of Kala –azar control (Desjeux, 2004; Boelaert, 2000; Guerin *et al.*, 2002; Mazlouri *et al.*, 2002).

2.9 Kala-azar treatment strategies

2.9.1 Use of anti-leishmanial drugs

Treatment of Kala-azar relies on specific anti-leishmanial drugs and the aggressive management of any concomitant bacterial or parasitic infections, anaemia hypovolemia (decreased blood volume) and malnutrition. The pentavalent antimonials (sodium stibogluconate and meglumine antimoniate) have been the first line treatment for Kala-azar in many areas for more than 70 years, given as a 30 days course of 20 mg antimony per kg body weight given by injection intramuscularly (Morel *et al.*, 2005) . Cheaper generic forms of drugs are available that have been shown to be equivalent to the branded products (Moore, 2001; Veeken, *et al.*; 2000, Ritmeijer, 2001). The second line drugs are Amphotericin B and AmBisome (Amphotericin B in liposome). AmBisome is a safer and more effective lipid formulation of Amphotericin B .Pentavalent antimonials is the most commonly used drug in Africa, and the only one used in Kenya and in West Pokot as well as the Kacheliba division, yet the drug is also very expensive in that many locals cannot afford its treatment.

Antimonials are toxic drugs with frequent, sometimes life-threatening adverse side effects, including cardiac arrhythmic and acute pancreatitis .Patients under the age of 2 or aged 45 or over with signs of advanced disease and or severe malnutrition are at higher risks of death during antimonial therapy owing to drug toxicity, slowness of drug action, Kala-azar complications or a combination of these factors (Collins *et al.*, 2006; Seaman *et al.*;1996) Conventional amphotericin B has replaced antimonials as the first – line treatment for Kala-azar in some areas of the Bihar state of India where treatment failure

rates for antimonials reached >60% . In reality antimonials are still in use in many peripheral public health facilities in these areas.

2.9.2 Traditional treatment pattern and Prevention measures

The mentioned communities devised strategies to cope with the disease include blood letting to reduce headaches and fever, sitting by the fire place, use of bitter herbs, visiting of witchdoctors and traditional healers. It is estimated that between 50-80% of the people in many communities predisposed to Kala-azar first visit drug outlets and other unprofessional practitioners before going to the hospital (Brabin *et al* ., 1985; Hahn, 1995).

CHAPTER THREE: METHODOLOGY

3.1 Research Design

A cross-sectional survey was used to determine the social demographic characteristics, economic factors, health seeking behavior, local people's attitude, perception, knowledge and behavior towards the existence of kala-azar in the area (Taylor, 2001; Hickey, 1986). This design was selected because sampling can be done to obtain a representative sample of the population, the source of data can be obtained from personal interviews, observations, self administered questionnaires; and that it can provide a quick assessment of the strength of relationships between factors (independent variable) and the health outcome (dependent variable). Both quantitative and qualitative data was obtained from the households based on these selected variables.

3.2 Variables

3.2.1 Independent variables

Were age, sex, marital status, family size, income and education, local people's attitude, perception, knowledge and behavior. These variables were measured using the responses of the questions on social demographic socio-economic and socio-cultural factors contained in the interview schedules administered to the respondents

3.2.2 Dependent variables

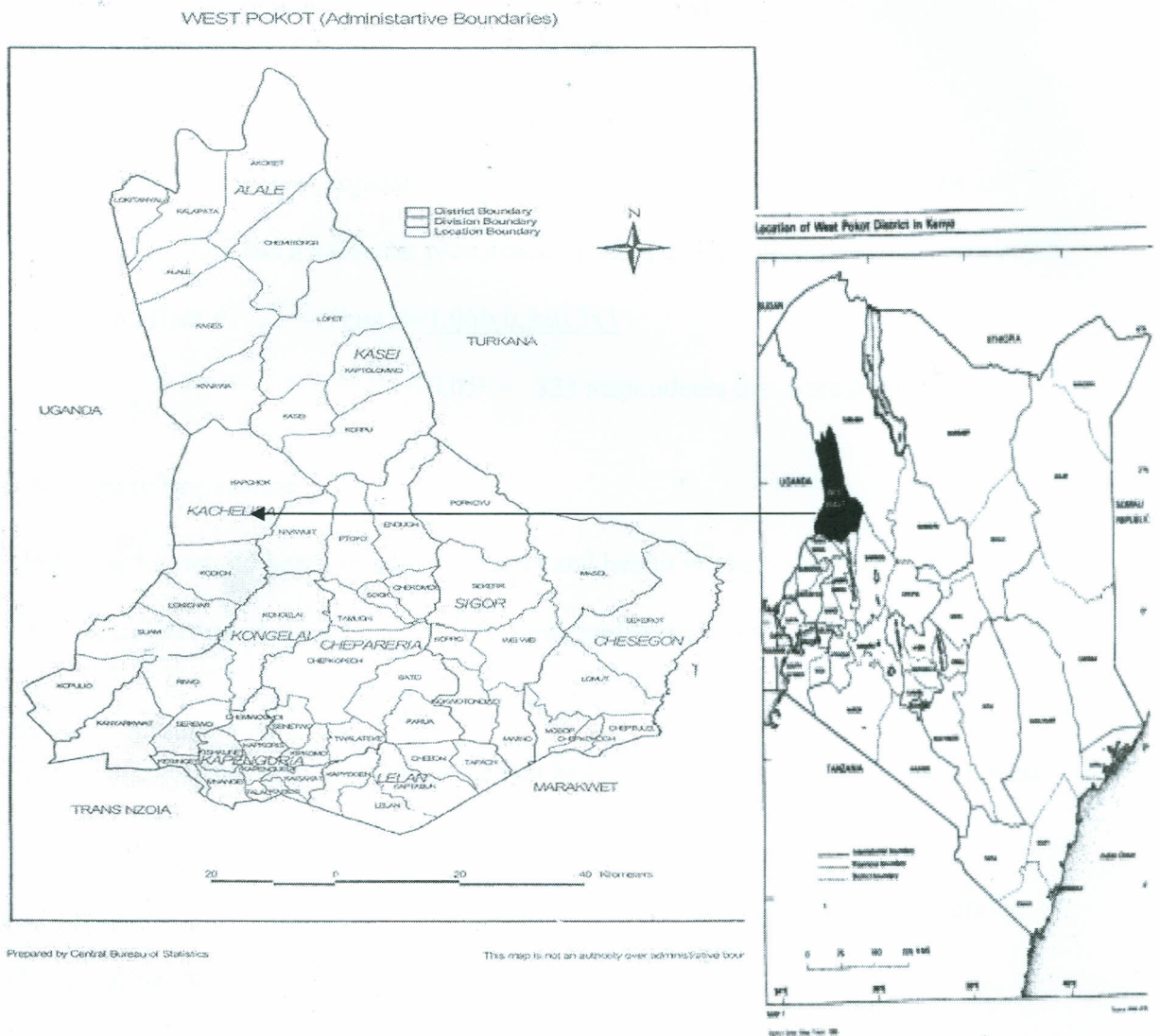
Were disease status measured considering the prevalence and incidence as well as its mortality; health seeking behavior measured considering when and where the respondents prefer for treatment .The association between the independent and dependent variables was measured using the chi-square test.

3.3 Study Area

The study was undertaken in Kacheliba Division of West Pokot District, an area prone to Kala-azar. West Pokot is one of the 17 districts in the Rift Valley province. It is situated along Kenya's western boundary with Uganda and borders Trans Nzioa and Marakwet districts to the South, Baringo and Turkana to the East and North respectively. The District is located 34'47'and 35' 49'East Longitude and 1'and 2' North Latitude, and covers an area of 9100 square km and stretches a distance of 132 km from North to South, with the broadest distance from East to West being 76 km the narrowest distance being 30 km. It has a major economic activity of agriculture and livestock keeping, population structure of 308,084 according to 1999 census, current population projection (2004) of 357,022, population density of 34 per km, and a growth rate of 3.1%.

The district comprises of 10 divisions: Alale, Kasei, Sigor, Lelan, Kapenguria, Kongelai, Chepareria, Chesegon, Tapach and Kacheliba which has a high prevalence of Kala-azar (30%) against its population of 20,151 and a percentage poverty of 56.1%. According to the first report on poverty in Kenya, 40% of the total populations in the district are poor. However, due to a number of factors, mainly drought, this figure has gone up and more people now live in conditions of poverty. It is estimated that 132,972 people in the district are actually poor and have been deprived their ability to meet their minimum food and basic non-food requirement (MOH, 2007).

Figure 3.1 Map of Kenya showing the study area (arrow)



3.4 Target population

The target population was the locals or the household respondents living in Kacheliba Division of West Pokot District, and predisposed to the disease.

3.4.1 Sample size

Sample size was determined by the formula recommended by Fisher *et al*, (1998), as follows $N = \frac{Z^2 PQD}{D^2}$

Where, N=Sample size Z =Standard normal deviate

(1.96) which corresponds to 95% confidence interval.

P=Proportion of the target population estimated to have a particular characteristic i.e.

Kacheliba Division has a kala-azar prevalence of 30%, $q=1-p$, d =Degree of accuracy=0.5

D=Design effect =1

Thus $N = \frac{1.96^2 \times 0.3 \times 0.7 \times 1}{0.05^2} = 323$ respondents that were interviewed.

3.5 Study Population

Were the household heads or adult members and health workers respondents living in Kacheliba Division of West Pokot District, and predisposed to the disease.

3.5.1. Inclusion criteria

i) All household heads or adult members that have lived in Kacheliba Division of West Pokot District for more than 6 months.

ii) Those that consented after the objective of the study had been explained carefully, clarifying that participation was voluntary.

3.5.2 Exclusion criteria

i) Non consenting residents.

ii) Not having lived in Kacheliba Division of West Pokot District for more than 6 months.

iii) Not being household head or adult member (being below 18 years of age).

3.6 Sampling procedures

3.6.1 Purposive sampling

The District was purposely selected because it contains the population of interest. The Division was also purposively selected because according to MSF survey of 2006. It has the highest prevalence of Kala-azar (30%) in comparison with other Divisions.

3.6.2 Simple random sampling

This technique was used to select the locations of Lokichar, Suam and Kodich and the 6 sub-locations of Orolwa, Kalemngorok, Ngengechwa, Karon, Cherangan and Kodich and the household's heads (Table 3.1).

Table 3.1: Locations, sub locations chosen and households sampled

Location	Sub-location	Population	No. of household	No. of household calc.	No. of household sampled
Lokichar	1. Orolwa	Loc 4075 Sub loc 1554	Loc 948 Sub loc 355	126	70
	2.Kalemngorok	1251	294		
Kodich	1.Cherangan	Loc 4786 Sub loc 1266	Loc 1033 Sub loc 275	106	37
	2.Kodich	2324	489		
Suam	1.Ngengechwa	Loc 5663 Sub loc 1835	Loc 1252 Sub loc 385	91	45
	2.Karon	1904	459		
Total		Loc 14524	Loc 3233	323	323

		Sub loc 10124	Sub loc 2257		
Grand total		Loc 14524 Sub loc 10124	Loc 3233 Sub loc 2257	323	323

2-sub-locations out of 3 in each of the 3 locations were chosen randomly and the numbers of households sampled from each of these sub-locations calculated.

3.7 Data collection Instruments

The interview schedules, key informant interviews, observations and focus group discussions were used to collect data. These were constructed according to each objective and hypothesis of the study. The data collected were pre-coded and collection from the households was done from the homes following prior appointments. The interviews were conducted in the local language (Pokot)/ and Kiswahili).

3.8 Quality Assurance

3.8.1 Pilot study

A pilot study was done in Kacheliba locations of Kapchok and Kopulio in order to ascertain the validity, reliability and suitability of the data collection instruments. Those locations did not participate in the study and had similar characteristics to the study area.

3.8.2 Research assistants

Research assistants (4), were trained on the use of interview schedules, making respondents understand questions, objectives and the significance of the study as well as explaining to them that participation is voluntary. They helped in the interpretation of

the local Pokot language, filling answers in the interview schedules and also assisted in locating the randomly selected respondents.

3.9 Data management and analysis

Data from the questionnaires was coded and entered into a spreadsheet and the database. The Software statistical Package for Social Sciences (SPSS) Version 11.5 (Taylor, 2001) was used to analyze the data. Analytical techniques were used depending on the type of data and the variables to be analyzed. Independent and the dependent variables such as age, gender, level of income and disease status were compared using Chi-square, where a probability value of $p < 0.005$ at 95% confidence interval, was considered significant (Taylor, 2001). Descriptive statistics such as frequencies, line graphs, pie charts and bar graphs, were used to describe, organize and summarize the data.

3.10 Logistical and Ethical Considerations

Clearance for the study was obtained from Kenyatta University, Ministry of Health and Ministry of Higher Education, Science and Technology. Further permission was sought from the Provincial administration West Pokot District, household heads and the community leaders. The purpose of the study was clearly explained to the participants while requesting them to give an informed consent as a sign of willingness. The study findings will be made available to the community members, local administration, ministry of health and the provincial administration.