# ASSESSMENT OF FACTORS ASSOCIATED WITH ACTIVE TRACHOMA IN CHILDREN AGED ONE TO NINE YEARS IN LOIMA SUB-COUNTY, TURKANA COUNTY, KENYA

**BY**

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**A THESIS SUBMITTED IN PARTIAL FULFILLMENT OF THE REQUIREMENTS FOR THE DEGREE OF MASTER OF PUBLIC HEALTH**

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## ABSTRACT

Trachoma is an infectious eyes disease caused by the bacteria *Chlamydia trachomatis*. In Kenya, trachoma is the second leading cause of blindness and is hyper-endemic in West Pokot, Baringo, Kajiado, Marsabit and Turkana. Children are often reservoirs of active trachoma, an infectious stage. A previous survey in Loima sub-County within Turkana County documented a 67% prevalence of trachoma, well above the WHO threshold of 10% prevalence. Interestingly, although Trachoma intervention projects exist in Loima sub-County, factors that have contributed to sustaining the high endemicity in the sub-County are poorly understood. This study therefore investigated the risk factors associated with active trachoma among children aged 1-9 years in Loima sub-County, Turkana County. A cross-sectional study that selected 520 children using a cluster-sampling technique was adopted. The sampling involved random selection of 13 sub-Locations, then households were randomly picked from eachselected sub-Location with proportional representation. In total, 520 children were enrolled. Closed Questionnaires were used to collect quantitative data. Observation method was used to examine the conjunctiva of both eyes of the child for clinical signs of active trachoma. Data was analysed using SPSS v20, while descriptive statistics and bivariate logistic regression methods were used for analysis. Results showed that 284(54.6%) out of 520 children who participated in the study had signs of active trachoma. The prevalence of trachoma varied by age, ranging from 30.8% in children between 1-5 years to 79.5 % in 6-9 years old ($P$=0.001). Bivariate logistic regression analysis identified predictors of active trachoma among children as: 1) family size (odds ratio [OR] 2.382, 95% confidence interval [95% CI] 1.318-4.34; $P$=0.004), 2) source of domestic water (OR 2.151, 95% CI 1.418-3.263; $P$<0.001), 3) household income (OR, 5.181; 95% CI, 1.621-16.559; $P$=0.006), 4) housing types (OR, 2.362; 95% CI, 1.311-4.204; $P$=0.005), 5) duration taken to fetch water (OR 1.822, 95% CI, 1.275-2.603; $P$=0.001), 6) distance between animal shed and house (OR 1.712, 95% CI 1.141-2.570; $P$=0.009) and 7) households where animals share houses with humans (OR 2.221, 95% CI 1.446-3.412; $P$<0.001). In conclusion, the study shows a high prevalence of active trachoma among children 1-9 years in Loima sub-County and therefore a disease of public health importance that involves both social-economic (family size, housing structures and household income) and environmental (water, sanitation and livestock) related factors. Control strategies to mitigate Trachoma in Loima sub-County should integrate identified social-economic and environmental factors to complement the existing prevention measures.

# CHAPTER ONE: INTRODUCTION

## 1.1 Background Information

Trachoma is an infectious eye disease caused by a bacterium *Chlamydia trachomatis*, which is passed from the eyes of one person to those of another by flies, fingers or shared cloths or towel (Satpathy et al., 2017). It is one of the neglected tropical diseases (NTDs) and a top priority under the disease control component of the Global Initiative for the elimination of avoidable blindness by 2020 (Pizzarello et al., 2004). It is the leading cause of preventable blindness worldwide (Burton & Mabey, 2009).

The disease is characterised by the presence of five or more follicles in the upper tarsal conjunctiva that appear white, grey or yellow (Satpathy et al., 2017). The reinfections over years lead to scarring in the conjunctivae area, and consequently, in some individuals, the eyelids turn inside out, a phenomenon called Trichiasis (Dean et al., 2008). The inward oriented eyelashes come into contact with the cornea, damaging it. This damage may heal, but leaves the cornea with scars that actually cause trachoma-related blindness (Rajak et al., 2012). This blindness from trachoma is irreversible.

The disease is found predominantly in the savannah areas of East and Central Africa and the Sahel of West Africa(Smith et al., 2013). It is estimated that approximately 1.3 million people are blind from this disease and probably a further 1.8 million have low vision (WHO, 2013). In areas were active trachoma is hyper-endemic, the prevalence among children aged below 10years may be 70% or higher, than in adult (Munoz et al., 2003). Often, chlamydial infections also appear to be in children aged under10 years, reaffirming the fact that young children are the primary reservoir of infection for the community (Solomon et al., 2003). Previous studies have also showed prevalence decreases with increasing age, with less than 5% of adults showing signs of active infection. Adults also carry infection in these

communities, and although the load may be lower, transmission may still be possible, and the presence of chlamydial antigen may continue to stimulate the scarring process (Bernabeu-Mestre et al., 2013; Hu et al., 2010).

In Kenya, trachoma is the second leading cause of blindness, accounting for about 19% of blindness. The diseases is endemic in 39 Counties, mainly in Rift Valley and Eastern regions but hyper-endemic in West Pokot, Baringo, Narok, Kajiado, Marsabit and Turkana (Karimurio et al., 2006). A previous baseline survey showed that the prevalence of active trachoma among 1-9 year old children in Turkana County was 38% (Karimurio et al., 2006). Loima sub-County, one of the six sub-counties in Turkana County had the high prevalence of 67% (Karimurio & Rono , 2010). This was above the WHO threshold, which declares any prevalence of active trachoma above 10% in children 1-9 years is a Country wide public health problem(Emerson et al., 2006).Subsequently, the Ministry of Health adopted the SAFE strategy, a combination of interventions measures that focus on surgery for trichiasis (inturned eyelashes), antibiotics, and facial cleanliness and for eliminating trachoma to entire Loima sub-County. However, the current prevalence of active trachoma among 1-9 year-old children in Loima sub-County after the intervention has not been assessed.

Although trachoma does not cause mortality, the impacts of the morbidity caused by trichiasis are detrimental. Blindness, in addition to taking the affected person out of the workforce, often also requires the fulltime efforts of a caretaker for the person with reduced vision. In Africa, this is often a child who is kept from going to school in order to accompany a blind relative (Abou-Gareeb et al., 2001). The economic effects of this are felt greatly by affected families, who are themselves at greater risk of becoming infected with active trachoma due to poor living conditions related to economic constraints (Wright et al., 2007).

Socioeconomic status is one of the most powerful risk factors for poor health outcomes (Haviland et al., 2005). However, the evidence base for a relationship between socioeconomic status and trachoma is mixed. For instance, trachoma severity was found to be significantly associated with low socioeconomic status (Ngondi et al., 2008). In addition, low education levels were shown to be associated with active trachoma (Dandona & Dandona, 2001). In contrast, in Sao Paulo, Brazil neither income nor socioeconomic status showed a significant relationship with the disease (Caligaris et al., 2006). However, in Loima sub-County Kenya, there is no document that shows this socioeconomic factors association with active trachoma.

Various studies have investigated environmental factors that mediate active trachoma but still no adequate understanding of the relationship. Studies reports in various countries including Tanzania (Mahande et al., 2012; Taylor et al., 1989; Zambrano et al., 2015), Gambia(Bailey et al., 1991; Harding-Esch et al., 2008), Nigeria (Mpyet et al., 2010), Sudan (Ngondi et al., 2006)and in Amhara region of Ethiopia (Mesfin et al., 2006)shows the higher risk of active trachoma in children with flies than those without flies (Mesfin et al., 2006; Mpyet et al., 2010; Ngondi et al., 2008). However, in studies of two trials on latrine provision for fly control did not show a significant reduction in Trachoma in Gambia and Ethiopia (Stoller et al., 2011). Furthermore, a health education study in Mali showed a significant reduction in Trachoma with provision of latrine services (Hagi et al., 2010) but not in another study in Niger (Abdou et al., 2007). These studies suggest that the influence of environmental improvements on the prevention of trachoma shows mixed results. In Loima Sub-County, no report has shown the influence of environmental factors associated with active trachoma.

## 1.2 Problem Statement

In Loima sub-County, trachoma is the leading causes of visual impairment that eventually negatively affect the full life potential of both individuals and the community. Indeed the irreversible blindness caused by the trachoma in the Sub-County can be prevented if early intervention strategies are implemented. However, more focus has been on other communicable diseases such as cholera, malaria and HIV & AIDs, with trachoma receiving little attention as it continues to silently cause morbidities across the sub-County.

Despite the presence of the Surgery, Antibiotics, Face Washing, and Environmental Change (SAFE) intervention strategy projects for Trachoma control and prevention that exist in Loima Sub-County, the sustainability of high prevalence of active trachoma presents a major public health challenge. The role of trachoma control projects, local individual, demography, socio-economic and environmental factors that influence active trachoma particularly in the Sub-County have not been intensely studied, and therefore not adequately articulated despite the WHO ambitious target of eliminating Trachoma by 2020. Therefore, establishing factors associated with sustaining high prevalence of active trachoma in Loima sub-County are paramount to inform control strategies.

## 1.3 Justification of the Study

This study sought to determine factors associated with persistence of high frequencies of active Trachoma among children aged between 1-9 years, which may lead to irreversible blindness in later age in Loima sub-County.

Prevalence data on active Trachoma generated for children aged1-9 years shall provide baseline information necessary for monitoring the progress made by trachoma prevention programs in Loima sub-County aimed at achieving the WHO VISION 2020 targets.

Results from this study may provide the broadest view of the actual socioeconomic and environmental factors associated with active trachoma in Loima sub-County. This may help in developing new region specific data driven strategies for trachoma prevention programs suited for specific targets of affected population in Loima sub-County. It may also provide an understanding on the factors that are responsible for the high prevalence of active trachoma among children in Loima sub-County despite presence of SAFE intervention projects. As such, data obtained from the study forms an essential component and resource to be utilized in efforts to decrease recurrent active trachoma in children aged 1 to 9 years that may progress to cause blindness in adulthood. Data from this study shall be used to realign the effectiveness of trachoma control measures in Loima sub-County, Turkana County.

## 1.4 Objectives

### 1.4.1 Main objective

To determine the factors associated of active trachoma among children 1 year to 9 years of age in Loima sub-county, Turkana County.

### 1.4.2 Specific objectives

1. To determine the prevalence of active trachoma among 1-9 year-old children in Loima sub-County.
2. To determine the socioeconomic factors associated with active trachoma among 1-9 year-old children in Loima sub-County.
3. To determine the environmental and behavioural factors associated with active trachoma among 1-9 year-old children in Loima sub-County.

### 1.5 Research questions

1. What is the prevalence of active trachoma among 1-9 year-old children in Loima sub-County?
2. What are the socio-economic factors associated with active trachoma in children aged 1-9 years in Loima sub-County?
3. What are the environmental and behavioural factors associated with active trachoma among 1-9 year-old children in Loima sub-County?

# CHAPTER TWO: LITERATURE REVIEW

## 2.1 Introduction

This chapter presents synthesis of literature review associated with prevalence and risk factors of trachoma infection among children aged 1-9 years of age and summary of related literature.

## 2.2 Causative Agents and Life Cycle

*Chlamydia trachomatis* belonging to family Chlamydiaceae, a Gram-negative obligate intracellular bacteria is the causative agent of trachoma and inclusion conjunctivitis and urogenital infections (Mariotti et al., 2004). The bacteria is known to result in various diseases in humans. The specific ocular serotype of *C. trachomatis* responsible for causing eye infections of trachoma are serotypes A, B, Ba, and C (Satpathy et al., 2017). Serotypes D-K typically occurs in the genital tract, where they present as a sexually transmitted disease (STD) as well as pelvic inflammatory disease and tubal factor infertility(Malhotra et al., 2013).

*C. trachomatis* contains a single chromosome of ~1 Mbp that codes for 875 genes and various copies of endogenous plasmids functioning as virulence factors (Andreasen et al., 2008). *C. trachomatis* has a two phases, it consists of metabolically active, larger (~1000 nm) reticulate bodies and smaller (~300 nm) resistant and metabolically inert elementary bodies, which functions as the infective form (Andreasen et al., 2008). The organism completes its life cycle in conjunctival epithelial cells within 48 to 72 hours, with the release of 200 infective EB (Burton, 2007). The infected human eye cells are characterized by the presence of a chlamydial inclusion in the perinuclear region follicles (Mishori et al., 2012). Follicles

are collections of lymphoid tissue subjacent to the tarsal conjunctival epithelium (Mishori et al., 2012).

### 2.3 Trachoma Pathogenesis

Clinically, trachoma is sub-divided into active (early-stage) and cicatricial (late-stage) disease. Active disease is more commonly found in children and is characterized by a chronic, recurrent follicular conjunctivitis, most prominently of the upper tarsal conjunctiva(Melese et al., 2003). Intense cases are characterized by the presence of papillary hypertrophy engorgement of small vessels with surrounding oedema (Melese et al., 2003). In more severe cases, there is a pronounced inflammatory thickening of the conjunctiva that obscures the normal deep tarsal blood vessels(El Toukhy et al., 2006). During an episode of active disease, the cornea can be affected(Dawson et al., 1989). There may be minimal symptoms of ocular irritation and a slight watery discharge (Zinkernagel et al., 2007).

### 2.4 Grading of Trachoma into Clinical Stages

In 1988, the World Health Organization (WHO) adopted the simplified trachoma grading system that classifies the disease into five clinical stages used in Trachoma surveys. Trachoma grades are listed from least to the most severe (Gambhir et al., 2007; Roper & Taylor, 2009; Thylefors et al., 1987), and include: (1) trachomatous inflammation, follicular (TF), (2) trachomatous inflammation, intense (TI), (3) trachomatous scarring (TS), (4) trachomatoustrichiasis (TT), and (5) corneal opacity (CO) (figure 1). Multiple infections over time produce scarring of the conjunctiva, leading to trichiasis, a process in which the eyelashes turn inward(Rajak et al., 2012). This latter stage (trichiasis) will eventually require eye-lid surgery to alleviate eyelash-rubbing on the eye and prevent blinding from corneal opacification (Habte et al., 2008) (Figure 1).

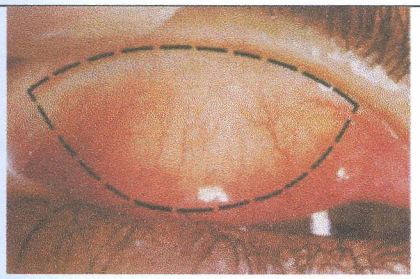
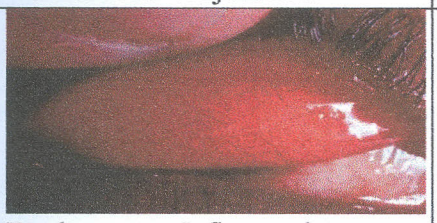
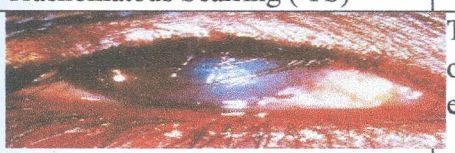
| | | |
|---|---|---|
| |  Normal tarsal conjunctiva. | **Normal Eyelid**:The eyelids and cornea are observed first for inturned eyelashes and any corneal opacity. The upper eyelid is then turned over (everted) to examine the conjunctiva over the stiffer part of the upper lid (tarsal conjunctiva). The normal conjunctiva is pink, smooth, thin and transparent. Over the whole area of the tarsal conjunctiva there are normally large deep-lying blood vessels that run vertically. |
| Grade 1 |  Trachomatous Inflammation-Follicular (TF) | **Trachomatous Inflammation-Follicular (TF):** the presence of five or more follicles in the upper tarsal conjunctiva. Follicles are around swelling that are paler than the surrounding conjunctiva, appearing white, grey or yellow. Follicles must be at least 0.5mm diameter. |
| Grade 2 |  Trachomatous Inflammation (TI) | **Trachomatous inflammation- Intense:** Pronounced inflammatory thickening of the tarsal conjunctiva that obscures more than half of the normal deep tarsal vessels. The tarsal conjunctiva appears red, rough and thickened. There are usually numerous follicles, which may be partially or totally covered by the thickened conjunctiva. |
| Grade 3 |  Trachomatous Scarring ( TS) | **Trachomatous Scarring (TS):** The presence of scarring in the tarsal conjunctiva. Scars are easily visible as white lines, band, or sheet in the tarsal conjunctiva. They are glistening and fibrous in appearances. Scarring, especially diffuse fibrosis, may obscure the tarsal blood vessels. |
| Grade 4 |  Trachomatous Trichiasis (TT) | **Trachomatous Trichiasis (TT):** At least one eyelash rubs on the eyeball. Evidence of recent removal of in-turned eyelashes should also be graded as trichiasis |
| Grade 5 |  Corneal Opacity (CO) | **Corneal Opacity (CO):** Easily visible corneal opacity over the pupil. The pupil margin is blurred viewed through the opacity. Such corneal opacities causes significant visual impairment (less than 6/18 or 0.3 vision), and therefore visual acuity should be measured if possible. |

Figure 2.1:The World Health Organization (WHO) simplified grading system for assessment of trachoma signs

(Source: from (WHO, 2004))

## 2.5 The Vector and Mode of Spread of Trachoma

The transmission of active trachoma by eye-seeking fly is not well understood since trachoma has been present in some area with very low fly density (Emerson et al., 2004). However, in trachoma endemic areas, flies are frequently seen clustering around the face and eyes of children where they feed on mucus and discharge (Last et al., 2014). The association of flies with the faces of infected children has not gone unnoticed and they have been considered as vectors of trachoma over years(Taye et al., 2007).

The mechanical vectors of the disease can pick up pathogens from infectious material and transferring them to an uninfected host. During feeding, the flies dip their hairy feet into the food sources as well as their proboscis (Nichols, 2005). These together with an inadequate water supply, inadequate disposal of human and animal waste contribute to an increase in fly population. These flies are attracted by the discharges from a dirty face and there is strong evidence implicating them, especially *Musca sorbens*, as the mechanical vectors for trachoma (Miller et al., 2004; Schemann et al., 2003; Taye et al., 2007). Thus, flies may be transferring *Chlamydia trachomatis* from the eyes of infected children to the eyes of uninfected people, on their feet and proboscis (Emerson et al., 2000). However, the transmission of trachoma is poorly understood and there are other suggested routes, which may be important in different settings and at different times.

## 2.6 Distribution of Trachoma

In the last two centuries, trachoma retreated from some formerly endemic regions, such as Europe and North America (Schachter & Dawson, 1990). This gradual change is attributed to general improvements in living standards, rather than specific interventions against the disease (Mecaskey et al., 2003). Today trachoma is prevalent in large parts of Africa, and in some regions of the Middle East, the Indian Subcontinent, South-east Asia and South

America (figure 2). In 2016, the larger part of Africa Region in which trachoma is known to be a public health problem, more than 247 000 people with trichiasis underwent operations (95% of the global total operated on for trichiasis), and nearly 83 million people in Africa were treated with antibiotics (97% of the total given antibiotics for trachoma worldwide)(Solomon & Kurylo, 2014). The highest prevalence of trachoma is reported from countries such as Ethiopia and Sudan where the prevalence of active trachoma in children is often greater than 50% and trichiasis is found in up to 5% of adults (Edwards et al., 2012; Elshafie et al., 2016; Oswald et al., 2017).

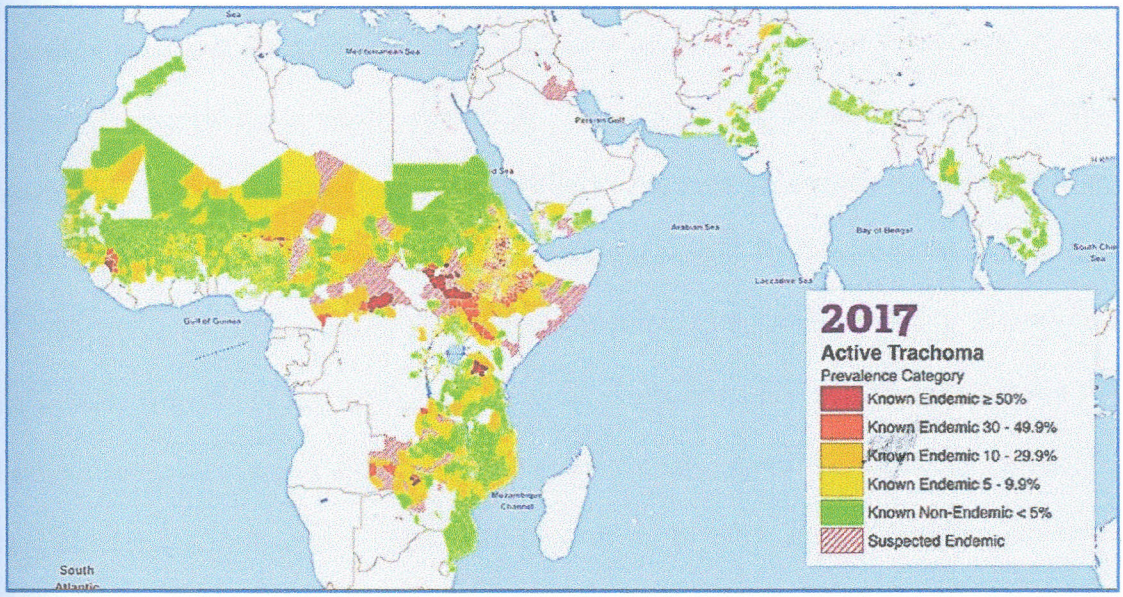



Figure 2.2: Distribution of active trachoma in Africa, 2017

Source: *trachoma atlas project (www.trachomaatlas.org)*

For many trachoma endemic countries, the socio-economic developments that might promote the disappearance of the disease are likely to be very slow in arriving, which in the light demographic trends and in the absence of effective control programmes could lead to an increase in the amount of trachoma blindness (Sanders et al., 2017).

## 2.7 Prevalence of Trachoma

Globally, more than 1 billion people reside in areas endemic for trachoma, of which more than 40 million people have the active form of trachoma while some 8.2 million individuals have trichiasis (Mariotti et al., 2009). It is estimated about 38 million cases of total blindness were attributed to trachoma. Additionally, the disease was the cause of some 110 million cases of low vision, to talling to almost 150 million cases of visual impairment (Burton & Mabey, 2009).

In South America, the upper basin of Rio situated near the Brazil-Columbian boarder represents a large area inhabited by Indians with high prevalence rates of Trachoma(Cruz et al., 2008). Unexpectedly, a nearby community, Sao Gabriel da Cachoeira (SGC), mainly composed of a diverse population presents a different situation concerning trachoma(Cruz et al., 2008). Sources suggest the scourge records high rates in the Rio Negro basin as opposed to the SGC because of poor water supply and sanitation (Stocks et al., 2014). Elsewhere, India is listed fifth out of the fifty-seven countries associated with high prevalence rates of trachoma worldwide (Burton & Mabey, 2009). The country started experiencing trachoma-related blind cases in the early 1960s with rates of up to 80%, mainly affecting children between 1 to 10 years. Thereafter, numerous interventions initiated projects to counter the disease with antibiotics (Khanduja et al., 2012). Tireless efforts in the country managed to bring down the prevalence rates of active trachoma to 5.0% (95% confidence interval 4.7-5.3%), varying from 1.5% to 9.0% among the states in children under 10 years and the magnitude of trichiasis to 0.15%(Luna et al., 2016). However, remote locations like Car-Nicobar, India still report high prevalence rates of 50.8% in children under the age of 10 years (Vashist et al., 2013).

Overall, Africa is the most affected continent with 27.8 million cases of active trachoma (68.5% of all) and 3.8 million cases of trichiasis (46.6% of all). These are located in 28 of the 46 countries in the WHO African Region, with an estimated population of 279 million living in endemic areas (Mariotti et al., 2009). The highest prevalence of trachoma is reported from Ethiopia and Sudan, where active trachoma is often found in more than 50% of children below 10 years, and trichiasis is found in up to 19% of adults (Abashawl et al., 2016; Adamu et al., 2016; Adera et al., 2016; Edwards et al., 2012; Elshafie et al., 2016). These countries have the disease distributed in a focal manner featuring predominantly in some households and communities (Habtamu et al., 2015; Ssemanda et al., 2015). Further, the disease has close association with low standards of living. More than 90% of trachoma cases come from rural areas of countries.

Further, Ethiopia's blindness prevalence, which stands at 1.5%, emanates from trachoma as the leading cause followed by cataracts. This means that most of the people affected by blindness in the country suffer their predicament due to trachoma (Alemayehu et al., 2015). Gambia presents a perfect case of a country in Africa affected by trachoma, where corneal opacities resulting from trachoma caused blindness. The disease remained mesoendemic in the country until recently when several initiatives targeted their efforts towards the scourge (Quicke et al., 2013). In Nigeria, the Kano State presents data that shows a high prevalence of trachoma and trichiasis (Mpyet et al., 2012). Based on data from a recent survey, the prevalence rates stand at 17.5% among children under the age of 10 years. Additionally, the area records a very high backlog of surgeries intended to save adults from the scourge (Mpyet et al., 2012).

In Kenya, few studies have been conducted on trachoma prevalence. Surveys done in 6 counties including West Pokot, Narok, Kajiado, Marsabit, Samburu and Turkana. The

prevalence of active trachoma was 35.0% (95% CI: 29.5% - 40.3%) in Samburu, 30.5% (95% CI: 25.6 – 35.8%) in Narok , 28.1% (95% CI: 23.1% – 33.6%) in Baringo, West Pokot 26.6% ((95% CI: 21.7% – 32.3%) in West Pokot and 42.3% (95% CI: 39% – 45.3%)in Turkana (figure 3) (Karimurio and Rono, 2010; Karimurio et al., 2006).

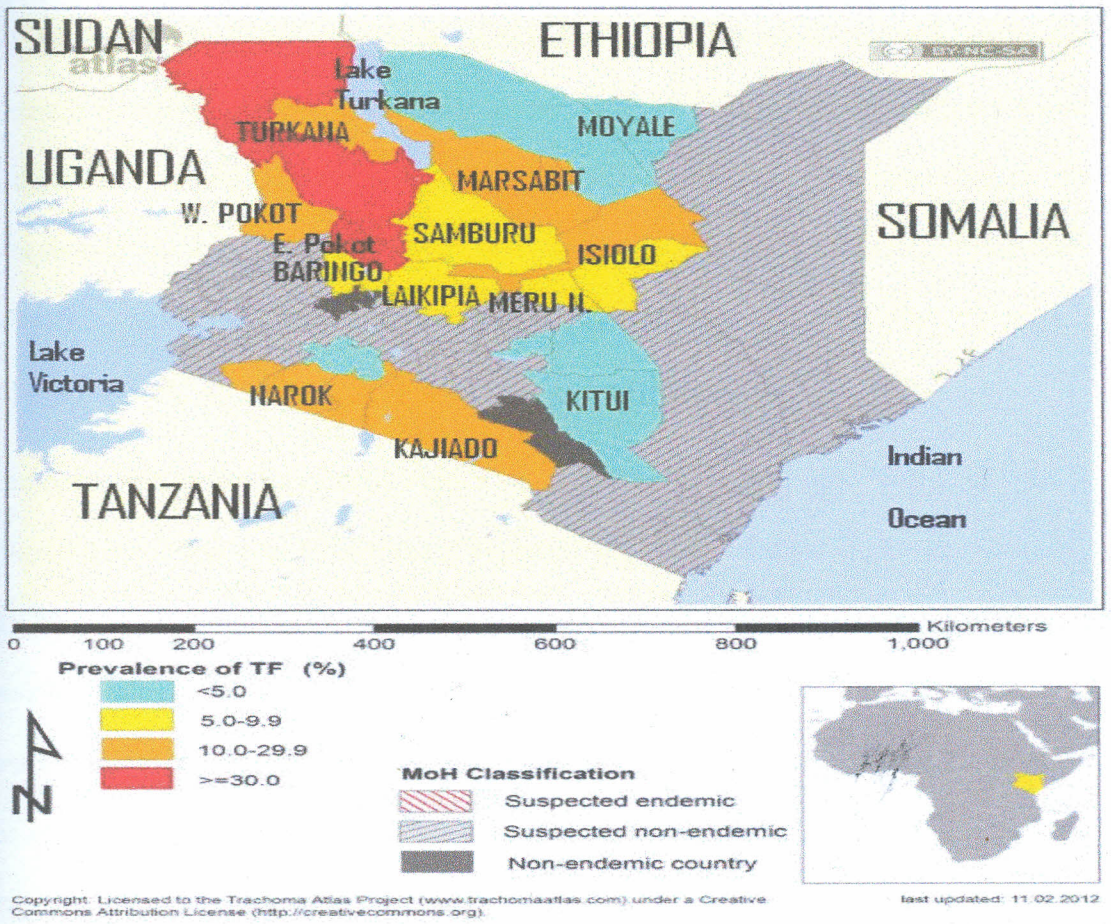



Figure 2.3: Prevalence of active trachoma in Kenya

Source: http://www.trachomaatlas.org, 2012.

This was above the WHO threshold, which declares an active trachoma is a County wide public health problem when the prevalence is above 10% of children 1-9 years (Solomon et al., 2006).

## 2.8 Socio Economic Factors Associated with Trachoma

Socioeconomic status is one of the most powerful risk factors for poor health outcomes. Persons of lower socioeconomic status suffer disproportionately from nearly all diseases and have higher rates of mortality than people of higher socioeconomic status (Stoever & Kim, 2007). However, the evidence base for a relationship between socioeconomic status and trachoma is mixed. For instance, trachoma severity was found to be significantly associated with thatch roof households and absence of electricity in Ethiopia (two indicators of low socioeconomic status) (Adera et al., 2016; Oswald et al., 2017). Further, living in a wood/earth home during childbearing years (also linked with low socioeconomic status) was found to be associated with trichiasis in Tanzania (Ngondi et al., 2008).

In contrast, in Sao Paulo, Brazil neither income nor socioeconomic status showed a significant relationship with the disease (Caligaris et al., 2006; Ferraz et al., 2010; Macharelli et al., 2013). In Amhara Ethiopia, the study found no association between trachoma and household ownership (Anteneh & Getu, 2016; Ngondi et al., 2008). However, there is evidence of a correlation between lower levels of trachoma and higher educational attainment (Luna et al., 1992; Regassa & Teshome, 2004). Further, one study found that illiteracy and poverty were associated with the development of trichiasis (Bogale et al., 2002). It is possible that, within apparently homogeneous communities, the individuals who are most vulnerable to developing the blinding complications of trachoma are the poorest members of the poorest communities, although this has not been adequately investigated (Jansen et al., 2007). In Loima sub-County, there is no document that shows this socioeconomic factors association with active trachoma.

Trachoma remains prevalent in developing and marginalised communities, particularly in Africa, where crowded living conditions are common and access to clean water, sanitation and health care are often limited (Emerson et al., 2000; Taylor et al., 2014; Wright et al., 2007). A study in Tanzania revealed that overcrowding of household members (low economic status) as well as flies posed high risks for the transmission of trachoma (Harding-Esch et al., 2010). The study also shown the high prevalence area with trachoma have associated socioeconomic issues affected individuals presenting poor housing, little or no formal education, and insufficient supplies of water (Harding-Esch et al., 2010).

In Baso Liben, a district in Ethiopia, the statistics of children under 10 year with active trachoma exceeds the guidelines laid out by WHO for antibiotic interventions (Ketema et al., 2012). Socioeconomic factors associated with the scourge in the Ethiopian district include low education, no latrines, lack of soap, and a low socioeconomic status (Ketema et al., 2012). Additionally, the children in the area have a high density of facial flies and unwashed faces, influencing the rate of trachoma in the region. Moreover, studies have found high rates of trachoma in low lands than middle and high lands (Alemayehu et al., 2015). However in Kenya, there is no direct research or data that formally quantifies the relationship between trachoma and economic poverty.

**2.9 Environmental Factors Associated with Trachoma**

Environmental sanitation is a package of measures aimed at eliminating factors that encourage proliferation of flies and the spread of the disease (Mathew et al., 2009; Pruss & Mariotti, 2000). However, studies on the influence of environmental improvements on the prevention of trachoma are sparse and what is available has shown mixed results. In a systematic review of various studies on environmental sanitary interventions in relation with trachoma (Hu et al., 2010), results showed that two trials on latrine provision for fly control did not show a significant reduction in Trachoma in Gambia and Ethiopia (Stoller et al.,

2011). A health education study in Mali showed a significant reduction in Trachoma (Resnikoff et al., 1995) but not in another study in Niger (Abdou et al., 2007). Most of the studies record a very low figure of amount of water consumed per capita in endemic regions. In Malawi, the presence of a dirty face was strongly associated with trachoma, as was the presence of flies on the child's face Trachoma prevalence increased with distance to a water source (Hagi et al., 2010). The disease prevalence decreased with a higher frequency of both face washing and bathing. The households that rarely use soap to clean their faces, after visiting the toilet, and other sanitation issues had higher likely chance of infection with active trachoma (Hagi et al., 2010).

In addition, previous studies have reported a strong association between distances to water sources and trachoma among children (Polack et al., 2006). In fact, in Mali, availability of water and use of water for hygiene practices such as washing face and hand washing was reported to reduce the prevalence of active trachoma (Hagi et al., 2010). In contrast, other studies have reported a lack of association between a distance to the water source or presence of water source in a village and endemicity of trachoma (Emerson, et al., 2000; Taylor et al., 1989).However, environment may vary between settings, hence there is need to identify environmental factors associated with active trachoma in specific geographical settings. In spite of this, no studies have been done on environmental determinants that are associated with active trachoma in Loima sub-County, Turkana County.

### 2.10 Prevention and Treatment Strategies of Trachoma

The World Health Organization (WHO) has evolved measures for the control of trachoma. These include tertiary prevention (surgery), secondary prevention (antibiotic treatment of infection), and primary prevention (facial hygiene and environmental change to improve sanitation) (Satpathy et al., 2017). This is known as the SAFE strategy where S stand for

early lid surgery, A for antibiotics, and F for facial cleanliness and E for environmental hygiene. The application of these measures has reduced the problem of trachoma in some countries significantly (Frick et al., 2003).

Also the WHO in association with non-governmental organizations (NGOs) established an alliance for the Global Elimination of Trachoma by year 2020 known as "GET 2020" (Halm, 2014). The main goal of the alliance was to ensure that trachoma would cease to be a disease of public health importance by year 2020, the strategy for such realization includes identification into the primary health care system. This will involve community involvement on health and health related interventions, which includes water supply, education, and sanitation. The assistance of the NGOS is important in view of the fact that most affected countries are poor developing countries with competing health priorities(Emerson, 2014). This effort is part of World Health Organizations large program for prevention of easily curable and treatable blinding conditions. The programme places special emphasis on cataract surgery, trachoma, onchocerciasis, vitamin A deficiency, glaucoma and childhood blindness, and all these constitute the goal for VISION 2020.

Surgery, for those who have trichiasis is to prevent blindness (West et al., 2005). The principle for surgery in these conditions involves rotating the marginal part of the eyelid outwards, away from the globe, so that the lashes are no longer in contact with eye. Various methods to achieve this have been described, including the Trabut's method (Schemann & Sacko, 1998). The bilamellar tarsal rotation is the procedure recommended by the WHO since a randomized controlled trial showed it to be the most effective (El Toukhy et al., 2006). Surgery is the component of SAFE that has been shown to contribute significantly to prevention of blindness. It also results in immediate and dramatic relief of discomfort for the patient. For this reason, it is the first component of the SAFE strategy. It should be performed

in the community as a way of gaining support for other elements of SAFE, which may not be seen to have such an immediate and obvious benefit (Emersonet al., 2000). Antibiotics are used in the treatment of inflammatory trachoma, which usually clusters in the community in the eyes of children and adults especially women. Various antibiotics have been tried and are being used. In the GET 2020 strategy, the pilot program is currently using Azithromycin (Burton et al., 2002). The Tetracycline ointment and Azithromycin tablets are the commonly used drugs in the treatment of active trachoma (Bowman et al., 2000). Azithromycin tablet and tetracycline eye ointment are used in community treatment of trachoma. Antibiotic distribution is community based. Patients are taught the proper technique for administration of topical drugs, or in the case of Azithromycin, ingestion is supervised (Amza et al., 2017). Where trachoma is hyper endemic this antibiotic distribution can be piggy backed to National Programme on Immunization (NPI) or in onchocerciasis endemic areas to Community Directed Treatment with Ivermectin (CDTI) programmed(Etya'ale, 2008).Age groups targeted for the antibiotic distribution are children ages 1-15 years. Facial hygiene in SAFE is a primary preventive measure. This is tied with the availability of water in the community (Stocks et al., 2014). Children's faces are the sources and sites of re infection with the organism, Chlamydia trachomatis, which causes the disease (Stocks et al., 2014). Increased water availability means that faces can be cleaned more thoroughly and frequently thus breaking the cycle of infection (Stocks et al., 2014).

Environmental changes have now more than ever before been found to be very important in primary prevention of trachoma (Pruss & Mariotti, 2000). The environmental change that followed development in the western world is responsible for the absence of trachoma in those areas (Stocks et al., 2014). Recent studies have also shown the impact of provision of water for improved sanitation, provision of latrines, and their use, control of flies and indiscriminate disposal of waste (human, animal or material), on trachoma prevalence. In an

Egyptian study the presence of pit latrines in all houses resulted in a reduction in trachoma prevalence in the population from 49% to 35%. The construction of pit latrines may offer the simplest and most acceptable environmental method for reducing trachoma in endemic areas (Travers et al., 2013). The elimination of cattle pollution has been shown to reduce the prevalence of severe trachoma in a study in Ethiopia (Oswald et al., 2017). Some have suggested that the E should include not just environmental change but education and economic development, perhaps SAFE with three Es(King et al., 2011).

### 2.11 The Conceptual Framework

The conceptual framework represents a relationship between varied factors and active trachoma among 1-9 year-old children in Loima sub-county. Figure 4 below shows the relationships of the independent and dependent variables that were investigated in the study.

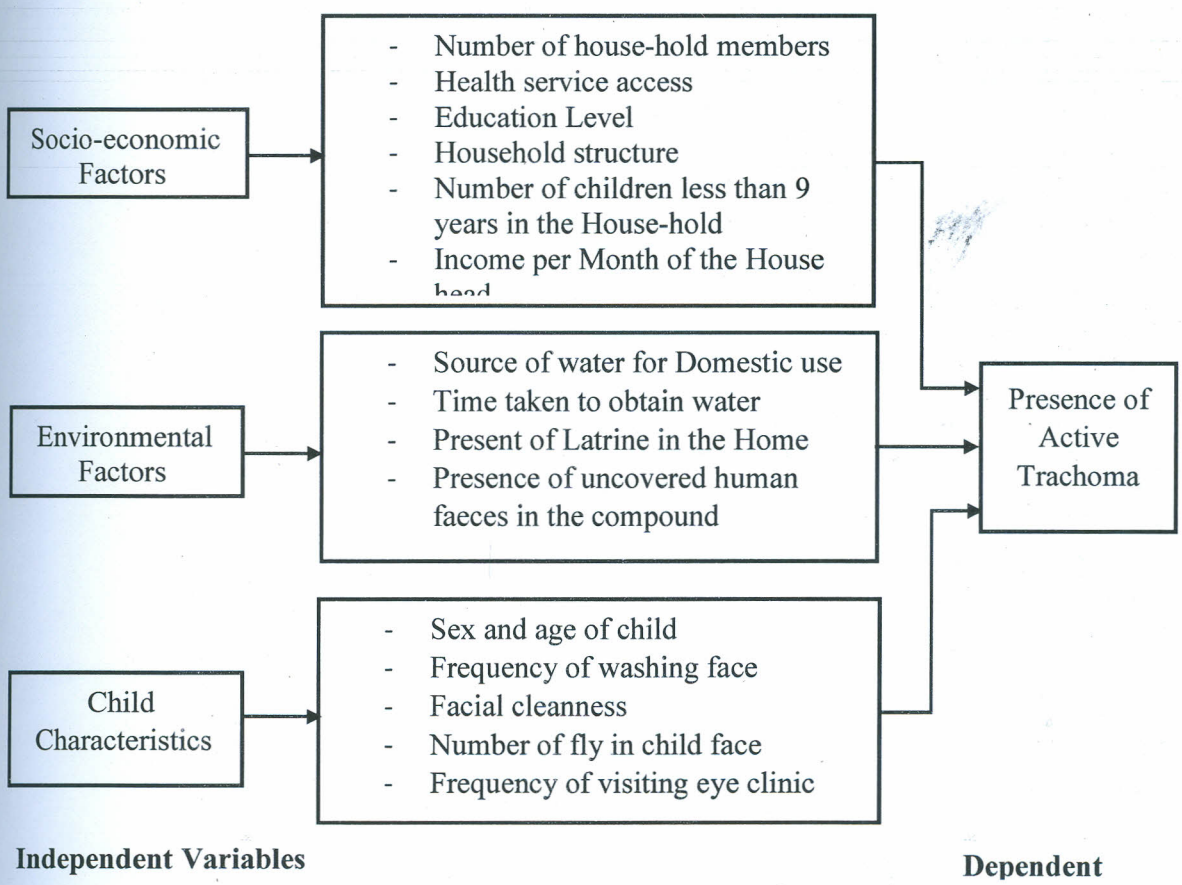



Figure 2.4: Conceptual Framework

The independent variables that may be related to active trachoma include: Demographic, social-economic and environmental factors. In addition, child characteristics, including gender and age may predispose them to active Trachoma. This independent variables may alter the prevalence of active trachoma, either increasing or decreasing the frequency, thus the dependent variables include prevalence of trachoma.

# CHAPTER THREE: METHODOLOGY

## 3.1 Study Site

The present study was conducted in Loima sub-county, one of the six sub-counties in Turkana County (figure 5). It previously formed part of the former Turkana Central District before its sub-division into two sub-Counties resulting in present day Turkana Central and Loima Counties, with Lorugum town as its Headquarters. It has a total coverage area of 8,914.8Km². The sub-County lies between longitudes 34° 30' and 35° 30' East and between Latitudes 2° 30' and 3°30' North. It comprises of two divisions, seven locations and twenty six sub-locations (Table 3.1).

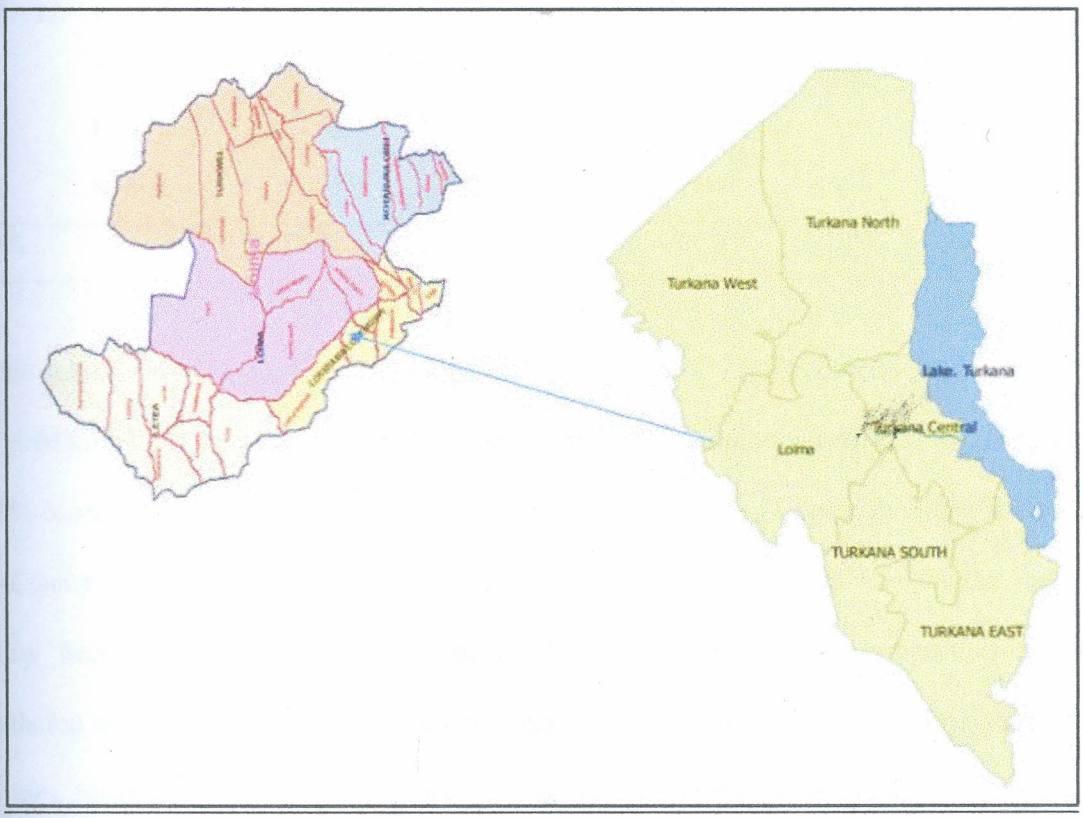



Figure 3.1: Turkana Map with Loima sub-Location

Source: (Google Map, 2016)

**Table 3.1: Size of the sub-County by Division, Location, Sub-location, Population andProportion of House-Hold Members**

Source: Sub-County Development Office, Loima.

| | | | | | | Proportion of House-Hold Members | | | |
|---|---|---|---|---|---|---|---|---|---|
| **DIVISION** | **Location** | **Area (KM²)** | **Sub-Location (n)** | **No. of Household** | **Total population** | **0-9yrs population** | **0-3** | **4-6** | **>7** |
| **LOIMA** | Loima | 2,119.10 | 4 | 2259 | 19848 | 10399 | 4.6 | 27.7 | 67.7 |
| | Lorenngippi | 617.7 | 5 | 3987 | 31622 | 5203 | 6.4 | 28.4 | 65.1 |
| | Lokiriama | 692.2 | 3 | 2713 | 21044 | 5900 | 4.9 | 26.5 | 68.5 |
| **TURKWEL** | Lorugum | 1,612.50 | 4 | 2156 | 20378 | 644 | 5.4 | 29.1 | 65.4 |
| | Nadapal | 1,250.30 | 4 | 1692 | 5687 | 179 | 7.1 | 32.4 | 60.5 |
| | Lomeyan | 1,934.70 | 3 | 1578 | 14691 | 464 | 4.6 | 28.4 | 67.0 |
| | Kotruk | 688.4 | 3 | 1357 | 7914 | 250 | 6.1 | 26.6 | 67.3 |
| **TOTAL** | 7 | 8,914.20 | 26 | 15742 | 121184 | 23039 | 5.6 | 28.4 | 65.9 |

Loima sub-County has an approximate human population of 120,000people, of whom 19% are children below 10 years of age. The sub-county has the highest incidence of poverty at 96.9% based on the constituency mountain of poverty. There are 11 heath facilities in Loima sub-County and 4 mobile outreach dispensaries. The average distance to nearest health facility from homesteads is approximately 40-50 km, with a larger proportion of the population walking long distances to access health services. In addition, poor infrastructural facilities, insufficient water for livestock and human use, livestock diseases, poor livestock marketing infrastructure and systems, high dependency tendencies and environmental degradation are other constraints faced by populations in Loima sub-County(Waila et al., 2017).

The sub-County is classified as arid and semi-land (ASAL) and experiences prolonged spells of inadequate water supply and limited access(Opiyo et al., 2015)The rainfall pattern and distribution is low, erratic, unreliable and unpredictable both in timing and distribution, averaging between 100 mm to 500 mm per annum(Moso et al, 2016). Most of the precipitation runs off through the myriad of seasonal streams and rivers that drain the highlands that surrounds the sub-Counties. As result, people walk long distances to collect water from rivers and streams. In areas where water exists, it is likely to be contaminated through common use by both humans and animals. The scarcity and low quality of water influences the level of health status in many households owing to poor sanitation and hygiene practices, especially those related to excreta disposal and hand washing.

### 3.2 Study Design

A community based cross sectional study that employed quantitative techniques and was conducted on children aged 1-9 years between August 2016 and September 2016.Quantitative approach employed structured administered questionnaire. The study involved comparisons of prevalence of active Trachoma and investigated its association with social-economic and environmental factors.

### 3.3 Study Population

All children aged between 1to 9 years at home with their parents or guardians were considered eligible for study on active trachoma (TF). In addition, household related factors were obtained for every child who participated in the study.

#### 3.3.1 Inclusion Criteria

Any child aged 1-9 years at home with parent or guardian who provided informed consent. In addition, mothers and/or caregivers who had lived in Loima Sub-County for at least past six months before the initiation of the study were included.

### 3.3.2 Exclusion Criteria

Any child aged less than 1 year or greater than 10 years was excluded. Parents whose age was below 18 years could provide consent for their children to participate in the study. However, if the under 18-years parents had no adult (parents or legal guardians) to consent for them to participate in the study, they were excluded from enrollment. Mothers or caregivers who failed to provide informed consent to be interviewed were also excluded from the study.

### 3.4 Sample Size Determination

A sample size is the approximate minimum number of persons that should be selected and examined in a study (Biau et al., 2008). The sample size calculation formula recommended by the WHO guide (*Equation 1*) was used to estimate all the samples in this study (Solomon AW, 2006).

$$= e\frac{d^2 \times b(1-b)}{c^2}$$

b = estimate of prevalence of trachoma between 1 to 9 years children is 38% based on the study done in all Turkana County (Kamurio & Rono, 2010)

c = Absolute precision = 0.076 (20% of prevalence)

d = a standardized normal deviate value that correspond to a level of statistical significance equal to 0.96 (96%)

e = Design effect = 3



$$= 3\frac{1.96^2 \times 0.38(1-0.38)}{0.076^2}$$

$$= 3\frac{1.96^2 \times 0.38(0.62)}{0.076^2}$$

$$= 470$$

Non-response rate = 10% of N = 10/100*470 = 47, the minimal sample size 470+47 =517.Therefore, the study required at least 517 samples to achieve sufficient power to detect

differences between the dependent and independent variables when they truly existed. However, in order to attain the desired sample size through cluster-sampling method, households were randomly selected from 13 sub-Location in Lioma County, accounting for proportional distribution based on the number of households in each sub-Location. As such, **520** children aged 1-9 years were recruited into the study after consents were obtained from parents and/or legal guardians.

### 3. 5 Sampling Procedure

The study employed a two-stage cluster-sampling technique procedure to determine the sample size, selected by stages and sampling units at each stage being sub-sampled from the (larger) units chosen at the previous stage(Murphy, 2008). Selections were made with the assistance of Sub-County Administrator, village and sub-village heads.

Specifically, random sampling was conducted in which four Locations namely Loringippi, Lokiriama, Lorugum and Lomeyan were selected in Loima Sub-County (figure 6). Step two involved selection of 13 sub-Locations from identified Locations, where three were from Loringippi, four from Lokiriama, three Lorugum and three from Lomeyan. Finally, random sampling was used to select households with children aged 1-9 years proportionally identified from the 13 sub-Locations (figure 6).

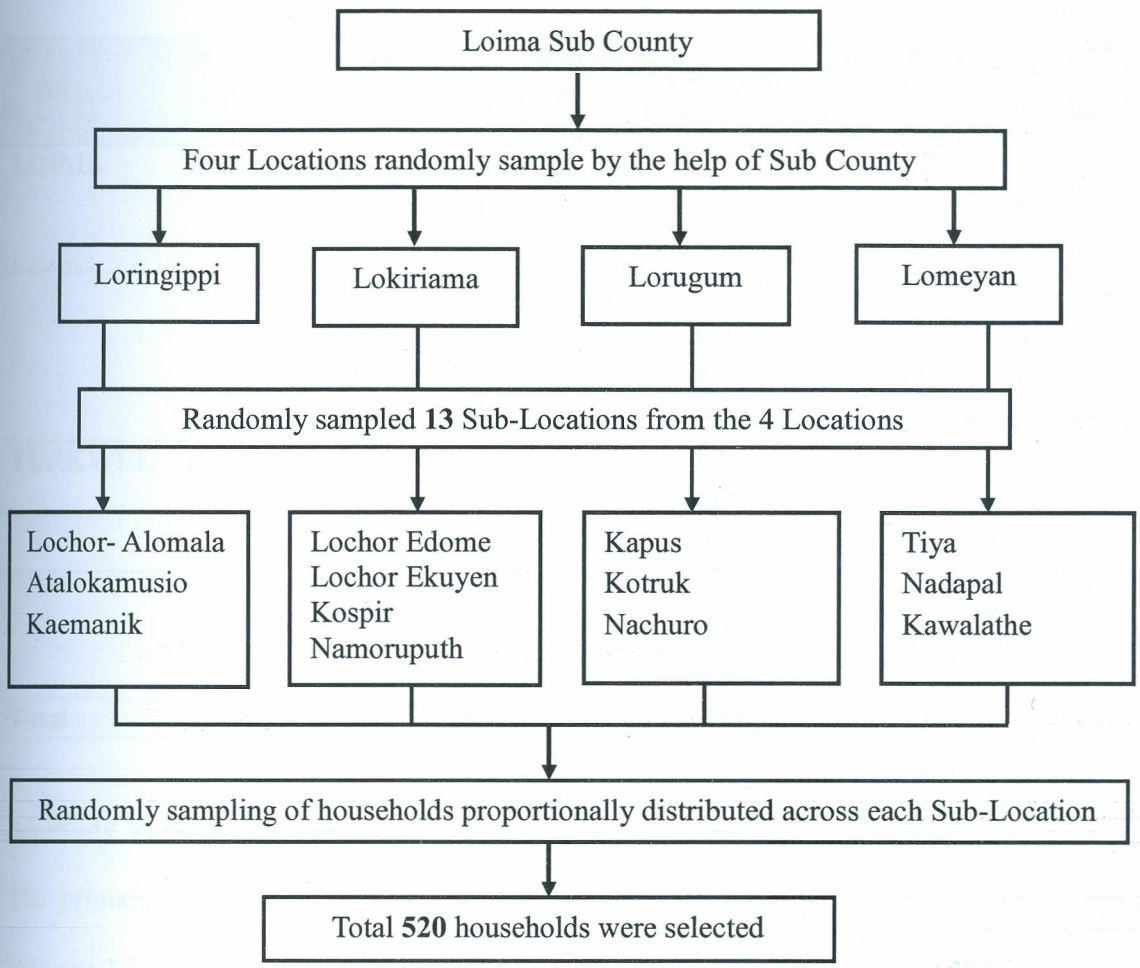



Figure 3.2: Cluster sampling steps in Loima Sub County

The sample was then proportionately distributed across the 13 sub-Locations as shown in Table 3.2below.

**Table 3.2: Proportional Distribution of Samples of Participating Households**

| Division | Location | Sub-Location | Number of Households | Proportion of Households | Selected Households |
|---|---|---|---|---|---|
| LOIMA | Lorengippi | Lochor- Alomala | 467 | 6.20% | 32 |
| | | Atalokamusio | 574 | 7.62% | 40 |
| | | Kaemanik | 520 | 6.90% | 36 |
| | Lokiriama | Lochor Edome | 631 | 8.38% | 44 |
| | | Lochor Ekuyen | 583 | 7.74% | 40 |
| | | Kospir | 605 | 8.03% | 41 |
| | | Namoruputh | 894 | 11.87% | 62 |
| TURKWEL | Lorugum | Kapus | 794 | 10.54% | 54 |
| | | Kotruk | 387 | 5.14% | 27 |
| | | Nachuro | 500 | 6.64% | 35 |
| | Lomeyan | Tiya | 498 | 6.61% | 34 |
| | | Nadapal | 532 | 7.06% | 36 |
| | | Kawalathe | 548 | 7.27% | 39 |
| **Total** | **4** | **13** | **7,533** | **100%** | **520** |

### 3.6 Study Variables

The primary outcome of interest was the presence of active trachoma in children aged between 1-9 years recruited from sampled households.

Review of previous studies (Adera et al., 2016; Bogale et al., 2002; Hagi et al., 2010; Harding-Esch et al., 2010; Hu et al., 2010; Ngondi et al., 2008; Oswald et al., 2017; Pruss & Mariotti, 2000; Stocks et al., 2014; Travers et al., 2013) showed the following independent variables were appropriate for this study; Social-economic factors that were assessed using the following variables; number of household members, Access to health services, level of household head education, the structure of the house, number of children below 9 years in a household and monthly income of the household head. Environmental factors were evaluated using these variables; source of water for domestic use, time taken to fetch water, presence of a latrine in the homestead, presence of uncovered human faeces in the homestead. Child

characteristics variables included gender, age, facial cleanness and presence of houseflies on child's face.

### 3.7 Data Collection Methods

#### 3.7.1 Data Collection Tools

Data were collected by face to face interview and observations and recorded on a structured and pretested questionnaires (Appendix IIA and IIB). As such, child characteristics, social-economic factors and environmental factors were recorded on structured questionnaires. Information on the cleanliness of compounds, presence of latrines in compounds, uncovered human waste, presence of flies in compounds and on children's faces, animals and distances of their shades from houses were collected through observation and recorded. Cases of active Trachoma were detected through clinical examination of children's eyes as described below.

The questionnaire was translated to a local language (Ngiturkana) spoken by a larger proportion of the target population before administration. A team of six individuals: the principle investigator, four assistants trained on basic research and one qualified ophthalmic nurse were involved in data collection.

#### 3.7.2 Validity and Reliability of Data Collection Tools

To ensure the validity and reliability of the research questionnaire, the translated questionnaire was reviewed by Ngiturkana expert to check for appropriateness of the wording of the questions and whether the meaning of the questions remained the same after the translation. In addition, upon obtaining permission from Chiefs/elders and consents from participating heads of households, a pre-test was conducted on 10% (of the total sample size) of non-participating households and use the revised questionnaire for final data collection. Recommended revisions were done based on the feedback received from the expert and a

pilot study results. Recommended revisions included: 1). correction of typographical errors in the questionnaire, 2). rephrasing of a number of questions and 3). Changes in the flow of questions. These recommendations from the pilot study and feedback from supervisors were included in the final questionnaire.

### 3.7.3 Quantitative Data Collection

As indicated above, face to face interviews were conducted for participating households and their children. The questionnaires were administered in the local language of the participants. Following sampling of participating households, appointments were made with the household heads and/or mothers of children aged 1-9 years, with the approval of village and sub-village heads. Interviews were conducted in the respondent's homesteads. The household heads or mothers of target children were the main respondents in the study. Before interviews were initiated, the respondents were briefed on the intent of the home visit and their permission to proceed with the study procedure was sought. If granted, the research team initiated the consenting process, first by explaining the purpose of the study, describing the of sets activities that would be conducted. Second, consenting was sought from respondents after detailed explanation of their rights to participate or not participate in the study, benefits and risks, their information confidentiality and assurance that the study was purely voluntary. Further, consent was sought for their children to participate in the study.

Upon consenting, interviews were then conducted, with respondents providing answers to the questions asked by the research team, and recorded on the questionnaires. All interviews were conducted in the local dialect (Ngiturkana) to ensure full comprehension of the questions asked and therefore guarantee appropriate responses. Interviews lasted about 40 minutes per respondent.

### 3.7.4 Clinical Assessment of Active Trachoma

Following the face to face data collection interview, examination of the children enrolled in the study was performed by a qualified ophthalmic nurse using binocular loupes (x2.5) and torch. Each eye was examined and assessed separately. First eyes were examined for any signs of watery discharge and/or swollen eyelids. Further, children were asked if eyes were painful and/or whether they were itchy. Second, the presence of in-turned lashes, signifying trachomatous trichiasis (TT) was examined and was recorded. Observation of five or more follicles in the upper tarsal conjunctiva (follicles at least 0.5 mm in diameter) were considered to indicate presence of active trachoma (Trachomatous inflammation follicular, TF).Clinical examination data was recorded in the appropriate section of the questionnaire (Appendices IIA and IIB).

## 3.8 Data Management and Statistical Analysis

### 3.8.1 Data Entry and Storage

After completing data collection, the questionnaires were checked for completeness and accuracy. Data was entered in Microsoft Excel sheet, cleaned and coded and exported to the Statistical Package for Social Scientists (SPSS) for analysis. The database was password protected and secured on a password protected laptop computer, which was safely stored by the principal investigator. The questionnaires containing the data were subsequently stored safely in locked cabinets by the principal investigator for any future reference.

### 3.8.2 Data Analysis

Data analyses were conducted using SPSS, version 20 (IBM SPSS Inc., New York, USA). Pearson's Chi-square test was used to compare distribution of test variables (including social-economic, environmental and child factors) between children with active Trachoma versus those without Trachoma. The association between the dependent variable (presence of active

Trachoma) and independent variables (social-economic, environmental and child factors) was determined using a binary logistic regression model that determined the odds ratio (OR) at a 95% confidence interval (CI). Logistic regression was therefore done to generate OR as an indicator of the likelihood of a child having active Trachoma as a function of the predisposing factors (social-economic, environmental and child factors) at 95% CI. Only variables found to present significant differences in proportions between children with active trachoma versus those without trachoma were included in the model. All results were considered significant at $\alpha = 0.05$. Findings are presented in tables.

### 3.9 Ethical Consideration

#### 3.9.1 Ethics Approval

Ethical approval was sought from the Maseno University Ethics Review Committee and permission to carry out the study obtained from School of Graduate Studies (SGS). The study was conducted with the permission of District Officer, chiefs, elders and heads of participating households.

Before commencement of the study, the consent forms and questionnaires were translated into Ng'iturkana. The principal investigator and his research team conducted meetings with local leaders and communities in all selected location during which the objectives of the study, including procedures to be followed was explained.

#### 3.9.2 Participants Consents

During the research process, participant read the consent forms before they signed. For those who would not read and write, oral explanations were conducted before fingerprints or marks were placed on the consent form (appendix 1). Respondents were informed that no harm or pain would be inflicted on them during the research process since there was no invasive procedures. Further, respondent right not participate or to withdraw from the study at any

point as they wished was explained. Respondents were informed that participation in the study was voluntary. In addition, all respondents were also informed not to write their name or initials on them for anonymity. The information collected was treated confidential by data entered into a password-protected personal computer.

### 3.9.3 Potential Risks and Benefits to Study Participants

The study entailed eye examinations of the children who participated. There was no harm or pain that was inflicted on the children during the examination process since there was no invasive procedures. No laboratory examinations was done. No medicines were used during examination.

Children found to be positive for active Trachoma referred to the nearest health facility for appropriate management and treatment. The principle investigator arranged such referrals with the heads of health facilities that provided support and treatment.

### 3.9.4 Study Limitations

This study was primarily limited to a time frame required to collect data because most parents and children were available in the house only in the evening. This was be minimized by increasing the number of research assistants as well as proper training on the data collection to maximize evening hours data collection.

Data collection was done at house hold level. This might be the cause of biases in answering some of the questions due to fear of disclosure of information given by respondent to research assistants. This was minimised by interviewing these respondent on a private place whereby a high degree of privacy was observed. The study was also limited to poor roads and insecurity in Loima region near Uganda border. The research team sought services of security guards and four wheel vehicles.

### 3.9.5 Plan for Data Dissemination and Utilization

The research report was disseminated to key authorities closely associated with the study. These include Turkana County Health Minister's office, Office of the County Director of health, and County Health Management Team. The intention behind such wide dissemination was to acknowledge their involvement and share the study findings and recommendations with the public through them, with a view to explore possibilities for the implementation of key recommendations, and for further necessary research and references by other researchers in future. The feedback to the study population was conducted in the form of dissemination 'baraza' meetings where all members of the target community were invited to attend.

## CHAPTER FOUR: RESULTS

### 4.1 Prevalence of active trachoma in Loima Sub-County, Turkana County, Kenya

The prevalence of active trachoma in Loima Sub-County, Turkana County, Kenya, is presented in table 1. A total of 520 children aged 1-9 years were physically examined for active trachoma using the WHO grading system (specifically grade 1). Those who showed signs of watery discharge, painful eyes, swollen eyelids, itching eyes and follicles were classified as having the disease. The signs of active trachoma were observed in children 1–9 years of age regardless of gender. Those who did not show the above symptoms were classified as free of disease. Out of the 520 children examined, 284(54.6%) were classified as having active trachoma (Table 4.1). In addition, out of the 266 children aged between 1 and 5 years in the study, 82 (30.8 %) had active trachoma. Similarity, from the 254 children aged between 6 and 9 years who participated in the study, 202 (79.5 %) had active trachoma. In addition, among the children presenting with active trachoma, 80 (50.6%) were male and 204 (56.4%) female (Table 4.1).

**Table 4.1: Prevalence of Active Trachoma in Loima Sub-County, Turkana County, Kenya**

| Category | Number (%) |
|---|---|
| **Presence of active trachoma** | |
| Yes | 284(54.6 %) |
| No | 236(45.4 %) |
| **Ageof children with active trachoma** | |
| 1≤5 | 82 (30.8 %) |
| 6≤9 | 202 (79.5 %) |
| **Gender of children with active trachoma** | |
| Male | 80 (50.6%) |
| Female | 204 (56.4%) |

Data are presented as absolute number and proportions of study participants. Descriptive statistics like percentage was used to present of prevalence of active trachoma. Abbreviation: ≤ - less than or equal to.

### 4.2 Socio-Demographic Characteristics of the Household Participants in Loima Sub-County, Turkana County, Kenya

As shown in Table 4.2, the distribution of the number of family sizes differed significantly between households presenting with children with active trachoma versus those without ($P$=0.001). Households with a family size > 5 had more children with active trachoma (90.8%) than those without trachoma (80.5%). Further, there were fewer households with children with active trachoma in family sizes ≤5 (9.2%) compared to those without trachoma (19.5%). All (100%) heads of households of children in the trachoma-infected group and uninfected group were unemployed with no formal education. The monthly income for the heads of house were comparable between the groups ($P$=0.120).A large proportion of households of participating children lived in temporary (*Manyatta*) houses (86.7% for those with trachoma and 87.8% for households without trachoma). Semi-permanent structures were occupied by 13.5% of households with children presenting with trachoma and 12.1% among children without trachoma. No permanent structures were recorded among participating households.

**Table 4.2: Socio-Demographic Characteristics of the Household Participants in Loima Sub-County, Turkana County, Kenya**

| Characteristics | Presence of Active Trachoma | | *P* Value |
|---|---|---|---|
| | Yes (n=284) | No (n=236) | |
| **Family Size** | | | |
| ≤5 | 26 (9.2) | 46 (19.5) | **0.001** |
| >5 | 258 (90.8) | 190 (80.5) | |
| **Occupation of Head of House** | | | |
| Unemployed | 284 (100.0) | 236 (100.0) | - |
| Employed | 0 (0.0) | 0 (0.0) | |
| **Monthly Income of Head of House (KSHs.)** | | | |
| ≤10,000 | 279 (98.2) | 222 (94.1) | 0.120 |
| >10,000 | 5 (1.8) | 14 (5.9) | |
| **House Structure** | | | |
| Temporary(*Manyatta*) | 256 (86.7%) | 188(87.8%) | **0.005** |
| Semi-permanent | 40 (13.5%) | 26(12.1%) | |
| **Education Status** | | | |
| Secondary or College | 0(0.0) | 0(0.0) | |
| Primary | 0(0.0) | 0(0.0) | - |
| None | 284 (100.0) | 236 (100.0) | |

Data are presented as number and proportions (%) of subjects, unless otherwise indicated. Significant Pvalues are indicated in bold.

### 4.3 Socio-Demographic Characteristics of Participating Children in Loima Sub-County, Turkana County, Kenya

Children (n=520), one from each selected household, were recruited in to this study. As shown previously, 284 (54.6%) children were found with active trachoma, and 236 (45.4%) children were uninfected. The distribution of children based on age group differed significantly ($P<0.001$) between the study groups (Table 4.3). There was a significantly larger proportion of children with active trachoma (71.1%) in the age group 6 to 9years compared to those without trachoma. Similarly, a larger proportion (78%) of children without trachoma were aged between 1 to 5 years (Table 4.3). However, the distribution of children based on gender were comparable between those with and without trachoma ($P=0.228$). The number of children less than 9 years in the household, categorized into those with only 1

child versus households with 2 or more children, did not differ significantly household with or without active trachoma (*P*=0.119).

**Table 4.3: Socio-Demographic Characteristics of Participating Children in Loima Sub-County, Turkana County, Kenya**

| Characteristics | Presence of Active Trachoma | | *P* Value |
|---|---|---|---|
| | Yes (n=284) | No (n=236) | |
| **Age of Selected Children** | | | |
| 1≤5 | 82 (28.9) | 184 (78.0) | **< 0.001** |
| 6≤9 | 202(71.1) | 52 (22.0) | |
| **Gender of Selected Children** | | | |
| Male | 80 (28.2) | 78 (33.1) | **0.228** |
| Female | 204 (71.8) | 158 (66.9) | |
| **Number of Children < 9 Years Old in Household** | | | |
| 1 | 154 (54.2) | 144(61.0) | **0.119** |
| ≥2 | 130 (45.8) | 92 (39.0) | |

Data are presented as number and proportions (%) of subjects, unless otherwise indicated. Significant Pvalues are indicated in bold.

### 4.4Association of Socio-Demographic and Economic Factors with Presence of Active Trachoma in Children Aged 1-9 Years in Loima sub-County, Turkana County, Kenya

Socio-demographic and economic factors associated with active trachoma of study participants in Loima Sub-County, Turkana County, Kenya, is presented in table 4.4 below. Children living in family size of more than five members had a greater odds of developing active trachoma compared to children from families of five members or less (Odds Ratio [OR], 2.382; 95% confidence interval [95% CI], 1.318-4.304; *P*=0.004). Children living in temporary houses (*manyattas*) were two times more likely to develop active trachoma (OR, 2.362; 95% CI, 1.311-4.204; *P*=0.005) compared to those living in semi-permanent house. Furthermore, children from households whose monthly income were KShs. 10,000 and less had a five times more likely to present with active trachoma (OR, 5.181; 95% CI, 1.621-16.559; *P*=0.006) relative to families with higher income above KShs. 10,000. The number of

children under 9 years of age leaving in households was not a factor predisposing to risk for active trachoma in this study (OR, 0.975; 95% CI, 0.635-1.497; *P*=0.907).No regression analyses were performed on employment status and level of education because all heads of households of children in both the trachoma infected and uninfected groups were unemployed with no formal education.

**Table 4.4: Socio-Economic Factors Associated with Active Trachoma in Children Aged 1-9 Years in Loima sub-County, Turkana County, Kenya**

| Socio-Economic Factors | OR with 95% CI | *P*value |
|---|---|---|
| **Number of Family Members** | | |
| ≤5 | Ref | |
| >5 | 2.382 (1.318-4.304) | **0.004** |
| **Number of Children < 9 Years in Household** | | |
| 1 | Ref | |
| ≥2 | 0.975 (0.635 -1.497) | **0.907** |
| **House Structures** | | |
| Temporary(*Manyatta*) | 2.362(1.311-4.204) | **0.005** |
| Semi-Permanent | Ref | |
| **Income per Month(KShs)** | | |
| ≤ 10,000 | 5.181 (1.621-16.559) | **0.006** |
| > 10,000 | Ref | |

Binary logistic regression analyses were performed to assess the association of family size, number of children less than 9 years in a family, housing structures and household income on the likelihood that participants would develop active trachoma. Data are presented as odds ratios (OR) and 95% confidence interval (CI). Abbreviations: ≤, less than or equal to. >, greater than. ≥, greater than or equal to. Significant *P* values are shown in bold.

### 4.5 Environmental and Behavioural Factors of Participant Households in Loima Sub-County, Turkana County, Kenya

Environmental factors of study participants in Loima Sub-County, Turkana County, Kenya, are presented in table 4.5 below. Source of water was reported as river by majority of the households (table 4.5). Majority (71.2%) of households without children presenting with active trachoma obtained their water from the river. In contrast, 47.9% of children with active trachoma were from households that obtained water from the Dam, a difference that was

statistically significant ($P<0.001$). In this study, majority (67.6%) of households with children with active trachoma spent less than 150 minutes to obtain household water, while 46.6% of children without trachoma were from households that had to walk for more than 150 minutes to fetch household water, differences that were significant ($P=0.001$).

The distance of garbage site from the main house was comparable between the groups (children with active trachoma versus those without; $P=0.360$). All (100%) households of the trachoma infected and uninfected children had no latrines in their compounds. In the absence of latrines in all households, participants were asked if they were willing to construct latrines in their compounds. A significant proportion (76.6% in the trachoma infected group and 66.9% in the uninfected group) indicated unwillingness to construct latrines ($P=0.001$). Further analysis on the presence of uncovered human faeces in the household compound showed that majority (52.8%) presenting with trachoma infected children had uncovered human faeces in the compound. In addition, 60.2% of households without human faeces in compounds did not have children presenting with active trachoma ($P=0.003$).

Since pastoralist communities inhabit the study area, participating households practiced animal husbandry. Therefore, the association between human-livestock interaction and presence of active trachoma in households were investigated. Majority of the households had animal sheds greater than 20 meters from the main house (table 4.5), 64.1% and 52.5% of children from such households presenting with trachoma infection ($P=0.008$). Similarly, a large proportion of household (74.6% and 56.8%) for infected and uninfected children, respectively reported not allowing animals to pass night in houses, a difference that was significant ($P<0.001$). However, the distribution households that shared fetched water with animals between infected and uninfected groups was comparable ($P=0.001$).Households that collected less than 40 litres of water or between 40-80 litres presented with more cases of active trachoma ($P<0.001$).

**Table 4.5 Environmental Factors of Study Households in Loima Sub-County, Turkana County, Kenya**

| Characteristics | Presence of Active Trachoma | | *P* value |
|---|---|---|---|
| | Yes | No | |
| **Source of Water** | | | |
| River | 148 (52.1) | 168 (71.2) | **<0.001** |
| Dam | 136 (47.9) | 68 (28.8) | |
| **Time to Obtain Water** | | | |
| ≤150 Minutes | 192 (67.6) | 126 (53.4) | **0.001** |
| >150 Minutes | 92 (32.4) | 110 (46.6) | |
| **Distance from Garbage Site** | | | |
| ≤20 Meters | 16 (5.6) | 18 (7.6) | **0.360** |
| >20 Meters | 268 (94.4) | 218 (92.4) | |
| **Willing to Construct a Latrine** | | | |
| Yes | 58 (20.4) | 78 (33.1) | **0.001** |
| No | 226 (79.6) | 158 (66.9) | |
| **Presence of Uncovered Human Faeces in Compound** | | | |
| Yes | 150 (52.8) | 94 (39.8) | **0.003** |
| No | 134 (47.2) | 142 (60.2) | |
| **Distance of Animal Shed from House** | | | |
| ≤20 Meters | 102 (35.9) | 112 (47.5) | **0.008** |
| >20 Meters | 182 (64.1) | 124 (52.5) | |
| **Animals Passing Night in the House** | | | |
| Yes | 72 (25.4) | 102 (43.2) | **<0.001** |
| No | 212 (74.6) | 134 (56.8) | |
| **Sharing of Fetched Water with Domestic Animals** | | | |
| Yes | 204 (71.8) | 160 (67.8) | 0.318 |
| No | 80 (28.2) | 76 (32.2) | |
| **Volume of Water Collected** | | | |
| <40 Litres | 142 (50.0) | 84 (35.6) | |
| 40 Litres to 80 Litres | 128 (45.1) | 120 (50.8) | **<0.001** |
| >80 Litres | 14 (4.9) | 32 (13.6) | |

Data are presented as number and proportions (%) of subjects, unless otherwise indicated. Values in bold indicate significant *P*-values.

## 4.6 Environmental and Behavioural Factors of Children Participants in Loima Sub-County, Turkana County, Kenya

The proportion of children with flies on their face was comparable between children presenting with active trachoma and those who were not infected (*P*=0.106; table 4.6).

Similarly, the number children washing face ($P$=0.268) was similar between the groups and the proportion of parents/guardians visiting eye clinic with their children was also comparable between the groups ($P$=0.389).

**Table 4.6 Environpmental Characteristics of Children Participated in Loima Sub-County, Turkana County, Kenya**

| Characteristics | Present of active trachoma | | *P* value |
|---|---|---|---|
| | Yes | No | |
| **Presence of Flies on Child's Face** | | | |
| Yes | 222 (78.2) | 170 (72.0) | **0.106** |
| No | 62 (21.8) | 66 (28.0) | |
| **Children Washing Faces** | | | |
| Yes | 56 (19.7) | 56 (23.7) | **0.268** |
| No | 228 (80.3) | 180 (76.3) | |
| **Frequency of Children Visiting Eye Clinic** | | | |
| Once per Year | 120 (42.3) | 100 (42.4) | |
| More than Once | 26 (9.2) | 30 (12.7) | **0.389** |
| None | 138 (48.6) | 106 (44.9) | |

Data are presented as number and proportions (%) of subjects, unless otherwise indicated.

### 4.7 Environmental Factors Associated with Predisposing Participating Households to Active Trachoma in Loima Sub-County, Turkana County, Kenya

Environmental factors associated with active trachoma in children aged 1-9 years in Loima sub-County, Turkana County, Kenya, are presented in table 4.7. Children from household whose main source of water were dams were two times more likely to develop active trachoma compared to those using rivers as main source of water (OR, 2.151; 95% CI, 1.418-3.263; $P$<0.001). Children from households that walked for more than 150 minutes to their main source of water were nearly two times more likely to develop trachoma compared to those that took less than 150 minutes (OR, 1.822; 95% CI, 1.275-2.603; $P$=0.001). The distance from the main house to the garbage site was not a factor in development of active trachoma (OR, 0.7231; 95% Cl, 0.3602-1.4513; $P$=0.362). The prevalence of trachoma in children from households willing to construct latrine was nearly two times higher compared to those from households unwilling to construct latrines (OR, 1.951; 95% CI, 1.234-3.087;

*P*=0.004).The prevalence of covered or uncovered human faeces in household compounds was not associated with development of active trachoma among children (*P*=0.090). Children living in houses whose doors were at distance of ≤20 meters from the animal shed were 1.7 times more likely develop trachoma compared to those from houses' doors of distance of >20 meters from the animal shed (OR, 1.712; 95% CI, 1.141-2.570; *P*=0.009). Animals spending night in the house was associated with trachoma infection, predisposing children twice relative to those residing in houses where animals pass night outside (OR, 2.221; 95% 1.446-3.412; *P*<0.001). Household water collection of 40- 80 litres was not associated with active trachoma (OR, 1.293; 95% 0.847-1.974; *P*=0.233). However, household water collection of less than 40litres was associated with active trachoma (*P*<0.001) relative to households with volumes of water greater than 80 litres.

**Table 4.7 Environmental and Behavioural Factors of Participating Households in Loima Sub-County, Turkana County, Kenya**

| Environmental Factors | OR with 95% CI | *P*-value |
|---|---|---|
| **Source of Water** | | |
| River | Ref | |
| Dam | 2.151 (1.418-3.263) | **<0.001** |
| **Time Taken to Obtain Household Water** | | |
| ≤150 Minutes | Ref | |
| >150 Minutes | 1.822(1.275-2.603) | **0.001** |
| **Distance from Garbage Site** | | |
| ≤20 Meters | 0.7231 (0.3602- 1.4513) | **0.362** |
| >20 Meters | Ref | |
| **Willing to Construct a Latrine** | | |
| Yes | Ref | |
| No | 1.951 (1.234-3.087) | **0.004** |
| **Presence of Uncovered Human Faeces in the Compound** | | |
| No | Ref | |
| Yes | 0.707 (0.474-1.055) | **0.090** |
| **Distance of Animal Shed from the House** | | |
| > 20 Meters | Ref | |
| ≤ 20 Meters | 1.712(1.141-2.570) | **0.009** |
| **Animals Passing Night in the House** | | |
| No | Ref | |
| Yes | 2.221(1.446-3.412) | **<0.001** |
| **Volume of Water Collected** | | |
| <40 Litres | 4.814 (2.208-10.492) | **<0.001** |
| 40 Litres to 80 Litres | 1.293 (0.847-1.974) | **0.233** |
| >80 Litres | Ref | |

Binary logistic regression analysis was performed to ascertain the effects of environment and behaviour on the likelihood that participants in households will have active trachoma. Data are presented as odds ratios (OR) and 95% confidence interval (CI). Abbreviation: ≤, less than or equal to. >, greater than. ≥, greater than or equal to. Significant *P* values are shown in bold.

## 4.8 Environmental Factors of Study Associated with Children Participating in the Study in Loima Sub-County, Turkana County, Kenya

The presence of flies on the child's face was not associated with development of active trachoma among children (OR, 1.3901; 95% Cl, 0.9318- 2.0740; *P*=0.106). Washing faces in children was also not associated with chances of infected with trachoma among children (OR, 0.719; 95% Cl, 0.482- 1.073; *P*=0.268). The frequency of children visiting eye clinic was

also not associated with trachoma infection among children in Loima Sub-County, Turkana County.

**Table 4.8 Environmental and Behavioural Factors of Children Participating in the Study in Loima Sub-County, Turkana County, Kenya**

| Characteristics | | *P* value |
|---|---|---|
| **Presence of Flies on Child's Face** | | |
| Yes | 1.3901 (0.9318 - 2.0740) | **0.106** |
| No | Ref | |
| **Children less than 9 Years Washing Faces** | | |
| Yes | 0.719(0.482-1.073) | **0.268** |
| No | Ref | |
| **Frequency of Children Visiting Eye Clinic** | | |
| Once per year | Ref | |
| More than once | 0.7222 (0.4010-1.3008) | **0.2784** |
| None | 1.0849 (0.7518 - 1.5656) | **0.6632** |

Binary logistic regression analysis was performed to ascertain the effects of environment and behaviour on the likelihood that participants in households will have active trachoma. Data are presented as odds ratios (OR) and 95% confidence interval (CI). Abbreviation: $\leq$, less than or equal to. $>$, greater than. $\geq$, greater than or equal to. Significant *P* values are shown in bold.

# CHAPTER FIVE: DISCUSSION

## 5.1 Introduction

The present study was set to determine the prevalence of active trachoma and associated risk factors among children less than 9 years in Loima sub-county, Turkana County, Kenya. This study revealed a prevalence of 54.6%, which varied from 30.8% in children aged between 1 and 5 years to 79.5 % in children aged 6–9 years. Socio-economic factors such as family size and the income were associated with active trachoma. In addition, environmental factors such as time to obtain water, distance of animal shed from the house, animals passing night in the house and the volume of water collected for household use were associated with active trachoma.

## 5.2 Prevalence of Active Trachoma among Children Aged 1-9 Years in Loima Sub-County, Turkana County, Kenya

The prevalence of active trachoma (54.6%) varied from 30.8 % in children aged between 1-5 years to 79.5 % in 6–9 years, suggesting that older children aged 6-9years were likely infected by exposure to various factors compared to children age between 1-5 years. In Turkana county, the 6-9- year- olds are often sent off with older siblings and other children to fetch water and look after livestock whereas the 1-5- year- olds are kept close to the mother (Ngugi, 2016), thus are less likely to be infected by exposure to other children (Abdou et al., 2007). This finding is consistent with a previous study reporting a prevalence of 53.9% among Ethiopian children aged 1-9 years (Golovaty et al., 2009). However, the findings of this study is higher than previous studies reporting a prevalence of between 6.4% to 35.0% among children aged 1-9 years leaving in Kajiado, Narok, Samburu, Baringo, West Pokot, Meru North and Lodwar sub-counties of Kenya (Karimurio et al., 2006; Loewenthal &Pe'er, 1990 ). This difference could be explained by the poor utilization of health services

and poor hygiene in Loima Sub-County, irrespective of numerous interventions to control the spread, which include mass antibiotic distribution. For instance, in this study, majority of family members (46.1%) do not take their children aged 1-9 years to clinics. In addition, latrine unavailability (100%) and presence of flies that act as a vector for trachoma (75.4% of children in this study had flies on their face) drive the prevalence of active trachoma in Loima Sub-county (Ketema et al., 2012; Nigusie et al., 2015). The higher prevalence of trachoma could also be explained by the less access to information attributed to high illiteracy rate (100%) of the household heads. This explanation is supported by studies conducted in Gambia and Tanzania which found the influence of educational status of household heads on children face washing (Harding-Esch et al., 2010; West et al., 2011). Taken together, the finding of the study confirms that trachoma is still a disease of public health interest in Turkana County. Therefore, there is need of well-organized Health education and Mobile eye clinic program that targeting children in Loima Sub-County, Turkana County.

### 5.3 Socio-economic Factors Associated with Active Trachoma in Children Aged 1-9 Years in Loima sub-County, Turkana County, Kenya

The findings of this study shows children living in households with family members more than five are more likely to have active trachoma than children living in households with family size less than five. These results were comparable with previous studies conducted in Ethiopian children (Nigusie et al., 2015). Incidence and persistence of trachoma due to efficient household transmission is high in individuals who live in relatively large households (i.e. with many individuals) than those who live in households with fewer individuals (Blake et al., 2009). The study finding also showed that children living in a temporary houses and households with low income monthly are likely to have active trachoma than children living in a semi-permanent and in households reporting high monthly income. This study is consistent with previous findings from studies in Vietnam and Tanzania (Jansen et al., 2007).

This implies Loima residents are poor since majority do not have a sustainable source of income thus do not have either the resources or the desire to maintain good community hygiene and priorities such as adequate food, shelter and warmth may take precedence. Therefore, Turkana County and National government should introduce skills training and enhancement program at the household level within the community, which subsequently will improve the economic status.

### 5.4 Environmental Factors Associated with Active Trachoma in Children Aged 1-9 Years in Loima sub-County, Turkana County, Kenya

The findings of this study showing an association between distances to obtain water (measured by time), distance of animal house from the main house, and animals passing night in the main house, with active trachoma reflect poor hygiene in Loima sub-county in Turkana County. This finding partly consistent with observations from previous studies conducted in Ethiopian and Tanzanian children (Alemayehu et al., 2015; Mahande et al., 2012; Nigusie et al., 2015). This could be explained by the observation of this study showing lack of latrines at the household level which are essential in reducing exposed human faeces, the main breeding ground for the trachoma transmission vector *Musca sorbens* (Emerson et al., 2000). Taken together, inaccessibility to latrine facilities and poor hygiene are risk factors for the presence of active trachoma. Therefore, improved access to latrines, water and sanitation, and active fly control are necessary to lower the burden of trachoma in Loima sub-county, Turkana County, Kenya.

# CHAPTER SIX: CONCLUSION AND RECOMMENDATIONS

## 6.1 Summary of Findings

The present study revealed a prevalence of 54.6%, which varied from 30.8% in children aged between 1-5 years to 79.5 % in 6-9 years. Socioeconomic factors such as family size and income were associated with active trachoma. In addition, environmental and behavioural factors such as distance to water source (measured by time), distance of animal shed from the house, animals passing night in the house were associated with active trachoma.

## 6.2 Conclusion

In summary these results indicate:

i. The prevalence of active trachoma is high (54.6%) in Loima sub-County, Turkana County, Kenya. Although prevalence in children aged 6-9 years higher as compare to children age 1-5 year, but still is an issue of public health concern.

ii. Temporary housing and low income earning of the family head in the household are risk factors for the presence of active trachoma in Loima sub-County, Turkana County, Kenya.

iii. Inaccessibility to latrine facilities and poor hygiene are risk factors for the presence of active trachoma in Loima sub-County, Turkana County, Kenya.

## 6.3 Recommendations from the Study

1. There is need of well-organized Health education about facial cleanliness, use of latrine, and proper solid waste and liquid waste disposal using multidisciplinary approach and mobile eye clinic program to focus on frequent eye check-up, mass distribution of antibiotics (such as azithromycin pills and tetracycline eye ointment) and perform surgery patient on *trachomatous trichiasis*within Loima community.

2. Turkana County and National government should introduce skills training and enhancement program at the household level within the community, which subsequently will improve the economic status.

3. Improved access to latrines, water and sanitation, and active fly control program are essential for lowering the burden of active trachoma in Loima sub-county, Turkana County, Kenya.

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