PREVALENCE OF TUNGIASIS AND ITS ASSOCIATED RISK FACTORS AMONG RESIDENTS OF KIPKELION WEST SUB-COUNTY, KERICHO COUNTY, KENYA

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Prevalence of Tungiasis and its associated risk factors among residents of Kipkelion West Sub-county, Kericho County, Kenya

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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 dedicate this thesis to my parents Mr. and Mrs. Chiuri, my daughter Annette, my sister Beatrice, my brother Erick and my friends Peter and James for their love, support, and encouragement during this study.

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LIST OF ABBREVIATIONS/ ACRONYMS

SPSS	Statistical Package for Social Scientists
KEMRI	Kenya Medical Research Institute
MOPHS	Ministry of Public Health and Sanitation
HIV	Human Immunodeficiency syndrome
AIDS	Acquired Immune Deficiency Syndrome
SSC	Scientific Steering Committee
ERC	Ethical Review Committee
NGO	Non Governmental Organization

ABSTRACT

Tungiasis is a parasitic skin disease caused by penetration of the female sand flea *Tunga penetrans*, also called jigger flea, into the epidermis of its host. It is highly prevalent where people live in extreme poverty, occurring in many Latin American and African countries. In Kenya it is endemic in several areas where its prevalence and associated factors have not been intensely studied. The main objective of this study was to determine the prevalence of tungiasis and establish its associated factors among residents of Kipkelion West Sub-county. A cross-sectional study was conducted in Kipkelion West Sub - county; Kericho county, Kenya. A total of 428 randomly selected households were visited. Pretested questionnaires on socio demographic characteristics and risk factors were administered to household heads and household members were examined for the presence of tungiasis. The level of statistical significance was set at P-value <0.05. Binary logistic regression was performed to determine the independent factors associated with tungiasis. The prevalence of tungiasis was 30.1 %(95% CI: 25.5%-34.4%). Risk factors that were associated with occurrence of tungiasis at multivariable analysis included: living in close proximity to domestic animals [AOR=6.58; 95%CI:3.42-12.65; P<0.001], walking barefoot [AOR=9.94; 95% CI: 4.18-23.61; P<0.001], wearing slippers outdoors,[AOR=6.45; 95% CI: 2.78-14.98; P<0.001], presence of uncollected waste products near residential buildings [AOR=3.73; 95% CI: 2.01-6.91; P<0.001], living in mud houses with cracks on the floors/ walls [AOR=6.92; 95% CI: 3.25-14.70; P<0.001], rearing chicken within the main house [AOR=8; 95% CI: 2.74-23.33; P<0.001], rearing free range chicken [AOR=6.59; 95% CI: 1.37-31.67; P<0.001] and presence of rats in the compound [AOR=2.18; 95% CI: 1.09-4.36; P=0.028].

Despite severe disease being present among the residents of Kipkelion West Sub County, none of those infested sought healthcare .The common practices were removal of fleas using sharp objects and application of products especially petroleum jelly.

The presence of tungiasis in the study area is associated to an important extent with a few risk factors which include:- lack of regular use of footwear, living in close proximity

to domestic animals, living in houses with cracked walls and floors, rearing chicken within residential houses, living in littered compounds and presence of rats in the compound. An integrated approach addressing these factors needs to be designed and implemented by an interdisciplinary team consisting of the affected, the populace, community leaders, health professionals, non-governmental institutions and policy makers.

CHAPTER ONE

INTRODUCTION

1.1 Background information

Tungiasis is a disease caused by the sand flea *Tunga penetrans*. This parasitic infestation is commonly found in developing countries, especially in resource-poor communities and where basic hygiene standards are poor. The female sand flea penetrates into the skin of its hosts where it grows rapidly in size. Some of the hosts include a variety of mammals, such as humans, dogs, cats, pigs and cattle (Eisele *et al*., 2003, Heukelbach *et al*., 2004). It feeds on the host's blood, produces eggs which are expelled into the environment, and eventually dies *in situ*.

Tungiasis results in considerable morbidity, manifesting itself in a number of symptoms such as intense local inflammation, deformation and loss of nails, formation of fissures and ulcers, deformation and auto-amputation of digits, gangrene, difficulty walking and gripping (when lesions are located on the hands), as well as sleep disturbances due to severe itching and pain (Chadee, 1998, Feldmeier *et al.,* 2002). Tungiasis lesions may serve as an entry port for *Clostridium tetani* (Greco *et al.,* 2001), rendering non-immunized individuals susceptible to tetanus. Individuals with a high parasite burden are therefore more vulnerable to severe disease. Why some individuals are heavily parasitized, but others harbour only a few sand fleas remains unknown. Tungiasis is common in resource-poor populations throughout Latin America, the Caribbean, and sub-Saharan Africa. In Africa, epidemiological data on this ectoparasitosis are scarce (Heukelbach *et al.,* 2005). Epidemiological data on tungiasis in Kenya where 2.6 million people are estimated to be at risk of infestation are scanty (Ahadi Trust Report, 2010). In an effort to fill this gap, a cross-sectional study was conducted in Kipkelion West Sub-County, Kericho County. The findings of this study will provide information for planning of effective and sustainable intervention measures.

1.2 Statement of the problem

Tungiasis is an important public health problem that is associated with considerable morbidity. Jigger infestation has continued to be ignored in many parts of Kenya where 2.6 million people are estimated to be at risk of infestation (Ahadi trust Report, 2010). Children drop out of school as they are unable to walk and write. Adults are unable to carry out their day to day activities normally. Those infested also face the challenge of stigmatization and discrimination. Re-infestation of individuals in endemic areas also greatly complicates effective public health interventions (National Policy Guidelines paper on Prevention and control of jiggers in Kenya, 2014). Evidence-based data describing the extent of the problem in the Kipkelion West Sub-county has not been available.

1.3 Justification

Tungiasis has long been known but is still neglected by those who are affected, the medical profession and the scientific community. Sustainable control measures against the parasitic disease can only be developed if prevalence and other associated factors are well understood. The outcome of this study is an attempt to contribute empirical evidence needed by the government and other stakeholders for planning of sustainable intervention measures in the region. The findings of the study also have a potential for contributing towards realization of Sustainable Development Goal number 3 which focuses on ensuring healthy lives and promoting well being for all at all ages.The findings of the study will also be useful in community sensitization.

1.4 Research questions

1. What is the prevalence of human tungiasis in Kipkelion West Sub-County?
2. What are the demographic, socio-economic, environmental and hygiene factors associated with human tungiasis in the Sub-County?
3. What are the health seeking behaviors of those infested with tungiasis?

1.5 Objectives

1.5.1 General objective

To determine the prevalence of tungiasis and establish its associated factors among the residents of Kipkelion West Sub-County to facilitate planning of sustainable intervention measures.

1.5.2 Specific objectives

1. To determine the prevalence of human tungiasis in Kipkelion West Sub-County.
2. To determine the demographic, socio-economic, environmental and hygiene factors associated with human tungiasis in the Sub-County.
3. To determine the health seeking behaviors of those infested with tungiasis

CHAPTER TWO

LITERATURE REVIEW

2.1 Historical background of tungiasis

The first documentation of the ectoparasite *T. penetrans* was made by Fernandez de Oviedo Gonzalez who in 1525 noted that Spanish conquerors in the native indigenous populations from Haiti frequently suffered from the disease (Heukelbach *et al.,* 2001). 10 years later, Gonzalo Ximenes de Quesada, a Spanish conqueror on a military expedition in Colombia, reported that an entire village had been abandoned by its inhabitants because of tungiasis. His soldiers were severely infested that they could hardly walk (Sachse *et al*., 2007). In the 17th Century, Aleixo de Abreu, a Portuguese physician working in the Brazilian government, provided the world with the first scientific description of *Tunga penetrans* (Hoeppli, 1963).

2.2 Epidemiology of tungiasis

Originally, the sand flea was only present in Latin American and the Caribbean. It was introduced into sub-Saharan Africa in the late 19th century (Heukelbach *et al.*, 2001). It was most likely introduced into Africa in 1873 by the infested crew and a load of infested sand on board of the ship Thomas Mitchell, traveling from Brazil to Angola (Sachse *et al*; 2007). Today, it is endemic in Latin America, Caribbean and sub-Saharan Africa (Heukelbach *et al*., 2001). The number of cases of tungiasis has been reported to be on the rise in Coast, Nyanza, Central, Rift valley and Western regions of Kenya (National Policy Guidelines on Prevention and control of jiggers in Kenya, 2014). Several community-based studies have been carried out on tungiasis in endemic areas. A study that was conducted in the rural area of Lagos State (Nigeria) recorded a prevalence of 40% (Ejezie, 1981). Similar prevalence was noted for villages in Southern Nigeria and Trinidad (Heukelbach *et al.,* 2001). A recent study in Kenya (Murang'a South district) detected a prevalence of 57% among school going children (Nicholas *et al*.,

2012).Prevalence in children is consistently higher than in adults, with a peak in the five to twelve year-old age group. Whether the situation in adults is due to less exposure, immediate extraction after penetration of the ectoparasite or acquired immunity in the older age groups is still a matter of debate (Chadee, 1998; Heukelbach, 2005). Usually higher prevalence's in males than in females have been reported, presumably because males spend most of the time outside and mostly barefoot, hence are more frequently exposed to *T. penetrans* (Chadee, 1998). The factors that predispose individuals exposed to similar conditions to different levels of infestation remain unknown (Wilcke *et al.*, 2002). Published data show that the highest prevalence of tungiasis is during dry season (Heukelbach, 2005). Epidemiological data on tungiasis in Kenya where over two million people are estimated to be at risk of infestation are scanty (Ahadi Trust Report, 2010).

2.3 Life cycle and animal reservoirs of Tunga Penetrans

Tunga penetrans is a small flea with a length of 1mm. It is distinguished from other fleas by its angular, double curved head and its narrow, short thorax. The larva emerges one to six days after the egg is laid. Larvae are found in various types of soil, although dry and sandy ground seems to be particularly suited to their development. Five to eleven days later, it develops into a pupa (Cardoso, 1990, Burke *et al*., 1991). Metamorphosis within the puparium takes nine to fifteen days after which the adult free-living flea emerges. The female flea penetrates into the epidermis of a host such as man, dog, cat or pig (Heukelbach *et al*., 2003). Other animal reservoirs include cattle, sheep, goats, horses, rats, mice, chicken, birds, elephants, monkeys and wild mammals (Cardoso, 1990, Heukelbach et *al*., 2004, Ugbomoiko *et al*., 2008). Infested domestic animals, rats and other animals that closely interact with man contribute to high human attack rates (Heukelbach *et al*., 2001, Ugbomoiko *et al*., 2008). Fertilization occurs after penetration of the female into its host Heukelbach *et al*., 2001). The gravid embedded jigger with hundreds of eggs in a capsule then develops six days later. The flea then lives in the host and expels eggs for several weeks. It dies after all eggs have been released (Eisele *et al*., 2003). Whether this occurs due to an inborn mechanism or whether host-derived factors

are also involved is not known (Heukelbach *et al*., 2001). The lesion desiccates *in situ* and eventually the remains of the ectoparasite are expelled. A small scar is left which as it is limited in the epidermis disappears over time (Eisele *et al*., 2003).

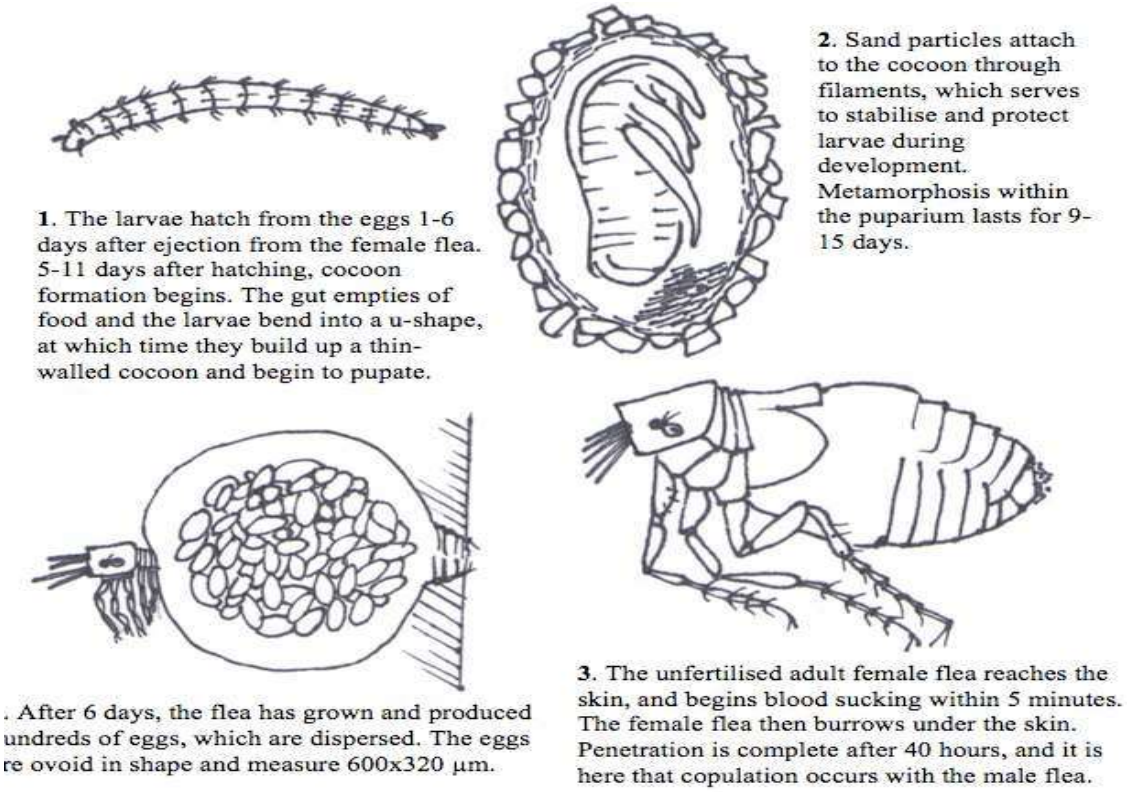

Figure 2.1: Lifecycle of *Tunga penetrans* (Eisele *et al.*, 2003)

2.4 Clinical presentation and natural history of tungiasis

The natural history of tungiasis has been divided into five stages -Fortaleza Classification (Eisele *et al*., 2003). According to this classification, a penetrating flea marks stage (I) of infestation. A red-brown itching spot with a diameter of one to two millimeters is described as the early stage or stage (II). A yellow-white watch glass-like patch with a central dark spot marks the (mature stage) stage (III). Dead flea or the last stage is referred to as stage (IV) and is described as a brown- black crust with or without surrounding necrosis. Attempts to remove the jigger are documented as manipulation (Eisele *et al*., 2003). The flea has limited jumping ability; therefore infestation is usually

limited to the feet (Heukelbach *et al.,* 2001). The preferred localization for jiggers is the periungual region of the toes, but lesions may occur on other parts of the body such as the hands, elbows, neck, anus and the genitals (Heukelbach *et al.,* 2002).

Some of the clinical signs: extreme itching, pain, inflammation, fibrous cyst, bumps, lesions or nodules (in form of white or red patches with dark spots), ulceration, especially in heavy infestation and discharge from the ulcers (Heukelbach *et al.,* 2001). If proper treatment is not given, secondary infections develop at the lesion's site (Goldman, 1976). Some of these secondary infections include: bacteremia or septicemia, lymphangitis, tetanus, the loss of toenails, autoamputation of the digits and gangrene (Chadee, 1998). In addition, severe infestation with jigger fleas can produce honeycomb-like lesions that can disfigure toes and make walking difficult (Cardoso, 1990).

2.5 Diagnosis of tungiasis

There are no diagnostic tests for tungiasis. This is most likely because the parasite is ectoparasitic with visible symptoms. However, clinical diagnosis of tungiasis is made by macroscopic inspection of the lesion (Heukelbach *et al.,* 2005). Localization of the lesion is a useful diagnostic method for the clinician. A biopsy may be done, though it is not required for diagnosis. The differential diagnosis of tungiasis includes verrucae vulgaris, ingrown foot nail creeping eruption, cercarial dermatitis, myiasis, folliculitis and mycotic granuloma (Burke *et al.,* 1991).

2.6 Treatment of tungiasis

Treatment of tungiasis consists of the topical application of dimeticones of low viscosity and the mechanical extraction of the entire flea under sterile conditions and subsequent disinfection of the lesions (Thielecke *et al*., 2014). In Kenya, treatment has been done at facility and outreach camps by soaking infested feet in antiseptic solution mainly potassium permanganate and hydrogen peroxide (MOH, Clinical Guidelines for Kenya,

2009). A study conducted in rural Kenya established that treatment with topical application of dimeticones of low viscosity as an effective means to kill embedded sand fleas (Thielecke *et al*., 2014). Mass treatment with ivermectin (2 doses of 200 μg/kg body weight 10 days apart) is said to have some benefits in preventing new infections but well-designed studies have not proved its efficacy (Heukelbach *et al.*,2004, National Policy Guidelines on Prevention and control of jiggers in Kenya , 2014). Patients with evidence of super infection should be treated with a broad-spectrum antibiotic. The antibiotic treatment should be systemic if the super infection is severe. (Feldmeier H *et al*., 2013b). Tetanus prophylaxis is also indicated for patients whose tetanus vaccination status is unknown or not up-to-date (Feldmeier *et al*., 2014).

2.7 Prevention and control of tungiasis

Wearing of closed shoes is the primary defense against tungiasis which should be strongly encouraged to control the disease in all endemic areas. Avoidance of contaminated areas, personal cleanliness, and disinfection of clothing, bedclothes, and furniture can also be important (National Policy Guidelines paper on Prevention & control of jiggers in Kenya, 2014). The use of non-persistent and other environment friendly chemicals is recommended. These include ICON or hypercypermethrin spray, carbaryl insecticidal dust, Propoxur insecticidal dust or spray, Deet topical repellant among others. Treatment of domestic animals with anti-flea compounds (on-host treatment) is another possibility. This will limit the available animal reservoir and might help reduce the total population of *T. penetrans.* Daily inspection of the feet with immediate extraction of embedded fleas and subsequent disinfections of the lesions also protect against complications (Heukelbach *et al*., 2002). The regular application of Zanzarin (combination of coconut oil, jojoba oil and aloe vera extracts) applied on feet up to ankle effectively prevents *T. penetrans* from penetrating into the skin. Protection varied between 86% and 100% in studies in Brazil and Madagascar, respectively (Feldmeier *et al*., 2006), Thielecke *et al*., 2013). When the repellent is applied twice daily on the feet, tungiasis-associated morbidity rapidly decreases and approaches zero

after 8 to 10 weeks of intervention (Feldmeier *et al.,* 2006; Thielecke *et al.*, 2013). When the repellent is applied intermittently, the reduction of morbidity is significant (Buckendahl *et al.*, 2010). A long lasting reduction of incidence of tungiasis can only be achieved through an approach integrating the environment, animal reservoirs and humans (Feldmeier *et al.,* 2014). In Kenya, jigger prevention and control have been prioritized by the ministry of health under the Division of Environmental health. In addition, civil society organizations and NGOs such as Ahadi Kenya Trust have also come out strongly to support the ministry in awareness creation, advocacy, treatment and control (National Policy Guidelines paper on Prevention and control of jiggers in Kenya, 2014).

2.8 Effects of tungiasis attack

Some of the effects of attack include: the inability to walk easily due to pain in the affected areas of the legs, inability to carry out normal day to day activities, stigmatization, low self-esteem resulting from the stigmatization and an increase in risk of transmission of infections such as HIV/AIDS that are passed from person to person due to sharing of sharp objects such needles used for extraction (Huekelbach *et al.*, 2004; Feldmeier *et al*., 2013a).

2.9 Tungiasis disease perception and healthcare-seeking behavior

Communities suffering from tungiasis do not recognize the disease as an important health threat (Wilcke *et al.,* 2002). Children with multiple lesions are not taken to health care facilities. In most cases fleas are removed by the patient or a caretaker. For this reason, lesions are not brought to the attention of medical professionals ((Wilcke *et al.,* 2002). Physicians' awareness of the disease is therefore deficient since tungiasis is considered a nuisance rather than an important infection (Heukelbach *et al*., 2003). Moreover, when complications arise at later stages, they are rarely attributed to *T. penetrans* (Heukelbach *et al.,* 2001).

CHAPTER THREE

MATERIALS AND METHODS

3.1 Study Site

The study was conducted in Kipkelion West Sub County where data collection was done at household level. Kipkelion West Sub County is one of the sub counties that form the expansive Kericho County. The Sub County was curved out of Kericho County in 2013. The Sub county is situated between longitude 35'02 and 35'40 East of the equator and latitude 02'35. The climate is warm and temperate with temperature ranges of between 10^{o} C to 29^{o} C, rainfall amounts ranging 1400mm to 2125mm annually and relative humidity of 64%. It has four wards namely: Kipkelion, Chilchila, Kamasian and Kunyak.

According to the Population and Housing Census (2009) the district population was 110,566 persons. The Sub County lacks proper infrastructure namely roads, water and sanitation, financial institutions, accommodation, office facilities and tertiary educational institutions. The Sub County forms a hilly shelf between the Mau Escarpment and the lowlands of Nyando and its geology is characterized by volcanic as well as igneous and metamorphic complexes. It's predominantly underlain by tertiary lavas (phonolites) and intermediate igneous rocks. A section of the Sub County is dominated by undifferentiated basement system rocks (granites), volcanic ash admixture and other pyroclastic rocks. The Sub County experiences highland tropical climate. Most inhabitants are subsistence farmers with maize being the major cash crop. They also keep domestic animals such as cattle, sheep, goat, chicken and pigs. A map of Kipkelion West Sub County is shown below (Figure 3.1).

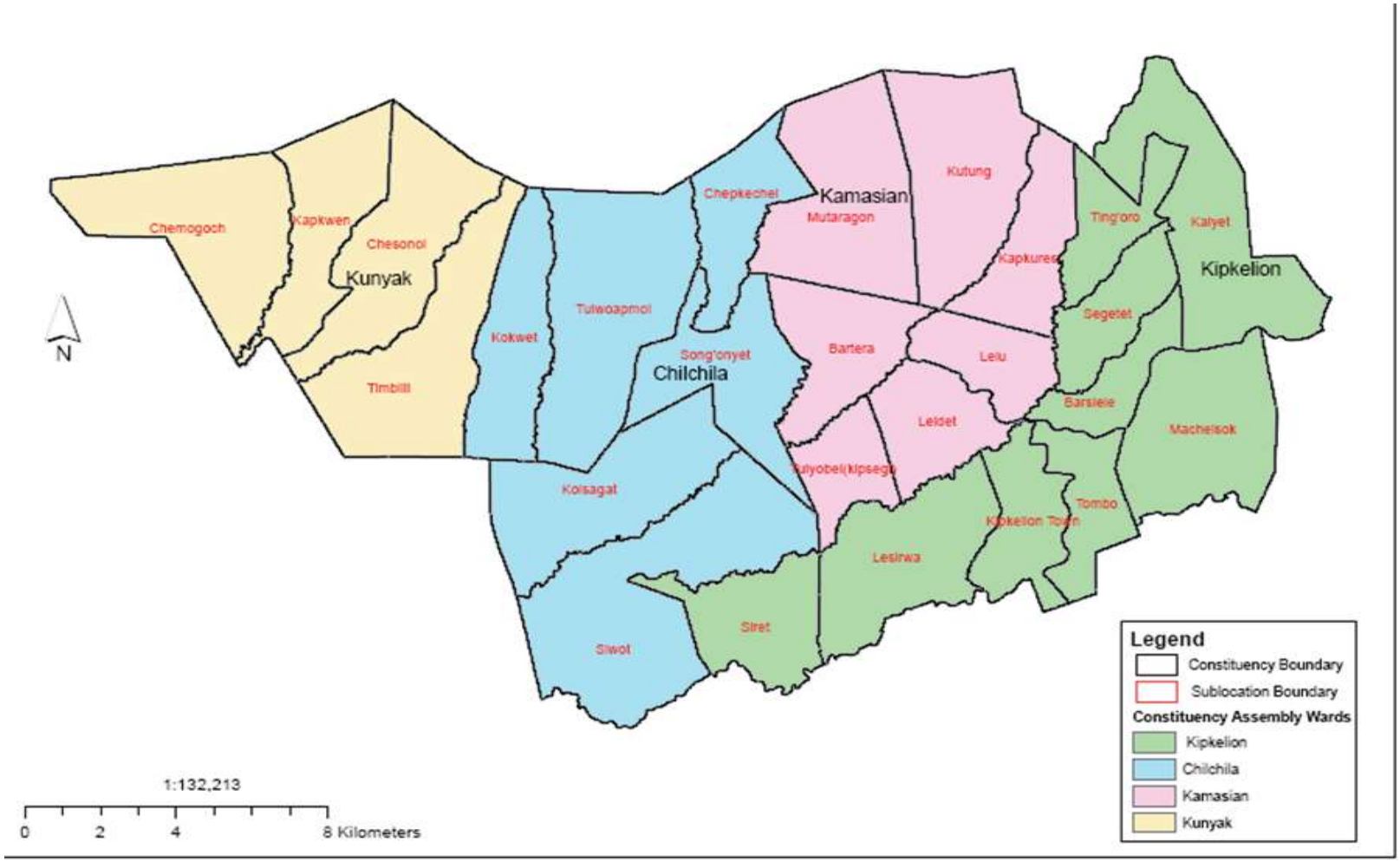

Figure 3.1: Map of Kipkelion West Sub County

3.2 Study Design

This was a descriptive cross-sectional and analytical study.

3.3 Study population

The study was conducted among residents of Kipkelion West Sub-County.

3.3.1 Inclusion criteria

Residents of Kipkelion West Sub County who gave written informed consent to be part of the study.

3.3.2 Exclusion criteria

Non residents of Kipkelion West Sub County and those who declined to give written informed consent.

3.4 Sampling and sample size determination

Sample size was determined using the single population proportion formula as used in Cochran, 1977.

$$n=\frac{Z^2\alpha/2 \text{ X } P\ (1-P)}{d^2}$$

Whereby;

N is the minimum sample size

d is the degree of precision, which is 5%

α is the level of significance (95%)

Z is the standard normal deviate that corresponds to 95% confidence interval

P = since prevalence rate of tungiasis for the study was not known, it was taken to be (50%)

Non-response rate or allow attrition = 10%

Therefore, $N = \frac{(1.96)^2 \times 0.50(1-0.50)}{(0.05)^2}$

=385+ non response rate of respondents (10%)

= 428.

3.4.1 Sampling Technique

Multistage stage sampling was used. At the first stage, 15 villages (clusters) were selected from the Sub County using simple random sampling.

At the second stage, households that were enrolled in the study from each village were determined by multiplying the weighted fraction by the sample size.

$$\text{Weighted fraction} = \frac{\text{Number of households in a given village}}{\text{Sum of households in the 15 villages}}$$

From each village, all households were listed then systematic random sampling was used, with a sampling interval (K) determined as follows:

$$K = \frac{\text{Number of households in a given village}}{\text{Representative sample needed from that village}}$$

Selection of the first household was done by simple random sampling from the list, the next household was determined by adding the sampling interval to the first household in the list that was randomly selected; this was repeated until the required number from that village was achieved. Questionnaires were administered to the household heads above eighteen years of age followed by visual clinical examination of any one household

member. In households with more than one member, random sampling was used to determine the person that was included in the study for visual clinical examination.

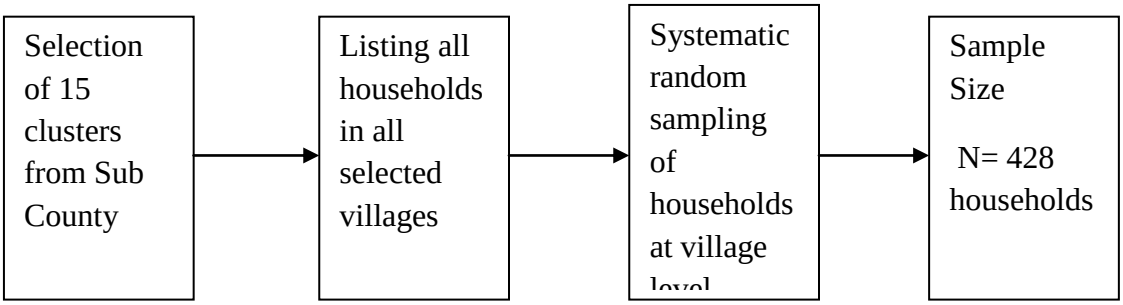

Figure 3.2: Sampling framework

3.4.2 Data collection tools

3.4.2.1 Questionnaire

The principal investigator, assisted by four people who were trained on basic research, conducted the research. A pre-tested structured questionnaire (Appendix 2) was administered in English, Swahili or Kalenjin/Kikuyu to the head of the household, after obtaining written informed consent (Appendix 1). The information collected consisted of:

(1) Socio-demographic factors (such as sex, age, education)

(2) Socio-economic factors

(3) Animal reservoirs (ownership and presence of domestic animals)

(4) Behavioral factors (practices related to tungiasis, such as health seeking behaviour)

(5) Human associated factors (regular use of footwear, sleeping place)

3.4.2.2 Clinical examination and case definition

Visual clinical examination for jiggers was performed by carefully inspecting the legs, feet, hands and arms. To guarantee privacy, other parts of the body were not examined. This approach was considered acceptable because in endemic communities, more than 99% of tungiasis lesion occur on these parts of the body (Heukelbach *et al.*, 2001). Diagnosis of tungiasis was done based on Fortaleza Classification (Eisele *et al*., 2003: a penetrating flea (stage I) an itching red-brownish spot with a diameter of one to three mm (stage II), a circular lesion presenting as a white patch with a diameter of four to ten mm with a central black dot (stage III), black crust surrounded by necrotic tissue (stage IV), and partially or totally removed fleas leaving a characteristic sore in the skin. The number of lesions was recorded. The presence of less than 5 lesions was considered as mild, 6–30 as moderate and more than 30 lesions as heavy infestation(Heukelbach *et al;* 2001).

3.5 Research Variables

Data on the following variables was collected:

3.5.1 Dependent variable

Presence of tungiasis, defined by having any form of infestation classified as stage I, II, III, IV, or manipulation.

3.5.2 Independent variables

Socio-demographic Factors:

- Age ,gender, residence, level of education, religion

Environmental Factors

- House structure: House floor, house roof, house lighting
- Waste disposal, availability of pit latrine
- Water source

Animal ownership and how/where they live

- Chicken, dogs, pigs
- Other domestic animals

Knowledge and practices towards tungiasis

Knowledge of what tungiasis is, causes of tungiasis, transmission, treatment, action taken when infested, responsible person for the said action.

3.6 Data management

Every questionnaire was cross-checked before leaving every household so as to ensure completeness of data. All questionnaires were stored in locked cabinets throughout the study and accessed only by authorized persons so as to ensure confidentiality and to avoid data loss. After data collection, double entry of the same data was done for accuracy purposes. The data was stored under passwords. Coding and verification of the data was done for easy manipulation, analysis and presentation. Preliminary analysis of the data was done to ensure that all variables are in a workable form before full analysis.

3.7 Statistical analysis

This was approached at three levels:

a) Description of the target population characteristics using statistical package for social sciences software. Descriptive statistics to obtain frequencies, means and proportions of the indicators of tungiasis were also computed. The outcome gave an estimate of the prevalence of tungiasis**.** The findings were presented in tables, pie charts and bar graphs.

b) Bivariate analysis. The dependent variable was cross tabulated with all the independent variables. Categorical variables were analyzed using chi square test. Odds ratio was computed for all variables established to be significant using the chi square test.

c) All variables observed to be significant in the bivariate analysis were included in a logistic regression to establish factors associated with occurrence of tungiasis.

3.8 Ethical considerations

The proposal for the study was presented to the KEMRI Scientific Steering Committee (SSC) and Ethical Review Committee (ERC) for scientific review and ethical approval respectively. Permission to collect data was sought from relevant local administration authorities. For the participating respondents, a verbal explanation was given after which they were requested to sign the consent form. Since most of the Sub county population only understands the local language, the consent form was translated into Kiswahili, Kikuyu and Kalenjin (Appendices V and VI). The data generated was only used for the purpose explained by the principal investigator to ensure confidentiality. All the respondents were considered and treated anonymously. All the information collected was treated with the highest degree of confidentiality possible.

CHAPTER FOUR

RESULTS

4.1 Socio-demographic characteristics of the respondents

A total of 428 respondents participated in the study. More males (56.1%) than females (43.9%) participated in the study. Level of education was generally low with 12.9% having not attended school at all and 64.5% of the respondents attended school up to primary level. Majority of the participants (78.3%) of were Christians (Table 4.1)

Table 4.1: Distribution of respondents by socio-demographic characteristics

Socio-demographic characteristics	Frequency (n=428)	Percentage (%)
Mean age (±SD) = 38.34(±11.8)		
Age in years		
18-29	126	29.4
30-39	114	26.6
40-49	101	23.6
50 and above	87	20.4
Sex		
Male	240	56.1
Female	188	43.9
Marital status		
Married	326	76.2
Single	58	13.6
Widowed	32	7.4
Divorced/separated	12	2.8
Level of education		
Not attended	55	12.9
Primary	276	64.4
Secondary and above	97	22.7
Religion		
Christian	335	78.3
Hindu	5	1.2
Traditional	52	12.1
No Religion	36	8.4

4.2 Socio-economic characteristics of the respondents

Most (69.4%) of the study participants were farmers. Well/river/stream were the major sources of water used by majority (80.8%) of the respondents. Paraffin lamp was the major (80.1%) type of lighting used by the respondents (Table 4.2).

Table 4.2: Socio-economic characteristics among respondents

Socio-economic characteristics	Frequency (n=428)	Percentage (%)
Occupation		
Unemployed	88	20.6
Farmer	297	69.4
Business man	:31	7.2
Civil servant	12	2.8
Sleeping place		
Mat on floor	178	41.6
Mattress on floor	35	8.2
Mattress on bed	215	50.2
House lighting		
Paraffin lamp	343	80.1
Solar/Electricity	85	19.9
Source of water		
River stream	316	73.8
Well	26	6.1
Borehole	26	6.1
Piped	60	14.0

4.3 Environmental and hygiene factors

Waste management in majority of households was done through burning and disposal in compost pits (51.6% and 56.1% respectively). Majority (51.4%) of the respondents were either barefoot or in slippers while outdoors and 58.4% were in slippers while indoors. A pit latrine was available in 81.1% of the households. (Table 4.3)

Table 4.3: Distribution of environmental and hygiene factors

Factors	Frequency (n)	Percentage (%)
Waste product disposal		
Yard	92	21.5
Back yard	96	22.4
Compost pit	240	56.1
Waste burning		
No	207	48.4
Yes	221	51.6
Wastes near the house		
Yes	113	26.4
No	315	73.6
State of the compound		
Dry/dusty	427	99.8
Bushy	1	0.2
Footwear in the house		
Barefoot	141	32.9
Slippers	250	58.5
Closed shoes	37	8.6
Footwear outdoors		
Barefoot	107	25
Slippers	113	26.4
Closed shoes	208	48.6
Availability of latrine		
No	81	18.9
Yes	347	81.1
Presence of cracks on the floors/ walls		
Yes	210	49.1
No	218	50.9
Floor Construction material		
Earthen	366	85.5
Cemented/tiled/wooden	62	14.5
Roofing type		
Grass	98	22.9
Iron sheet	330	77.1

4.4 Presence of domestic animals in the homestead

Animal reservoirs of the sand flea were present in majority of the households.

Table 4.4: Distribution of presence of domestic animals

Factors	Frequency (n)	Percentage (%)
Chicken ownership		
Yes	303	70.8
No	125	29.2
Number of chicken present		
More than 5 chicken	109	36.0
1 to 5 chicken	194	64.0
Living place for chicken		
Main house	76	25.1
Free range	24	7.9
Poultry house	203	67.0
Presence of dogs		
Yes	241	56.3
No	187	43.7
Number of dogs		
1-2 dogs	218	50.9
3-5 dogs	25	5.9
None	185	43.2
Living place for dogs		
Free roaming	178	41.6
Kennel	65	15.2
Presence of rats		
Yes	264	61.7
No	164	38.3
Presence of other animals		
Cow	177	41.4
Sheep/goat	98	22.9
None	153	35.7
Domestic animals living near premises		
Yes	239	55.8
No	189	44.2

4.5 Prevalence of tungiasis

The prevalence of tungiasis was 30.1% with 95% confidence interval of 25.75% to 34.45% (Figure 4.1).

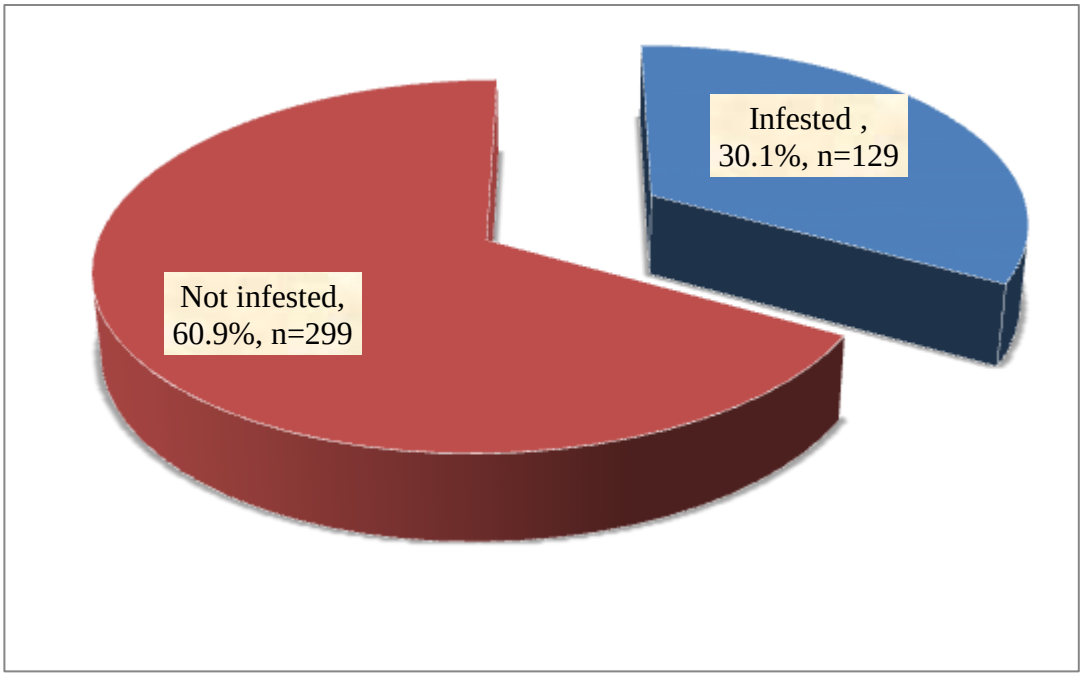

Figure 4.1: Distribution of Tungiasis among respondents

4.5.1 Distribution of tungiasis by age

Majority (35.7%) of those infested were school going children aged between 5 to 12 years. Those above 50 years also had a higher percentage (20.1%) of infestation compared to other age groups (Table 4.5).

Table 4.5: Distribution of tungiasis by age

Age in years	Frequency (n=129)	Percentage (%)
<5	14	10.8
5-12	46	35.7
13-35	21	16.3
36-50	22	17.1
>50	26	20.1

4.5.2 Stages and sites of infestation

Foot toes, soles and heels were identified to be the preferred sites for jigger infestation. There was minimal infestation on the arms. Figure 4.2 shows the distribution of the stages and sites of infestation among those that were found to be infested.

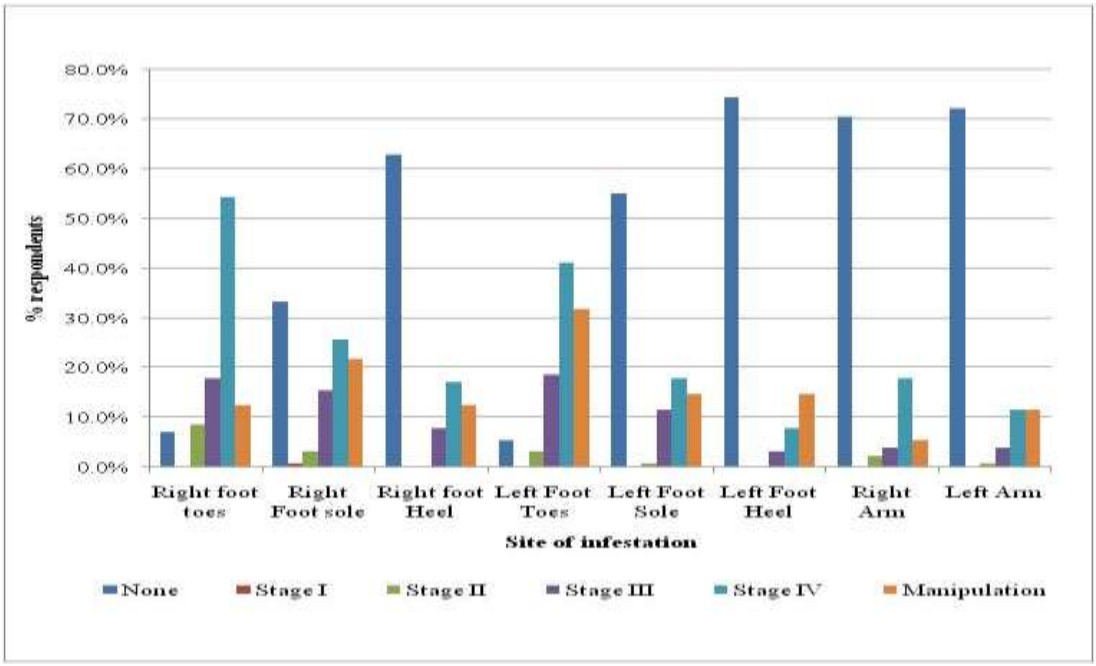

Figure 4.2: Distribution of stages and sites of infestation

4.5.3 Clinical findings among those infested with tungiasis

Most common symptoms among those that were infested were itching (86%), pain upon pressure (84.5%) and difficulty in walking (44.2%). Figure 4.3 shows the distribution of symptoms as reported by the infested respondents.

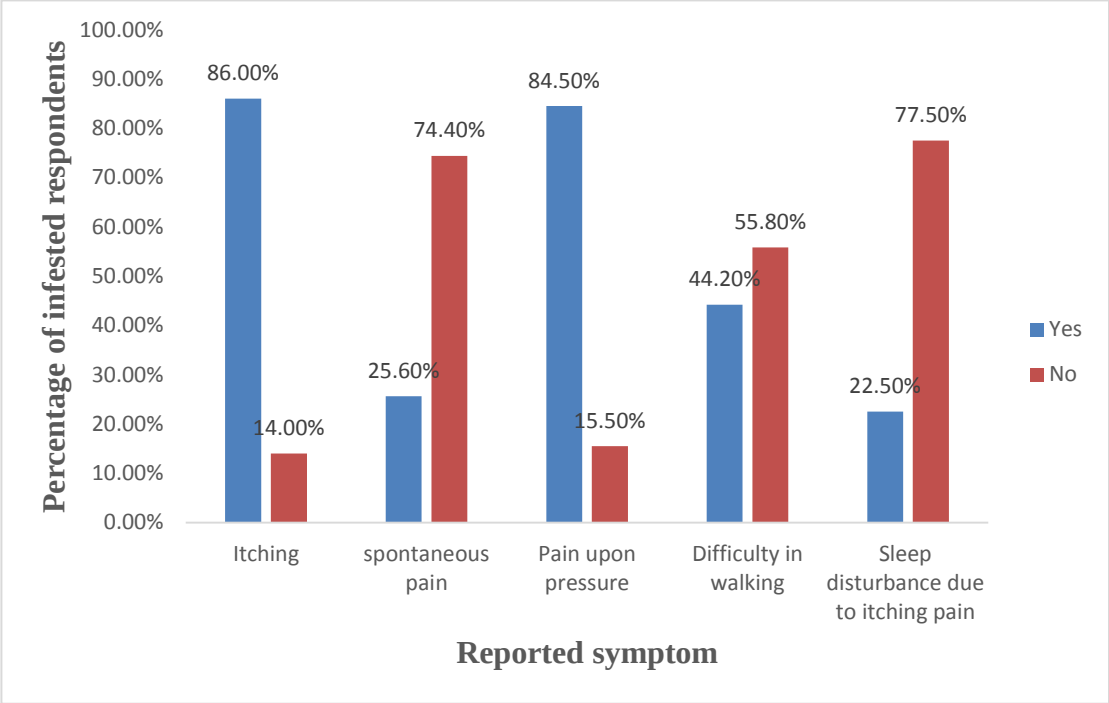

Figure 4.3: Distribution of reported symptoms among the infested participants

4.5.4 Distribution of number of lesions (severity) among those infested tungiasis

Majority (70.5%) of the respondents had between 6-30 lesions, while 17.8% had less than 5 lesions and 11.6% had more than 30 lesions (Figure 4.4).

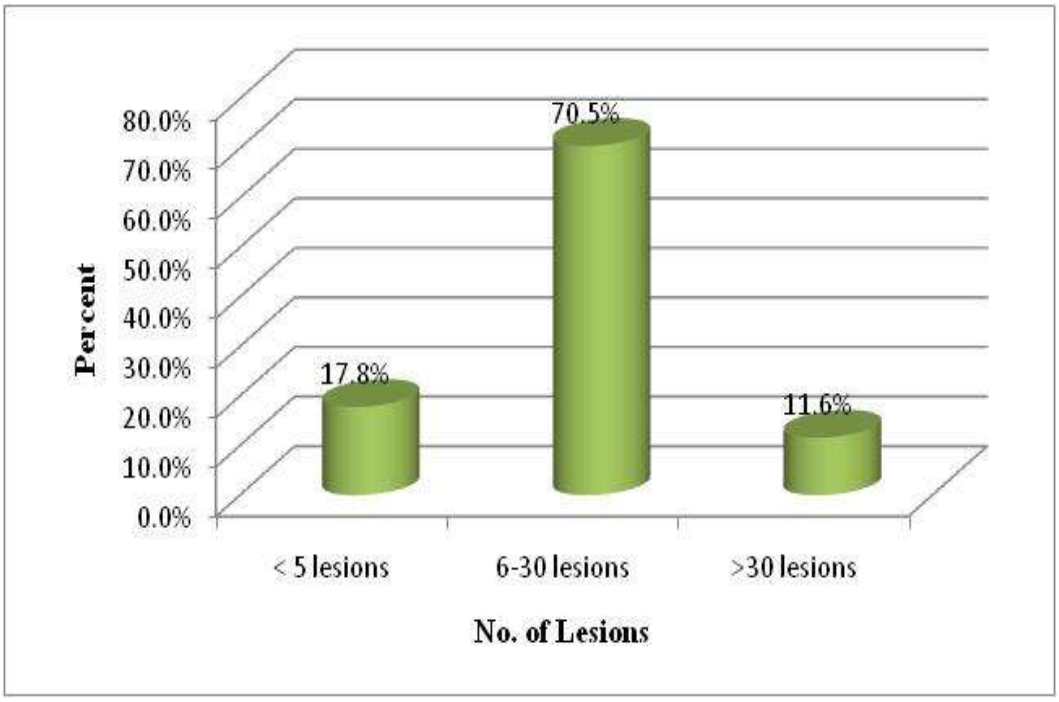

Figure 4.4: Number of Lesions

4.6 Bivariate analysis

4.6.1 Association between socio-demographic characteristics and occurrence of tungiasis

. There was a statistically significant association between level of education and occurrence of tungiasis. There was a significantly higher prevalence of Tungiasis among those who did not attend school at all 28(50.9%) [OR=6.7; 95% CI: 3.05-14.73; P<0.001] and among those who attended primary school 88(31.9%) [OR=3.03; 95% CI: 1.60-5.72; P=0.001] compared to those who attended secondary and above 13(13.4%). However, there was no statistically significant association (P > 0.005) between age, sex, marital status, religion of the respondents with jigger infestation (Table 4.6).

Table 4.6: Distribution of socio-demographic characteristics and prevalence of tungiasis

Socio-demographic characteristics	Jigger infestation		*P value	*OR	95%CI	
	Infested, n(%)	Not infested, n(%)			Lower	Upper
Age in years						
18-29	29.4%	70.6%	0.192	0.68	0.38	1.21
30-39	28.1%	71.9%	0.140	0.64	0.35	1.16
40-49	26.7%	73.3%	0.102	0.60	0.32	1.11
50 and above (Reference)	37.9%	62.1%		1		
Sex						
Male	32.1%	67/9%	0.322	1.24	0.81	1.88
Female (Reference)	27.7%	72.3%		1		
Marital status						
Married	27.3%	72.7%	0.283	0.53	0.16	1.70
Single	36.2%	63.8%	0.722	0.80	0.22	2.82
Widowed	43.8%	56.2%	0.901	1.09	0.28	4.17
Divorced/separated (Reference)	41.7%	58.3%		1		
Level of education						
Not attended	50.9%	49.1%	**<0.001***	**6.70**	**3.05**	**14.73**
Primary	31.9%	68.1%	**0.001***	**3.03**	**1.60**	**5.72**
Secondary& above (Reference)	13.4%	86.6%		1		
Religion						
Christian	29.6%	70.4%	0.417	0.74	0.361	1.524
Hindu	40.0%	60.0%	0.866	1.18	0.174	7.998
Traditional (Reference)	28.8%	71.2%	0.473	0.72	0.29	1.776
No Religion	36.1%	63.9%		1		

OR = Odds Ratio, CI= Confidence Interval, *Significant P value and OR Bolded

4.6.2 Relationship between socio-economic characteristics and occurrence of Tungiasis

Relationship between socio-economic characteristics and jigger infestation is summarized in Table 4.7. Occurrence of tungiasis was significantly higher among respondents who slept on mats on the floor 95(53.4%) [OR=11.81; 95% CI: 6.78-20.58; P<0.001] than in those who slept on mattress on bed 19(8.8%). Similarly, respondents who slept on mattress on floor were more likely to be jigger infested 15(42.9%) than those who slept mattress on bed (8.8%), [OR=7.74; 95% CI: 3.41-17.54; P<0.001]. The type of house lighting used was also examined and tungiasis was significantly higher among those who used paraffin lamp 124(36.2%) [OR=9.06; 95% CI: 3.58-22.96; P<0.001] than among those who used solar or electricity 5(5.9%).

Table 4.7: Relationship between socio-economic characteristics and tungiasis

Socio-economic characteristics	Jigger infestation		*P value	*OR	95%CI	
	Infested, n(%)	Not infested, n(%)			Lower	Upper
Occupation						
Unemployed	35.2%	64.8%	0.486	1.63	0.41	6.47
Farmer	31.0%	69.0%	0.661	1.35	0.36	5.09
Business man	9.7%	90.3%	0.208	0.32	0.06	1.88
Formal employment (Reference)	25.0%	75.0%		1		
Sleeping place						
Mat on floor	53.4%	46.6%	**<0.001***	**11.81**	**6.78**	**20.58**
Mattress on floor	42.9%	57.1%	**<0.001***	**7.74**	**3.41**	**17.54**
Mattress on bed (Reference)	8.8%	91.2%		1		
Source of water						
River stream	32.6%	67.4%	0.247	1.45	0.77	2.72
Well	23.1%	76.9%	0.849	0.90	0.31	2.66
Borehole	19.2%	80.8%	0.562	0.71	0.23	2.23
Piped (Reference)	25.0%	75.0%		1		
House lighting						
Paraffin lamp	36.2%	63.8%	**<0.001***	**9.06**	**3.58**	**22.96**
Solar/Electricity (Reference)	5.9%	94.1%		1		

OR = Odds Ratio, CI= Confidence Interval, *Significant P value and OR Bolded

4.6.3 Relationship between environmental and hygiene factors and occurrence of tungiasis

There was no significant association between the site of waste product disposal and occurrence of tungiasis. However, respondents who did not burn their waste products had significantly higher prevalence of tungiasis [OR=1.68; 95% CI: 1.11-2.55; P<0.005] compared to respondents who burned waste products. Respondents that had waste products near the house had significantly higher proportion of jigger infestation 67(59.3%), [OR=5.94; 95% CI: 3.73-9.48; P<0.001] compared to those without waste products near the house 62(19.7%). Latrine availability was a significant factor in occurrence of tungiasis. Prevalence of Tungiasis was higher among study participants who did not have a pit latrine in the compound 32(39.5%) [OR=1.68; 95% CI: 1.02-2.78; P<0.005] than in those who had a latrine 97(28%).

Footwear was a statistically significant factor in occurrence of tungiasis. Respondents who were barefoot while indoors had a significantly higher prevalence of jigger infestation 85(60.3%) [OR=12.52; 95% CI: 4.21-37.29; P<0.001] than those who wore closed shoes 4(10.8%). In addition, respondents that stayed barefoot and those that wore slippers while outside the house [64(59.8%) [OR=20.63; 95% CI: 10.60-40.14; P<0.001] and 51(45.1%) [OR=11.40; 95%CI: 5.91-21.99; P<0.001] respectively had significantly higher occurrence of tungiasis when compared to those that wore closed shoes outside the house 14(6.7%). Presence of cracks on the walls and floors of the house was a significant factor in occurrence of tungiasis [116(55.2%) [OR=19.46; 95% CI: 10.44-36.29; P=0.001]. Respondents that lived in houses with earthen type of floor had significantly increased chance of jigger infestation 125(34.2%), [OR=7.52; 95% CI: 2.67-21.19; P<0.001] compared to those that lived in houses with cemented or wooden floors 4(6.5%).Roofing type was also a statistically significant factor with those living in thatched houses having a higher risk of jigger infestation 47(48.0%), [OR=2.79; 95% CI: 1.75-4.45; P<0.001] compared to those living in houses made of iron sheet (Table 4.8).

Table 4.8: Relationship between environmental and hygiene factors with occurrence of tungiasis

Factors	Jigger infestation		*P value	*OR	95%CI	
	Infested, n (%)	Not infested, n (%)			Lower	Upper
Waste product disposal						
Yard	25.0%	75.0%	0.163	0.68	0.40	1.17
Back yard	28.1%	71.9%	0.394	0.80	0.47	1.34
Compost pit (Reference)	32.9%	67.1%		1		
Waste burning						
No	35.7%	64.3%	**0.014***	**1.68**	**1.11**	**2.55**
Yes (Reference)	24.9%	75.1%		1		
Wastes near the house						
Yes	59.3%	40.7%	**<0.001***	**5.94**	**3.73**	**9.48**
No (Reference)	19.7%	80.3%		1		
Availability of latrine						
No	39.5%	60.5%	**0.043***	**1.68**	**1.02**	**2.78**
Yes (Reference)	28.0%	72.0%		1		
Wearing shoes in the house						
Barefoot	60.3%	39.7%	**<0.001***	**12.52**	**4.21**	**37.3**
Slippers	16.0%	84.0%	0.417	1.57	0.53	4.68
Closed shoes (Reference)	10.8%	89.2%		1		
Wearing shoes outdoors						
Barefoot	59.8%	40.2%	**<0.001***	**20.63**	**10.60**	**40.1**
Slippers	45.1%	54.9%	**<0.001***	**11.40**	**5.91**	**21.9**
Closed shoes (Reference)	6.7%	93.3%		1		
Presence of cracks on the floors/walls						
Yes	55.2%	44.8%	**<0.001***	**19.46**	**10.44**	**36.3**
No (Reference)	6.0%	94.0%		1		
Floor Construction material						
Earthen	34.2%	65.8%	**<0.001***	**7.52**	**2.67**	**21.2**
Cemented/tiled/wooden (Reference)	6.5%	93.5%		1		
Roofing type						
Grass	48.0%	52.0%	**<0.001***	**2.79**	**1.75**	**4.45**
Iron sheet (Reference)	24.8%	75.2%		1		

OR = Odds Ratio, CI= Confidence Interval, *Significant P value and OR Bolded

4.6.4 Association between presence of domestic animals and occurrence of tungiasis

There was no statistically significant association between prevalence of tungiasis and ownership of chicken at the household level (P>0.05). However, the living place for chicken was significantly associated with jigger infestation. Tungiasis was significantly higher among respondents whose chicken lived in the main house 56(73.7%) and in free-range chicken 9(37.5%) than in respondents whose chicken lived in a poultry house 28(13.8%), {[OR=17.5; 95% CI: 9.16-33.45; P<0.001] and [OR=3.75; 95% CI: 1.50-9.39; P<0.001] respectively}. Occurrence of tungiasis was higher among respondents who had their domestic animals live in close proximity to their living premises102 (42.7%) than in those whose animals lived away from the living premises 26, (13.9%) [OR=4.61; 95% CI: 2.83-7.5; P<0.001]. Presence of rats in the compound increased the risk of infestation 108(40.9%) compared to living in compounds without rats 21(12.8%), [OR=4.71; 95% CI: 2.80-7.93; P<0.001] (Table 4.9).

Table 4.9: Relationship between presence of domestic animals and occurrence of tungiasis

Domestic animals	Jigger infestation		*P value	*OR	95%CI	
	Infested, n(%)	Not infested, n(%)			Lower	Upper
Chicken ownership						
Yes	30.7%	69.3%	0.698	1.10	0.69	1.73
No (Reference)	28.8%	71.2%		1		
Number of chicken present						
More than 5 chicken	26.9%	73.1%	0.248	0.74	0.45	1.23
1 to 5 chicken	33.2%	66.8%		1		
Living place for chicken						
Main house	73.7%	26.3%	**<0.001***	**17.50**	**9.16**	**33.45**
Free-range	37.5%	62.5%	**0.005***	**3.75**	**1.50**	**9.39**
Poultry house (Referent)	13.8%	86.2%		1		
Presence of dogs						
Yes	27.8%	72.2%	0.232	0.78	0.51	1.18
No (Reference)	33.2%	66.8%				
Number of dogs						
3-5 dogs	28.0%	72.5%	0.960	1.02	0.41	2.58
1-2 dogs	27.5%	72.5%		1		
Living place for dogs						
Free roaming	29.2%	70.8%	0.343	1.38	0.71	2.66
Kennel (Reference)	23.1%	76.9%		1		
Presence of rats						
Yes	40.9%	59.1%	**<0.001***	**4.71**	**2.80**	**7.93**
No (Reference	12.8%	87.2%		1		
Domestic animals living near premises						
Yes	42.7%	57.3%	**<0.001***	**4.61**	**2.83**	**7.50**
No (Reference)	13.9%	86.1%		1		

OR = Odds Ratio, CI= Confidence Interval, *Significant P value and OR Bolded

4.7 Multivariable analysis

Logistic regression analysis was performed in order to identify factors associated with occurrence of tungiasis. All variables with P value <0.15 during bivariate analysis were considered in multivariable analysis. Upon fitting all these factors using binary logistic regression and by specifying *'backward conditional'* progressive stepwise method with removal at P<0.05, six factors were established to be associated with occurrence of tungiasis (Table 4.10).

Staying barefoot and wearing slippers outdoors had a 10-fold [AOR=9.94; 95% CI: 4.18-23.61; P<0.001] and 6.45- fold higher risk of infestation respectively [AOR=6.45; 95% CI: 2.78-14.98; P<0.001] compared to wearing closed shoes. Respondents that had domestic animals live near their living premises had a 7- fold higher risk of infestation compared to those who did not live in close proximity to their domestic animals [AOR=6.58; 95% CI: 3.42-12.65; P<0.001]. Presence of rats in the compound had a 2.18-fold higher risk of jigger infestation compared to living in compounds without rats [AOR=2.18; 95% CI: 1.09-4.36; P=0.028].Respondents who reared chicken in the main house had an 8- fold higher risk of jigger infestation compared to those who kept their chicken in a poultry house [AOR=8; 95% CI: 2.74-23.33; P<0.001]. Similarly, respondents who reared free range chicken had a 7-fold higher risk of jigger infestation compared to those who reared their chicken in a poultry house [AOR=6.59; 95% CI: 1.37-31.67; P<0.001].

Presence of waste products near the house had a 4-fold higher risk of jigger infestation [AOR=3.73; 95% CI: 2.01-6.91; P<0.001] compared to living in a compound without waste products. Respondents living in houses with cracks on the floors and walls had a 7- fold higher risk of jigger infestation when compared to respondents who lived in houses without cracks on the floor and walls [AOR=6.92; 95% CI: 3.25-14.70; P<0.001].

Table 4.10: Factors associated with tungiasis at multivariable analysis

Factors	AOR	95%CI		
		Lower	Upper	P value
Wearing shoes outdoors				
Barefoot	**9.94**	**4.18**	**23.61**	**<0.001***
Slippers	**6.45**	**2.78**	**14.98**	**<0.001***
Closed shoes	**1.00**			
Wastes near the house				
Yes	**3.73**	**2.01**	**6.91**	**<0.001***
No	**1.00**			
Presence of cracks on the floors/walls				
Yes	**6.92**	**3.25**	**14.70**	**<0.001***
No	**1.00**			
Living place for chicken				
Main house	**8.00**	**2.74**	**23.33**	**<0.001***
Free range	**6.59**	**1.37**	**31.67**	**0.019***
Poultry house	**1.00**			
Domestic animals living near premises				
Yes	**6.58**	**3.42**	**12.65**	**<0.001***
No	**1.00**			
Presence of rats				
Yes	**2.18**	**1.09**	**4.36**	**0.028***
No	**1.00**			

OR = Odds Ratio, CI= Confidence Interval, *Significant P value ≤0.05

4.8 Health seeking behavior and practice towards tungiasis

Health seeking behavior and practices towards tungiasis among those that were infested is shown in Table 4.11. Most of the respondents and their household members determined that they were jigger infested by itching (90.7% and 86.7% respectively).Two methods of dealing with jigger infestation were reported i.e. removing

and removing and application of products. Majority of the participants reported to use extraction method. Majority (14.5% (62) of those infested reported that they used needles to remove jiggers, 16.1% (69) used thorns while 0.2% (1) used a blade. No respondent or household members visited a health facility for treatment.

Table 4.11 Health seeking behavior and practices towards Tungiasis

Characteristics	n=129	%
Symptoms of Jiggers		
Regular inspection	12	9.3
Itching	117	90.7
Action taken when one has jiggers		
Nothing	1	0.8
Remove	118	91.5
Remove and apply products	10	8.5
How jigger is removed		
Needle	61	47.3
Blade	1	0.8
Thorn	67	51.9
Number of household members infested		
1-2 members	88	68.2
3-4 members	34	26.4
5-6 members	4	3.1
7-8 members	3	2.3
Means of determining infestation		
Regular inspection	4	3.1
Itching	113	87.6
Complain	12	9.3

CHAPTER FIVE

DISCUSSION

5.1 Discussion

The results of this cross-sectional study show that tungiasis is a problem of public health concern in Kipkelion West Sub County. This is similar to recent studies from Nigeria and Cameroon which indicated that it is a major public health problem in West Africa (Ugbomoiko *et al.,* 2007b). The level of education was generally low with majority of the respondents having acquired education up to primary level. Majority of the participants were married Christians who lived in semi-permanent houses with earthen floors. Farming emerged to be the main economic activity practiced by majority of the household heads that participated in the study. Previous findings of tungiasis being a disease of the poor were further confirmed in this study where higher odds of infestation were observed in the participants whose household heads were unemployed compared to those whose care givers were employed. This may be attributed to affordability of some basic commodities including soap, water and insecticide regarded as protective factors in a Nigerian study (Ugbomoiko *et al.,* 2007b).

An overall point prevalence of 30.1% was established in this study. This is within the prevalence rate range of between 21% and 43% documented in a few similar studies done in Nigeria (Ade-Serrano & Ejezie, 1981; Arene, 1984; Nte & Eke, 1995, Ugbomoiko *et al.,* 2007b). However, the findings of this study were contrary to a study that was conducted in Murang'a South, Kenya that obtained a prevalence of 57% among school going children aged 5-12 years (Nicholas *et al*., 2012). Distribution of infestation by gender was not statistically significant. However, similar to previous studies in a rural setting in Nigeria, the proportion of male infested was slightly higher than female. This could be attributed to higher exposure as males spend more time outside (mostly barefooted) and different disease related behavior. (Ugbomoiko *et al.,* 2007b) Itchiness, pain upon pressure and sleep disturbance were identified to be the main symptoms

experienced by majority of those infested in the study area. School going children (5-12 years) were the most vulnerable age group in KipkelionWest Sub County and this similar to findings of other studies conducted in Nigeria, Brazil and others regions in Kenya (Ugbomoiko *et al;* 2007; Heukelbach *et al;* 2001; Nicholas *et al*; 2012; Kamau *et al;* 2014). Majority of those infested had moderate infestation. This is similar to findings of other studies conducted in Nigeria, Brazil and others regions in Kenya (Ugbomoiko *et al.,* 2007; Heukelbach *et al.,* 2001; Kamau *et al.,* 2014).

The importance of housing conditions for transmission of tungiasis has been described in previous studies. In a Brazilian study, living in a house built on dune, living in a house made of palm products and having a floor of sand or clay inside the house were important risk factors for infestation in multivariate analysis (Muehlen *et al.,* 2006). Similar to studies conducted in Nigeria and Murang'a the house type was not an independent factor associated with occurrence of tungiasis but was confounded by the type of floor inside the house and presence of cracks on walls and floors (Nicholas *et al*., 2012; Kamau *et al.,* 2014; Ugbomoiko *et al.,* 2007). Earthen floor found in majority of the houses in Kipkelion provides an ideal breeding environment for the jigger flea. Earlier studies have indicated house lighting to influence the hide places' for the jigger flea. This was confirmed in this study where majority of the household members found to be infested used paraffin lamp which does not provide adequate lighting. A source of water which has been reported in a previous study in Nigeria to have an indirect relationship with tungiasis was assessed in this study (Ugbomoiko *et al.,* 2007). Most households (80.8%) used well, river or streams water which were more than a kilometer from the households. This influences hygiene standards particularly sprinkling of water on earthen floors which was the most common type of floor in residential houses of those found to be infested.

It is known that animal reservoirs play an important role in transmission of the jigger flea in endemic communities. Dogs, chicken, cats and rats have particularly been reported to be commonly infested (Heukelbach *et al.,* 2004). Data from the study

indicate that rats and chicken were the most significant animal reservoirs in KipkelionWest Sub County. This is unlike studies in Nigeria and Cameroon where pigs were emphasized to be the most important animal reservoirs (Njeumi *et al.,* 2002; Ugbomoiko *et al.*, 2007a). Similar to the Nigerian and Murang'a studies but contrary to the Brazilian study dogs, were not identified to increase the prevalence in the study area. Reduction of rat population and dusting animal reservoirs with insecticides which have been described as effective intervention measures would also be applicable in the study area (Heukelbach *et al.,* 2004).

Use of closed shoes whenever the feet touch contaminated soil has been previously reported to prevent tungiasis in Brazil (Heukelbach *et al.,* 2001). Its consistent use has also been reported to reduce infestation rate by half in Nigeria (Ugbomoiko *et al.,* 2007a). Similarly, lack of regular use of footwear emerged to be a very significant factor associated with occurrence of tungiasis in Kipkelion West Sub County. Living in littered compounds also emerged to be a significant factor associated with occurrence of tungiasis in Kipkelion West Sub County. Proper waste disposal discussed as a factor to reduce the incidence of tungiasis in a Nigerian study may also be applicable in the study area. (Heukelbach *et al*; 2004).

Efforts to determine knowledge on what should be done in case of jigger infestation revealed that communities suffering from tungiasis do not recognize it as an important health problem. This is similar to published data from north-east Brazil (Wilcke *et al.,* 2002). Despite severe disease being present among the residents of Kipkelion West Sub County, those infested did not seek heath care. As a result of this behavior those infested are at risk of developing super infections and secondary conditions such as tetanus and HIV. With regard to action taken when infested, majority of respondents reported to either remove or remove and apply products. None of the respondents reported use of insecticides to fumigate the houses and to dust domestic animals which have been described as protective measures in the Nigerian and Brazilian studies (Ugbomoiko *et al.,* 2007; Heukelbach *et al.,* 2001).

CHAPTER SIX

CONCLUSIONS AND RECOMMENDATIONS

6.1 Conclusion

The prevalence of tungiasis in the study area was 30.1%. Factors associated with occurrence of tungiasis in Kipkelion West Sub County included: chicken ownership, presence of rats in the compound, presence of cracks on walls of the residential houses, presence of waste products near the living premises, domestic animals living close to the residential houses and regular use of footwear. None of those respondents found to be infested sought health care.

6.2 Recommendations

For effective and sustainable control of tungiasis, it is recommended that the Ministry of Health should encourage the following:

i. treatment of affected individuals with sterile material
ii. reduction of rat population
iii. dusting or spraying domestic animals with insecticides
iv. improve housing conditions (cement floors inside houses,smearing cracked walls)
v. Health education focusing on behavior change among those infested (seeking health care in the formal health care system)
vi. Awareness campaigns by partners such as Ahadi Kenya trust on importance of regular use of footwear
vii. Improve sanitation, waste management and hygienic conditions
viii. Separation of animals from domestic residence

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APPENDICES

APPENDIX 1: INFORMED CONSENT FORM

TITLE OF STUDY: Prevalence of tungiasis and associated factors among residents of Kipkelion West Sub County; Kericho County, Kenya.
INVESTIGATOR: Chiuri Waruguru

INSTITUTION: Jomo Kenyatta University of Agriculture and Technology.

INTRODUCTION

Tungiasis is a parasitic skin disease caused by permanent penetration of the female sand flea *Tunga penetrans*, also called jigger flea, into the epidermis of its host. In Kenya 2.6 million people are estimated to be at risk of infestation.

PURPOSE OF THE STUDY

The aim of this study is to determine the prevalence and associated factors for tungiasis among residents of Kipkelion West Sub County.

STUDY PROCEDURES

The principal investigator and research assistants will recruit residents of the district for interviews. During the interviews, participants will be asked questions pertaining to the demographic characteristics as well their health status particularly in relation to tungiasis. Participants will also be requested to give any relevant information about the factors associated with tungiasis. Visual clinical examination for jiggers will also be performed by carefully inspecting the legs, feet, hands and arms of one your household members. If therefore, you wish to participate, the principal investigator requests that you give permission by signing the consent form.

RISKS/DISCOMFORTS

There are no direct risks to the subjects who will participate in this study.

BENEFITS

This research project is purely academic; there are no direct benefits to the participants. The findings will benefit science by adding information to solve health challenges in the society. However, participants recruited for the study will be able to know whether they have tungiasis or not; those with the disease will be referred to the public health officials for appropriate care.

CONFIDENTIALITY

All information given will be treated with a high level of confidentiality; no name(s) will be used. Instead, a unique code for each informant will be used. The questionnaires will be locked up for information security and will be destroyed after exactly one year from the day of data collection.

CONSENT AGREEMENT

I have read the information, or it has been read to me. I have had the opportunity to ask questions about it and any questions I have asked have been answered to my satisfaction. I consent voluntarily to participate as a subject in this study and understand that I have the right to withdraw from the study at any time without in any way affecting my further health care.

You will be given a copy of this form to take with you.
Thank you for your participation.

CONTACTS

In case of any queries or concerns, please contact the following:-

Chiuri Waruguru: Principal investigator

Cell phone no.: +254 724 817 585

Email: sarahwaruguru@ymail.com or

Wesley Kirui, Main Study Assistant

Public Health Officer, Kipkelion West Sub County

Cell No: 0727 230 431; Email: wesorui@yahoo.com or

The Principal;

College of Health Sciences

Jomo Kenyatta University of Agriculture and Technology

P.O. Box 62200-00200; Nairobi

Tel-067-52711

itromid@kemri.org or

The Secretary; KEMRI Ethics Committee

P.O. Box 54840-00200; Nairobi; Tel-2722541-2713349-072220590
erc@kemri.org

Participant signature ----------

Date ----------

Thumb print/signature ----------

Researcher's signature ----------

Date ----------

APPENDIX II: QUESTIONNAIRE

PREVALENCE OF TUNGIASIS AND ITS ASSOCIATED RISK FACTORS AMONG RESIDENTS OF KIPKELION WEST SUB COUNTY, KERICHO COUNTY, KENYA

Basic Information

1) Household number: ----------
2) Name of village: ----------
3) Date of interview: Day----------Month----------Year----------
4) Data collector's name and signature:----------
5) Checked by: ----------

A) Socio-demographic factors

1) Age/ *Kenyit*: _____
2) Sex/*Muren anan Kwonda*: (1) Male/*Muren* ( ) Female/*Kabokorion* ☐
3) Duration of residence/*kiri mengise kenyisiek ata eng*

   (1) > 6 months/*Ne sire* arawek *lo* ( ) ≤ 6months/*Ne tom koit arawek lo* ☐
4) Marital status/ *Girikese/gikitunin?*

	Single	*Ne tom kitun anan kotunis*	
2	Married	*Itunot anan ko ne kikitun*	
3	Separated	*Che kikomeny ter ter*	
4	Divorced	*Che kikobesio*	
5	Widow(er)	*Ne kisirto boiyot anan ko chebioset*	
6	Other(Specify)	*Ak alak*	

4) Level of education / *giit ata en sugul?*

0	None	*Momi*	
1	Nursery	*Tunet ne tai nebo somanet*	
2	Primary	*Gilasit agenge agoi sisit*	
2	Secondary	*Gilasit sokol agoi taman aka eng*	
4	Tertiary	*Kou somanet age kakaitar glasit taman aka eng*	

5) Religion / *obendi kaniset ainon?*

0	No Religion	*Matinye kaniset*	
1	Christian	*Christianinindet*	
2	Hindu	*Hinduek*	
3	Traditional	*Kipkaa*	
4	Muslim	*Isilamiek*	
5	Other	*Ak alak*	

6) Occupation / *iyoe boisio nee?*

0	Unemployed	*Momi boisiet*	
2	Farmer	*Temininteت*	
3	Businessman	*Chi ne yae mungaret*	
4	Formal employment	*Kibaitinikab serikali*	
5	Other	*Ak alak*	

C) Human associated Factors

1. What do your children sleep on / *ruene lagokuk?*

(1) Mattress on bed ☐ (2) Mattress on floor (3) Mat on floor ☐ (4) other ☐

(1)Mutoit eng kitanda ☐ *(2) mutoit en ngwony* ☐ *(3) Mukeke eng ngwo* ☐ *(4) alak* ☐

2. What kind of shoes do children put on when inside the house / *kweonik achon che ilochi lagok yon miten ko?*

(1) Closed shoes ☐ (2) Slippers/ *simbe* ☐ (3) Barefoot/ *ngwon* ☐ (4) Other/ *alak*

3. What kind of shoes do children put on when outside the house / *kweonik achon che ilochi lagok yon miten sang?*

(1) Closed footwear ☐ (2) Slippers/ *simbel* ☐ (3) Barefoot/ *ngwony* ☐ (4) Other/ *alak*

4. Where do children spend most of their time / *ibure en ano lagok sait age tugul?*

(1)Veranda in front ☐ (2) Yard ☐ (3) Backyard ☐ (4) other _____

(1) tai eng got ☐ *(2) biiut* ☐ *(3) bi keter* ☐ *(4) alak* ☐

5. What do adults sleep on /*Nee tukuk che ruenbik che echen?*

(1)Mattress on bed ☐ (2) Mattress on floor ☐ (3) Mat on floor ☐ (4) other ___

(1)Mutoit eng kitanda ☐ *(2) mutoit en ngwony* ☐ *(3) Mukeke eng ngwony* ☐ *(4) alak* ☐

6. What kind of shoes do adults put on when inside the house / *kweonik achon che ilochi bik che echen yon miten ko?*

(1) Closed footware ☐ (2) Slippers/ *simbel* ☐ (3) Barefoot/ *ngwony* ☐ (4) Other/ *alak*

7. What kind of shoes do adults put on when outside the house/ *kweonik achon che ilochi bik che echen yon miten sang?*

(1) Closed footware ☐ (2) Slippers/ *simbel* ☐ (3) Barefoot/ *ngwony* ☐ (4) Other/ *alak*

B) Housing and associated factors

8. House structure/ *kigitegen nee kong'wong'?*

(1) Brick/ blocks ☐ (2) Stone building ☐ (3) Wood only ☐ (4) Iron ☐ sheets

(5) Mud/cement ☐ (6) Mud/wood ☐ (7) other _____

(1) kotab matubaruk (2) kotab koita (3) kotab bokoinik (4) kotab kibatit

(5) kotab menet/ simenti (6) kotab menet nebo bokoinik (7) alak

9. Number of rooms in the house / *romisiek ata kong'wong'?*_____

10. House floor / *kigitegen nee ng'wony?*

(1) Cemented ☐ (2) Tile ☐ (3) Wooden ☐ (4) Earthen ☐ (5) Other

(1) simenti (2) taels (3) bokoiyot (4) kemalen ngatatiat (5) alak

11. House roof / *kigimugulen nee kong'wong'?*

(1) Iron sheet ☐ (2) Grass/Makuti ☐ (3) Tiles ☐ (4) concrete (5) other _____

(1)Kipatit (2) suswek (3) taels (4) kibatit ne (5) alak

12. House lighting / *ololel nee?*

(1) Electricity ☐ (2) Solar ☐ (3) Paraffin lamp (4) Other

(1) sitimet (2) solait (3) taitab mwanik (4) alak

13. Source of water supply / *oboisen beek che bunu ano?*

(1)Piped ☐ (2) Borehole ☐ (3) Well ☐ (4) River/Stream ☐ (5) Other _____

(1) paiput (2) keringet (3)togomto (4) ainet ne rote (5) alak

14. Waste product disposal / *ontoiy ano takataka?*

(1) Yard ☐ (2) Backyard ☐ (3) Outside/public disposal ☐ (4) other _____

(1) Biuutab got (2) Batetab kot (3) Bii (4) Alak

15. Do you burn the waste / *tos obele takatakee?*

(1) Yes/ *eei* ☐ (0) No/ *acha* ☐

16. Veranda in front of the house / *veranda kogigichoben nee?*

(1) Yes/ *eei* ☐ (0) No/ *acha* ☐

17. If yes type of floor / *ngowny kogigichoben nee?*

(1) Cement ☐ (2) Wooden ☐ (3) Earthen ☐ (5) Other _____

(1)Simenti (2)bakoiyat (3) ngony buch (5) alak

C) Ownership and presence of domestic animals

18. Do you have chicken / *otinye ingokenik?*

(1) Yes/ *eei* ☐ (0) No/ *acha* ☐

If yes how many / *ata?*

(1) (2) (3) (4) (5) (more than 6) Other _____

(Agenge),(aeng), (somok), (agwan), (mut) (sire loo) alak

If yes how do they live / *menye ano?*

(1) Free ☐ (2) Poultry house ☐ (3) Main house ☐

(1) matinye kot (2) Kotab ikogenik (3) Kot ne kimenye

19. Do you have dogs / *otinye ngo'kto?*

(0) No/ *Acha* ☐ (1) Yes/ *eei* ☐

If yes how many / *ata?* (1) (2) (3) (4) (5) (more than 6) Other _____

(Agenge),(aeng), (somok), (agwan), (mut) (sire loo) alak

If yes how do they live / *menye ano?*

(1) Free ☐ (2) Kennel ☐ (3) Main house ☐

(1) Matinye kot (2) Kotab ngonkto (3) Kot ne kimenye

20. Do you have pigs / *otinye ngurwet?*

(0) No/ *Acha* ☐ (1) Yes/ *eei* ☐

If yes how many / *ata?* (1) (2) (3) (4) (5) (more than 6) Other _____

(Agenge),(aeng), (somok), (agwan), (mut) (sire loo) alak

If yes how do they live / *menye ano?*

(1) Free ☐ (2) pigsty ☐

(1) matinye kot (2) kotab nguronik

21. Other animals / *otinye tiongik alak?*

(0) No/ *acha* ☐ (1) Yes/ *eei* ☐

If yes, what are they / *achon?*

(1) Goat ☐ (2) Cow ☐ (3) Other _____

(1) artet (2) teta (3) alak

22. Are there rats in the house/compound / *mi murek got anan bii?*

(1) Yes/ *eei* ☐ (0) No/ *acha* ☐

D) Knowledge and Practices towards Tungiasis

23. What is tungiasis/ *Nee ingele kanamin imbulugik?*

24. How does one get it (transmission)/ *Namdo ano chito?*

25. Are you jigger infested/*Kika konamin mbulungik besio*?

(1) Yes/ *eei* (0) No/ *acha*

26. If yes, are you frequently infested by jiggers / *Nomin obogora imbulugik*

(1) Yes/ *eei* ☐ (0) No/ *acha*

(If no, proceed to question 30)

If yes, how do you determine / *got ko ee inotoiy ano?*

(1) Regular inspection ☐ (2) Itching ☐ (3) other _____

(1) Kichekeni kila (2) Iututi (3) Iyoyi 4. alak

27. What do you do when you have jiggers / *iyonee yon tinye mbulugik?*

(0) Nothing ☐ (1) Remove ☐

(2) Apply products ☐ (3) Remove and apply products ☐

(4) Visit the health center/hospital ☐

(0) momi kiy (1) Kinem (2) I ilen kerichek (3) Inemu ak iilen gerichek

(4) Imut koba sibitali

28. If you remove, who does it / *got ginemu go nemu ngo?* _____

29. How is it done / *ginemundo ano?*

(1) Needle ☐ (2) Blade ☐ (3) Thorn ☐ (4) Other _____

(1) sindanut (2) Embeit (3) Katet (4) alak

30. Are your household members jigger infested? / *tos namei enkotugul tutu?*

(1) Yes/ *eei* ☐ (0) No/ *acha* ☐

(If no, proceed to question 33)

If yes how many?.....

How old? (1) <5yrs (2) 5-12yrs (3) 13-35yrs (4) 35-50yrs (5) >50 yrs

Kenyisiek ata? (1) Mut akoba barak (2)Muit koit tamanak aeng (3)tamanak aeng akoi sosom ak mut (4) Sosomak mut akoi sitini (5) Masire Sitini

If yes, how do you determine / *got ko ee inotoiy ano?*

(1) Regular inspection ☐ (2) Itching ☐ (3) Complain ☐ (4) other _____

(1) Kichekeni kila (2) Iututi (3) Iyoyi (4) alak

31. What do you do when household members have jiggers / *Tos iyonee yon miten bik en ko che tinye tutu?*

(0) Nothing ☐ (1) Remove ☐

(2) Apply products ☐ (3) Remove and apply products ☐

(4) Take them to hospital/health center ☐

(0) Momi kiy (1) Kinem (2) I ilen kerichek (3) Inemu ak iilen gerichek

(4) Imut koba sibitali

32. If you remove, who does it / *got ginemu go nemu ngo?* _____

33. How is it done / *ginemundo ano?*

(1) Needle ☐ (2) Blade (3) Thorn ☐ (4) Other _____

(1) Sindanut (2) Embeit (3) Katet (4) alak

APPENDIX III: OBSERVATION CHECKLIST

Checklist Number _____

Date of visit: _____

Name of data collector and signature: _____

Name of the village: _____

Number of the household: _____

N.B: Observe the following factors and tick yes or no during the data collection period

1. **Housing and compound sanitation**

No	**Questions**		(1) Yes	(0) No
1.	Type of the construction material(walls)	Brick/ blocks		
		Stone building		
		Mud/wood		
		Mud walls		
		Wood only		
		Iron sheets		
		Other		
2.	Are there cracks on the walls?			
3.	Type of the floor inside the house	Cemented		
		Earthen		
		Wooden		
		Tiles		
		Other		
4.	If earthen, is it frequently sprinkled with water?			
5.	Type of the house roof	Iron sheet		
		Grass		
		Tiles		
		Concrete		
		Other		
6.	Is there a veranda in front of the house?			

7.	If yes to 4 what is it made of	Cement		
		Earthen		
		Wooden		
		Other		
8.	What kind of lighting do they use	Electricity		
		Paraffin lamp		
		Solar lamp		
		Other		
9.	What is the water source	Piped		
		Well		
		Borehole		
		River/Stream		
		Other		
10.	Is the inside of the house clean?			
11.	Is the compound clean?			
12.	Is a latrine available in the compound?			
13.	Are there waste disposal bins	In the house		
		In the compound		
14.	Are there waste products near the house?			
15.	Is the compound	Muddy		
		Dry/dusty		
		Bushy		

2. Human associated factors and presence of domestic animals

No	Questions		Yes	No
1.	What do the people put/wear on outside the house	Slippers		
		Barefoot		
		Shoes		
2.	What do children sleep on?	Floor		
		Mat on floor		
		Mattress on bed		
3.	What do adults sleep on?	Floor		
		Mat on floor		
		Mattress on bed		
4.	Are there domestic animals in the compound?			
5.	If yes to 4, which ones	Dogs		
		Cats		
		Pigs		
6.	Do the domestic animals live in close proximity to the residential houses?			

APPENDIX IV: CLINICAL EXAMINATION FORM

Date ____/____/____ Household number ____

Name _____ Age: _____ Sex: _____

RIGHT FOOT

Toes

None ☐ Stage (I) ☐ Stage (II) ☐ Stage (III) ☐ Stage (IV) ☐ ☐ Manipulation

Sole

None ☐ Stage (I) ☐ Stage (II) ☐ Stage (III) ☐ Stage (IV) ☐ Manipulation ☐

Heel

None ☐ Stage (I) ☐ Stage (II) ☐ Stage (III) ☐ Stage (IV) ☐ ☐ Manipulation

LEFT FOOT

Toes

None ☐ Stage (I) ☐ Stage (II) ☐ Stage (III) ☐ Stage (IV) ☐ Manipulation ☐

Sole

None ☐ Stage (I) ☐ Stage (II) ☐ Stage (III) ☐ Stage (IV) ☐ Manipulation ☐

Heel

None ☐ Stage (I) ☐ Stage (II) ☐ Stage (III) ☐ Stage ☐ (IV) ☐ Manipulation

RIGHT ARM

None ☐ Stage (I) ☐ Stage (II) ☐ Stage (III) ☐ Stage ☐ (IV) ☐ Manipulation

LEFT ARM

None ☐ Stage (I) ☐ Stage (II) ☐ Stage (III) ☐ Stage (IV) ☐ ☐ Manipulation

OTHER PATHOLOGIES

- ☐ Itching
- ☐ Spontaneous pain
- ☐ Pain upon pressure
- ☐ Difficulty in walking
- ☐ Sleep disturbance due to itching/pain

Total number of lesions ……

Guideline for clinical examination

Stages will be assigned as follows;-

Stage (I)-penetrating fleas **Stage (II)** - A red-brown itching spot with a diameter of 1-2mm (early lesion)

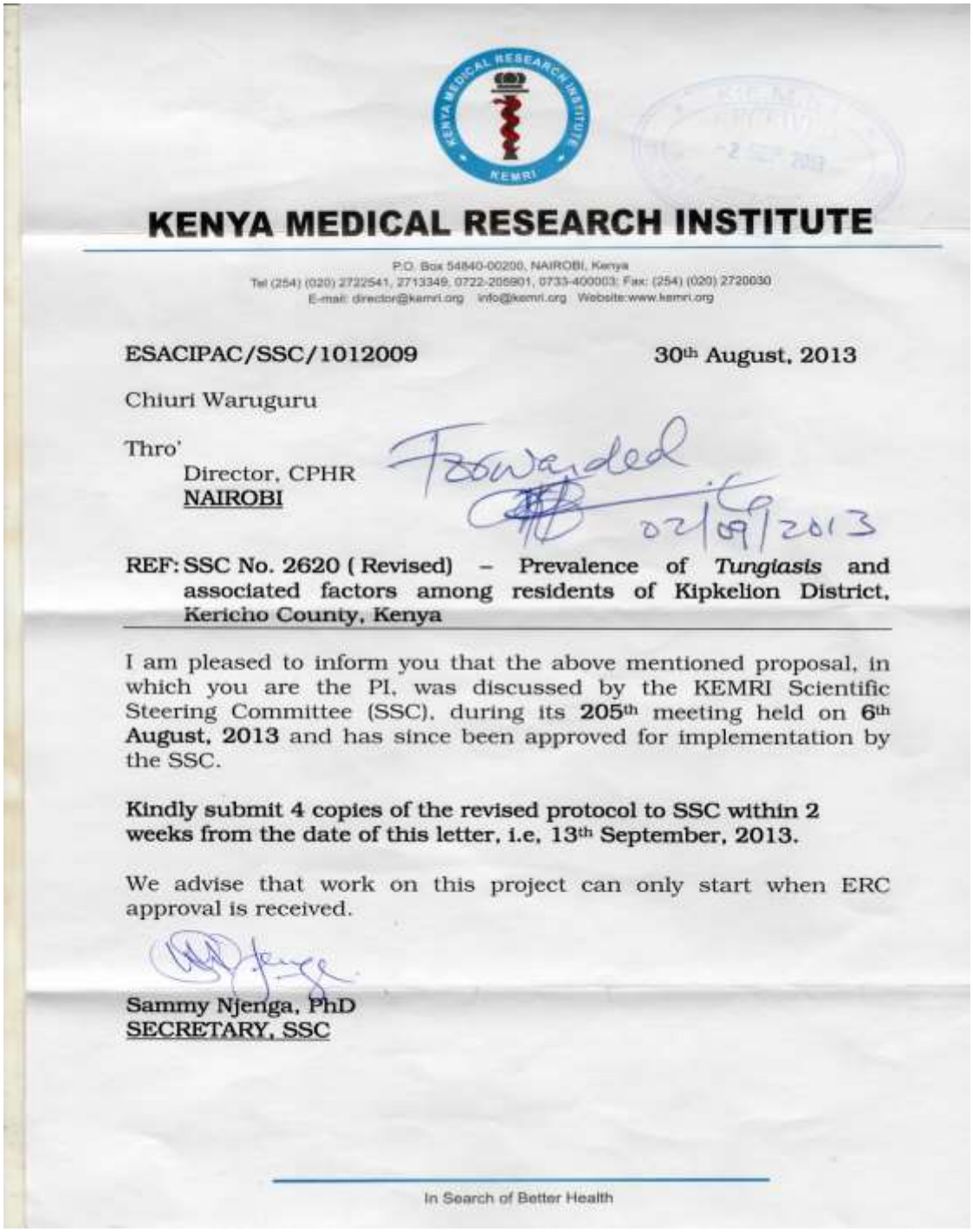
Stage (III) - A yellow-white watch glass-like patch with a diameter of 3-10mm with a central dark spot (mature stage)

Stage (IV) - lesions containing dying or already dead fleas

None –No infestation at all

Manipulation- Embedded sand fleas with evidence of manipulation by the patient or his/her caretaker

APPENDIX V: SCIENTIFIC STEERING COMMITTEE APPROVAL LETTER



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ESACIPAC/SSC/1012009 **30th August, 2013**

Chiuri Waruguru

Thro'
Director, CPHR
NAIROBI

Forwarded
02/09/2013

REF: SSC No. 2620 (Revised) – Prevalence of *Tungiasis* and associated factors among residents of Kipkelion District, Kericho County, Kenya

I am pleased to inform you that the above mentioned proposal, in which you are the PI, was discussed by the KEMRI Scientific Steering Committee (SSC), during its **205th** meeting held on **6th August, 2013** and has since been approved for implementation by the SSC.

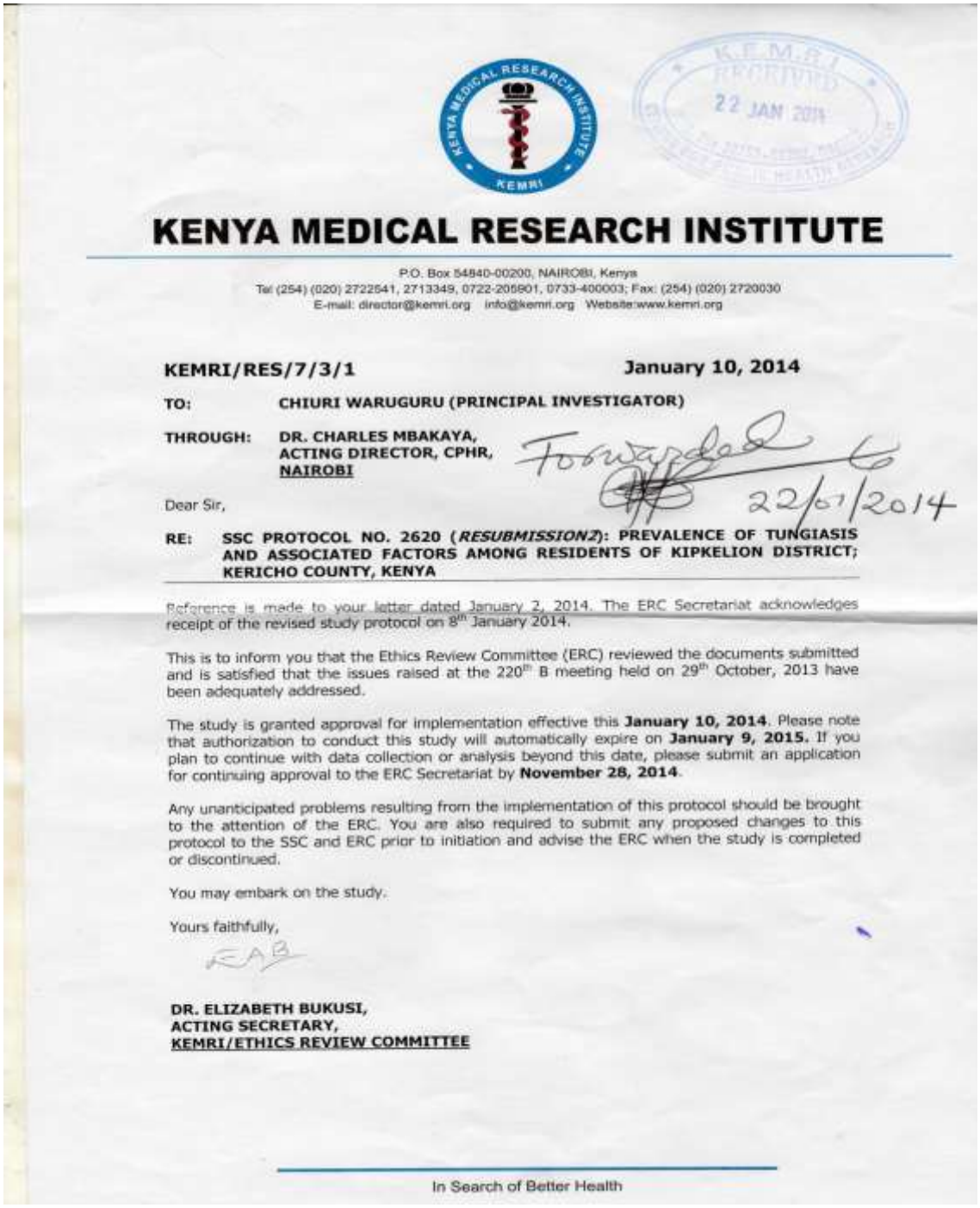
Kindly submit 4 copies of the revised protocol to SSC within 2 weeks from the date of this letter, i.e, 13th September, 2013.

We advise that work on this project can only start when ERC approval is received.

Sammy Njenga, PhD
SECRETARY, SSC

In Search of Better Health

APPENDIX VI: ETHICAL REVIEW COMMITTEE APPROVAL LETTER



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KEMRI/RES/7/3/1 **January 10, 2014**

TO: **CHIURI WARUGURU (PRINCIPAL INVESTIGATOR)**

THROUGH: **DR. CHARLES MBAKAYA,**
ACTING DIRECTOR, CPHR,
NAIROBI

Forwarded
22/01/2014

Dear Sir,

RE: **SSC PROTOCOL NO. 2620 (*RESUBMISSION2*): PREVALENCE OF TUNGIASIS AND ASSOCIATED FACTORS AMONG RESIDENTS OF KIPKELION DISTRICT; KERICHO COUNTY, KENYA**

Reference is made to your letter dated January 2, 2014. The ERC Secretariat acknowledges receipt of the revised study protocol on 8th January 2014.

This is to inform you that the Ethics Review Committee (ERC) reviewed the documents submitted and is satisfied that the issues raised at the 220th B meeting held on 29th October, 2013 have been adequately addressed.

The study is granted approval for implementation effective this **January 10, 2014**. Please note that authorization to conduct this study will automatically expire on **January 9, 2015.** If you plan to continue with data collection or analysis beyond this date, please submit an application for continuing approval to the ERC Secretariat by **November 28, 2014**.

Any unanticipated problems resulting from the implementation of this protocol should be brought to the attention of the ERC. You are also required to submit any proposed changes to this protocol to the SSC and ERC prior to initiation and advise the ERC when the study is completed or discontinued.

You may embark on the study.

Yours faithfully,

EAB

DR. ELIZABETH BUKUSI,
ACTING SECRETARY,
KEMRI/ETHICS REVIEW COMMITTEE

In Search of Better Health

APPENDIX VII: ABSTRACT OF PUBLISHED ARTICLE

UHSR International Journal of Health Sciences and Research
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Original Research Article

Prevalence of Tungiasis and Its Associated Factors among Residents of Kipkelion West Sub-County; Kericho County, Kenya

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Received: 26/06/2015 *Revised: 16/07/2015* *Accepted: 29/07/2015*

ABSTRACT

Background: Tungiasis is a parasitic skin disease caused by penetration of the female sand flea *Tunga penetrans*, also called jigger flea, into the epidermis of its host. It is highly prevalent where people live in extreme poverty, occurring in many Latin American and African countries. In Kenya it is endemic in several areas where its prevalence and associated factors have not been intensely studied. Objectives: This study was aimed at determining the prevalence of tungiasis, establishing factors associated with tungiasis among residents of Kipkelion West Sub-county and establishing health seeking behavior among those that were found to be infested.

Material and Methods: A total of 428 randomly selected households were visited. Pretested questionnaires were administered to household heads and household members were examined for the presence of tungiasis. The level of statistical significance was set at P- value <0.05. Binary logistic regression was performed to determine the independent factors associated with tungiasis.

Results: The prevalence of Tungiasis was (129)30.1%. Factors that were independently associated with occurrence of tungiasis included: living in close proximity to domestic animals [AOR=6.58; 95%CI:3.42-12.65; P<0.001], staying barefoot [AOR=9.94; 95% CI: 4.18-23.61; P<0.001], wearing slippers outdoors,[AOR=6.45; 95% CI: 2.78-14.98; P<0.001], presence of waste products near residential buildings [AOR=3.73; 95% CI: 2.01-6.91; P<0.001], living in houses with cracks on the walls [AOR=6.92; 95% CI: 3.25-14.70; P<0.001], rearing chicken in the main house [AOR=8; 95% CI: 2.74-23.33; P<0.001], rearing free range chicken [AOR=6.59; 95% CI: 1.37-31.67; P<0.001] and presence of rats in the compound [AOR=2.18; 95% CI: 1.09-4.36; P=0.028]. None of those infested sought healthcare.

Conclusion: An integrated approach addressing factors that were established to be significant in occurrence of Tungiasis in the study area needs to be designed and implemented by an interdisciplinary team (that is the populace, community leaders, health professionals, non-governmental institutions and policy makers).

Keywords: Tungiasis, jigger infestation, *Tunga penetrans*, ectoparasitosis.

INTRODUCTION

Tungiasis is a disease caused by the sand flea *Tunga penetrans*. This parasitic infestation is commonly found in developing countries, especially in resource-poor communities and where basic hygiene