

## **Impact of Tungiasis on acquisition of basic education among children aged 5-14 years in Murang'a County, Kenya**

**Josephine Ngunjiri Bed.Sc., MSc.,** University of Nairobi Institute of Tropical and Infectious Diseases, P.O Box 19676-00202, College of Health sciences Email; Wjngunjiri@gmail.com/jshikuh@yahoo.com

**Peter N. Keiyoro Ph.D.,** Senior Lecturer: Biological sciences, School of continuing and Distance education University of Nairobi, P. O Box 30197-01000, Nairobi

**Walter Mwanda Professor of Haematology,** University of Nairobi Institute of Tropical and Infectious Diseases, P. O Box 19676-00202, College of Health sciences.

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Corresponding Author ; JosephineNgunjiri ; email Wjngunjiri@gmail.com/jshikuh@yahoo.com

### **Abstract**

#### **Background**

*Millions of school age children all over the world are out of school due to various reasons which range from disabilities caused by diseases, natural calamities, insecurity, and poor infrastructure to lack of basic amenities. Tungiasis is a neglected disease that is caused by female Tungiasis flea, Tungapenetrans that embeds on the hosts' epidermis. This Study was carried out to determine Tungiasis prevalence among school age children 5-14 years and to relate the disease status to acquisition of basic education.*

#### **Methodology**

*A cross-sectional descriptive research design in which 200 households were systematically randomly selected from which a maximum of two children aged 5-14 years were recruited adding to a total of 384 children. Questionnaires, interview guide, observation check list and physical examination guide were used to collect data. Data analysis was carried out using SPSS version 21 software. Correlations and regression tests, Wald chi square test were carried out in addition to descriptive statistics.*

#### **Results**

*A total of 347 children aged between 5-14 years participated in the study from a sample of 384 children drawn from 200 households. Prevalence of Tungiasis at household level was at 37 % (74 households) while among children the prevalence was at 44 % (153), out of whom 63% (97) were male and 37% (56) were female. It was shown that children who were younger aged below 11 years were vulnerable to Tungiasis at p-value 0.048. Family size and Tungiasis status have a negative Pearson relationship -0.01. However the relationship is not statistically significant (p-value 0.979). This study found that, children suffering from Tungiasis were likely to repeat same class even more than one time (p-value 0.007). Tungiasis status was found to influence the ability of children to attend school at p value 0.001.*

#### **Conclusion**

*Tungiasis is prevalent among the children aged between 5-14 years in endemic areas. Chronic Tungiasis that had lasted for more than 1 year was common among children. Severe Tungiasis caused morbidity among children, low rate of school attendance and caused high dropout rates. Acquisition of basic education can be improved by addressing and managing Tungiasis which would improve school attendance, retention and dropout rates.*

**Key words: disability, time, Tungiasis, child and basic education**

## **Introduction**

Acquiring education among children can be derailed by various reasons which could range from ill health, need for children to work or care for sick family members, insecurity, natural calamities, inability to afford uniforms to inadequate sanitation and basic amenities. In the year 2010, 1.01 million primary school children were not schooling in Kenya due to various reasons which may have included disabilities caused by infectious diseases (UNESCO, 2012). This is in spite of major efforts made to increase literacy levels for example free compulsory education in Kenya (Ingubua and Wambua, 2011). Acquisition of education has been thought to be a tool in which the socio economic status can be improved thus enhancing the living standards and access to health care of individuals, families and communities (Ojiambo, 2009; Bogonko, 2006).

Tungiasis is caused by female *Tungapenetrans* commonly known as jigger flea or sand flea. The disease is self-limiting in cases where re-infestation is not common. The ectoparasitic skin condition is a neglected disease and mainly affects resource poor members of the communities (Feldmeier and Heukelbach, 2009; Molyneux *et al.*, 2005; Heukelbach *et al.*, 2001). Children suffering from Tungiasis often experience socio inequalities due to the morbidity caused by the disease. Other socio inequalities among children suffering from the disease arise because of stigmatization of the patients and minimal efforts in prevention and management of the disease. The socio inequalities would limit access to quality health care, education, proper sanitation, clean water and basic needs (Helman, 2007). Therefore children suffering from Tungiasis must be enabled to obtain health care and formal education. It has been found that one year in primary school would improve income by 10% and individuals who have been in school for more than six years are likely to seek health care especially women of child bearing age (Psacharopoulos and Patrinos, 2004).

Tungiasis affects all age groups with different levels of severity and outcomes that reduce the quality of life. For instance if the parents are affected by the disease there is a likelihood that their economic productivity would be reduced which may promote child labor in endemic areas. This is because the disease outcomes include physical disabilities, isolation and psycho socio stress. In other studies school age children who were diagnosed with parasitic worms' infections had lowered school attendance, cognitive and physical development that was found to improve after treatment (Miguel and Kremer, 2004). Parasitic infections have also been cited to reduce learning ability among children, retard their growth and reduce their potential for future employability (Hotez *et al.*, 2009; Bleakley, 2003; WHO, 2004; Grantham-McGregor and Ani, 2001). School attendance has been used as an indicator of performance (Grigorenko *et al.*, 2006, Partnership for Child Development, 2002). Performance in tests among School age children in most cases are used to determine suitability of promotion to the next class/grade and transition to secondary school.

Morkve (2013) noted that Tungiasis is a threat to learning process of the children leading to school dropout in endemic areas. Children aged 5-14 years are in their formal schooling years during which they acquire basic education. Community-based studies have consistently shown prevalence of Tungiasis range between 16% and 55% in endemic areas with a highest prevalence among the children aged 5 to 14 years, the elderly and the male across the two prone age groups (Muehlen *et al.*, 2003). This could be because the vulnerable age groups have limited self-care when infested by the female jigger flea, spend more time at home. Other disabilities caused by Tungiasis may limit capacity to self-care and access to effective intervention measures. In Kenya, efforts to avert the burden caused by Tungiasis are hoped to be enhanced by a policy launched by Ministry of Health (GOK-Tungiasis policy, 2015).

Murang'a County is considered to be one of the Tungiasis endemic areas in Kenya. Other areas with different levels of Tungiasis prevalence include Nyeri, Kwale, Malindi, Kericho, Narok, Emuhaya, Meru and Kakamega counties (AHADI, 2009). In one of the study in Murang'a the overall prevalence was found to be 49% (Ngunjiri and Keiyoro, 2011). It has been reported that 50 per cent of the children suffering from

Tungiasis may miss to attend classes (AHADI, 2009). Severe complications due to Tungiasis are common in areas where people experience constant re-infestation and where hygiene conditions are poor (Feldmeier, *et al.*, 2006). Bacterial super infection is often present, abscesses and ulcers are commonly seen among patients diagnosed with Tungiasis (Sousa *et al.*, 2002). Pain, inflammation and fissures hinder individuals from walking; other sequelae include deformation and loss of toenails, as well as deformation of digits. In non-vaccinated individuals, lesions may be a point of entry for tetanus infection (Heukelbach, 2005; Joseph *et al.*, 2006). All these disease outcomes are overbearing especially to the children thus the need to be quantified and put mechanisms in place to prevent and manage the condition.

On the other hand, Kenyan government is committed to the provision of quality education and training as a right to all Kenyans in accordance with the Kenyan law, Education act 2013 and the international conventions, such as the Education For All (EFA) goals, and has developed strategies for moving the country towards the attainment of this goal (Ingubua and Wambua, 2011). The implementation of Free Primary Education (FPE) is critical to the attainment of Universal Primary Education as a key milestone towards realization of the EFA goals. The health issues including Tungiasis may complicate the realization of these goals. Missing to attend school even for a few days for any reason has been found to contribute to low scores in standardized tests and substantial school dropout rates (Chang and Romero, 2008). The rate of school attendance at primary school have also been attributed to progressing and completion of secondary school education ( McGiboney ,2012). This has been explained by the fact that when children attend school they socialize, play and develop attitudes and physical abilities . The skills and attitudes to socialize, complete task, take responsibility motivates these children to pursue further education and become responsible citizens. This further informed on the need to carry out the study to establish the impact of Tungiasis on acquisition of basic education among children aged 5-14 years.

### **Methodology**

The study was conducted in Kandara Sub County in Murang'a County in central Kenya. The County covers an area of 930 Km<sup>2</sup>, a population density of 374 per Km<sup>2</sup> and a total population of 942,581 according to the 2009 census with a growth rate of 0.2 per annum. The temperatures in the county varies between a maximum of 26° C and 30° C while the minimum annual temperatures range between 14° C and 18° C. More than 95% of the land is generally mountainous landscape with red volcanic soils.

The inhabitants in the area have limited source of income in which about 39% are live below poverty line (one dollar per day ) rendering many school children to drop out of school prematurely. According to Murang'a county strategic plan (2005 – 2010) the primary school dropout was reported to be 6% for boys and 11% for girls. In the area, the main economic activity is small scale farming in which domestic animals dwell in close proximity with human beings. Housing conditions are inadequate and some of the houses are made of earthen floor, mud walls and have no connection to electricity. Infrastructures such as roads are under construction since some are usually impassable during the rainy season. The selection of the area of study was because it is a Tungiasis endemic area.

### **Study design.**

The principles of descriptive cross-sectional research design guided the study. The preliminary procedures and data collection were carried out between June, 2014 and 8th May, 2015. Preliminary procedures included visiting the study area, pretesting and modifying questionnaires, interview guides and physical examination guide, seeking consent and needed for recruiting participants.

The sample size was determined according to Fishers formula for prevalence studies (Fisher *et al.*, 1998). A total of 384 children 200 households aged 5-14 years who met the inclusion criteria were concurrently enrolled during the study. Out of these ten households with a total of 19 children opted out of the study during

data collection. Also 20 public primary schools were randomly sampled in addition to following children to their respective schools to determine class attendance.

### **Diagnosis of Tungiasis among the children**

The participants were requested to clean the feet and hands for accurate macroscopic examination. This was done on all body parts except private parts. Parents of the same gender will be requested to assist in macroscopic examination. The infestations were confirmed by the presence of the embedded female *T. penetrans* at various stages of development (Eisele *et al.*, 2003). In addition the participants were interviewed to capture the symptoms experienced at the time of recruitment and duration they had suffered the disease. Also depending on severity of the symptoms the disease status was categorized into mild and severe forms. In schools, the prevalence was determined via macroscopic examination. Where possible this is done after they have washed their feet using water, soap and disinfectant. Those with open wounds benefited from Grabacin and those who had confection with ringworms benefited from whitefield.

### **Determining variables of Acquisition of basic education**

School absenteeism was determined as described by Endy *et al.* (2002). Data on school attendance was done by checking class attendance for the year 2014 and the year 2015 from the class registers. The children recruited were followed to their respective schools. All the recruited children were attending schools in Kandara Sub County. In the schools, in attendance, questionnaires were administered and interviews carried out among the teacher in charge of health. In addition, a separate framework was used in order to follow the individual child's school attendance to increase reliability of capturing attendance (Endy *et al.*, 2002).

School dropout was determined from the schools by checking the registers, interviewing the head teacher and from the households. Class repetition was captured from, class registers, the age difference in which the age mates were enrolled in the current year and also interview from the parents. Observations and interviews were made to find out how disabilities caused by Tungiasis affected limited the children in engaging in learning activities which would promote acquisition of basic education

### **Inclusion and Exclusion Criteria**

Households sampled were included if there was a child aged 5-14 years present during sampling process and was located in either of the six constituency wards of Kandara sub county. Children and parents present during the visit of 200 sampled households were examined for presence of embedded female *T. penetrans*. In each household a maximum of two children were randomly selected to participant in the exercise. Children aged 5-14 years, both males and females were included in the study. All children in the sampled households were randomly recruited without considering Tungiasis status. Those suffering from Tungiasis must have had at least two clinical manifestations and confirmation of diagnosis by macroscopic examination of presence of parasitic female *T. penetrans* to be positively identified as suffering Tungiasis. The children attending school were included if the school they were enrolled was in Kandara sub county. The children who had embedded female *T. penetrans* but without clinical manifestations were not included in the study. Also those who were to be transferred to other schools during the study period were excluded from the study as well as those suffering from severe mental illness. Also children aged below 5 years and more than 14 years were excluded.

## Ethical considerations

An ethical approval from Kenyatta National Hospital ethics research committee was obtained (KNH-ERC/A/163) and also a research permit to conduct the study was obtained from the Ministry of Education, Science and Technology (NCST/RCD/12A/133). The copies of ethics approval and research permits were submitted to county government administrators and officials before starting data collection. An introduction letter was presented by the researcher to all participants during data collection. This will then be followed by explanation of objectives of the study. An opportunity to ask questions for clarification was given which enabled the participants to complete a written consent for participation.

## Statistical analysis

Data were checked for entry errors and analyzed using the statistic package for social scientist (SPSS) software package (version 21.0). Quantitative data analysis performed included descriptive analysis, mean, variance, standard deviation, skewness to test on normality. To test for association between two variables Chi-Square test was used while Pearson correlation test was carried out to determine relationships between two variables.

## Results

A total of 347 children aged between 5-14 years participated in the study from a sample of 384 children drawn from 200 households. The mean age of the children that participated was 10.16 years with SD 2.195. Prevalence of Tungiasis at household level was at 37 % (74 households) while among children the prevalence was at 44 % (153), out of whom 63% (97) were male and 37% (56) were female. Among the 20 schools sampled 85 % (17 schools) had at least some cases of Tungiasis with an average prevalence of 3.9 % (16 children) in each school. Test results show that the age of the children had a statistical significance, 5-9 years age group were more vulnerable to suffer from Tungiasis at ( $P < 0.048$ ). The family size mean was 4 individuals for all for the sampled households. Family size and Tungiasis status have a negative Pearson relationship -0.01. However the relationship is not statistically significant ( $p$ -value 0.979). This study found that, children suffering from Tungiasis were likely to repeat same class even more than one time ( $p$ -value 0.007). Hence the children were in primary school for more than eight years which encouraged dropout and low transition to secondary schools. School attendance was reduced at 1.83 days per term among all the children due to Tungiasis. However children suffering from severe Tungiasis lost five times school days, 12.74 days than those suffering from mild Tungiasis who lost 2.4 school days per term. Regression coefficient for Age (Years) has been found to be statistically different from zero in estimating Tungiasis Status given family size, number of school days missed, gender and head of household at  $p$  value 0.048. Also the regression coefficient for number of school days missed has been found to be statistically different from zero in estimating Tungiasis Status given family size, number of school days missed, gender and head of household at  $p$  value 0.001.

### Age and gender of the children in relation to Tungiasis prevalence

The age of a child affects their ability to take care of themselves in terms of removing embedded female *T. penetrans* and their tolerance of the pain when removing. In this study, the infestation was found to be more among children aged below 11 years both male and female who were 82% (121 children). This was also evident in terms of gender distribution whereby children who were male aged 5-11 years accounted for 83% (86) of all the male children suffering from Tungiasis. Among female children who were suffering from Tungiasis 35 (81%) were also aged between 5 years and 11 years. Children aged 12-14 years both male and female suffering from Tungiasis were 26 (18 %). Male children were more 18 (69%) of all the children suffering from Tungiasis in this age group while the female were 8 (31%) aged between 12-14 years. It was observed during data collection that some children were in one or two classes lower than their age mates although others had retained their good performance.

**Table 1; Distribution of the children by Age Bracket**

	<b>Both Male and female</b>	<b>Percent</b>	<b>Male</b>	<b>Female</b>	<b>Male Percent</b>	<b>Female Percent</b>
5 - 9 Yrs	135	38.9%	68	67	37.2%	40.9%
10 - 14 Yrs	212	61.1%	115	97	62.8%	59.1%
<b>Total</b>	<b>347</b>	<b>100.0%</b>	<b>183</b>	<b>164</b>	<b>100.0%</b>	<b>100.0%</b>

The prevalence of Tungiasis varied across different age groups. Test results shows that the age of the children had a statistical significance in relation to vulnerability to suffer from Tungiasis at (P<0.048). The children who were younger between the ages of 5 years and 11 years were the most vulnerable than their older siblings or class mates. This is could be because of their immunity is not as stronger as older children aged above 12 years and may have limited self-care. Also after the age of five which coincides with commencement of formal schooling during which mortality rate is said to decrease therefore less health care is given to these children above 5 years. This could also be because the parents have younger siblings who require more attention which was the case in most households.

**Table 2:Age and Tungiasis prevalence**

Tungiasis status	Age_Bracket		Total
	5 - 9 Yrs	10 - 14 Yrs	
Number of children	56	66	122
Prevalence of mild Tungiasis	41.5%	31.1%	35.2%
Number of the children	18	13	31
Prevalence of severe Tungiasis	13.3%	6.1%	8.9%

**Clinical manifestation of Tungiasis**

Tungiasis status differed in severity and duration. The participants recruited must have had at least two symptoms. Tungiasis status differed in severity and duration. The disease status was categorized into two mild Tungiasis and severe Tungiasis. Mild Tungiasis was defined as the condition manifested by 2-3 symptoms while severe Tungiasis was defined when an individual condition manifested with more than 4 symptoms, in which two limited physical abilities such as difficulty in walking, use of hands. In both diseases status confirmation diagnosis was by embedded female *T.penetrans* at various stages as described by Eiseleet al, 2003. The figures below give the difference between severe Tungiasis in figure 1 and mild Tungiasis in figure 2.



**Figure 1; Manifestation of Tungiasis**

The participants recruited must have had at least two symptoms in addition to confirmation of embedded *T.penetrans*. Location of lesions and severity also differed as well as whether wet or dry.

**Table 3: Tungiasis status among the children**

	Frequency	Percent	Male	Female	Male Percent	Female Percent
Mild Tungiasis	122	35.2%	77	45	42.1%	27.4%
Without Tungiasis	194	55.9%	86	108	47.0%	65.9%
Severe Tungiasis	31	8.9%	20	11	10.9%	6.7%
<b>Total</b>	<b>347</b>	<b>100.0%</b>	<b>183</b>	<b>164</b>	<b>100.0%</b>	<b>100.0%</b>

Tungiasis status was also described in terms of the duration an individual had suffered the disease. Chronic Tungiasis was defined as cases that had been persistent for more than one year. The duration each child had lived with Tungiasis was taken into account as shown in table 4.

**Table 4: Distribution of the number of years respondents have been suffering from Tungiasis.**

	All participants	Percent	Male	Female	Male Percent	Female Percent
Less than 1 Yr	215	62.0%	100	115	54.9%	69.7%
1 - 2 Yrs	63	18.2%	40	23	22.0%	13.9%
3 - 4 Yrs	63	18.2%	37	26	20.3%	15.8%
5 + Yrs	6	1.7%	5	1	2.7%	0.6%
<b>Total</b>	<b>347</b>	<b>100.0%</b>	<b>182</b>	<b>165</b>	<b>100.0%</b>	<b>100.0%</b>

The common symptoms were lesions on feet, pain, itching, lack of sleep, loss of toe nails and inflammation. The other symptoms among those with severe Tungiasis were difficulty in walking, lesion on hands, loss of finger nails. The symptoms were observed, reported by the child, parent or the teacher as shown in table 5.

**Table 5; Symptoms among the children associated with Tungiasis.**

Symp Toms	Lesion on feet	Lesion on hands	Def ormed toes ,feet and fingers	Diff iculty in walking	He ada che	Itc hin g	Lac k of slee p	Pai n	Re duce d playi ng level	Los e of toe nail s and fing er	Infla mmatio n And pus	U na bl e to w rit e	Fea r and isol atio n
Number of children with the each symptom	150	43	13	11	1	127	40	129	2	20	10	1	13

**Descriptions of the schools/classrooms and pupils homes visited during this study**

A number of schools in Murang’a use incomplete and semi-permanent structures as classrooms. About 6.5% of them had wooden walls while 93.5% had stone/bricks walls. About 37.7% had earthen dusty floors, 5.7% were partly cemented while 56.6% were cemented. *T.penetrans* flea that causes Tungiasis breed and camouflage in dusty classroom floors, dirt, rubbish, cracks in floors and walls. All the classes had iron sheets roofs. However, some parts of the schools open play field were found to be dusty. Going barefoot, as many young children are, is a risk factor that can be attributed to suffer from Tungiasis.

The environment where most pupils come from were favorable grounds for breeding of *T.penetrans* as over 90.0% homes had mud/earthen walls and dusty earthen floors. Exposed dusty floors, walls and compounds common among many village homes in Murang’a mean that *T.penetrans* can breed inside the houses. The mud walls and earthen floors create favourable ground for the breeding of *T.penetrans* and triggers emerging of adult stage from pupae cocoon thus increasing parasite load to humans in the dwelling who are preferred hosts. Table 6 summarizes the findings.

**Table 6: Types of material used to build of classrooms**

	Classrooms			
	Walls		Floors	
	Freq.	Percentage (%)	Freq.	Percentage (%)
A Cemented			69	56.6
B Partly Cemented			7	5.7
C Stone/bricks	115	90.6		
D Wood	8	6.5		
E Mud			46	37.7
<b>TOTAL</b>	123	100.0	122	100.0

**School attendance and Tungiasis**

In schools, available class registers were examined for absenteeism. Pupils were also asked to indicate whether they had been absent from school due to Tungiasis related issues. Majority of the pupils with severe Tungiasis (65.4%) indicated that they had failed to attend their classes due to Tungiasis as they could not walk to school due to pain. Only 34.6% never absenteeism themselves from school though some of them had mild infestation of Tungiasis.

The number of school days lost due to Tungiasis differed with Tungiasis status .The school absenteeism was found to be less among those with mild Tungiasis of them 2.4 days per term and 7.2 days per year. Children suffering from severe Tungiasis lost five times more school days compared to children suffering from mild Tungiasis. In total 633 days are lost per term due to Tungiasis and 1899 days per every academic year. This is true considering that the average duration of Tungiasis was 1.0209 years.Male children missed to attend school regularly due to Tungiasis compared to female children.The number of days is summarized in table 7 in terms of Tungiasis status and gender.

**Table 7; Number of days children aged 5-14 years missed school due to Tungiasis per term.**

Number of days	No. of respondents		Gender				Tungiasis Status			
	Frequency	Percent	Male	Female	Male	Female	Mild	Severe	Mild	Severe
					Percent	Percent			Percent	Percent
0	305	87.9%	159	146	86.9%	89.0%	103	8	84.4%	25.8%
5	17	4.9%	10	7	5.5%	4.3%	9	8	7.4%	25.8%
10	10	2.9%	6	4	3.3%	2.4%	4	6	3.3%	19.4%
15	6	1.7%	4	2	2.2%	1.2%	2	4	1.6%	12.9%
20	1	0.3%	0	1	0.0%	0.6%	0	1	0.0%	3.2%
40	4	1.2%	2	2	1.1%	1.2%	2	2	1.6%	6.5%
60	2	0.6%	1	1	0.5%	0.6%	0	2	0.0%	6.5%
65	2	0.6%	1	1	0.5%	0.6%	0	2	0.0%	1.6%
<b>Total</b>	<b>347</b>	<b>100.0%</b>	<b>183</b>	<b>164</b>	<b>100.0%</b>	<b>100.0%</b>	<b>122</b>	<b>31</b>	<b>100.0%</b>	<b>100.0%</b>

During the examination of the registers the days the children missed to attend school was taken into account .Data from class register revealed that missing classes and other school activities was a trend for pupils during the dry seasons. Among the children suffering from severe Tungiasis 23.2% had difficulty in walk as results of pain and wounds on sole of the feet, between the toes and heel. They also suffered from stigma and harassment from their peers. Lack of school uniform was cited by 6.1% pupils while 4.8% indicated other reasons. However, majority of them (65.9%) indicated that they failed to attend classes due to sickness.Table8 summarizes thefindings.

**Table 8: Reasons for missing to attend school**

		Frequency	Valid Percent
A	Sickness	54	65.9
B	Tungiasis	19	23.2
C	Lack of school uniforms	5	6.1
D	Lack of sanitary pads and Others	4	4.8
	Total	82	100.0

**Impact of Tungiasis on Repetition**

It is imperative to note that teachers and head teachers in the schools visited were generally reluctant to talk about repetition in their schools because officially the MoEST does not allow schools to force children to repeat classes. Besides, most parents do not support the exercise. However the data on the number of pupils who had repeated a class was obtained in three complementary ways. The first one was by asking the class teacher who the repeaters were in each stream or class. The second one was by checking the current and previous class registers of two consecutive grades and lastly through the use of questionnaire filed by pupils. If the name of a pupil appeared in a class registers of say primary one in two consecutive years, then such a pupil was considered to have been a repeater. In some schools, pupils are forced to repeat several times to improve their performance. About 54.3% of the sampled pupils who participated in this study indicated that they were repeaters.

**Table 9: Rate of class repetition among children suffering from Tungiasis.**

		Frequency	Percent
A	Yes	69	54.3
B	No	58	45.7
TOTAL		127	100.0

Children who had repeated at least once were the majority (70.0%), 23.3% had repeated twice while 6.7% had repeated three times in the course of their study. Repetition may be one aspect that may promote school dropout among the children who felt left out.

**Reasons Why Pupils Repeated Some Classes**

In normal circumstances, parents would prefer their children to continue with their learning without interruptions or even repeating classes. This has not been the case as some children are forced to repeat classes due to diverse reasons. When the respondents were asked why their children repeated classes, 39.5% of the respondents indicated poor performance of the pupil as the main reason. Likewise, those who indicated sickness as the reason that made children repeat classes represented 39.5% of the respondents while 11.6% respondents indicated disabilities associated with Tungiasis. A small fraction 7.0% indicated lack of school uniform as a reason. Some children are sent home due to indiscipline and are forced to repeat classes when they are accepted back. As can be observed most of the reasons cited were implications brought about by Tungiasis’s infestation as shown in table 10.

**Table 10: Causes of repetition among children**

		Frequency	Percent
A	Poor performance	17	39.5
B	All causes of ill health	17	39.5
C			11.6
D	Lack of school uniforms	3	7.0
E	Tungiasis	6	2.3
Total		43	100.0

**Relationship of Tungiasis on class repeated**

This study found that, there was a significant relationship between Tungiasis and class repetition (p-value 0.007 (<0.05)). The assumption for this was that since most pupils failed to proceed to the next grade due to poor performance resulting from irregular class attendance and low class concentration during lessons as a result of Tungiasis. This findings show that Tungiasis infestation has an impact on class repetition.

**Impact of Tungiasis on school drop out**

Tungiasis has contributed to stigmatization among children and parents from their peers and local communities leading to low enrolment in schools. Drop-out just like repetition figures were not easy to collect. This is because at primary school level there is no systematic monitoring of who drop-out and why. There is a general assumption among school heads and teachers that most children who fail to come to school after sometimes generally transfer to other schools. The record keeping in about 90 per cent of the primary schools visited is non-existence or is very poor. It became necessary therefore to visit each class and enquire from the class teacher and the pupils which of the pupils could have dropped out of the stream or class during the course of the year. About 20.5% pupils indicated that there are pupils at their homes who had dropped out of school.

Male children were found to be more likely to drop out of schools than their female counterparts. Pupils were asked to indicate reasons that had caused them to drop out of school, where they are currently as well as their proposed remedies to the problem. About 80.4% students indicated that it was due to Tungiasis related implications and child labour. However, there are indication of cases where pupils, especially girls who drop-out because of pregnancy or early marriages. Some school dropout who were still of tender age were staying with their parents while the older ones could be traced in shopping centers where they were engaged in income generating activities.

**Table 11: Drop out among male and female children**

		Male		Female	
		Frequency	Percent	Frequency	Percent
A	1	9	42.9	8	57.1
B	2	9	42.9	3	21.4
C	3	3	14.3	2	14.3
D	More than 4	0	0.0	1	7.1
Total		21	100.0	14	100.0

**Class and schools achievement in internal and national exams**

Academic performance among children suffering from Tungiasis was rated by the individual child, class teacher and the parent in relation to the perceived academic ability of the child or performance before suffering from Tungiasis. The average of performance rate was 28.9% with average performance (annual average score in all subjects 40-50%), 26.4% rated as poor performance (annual average score in all subjects 30-40%) and 21.5% very poor (annual average score in all subjects of below 30%). The results showed most of the children, teachers and parents were dissatisfied with the performance and had no confidence they would attain good scores to join admission in public secondary schools. The below expected performance can be attributed to chronic Tungiasis which was common among the children meaning that a child had suffered from Tungiasis for more than one year. This can be attributed to reduced low school attendance due to Tungiasis which can be used as an indicator of performance.

**Discussions**

In this study, the overall prevalence was found to be at 40% among children aged 5-14 years slightly lower than 44% recorded by (Ngunjiri and Keiyoro, 2011). In other studies higher prevalence rates have been reported inclusive of other age groups during the dry season in poor rural communities and urban slums in Brazil, (Muehlenet *al.*, 2003, and Carvalhoet *al.*, 2003). Njeumiet *al.*, 2002 reported a prevalence of about 50% in school children from different communities in the West Province of this neighboring country to Nigeria. Most of the lesions were localized on the feet thus making pupils to have difficulty in walking and deformation of the toenails. School-aged children have a longer duration of interaction with the endemic environment without adopting appropriate protective behavior. The majorities of them walk barefooted or, at best, wear slippers. The high prevalence in children is probably a result of their greater exposure (playing barefoot in the community).

Though the rate of Tungiasis varied across different age groups, test results showed that age of the pupils influence infestation of Tungiasis ( $P < 0.048$ ). The different prevalence may be influenced to an important degree by the different exposure and behavior with age. One possible reason why older children had a lesser prevalence of Tungiasis than younger ones was because most of them were able to take care of their personal hygiene. Observations have revealed that skillful older children carry out flea extraction for their friends and younger children at school (Ugbomoiko, 2007). The pupils who were very young had high concentration of Tungiasis' infestation than older pupils. This may be due to limited knowledge about the parasites, inability to care for themselves or playing in dirty, dusty environment where the parasite thrives. Secondly they may have just been enrolled to school translating into less contact with the parent thus less physical examination. Younger sibling competed for care with their older siblings or left to be taken care of by grandparents, aunts or even on their own. Thirdly their ability to remove embedded female *T. penetrans* limited and less tolerance of the pain experienced during the process of removal.

Parents and children suffering from severe Tungiasis were terrified of the removal process and even some never reported the infestation and only when compelled they were examined by which time the parasite load was high. Some the children suffering from Tungiasis chose to have the embedded female *T. penetrans* bear the pain of the removal process. This so because removing embedded female *T. penetrans* with a sharp instrument which has remained the main intervention even when the parasite load is high (Kimani *et al.*, 2012). Fourthly majority of these children suffering from Tungiasis are aged between 5 years-11 years attending the preschool and lower classes in primary school which runs up to midday or 3.00PM. Therefore these children go home early from school, spending more hours in an environment with adult *T. penetrans*. The host and contaminated environment contact promotes new infestations. These findings is in agreement with Muehlen *et al.* (2003) who found out that S-shaped prevalence pattern, with the highest prevalence in the 5–14-year age group and  $\geq 60$ -year age groups, has been reported previously from a rural community in Brazil.

The parasite affected both gender (male and female) none discriminatively. Though the rate of Tungiasis varied among both sexes, the test results shows that there was no statistically significant relationship between gender and infestation ( $P = 0.064$ ). Indeed, data on sex distribution are inconsistent and, similar to age, are probably related to different exposure and disease-related behavior. For example, in some studies it has been observed more females than males to be affected in south Brazil, whereas other studies from Brazil, and Nigeria found more males to be affected, or no significant difference between the sexes (Carvalho *et al.*, 2003; Ade-Serrano MA, *et al.* 1981; Arene FO, 1984; Muehlen *et al.*, 2003).

Children failed to attend their classes due to Tungiasis as they could not walk to school due to pain. Discussions with teachers revealed that some pupils has been arriving to school late and some had drop out of school because they could not walk normally and even when they tried, the pain from their feet is too much to bear. Worse still, they had to cope with the stigma attached to Tungiasis. Some pupils who are Tungiasis-free often shun them, call them names and mimic their walking style. The children suffering from severe Tungiasis lost five times more days than those children suffering from mild Tungiasis. This could be attributed to the fact that the symptoms were also severe such as lesions on sole, toes, heel that were painful and or itching. Hence leading to difficulty in walking and persistent pain which promoted the parent to keep the child at home or the child opted to remain at home especially if inflammation occurred from time to time.

Majority of the pupils (70.0%) had repeated once, 23.3% had repeated twice while 6.7% had repeated three times in the course of their study. When the respondents were asked why their children repeated classes, 39.5% of the respondents indicated poor performance of the pupil as the main reason. Likewise, those who indicated sickness as the reason that made children repeat classes represented 39.5% of the respondents while 11.6% respondents indicated inability to walk to school due to Tungiasis. This study found that, there was a

significant relationship between infestation of Tungiasis and class repetition (p-value 0.007 (<0.05)). Those who were in lower classes than their age could be due to low scores in the test to promote them to the next class probably due to the long periods with disabilities caused by Tungiasis. This presumed that since most pupils failed to proceed to the next grade due to poor performance resulting from irregular class attendance and low class concentration during lessons as a result of Tungiasis. The physical disabilities and stigmatization have forced children in the area to drop out of school. Drop-out just like repetition figures were not easy to collect. Boys were more likely to dropout to engage in income generating activities of schools than girls. Majority of the pupils (28.9%) rated their performance as average, 26.4% rated it as poor and 21.5% very poor. The results shows most of the pupils were highly dissatisfied with their performance and had no confidence they would attain good scores to join admission in public secondary schools.

In conclusion, Tungiasis is prevalent among the children aged between 5-14 years with average of 16 children (3%) in most schools 78%.

Chronic Tungiasis that had persisted for more than 1 year is common among children aged 5-14 years.

Acquisition of basic education can be improved by addressing and managing Tungiasis in endemic areas which would improve school attendance, retention and dropout.

Severe Tungiasis caused high morbidity, low rate of school attendance and dropout.

Schools could be the most effective points of managing and controlling Tungiasis among the children in collaboration with community health workers who should do follow ups at household levels. Hence the teacher in charge should be empowered to carry out the interventions which could be also cost effective when done at school since most of the children get help simultaneously. This could also help reduce stigmatization if integrated with other routines such as deworming and first aid.

The findings can be generalized across other endemic areas, limited to the age group aged between 5-14 years with the following outcomes. This is because other age groups may experience levels of the Tungiasis and socio implications.

### **Suggestion for further studies**

- i. Effect of effective intervention measures on school attendance among the age group.
- ii. Influence of Tungiasis on other activities among all the age groups.
- iii. Longitudinal study on Impact of chronic Tungiasis among children aged 5-14 years on their health.

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