Soil Transmitted Helminthes (STHs): Prevalence and the effect of de-worming in children (4 –15 years) in Mutengene, S.W. Region, Cameroon

ABSTRACT

Soil-transmitted helminthes (STHs) (*A. lumbricoides, T. trichiura and hookworms*) constitute a significant public health problem globally. These infections are widely distributed in tropical and subtropical areas and the their transmission is highly dependent on the degree to which the environment is contaminated with infectious stages and the amount of contact between human hosts and polluted soil. There are three main intervention strategies for controlling STH infections including ant-helminthic drug treatment (de-worming), improved sanitation and health education. The objectives of this study were to determine the prevalence of STHs and assess the effects of de-worming among children 4 to 15 years in Mutegene.

It was a cross-sectional study, involving school children of both sexes. A systematic random sampling method was used to collect data. Basic demographic data was obtained from the class registers. A structured questionnaire was used to collect information. Stool samples were collected, transported to the laboratory for macroscopic and microscopic analysis. Data was analyzed using SPSS version 21 and the Chi-square test.

The result obtained showed an overall prevalence of 3.6% (n=9) with the most frequent species being Trichuris *trichiura 2.4*% (n=6) followed by *Hookworm 0.8% (n*= 2) and the least was *Ascari*s *lumbricoides* 0.4 %(n=1). On the impact of de-worming, out of the 9 infected cases, seven (7) indicated that they had not taken worm medicines (neither albendazole nor mebendazole), one (1) did not know and only one (1) infected person was among those that had been de-wormed before. This showed that the de-worming process had a positive impact in eliminating helminthiasis.

In conclusion**,** the low prevalence could be explained by the prior de-worming of children. It was recommended that continuous health education should be given through community radios and televisions as a means of making the people understand the mode of transmission and methods of prevention of STH infection better.

Key words: soil-transmitted helminthes, prevalence, de-worming, transmission, prevention.

INTRODUCTION

1.0 Introduction

Soil-transmitted helminths (STH) are among the group of Neglected Tropical Diseases (NTD), which is widely distributed in tropical and subtropical regions [1]. These infections remain a significant public health problem of developing countries. Soil-transmitted helminth (STH) species include: *Ascaris lumbricoides, Trichuris trichiura and hookworm (Necator americanus and Ancylostoma duodenale*). Its transmission is through direct infection on the skin or through eggs that are contaminated by soil with poor environmental sanitation [1]. STHs infections are mostly caused by exposure to faecally contaminated water, soil or contaminated food [2].

Soil transmitted affects more than 1.5 billion people in tropical regions in Africa, Asia and Latin America [3]. Infections are widely distributed in tropical and subtropical areas, with the greatest numbers occurring in sub-Saharan Africa, the Americas, China and East Asia [3]. Globally, Ascaris *lumbricoides* is the most prevalent STH infecting about 1.2 billion people followed by *Trichuris trichiura* (infecting about 795 million people) and hookworm (*Ancylostoma duodenale and Necator americanus*), which infects nearly 740 million people worldwide [4].

The transmission of these parasites is highly dependent on a number predisposing factors to include both environmental and behavioral factors that influence (i) parasite survival, (ii) the degree to which the environment is contaminated with infectious stages and (iii) the amount of contact between human hosts and polluted soil [5]. Soil-transmitted helminths depend on environments contaminated with egg-carrying faeces for transmission [6]. Consequently, helminths are intimately associated with poverty, poor sanitation and lack of clean water [5]. Two most important environmental factors are climate and soil conditions, as STHs larvae predominanly develop in tropical and sub-tropical climates, with warm temperatures, high humidity and moist soils. High and low land surface temperature and extremely arid environments limit STHs transmission [7]. Unhygienic sanitation, inadequate water supply and the use of untreated night soil fertilizer are man-made environmental factors favouring STH‟s transmission [7]. Behavioural risk factors include toilet usage, wearing shoes, personal hygiene and habits such as washing hands, eating raw food and Occupations with high soil contact such as farming also increase the risk of STHs infection [8]. Educational level and socio-economic status, however, have been shown to be positive predictors for improved hygiene behavior, which in turn is protective against STHs infections [6, 7].

There are three main intervention strategies for controlling of STH infections namely anthelminthic drug treatment, improved sanitation and health education [9]. The World Health Organization recommends both albendazole and mebendazole as the drug of choice to be used in public health program for controlling STH infections. Studies demonstrate that regular de-worming among school-aged children has significantly improved their physical and cognitive outcomes, nutritional status, physical fitness, appetite, growth and intellectual development [10]. It has also been reported that when pregnant women in endemic areas were treated once or twice during their pregnancy, there were substantial improvement in maternal survival [10]. Although periodic de-worming can significantly reduce the number of adult worms in the gastrointestinal tract which is also reflected in reduced egg counts, there are some obstacles that diminish the effectiveness of the drug. Factor such as low efficacy of the anthelminthic drug, for example, single dose albendazole or mebendazole are ineffective against hookworm and *T. trichiura* infections [11]. Sanitation is the only definitive intervention to control STH infections but In order for this intervention to be fully effective, it should cover a high proportion of the population. [12]. Likewise, if improved sanitation were to be used as the main control intervention, it can take years or even decades to be effective [13]. Health education is another major intervention in controlling STH infections aimed at reducing transmission and re-infections, promoting healthy behaviors such as encouraging the use of latrines and hygienic behavior [9].

The World Health Organization recommends annual treatment in areas where the prevalence of STH is between 20 and 50% and biannually where the prevalence is over 50% [14]. However, deworming has a temporary effect on transmission and cannot prevent re-infection [15]. A prevalence as low as 6% could lead to rapid spread of STHs especially in conditions of poor hygiene and overcrowding [16]. Also, considering the fact that there has been an impact on the environmental and social factors because the Anglophone crisis has led to influx of so many internally displace persons into Mutengene, there is the need to assess the prevalence of STHs. The crisis has led to the interruption of the school-base de-worming campaign which was periodically carried out by the government in school age children with the goal of complete eradication of STHs. Thus, this study was designed to determine the prevalence of STHs and assess the effects of de-worming among children 4 to 15 years in Mutengene, S.W Region, Cameroon.

Objectives

The overall objective was to determine the prevalence of STHs and assess the effects of de-worming and preventive/control strategies among children 4 to 15 years in Mutegene.

The specific objectives of this study were:

- To determine the general prevalence STHs among children 4 – 15 years in Mutengene community and identify the different species of worms present.
- To assess the effects of de-worming on the prevalence of STHs among children in Mutegene.

2.0 MATERIALS AND METHODS

2.1 Study Design and study period

The study design was cross-sectional involving school children (both male and female). Five primary schools (Government and private) were randomly selected in the study area. The five randomly selected schools were Divine Faith Bilingual Primary and Nursery school, Saint Joseph Catholic School Buea road, Saint Alexender Primary and Nursery school qurter 10, CBC Primary and Nursary School Limbe road, and Government school Tiko road. At each selected schools about forty percent of pupils in each class were randomly included in the study. This study was carried out in the Mount Cameroon area (precisely in Mutengene) from March 2021 to June 2021.

2.2 Study Area

This study was carried out in Mutengene, in the Tiko Health District (THD) located in Fako Division of the South West Region of Cameroon. Mutengene has a total surface area of 484 km^2 and is located between Longitude 8.6°10'E and Latitude 4°5.2'N [17]. Mutengene has a coastal equatorial climate with daily temperatures ranging from 28°C to 33°C. Soil types include the sandy alluvial and volcanic soils, which encourages three quarter of the population to be involved in subsistence agriculture. The main watercourses in the Mutengene municipality include the Ombe River, Ndongo and Benyoh streams, which empty into the Atlantic Ocean. It has a total population of 147,423 and 12.02% (17,722) of this population are primary school children [17]. It has many secondary and primary schools, one hospital and two health centers. The population is also involved in some industrial activities with the main industries being a plastic industry, a brewery industry (brasseries du Cameroon depot) and a quarry located in Ombe. It is predominantly a farming community but with a mixture of traders, artisans and civil servants. Food crops grown in the area include maize (*Zea mays),* yam (*Dioscorea spp*), cassava (*Manihot esculenta*), cocoyam (*colocasia spp*), vegetables, cocoa (*Theobroma cacao*), bananas, plantain and oil palms (Elaeis *guinensis*). These crops are usually mixed or intercropped. The population is also involved in pig raring and poultry farming specifically for local consumption.

2.3 Study Population, Inclusion criteria and data collection tools

The study included 250 pupils of both sexes, aged 4 - 15 years. Pupils were enrolled into the study only if they fulfilled the inclusion criteria and were pupils in one of the chosen schools. The inclusion criteria were:

- Children, who gave their assent, answered the questionnaire and their parents/legal guardians gave their consent by signing the informed consent forms.
- Children who were neither sick nor suffering from severe medical conditions.
- Children whose stool samples were delivered on the sample collection day.
- Children who submitted enough sample for the laboratory diagnosis.

The tools used for the research included a clinical laboratory analyses form, a simple structured questionnaire administered in English and exceptionally in Pidgin English, and consent/assent forms and a laboratory request form.

2.4 Sample size

The sample size for this study was calculated using the Lorentz formula, which states that

$$n = Z^2 P(1-P)/e^2$$

- Where: n - Maximum Sample size of the study population.
- Z – a constant corresponding to the confidence level for example (1.65 for 90% confidence, 1.95 for 95% confidence, and 2.575 for 99% confidence). In this study, 2.575 for 99% confidence interval was used).
- P – Estimated value or percentage of a sample that has similar condition of interest,
- e – The margin of error or precision of the event of interest (0.05). With P = 6.5% (Ndamukong-Nyanga *et al*. for intestinal helminths prevalence in Tole, SW Cameroon) [16].

Z =2.575, e = 0.05 It implies that $n = \{(2.575)^2 (0.065) (1-0.065)\}/ (0.05)^2 = 162$.

The minimum calculated sample size was 162. However, four hundred and twenty-two (422) participants were issued consent/assent forms and only 250 pupils responded positively and succumbed to the stool collection procedures.

2.5 Sampling techniques

In order to reduce cost and improve sampling efficiency, random sampling technique was used to recruit the study participants. Five (5) primary schools were randomly selected out of 17 primary schools. Random selection was done by writing the name of each school on a separate piece of paper, which was then placed in a box and thoroughly mixed before selection. A simple random sampling technique was applied by blindly picking 5 of the papers and the name of the selected school(s) written in a field note book. A total of 5 schools were selected. This was closely followed by visit to the schools. The first visits were made to each school in the month of May to explain the purpose and methodology of the survey and potential benefits of the study to the head teachers and parents/guardians (during parent and teachers' association (PTA) meetings). The second visits were made to talk to the pupils about the studies and only the Pupils who gave their assent and returned consent forms signed by parents and guardians were accepted in the study.

The third visits were made to ensure that within each selected school to sort out the pupils per class. For small class sizes (less than 30 pupils), the entire class was selected if they fulfilled all the inclusion conditions. For classes with more than 60 pupils, the systematic random sampling approach was used. From the class list of each class, every third or fourth pupil was sampled depending on the number of pupils in the class making sure that they fulfilled the inclusion criteria. Basic demographic data like age and sex were obtained from class registers.

2.6 Data collection

Only children whose parents signed the consent form were qualified to respond to the questionnaire with the help of the research team and their class teachers. After Completion of the questionnaires, children were given specimen containers and instructed on how to collect the stool specimen. The stool samples were put in mobile cooler-boxes containing ice packs to preserve the eggs. Stool samples were then transported to the laboratory and processed within 12 hours. Macroscopic and microscopic examination was done within 1 hour of preparation to avoid misdiagnosis especially in relation to hookworm ova.

Children were identified by individual codes and their names written separately in a notebook for the purpose of precision during return of their results. Both qualitative and quantitative data were collected.

2.7 Questionnaire

Each child was questioned separately on his/her socio-demographic and behavioral factors. This was done to avoid influence from friends. Qualitatively, a structured questionnaire was used to collect information on demographic characteristics, parental occupation, hand washing practices, walking barefoot, presence of toilets and its usage and types of water sources available for domestic purposes.

2.8 Sample Processing

2.8.1 Macroscopic Examination

After reception of the specimen on the date of collection, samples were examined macroscopically for colour, consistency (such as formed, unformed) and the presence of constituent such as blood and mucus). Microscopic examination was done to check for the presence of adult worms, worm segment, ova (eggs) or cysts.

2.8.2 Microscopic Examination

Saline wet mount **were** carried out within hours on the faecal specimen for identification of ova, larvae, yeast cells, intestinal flagellates, etc while iodine wet mount was carried out for identification of cyst of parasite and concentrated technique was carried out to identify cyst, ova and larvae of parasites.

Iodine saline wet mount

Saline and iodine preparations to detect E. histolytica and other parasites was be performed. As follows:

- A drop of fresh physiological saline was placed on one end of a slide and a drop of iodine on the other.
- Using a piece of stick, a small amount of fresh specimen (especially mucus and blood) was mixed with each drop ensuring that the preparation is not too thick otherwise it will be impossible to see amoebae or cysts.
- The preparation was covered with a glass cover slid.
- The preparations were examined using the 10X and 40X objectives with the condenser iris closed sufficiently to give good contrast with attention paid mostly for motile *E. histolytica* trophozoites , red blood cells and motile *G. lamblia* trophozoites.

Formals- Saline ether sedimentation method

This is the recommended procedures as most types of worm eggs (round worms, tapeworms, schistosomes, and other fluke eggs, larvae, and protozoan are easy to identify [18].

The formal-saline ether sedimentation method [19] was performed as follows:

- Feces (2.5gm) was emulsified in 7 ml of 10% formalin in a 50 ml falcon tube.
- The suspension was strained through two folded gauzes, and collected into 15 ml conical tube.
- 10 ml of normal saline was added to 3ml of the filtrate and centrifuge at 2000 RPM for 2 minutes and the supernantant discarded.
- 10ml of formaline was then added to I to 1.5 ml of the sediment
- Then 3 ml of ether was added to the filtrate and, the tube was capped, well mixed for 30 seconds and centrifuged at 2000 rpm for 1 minute.
- The fatty layer and debris at the top of the tube was loosen with an applicator stick and the tube inverted quickly to discard the supernatant ensuring that few drops of suspension remained.
- The sediment was mixed with the few drops of suspension.
- Few drops of the mixture were then transferred on to a clean glass slide and covered with a cover-slip.
- The preparation was viewed with the help of a microscope using 10x objective, and turning into 40x for confirmation and identification of the organism(s) seen [19].

2.9 Data Analysis

Data obtained were entered into the computer using Microsoft excel 2007 version, entry errors were checked and analysis was carried out using SPSS for windows version 21 (SPSS Inc., Chicago, IL, USA). Categorical variables like the demographic characteristics of the respondents were presented as frequencies and percentages, and analyzed in relation to risk parameters using the Chi-square test. The significant associations were identified based on $p < 0.05$ [100]. Cross tabulations of important variables of the questionnaire were done and the statistical significance of variables was estimated using Chi-square test.

2.10 Administrative authorization, ethical clearance and consent

Consent/Assent All pupils were issued consent/assent forms to seek for their parents' approval. Pupils were accepted to participate in the studies when they brought back signed informed consent / assent forms following the approval of their parents / guardians.

Ethical clearance was obtained from the Institutional Review Board of the Faculty of Health Science, University of Buea, Cameroon. Administrative authorizations were gotten from the Regional Delegation of Public Health, and basic education and head teachers of the five randomly selected primary Schools in Mutengene area. Additional administrative approvals were gotten from the inspectoriate of basic education head teacher followed and for. A brief talk was given to the participants on the objectives, protocol and benefits of the study.

2.11 Confidentiality

Confidentiality was ensured by giving serial numbers to each participant who used it in both the questionnaire and the stool container. Participant's names were only used for the purpose of issuing of individual results. Stool samples were analysed by trained Medical Laboratory Scientists with experience in biosafety. After stool collection, it was ensured that the participants disinfect and washed their hands with a hand washing detergent to avoid contamination. Parents of children with STH infection were properly informed, to consult at the Health Centre to ensure proper management of their clinical condition.

3.0 RESULTS

3.1 Socio-demographic characteristics of the study population

A total of 250 children (aged 4-15 years, mean 11.18 ± 1.83n) completed the study. In term of gender, 48% (n=120) were boys and 52% (n=130) were girls. The children were grouped into three (5 – 8years, 9 – 12 years and 13 – 15 years). The 9-12 years had 68% (n=170) participants and 5-8years had the least 7.2% (n=18). Participants were selected in all the classes with the highest coming from primary six (56%, n=140. Details about the demographic characteristics can be obtained from table 1.

Table 1: Socio-demographic Characteristics of the study population

SN	Characteristics	Variable	Frequency (n)	Percentage (%)
1.	Gender	Male	120	48
		Female	130	52
		Total	**250**	**100**
2.	Age range (years)	5 – 8	18	7.2
		9 – 12	170	68
		13 – 16	62	24.8

		Total	**250**	**100**
	Mean Age (M ± 2 std)	11.18 ± 1.83		
4.	Class	Primary 1	3	1.2
		Primary 2	1	0.4
		Primary 3	5	2
		Primary 4	38	15.2
		Primary 5	63	25.2
		Primary 6	140	56
		Total	**250**	**100**

Of the 250 study participants, 75.5% (n=189) lived in cemented houses, 21.6% (n=34) lived in tiled houses, and 2.7% (n=7) in earth houses. The study also indicated that majority of the participants 72.8% (n=101) got their water from the public taps and very few 1.6% (n=4) got their water from rivers. As concern cooking, a greater portion of the participants (N = 187, 74.8%) used fire wood, seconded by gas (21.6%, n=54) and smaller proportion used charcoal. Statistics from the survey also showed that majority of the participants (43.6%, n=109) used pit latrine and 141 (56.4%) used flushable toilets. For other social amenities such as television, electricity and refrigerator, many had television (92.2%, n=232), electricity, 90.4%, n=226) and refrigerators, (64.4%, n=161) as opposed to the minority that did not have these amenities. The study also revealed that 37.6 %, n=94) had one or more domestic animals in their homes. Details can be obtained from table 2.

Table 2: type of houses used by participants

SN	Characteristics	Variable	Frequency (n)	Percentage (%)
1	**Floor type**			
		Cemented	189	75.6
		Earth	7	02.8
		Tiles	54	21.6
		Total	**250**	**100**
3	**Water for house for domestic used**	Public tap	101	72.8
		Well without pump	44	17.2
		Well with pumps	88	12.2
		Water truck	13	05.2
		River	4	01.6

		Total	**250**	**100**
4	**Source of fuel for cooking**	Fire wood	187	74.8
		gas	54	21.6
		charcoal	1	0.4
		kerosine	8	03.2
		Total	**250**	**100**
5	**Toilet**	Flushable toilet	141	56.4
		Pit latrine	109	43.6
		Total	**250**	**100**
6	**Television**	Yes	232	92.2
		No	18	07.2
		Total	**250**	**100**
7	**Refrigerators**	Yes	161	64.4
		No	89	35.6
		Total	**250**	**100**
8	**Electricity**	Yes	226	90.4
		No	24	09.6
		Total	**250**	**100**
10	**Domestic Animals around houses**	Yes	94	37.6
		No	156	62.4
		Total	**250**	**100**

3.2 Prevalence of STH and the different species in school children in mutengene

Out of the 250 stool samples collected, 9 (3.6%) had at least one species of parasite (Figure 1). The most frequently observed STH in this study was *Trichuris trichiura* (n = 6, 2.6%) followed by Hookworm (n = 2, 0.8 %) and *Ascaris lumbricoides* (n=1, 0.4%) (Figures 1 and 2). The prevalence of parasites in relation to sampling sites during the sampling period varied significantly (P = 0.05, X^2 = 0.821)

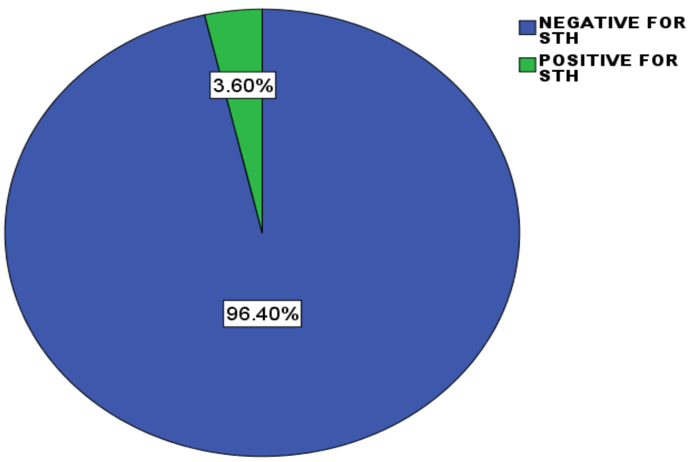

Figure 1: prevalence of STH in school children in mutengene

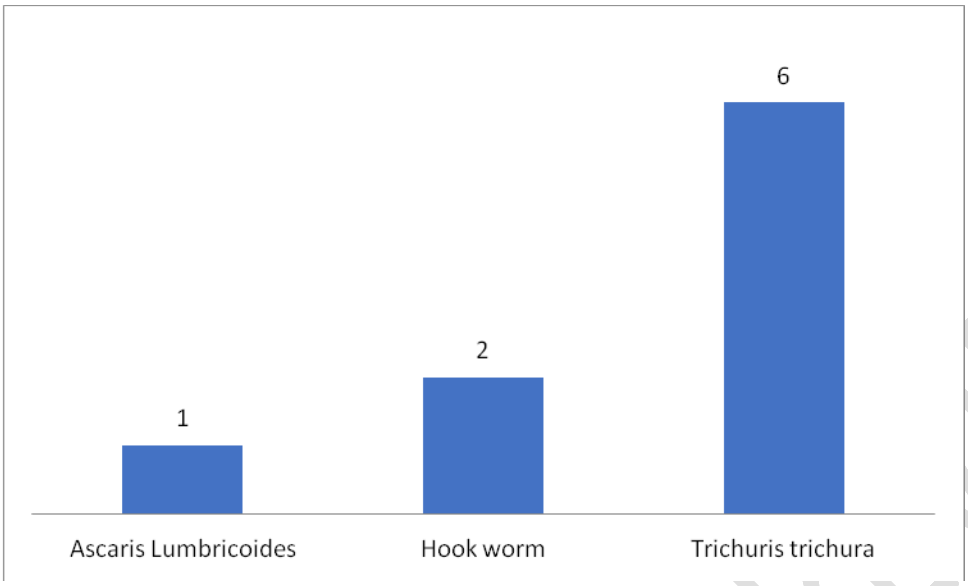

Figure 2: Different species of soil transmitted helminths present among participants

Considering prevalence per species per school, *Trichuris trichuria* was identified in four schools. The infection affected both males and females but was more in males (3.1%, n=4) than females (n = 2) in the case of *Trichuris trichura.* Considering prevalence per residential area (qurter), *Trichuris trichuris* occurred in three qurters (quarter 2, 13 and 11) with the highest prevalence (4.8%, n=3), found in qurter 11. *Hookworm* infection occurred only in qurter 12 and 13 with the same intensity while *Ascari*s was found only in qurter 19. In terms of age ranges *Trichuris trichuris* had the highest prevalence (1.6%, n=4) in 9-12 age range, hookworm and *Ascairs* had same prevalence (n = 1, 0.4%) in qurter 12, 13 and 19.

Table 6 presents the pattern of infection by age and sex. Out the 250 pupils, 120 were males and 5 were positive, giving a prevalence of 2.0%. From the 250, 130 were females and 4 were infected (3.1%). Both males and females harbored the three helminth species encountered. However, the difference in prevalence was not statistically significant ($P > 0.05$) between males and females. The prevalence in age range 5-8 years was 0.8% (n=2), 1.6% (n=4) in 9-12 age range and 1.2% (n=3) in age ≥10 as shown in Table 3. The difference in prevalence was not significant among age groups.

Table 3: the prevalence of infection by age and sex

SN	Characteristics	Variable	Frequency (n)	Prevalence N (%)	Chi square(χ2)	p-value
1.	Gender	Male	120	5 (2.0)	**0**.214	0.741(2 Sided)
		Female	130	4 (1.6)		
		Total	250	9 (3.6)		
2.	Age range (years)	5 – 8	18	2 (0.8)	3.962	p-value.138
		9 – 12	170	4 (1.6)		
		13 – 16	62	3 (1.2)		
		Total	250	9 (3.6)		

In terms of classes primary 3-5 had greater number of positive cases as compared to primary1 and 2 (See table 4 for details).

Table 4: prevalence of soil transmitted helminthes among school age children according to classes

SN	Characterisitc	Variable	Frequency	Prevalence	Chi square(χ2)	p-value
	Class	Primary 1	3	0	**Chi square(χ2)** 5.429	p-value 0.366
		Primary 2	1	0		
		Primary 3	5	1 (0.4)		
		Primary 4	38	2 (0.8)		
		Primary 5	63	3 (1.2)		
		Primary 6	140	3 (1.2)		
		Total	250	9(3.6)		

The Chi square analysis of prevalence of STH species among school age children in various quarters in Mutengene community revealed the highest overall prevalence of (1.6 %, n=4) in quarter 11 seconded by quarter13 with an overall prevalence of (0.8%, n=2). Four of the quarters had an overall prevalence of 1 (0.4%) the rest had no case of worm infection identified.

3.3 The effects of de-worming with ant-helminthic drugs on the prevalence of STHs among children in Mutengene community

Result of the investigation of the impact of de-worming with ant-helminthic drugs among school age children in Mutengene community generally proved that from the 250 stool samples of participants who took either albendazole or mebendazole, 96.4% (n=241) tested negative while only 3.6% (n=9) tested positive, showing that the de-worming process had a positve impact in eliminating STH. Analysis of participants in terms of drug type showed that from the 97(95.2%) that took albendazole, 38.6 % (n=93) tested negative and only 4(1.6%) of the participants tested positive. Similarly, out of 37.3% (n = 90) who took Mebendazole, 36.5% (n=88) of them tested negative and only 0.8% (n=2) were positive (See table 5).

Table 5: the impact of de-worming with ant-helminthic

SN	Variables		Total examined	Percentage	No Infected	prevalence	Chi square	p-value
	Infected with worms	yes	161	66.8	2	0.8	**Chi square(χ2)** 4.125	p-value .248
		no	44	18.3	7	2.8		
		I do not know	36	14.4	0	0.0		
		Total	**241**	**96.4**	**9**	**3.6**		
	Ever taken worm treatment	yes	191	79.3	1		**Chi square(χ2)** .832	p-value .842
		no	31	12.9	7	2.8		
		I do not know	19	7.9	1	0.4		
		Total	**241**	**96.4**	**9**	**3.6**	**Chi square(χ2)** 41.065	p-value .000
	Last time you had worms	>6 months	55	22.8	3	1.2		
		<6 months	67	27.8	3	1.2		
		I do not know	119	49.4	3	1.2		
		Total	**241**	**96.4**	**9**	**3.6**		
	Type of worm medicine taken	Albendazole	93	38.6	4	1.6	**Chi square(χ2)** 1.550	p-value .818
		I do not know	9	3.7	0	0.0		
		Mebendazole	88	36.5	2	0.8		
		Others	51	21.2	3	1.2		

		medicines						
		Total	**241**	**96.4**	**9**	**3.6**		
	Last time dewormed	Do not know	98	3.3	6	2.4	**Chi square(χ2)** 9.698	p-value .138
		Month ago,	50	20.7	1	0.4		
		NA	5	2.1	0	0.0		
		Over a year	88	36.5	2	0.8		
		Total	241	96.4	9	3.6		

4.0 Discussion

Findings from the study showed that Soil-Transmitted Helminths infections are no longer endemic nor continue to be a major public health concern among school age children in Mutengene community (if the school-based de-worming process and other preventive and control measures continues). This is because from the 250 participants that took part in the study, only 3.6% (n=9) of the study participant were infected with at least one or more of the STH species under investigation. The prevalence is lower than that previously reported in similar studies carried out on soil-transmitted Helminth in Southwest Region Cameroon. Studies by Ndamukong-Nyanga et al, [16] reported a prevalence of 6% in Tole, S.W. Region of Cameroon. However, other studies carried out in the Mount Cameroon area, South West Region of Cameroon showed that the prevalence of STH was 1% in Tiko, which is lower than that of our studies [20]. The reason for higher prevalence in this study as compared to that of similar studies in Tiko Subdivision can be attributed to a number of factors, including the Anglophone crises which has taken more than four years. The impact of this crisis has been negative because the frequency of mass de-worming of schoolchildren by the government reduced due to the political crisis. Secondly previous studies showed that transmission of STHs occurred more in countries where poverty, poor nutrition, inadequate sanitation, overcrowding, poor housing, failure to put on footwear, poor socioeconomic status, lack of clean drinking water, and minimal health care prevailed [9]. This similar condition has been experienced in our study area due to influx of internally displaced persons (IDP) into Mutengene leading to overcrowding in houses, poor environmental and personal hygiene, limited toilet facilites lack of knowledge of waste management and lack of health education [14].

Considering gender and age ranged this study revealed that male participants had higher prevalence 5(4.2%) compared to female individuals which is consistent with findings of other studies [16, 20]. This could be attributed to variation in exposure to risk factors. The survey also revealed that pupils of the age range 9-12 years had higher prevalence 4 (2.4%) and this could be attributed to their hygiene habits as our analysis during the studies showed that 145(58%) of pupil in this age range are not fully educated about the danger of either sucking the finger or biting the nails or proper hand washing which are risk factors to transmission of STH. Result obtained from the research proved that children from qurter 11 and qurter 13 had a high prevalence 1.2% and 0.8% respectively as compared to other quarters. This finding was not a surprise as this result just confirmed the poor level of environmental hygiene of these qurters whch are identified to be dirty and have poor waste management.

Also, in terms of classes primary 5.and 6 had the highest prevalence. This high prevalence is attributed to several factors such as lack of environmental sanitation, low level of education, lack of access to safe drinking water, good toilet facilities and proper personal hygiene conditions, poverty and ignorance [21].

Our investigation on the impact of de-worming with ant-helminthic among school age children in Mutengene community showed that out of the 9 infected cases, seven (7) indicated that they had not taken worm medicines (neither albendazole nor mebendazole), one (1) did not know and only one (1) infected person was among those that had been de-wormed before. This showed that the de-worming process had a positive impact in eliminating helminthiasis.

It is important to note that treating this age group is of importance in reducing transmission rate. In addition, there could be environmental and behavioral factors that could have led to the sustained prevalence of STH infections in primary school children in Mutengene community beside the crisis. The positive cases of STH found in this study were of the age group 9-12 similar to 9 and 11 years old which is consistent with the findings of Tabi, Mbuh and others in 2012 [23] who found out that the prevalence of STH was highest among children aged between 6 and 12 years [22 and 23]. In relation to gender, the prevalence of STH was similar in males and females (because the difference was not statistica;ly significant), which is consistent with reports of a previous study in the South West Region of Cameroon by Ndamukong-Nyanga *et al*., in 2015 [16] but in contrast to the study carried out by Ntonifor and others [24] behind the Mount Cameroon area who found out that the prevalence of STH was statistically higher in males than females. These findings also agreed with those of Kuete et al in 2015 [25].

The prevalence of 3.6% is considered low and could have been achieved because government re-enforced the policy of disease prevention and control by enhancing, the subsidization of drugs in pro-pharmacies and health centres all over the country and by education on television and radio [26]. These are evident in our study by the fact 226 (90.4) of our respondents indicated the presence of electricity in their homes and 232 (92.2%) of them had televisions which can help them gain some knowledge about prevention and control of STH through health education program. This control strategy is in line with WHO's control intervention which is based on the periodic administration of ant-helminthics to groups of people at risk, supported by the need for improvement in sanitation and health education [27]. W.H.O. also recommends annual treatment in areas where prevalence rate of soil transmitted helminthiasis is between 20% and 50%, and a bi-annual treatment in areas with prevalence rates of over 50% [27]. In addition, the prevalence of infection can generally be low according to consistent findings of Mugono and others in 2014 in North-Western Tanzania [28] who reported that in regions where STH is targeted for elimination with annual mass de-worming, high worm burdens are not very common and most of the individuals infected with STH will normally excrete a low number of eggs [29].

4.1 Conclusion

- This study revealed that soil-transmitted helminth infection was present in Mutengene community with an overall prevalence of 3.6%.
- The Soil-Transmitted Helminths parasite species found in our study area included *A. lumbricoides*, *T. trichiura*, and *hookworms*, *Trichuris trichura*. H*ookworm*s were the dominant parasites among the school-children. The study revealed that *A. lumbricoides* was the least parasite among the children.
- Out of 250 participants who took either albendazole, mebendazole or other worm medicine, 241(96.4%) of them tested negative for STH while only 9 (3.6%) tested positive.
- This indicates that re-infection is common even after de-worming if proper hand hygiene is not done.

4.2 Recommendations

- Since this study has proven that STH still exist in Mutengene community, the following measure could be put in place:
- Health education could be given through community radios and televisions as a means of making the people understand the mode of transmissionand methods of prevention of STH infection better.
- Secondly chemotherapy approach could be adopted in order to interrupt transmission and to achieve local elimination of helminthiasis and other related intestinal parasites.

- Constant and adequate de-worming should equally be recommended to complement hand hygiene. The population could be provided with good social amenities that include good water and hand washing equipments. Cheap water treatment could be taught to the people.
- Those who do not have access to portable tap water could be encouraged to be boiling their drinking water.
- Indiscriminate defecating should be discouraged as this will contaminate the available water sources. Government could provide a good waste management system to the Mutengene community and also teach them lesson on good waste management via meeting houses, churches, television and the radio.

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