

Some Epidemiological Studies on Soil-Transmitted Helminthic Infection among Primary School Children in Ukum Local Government Area, Benue State

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Abstract:

Background: Soil-transmitted helminthes infections (STHs) are among the most widely recognized infections among pupils in developing countries. This study investigated soil-transmitted helminthic infections among primary school children and the distribution of helminthes eggs in soil samples from selected primary schools in Ukum Local Government Area, Benue State.

Methodology: Soil and faecal samples were collected from the school environment and pupils respectively. The soil samples were analyzed using floatation technique while Kato-Katz technique was used to examine the faecal samples.

Results: The total prevalence was 85.6% (154 pupils out of 180 that were examined were infected), *Taenia* species and *Ascaris lumbricoides* had the highest prevalence than hookworm and *Trichuris trichiura* 32%, 29%, 18% and 11% respectively. The prevalence of STH were highest in L.G. A. Primary school and God's Heritage Nursery and Primary School (17.6% and 16% respectively). However, the results did not differ statistically ($P>0.05$). Fifty seven percent (57%) of the helminthes eggs recovered from soil samples were that of *Ascaris lumbricoides* while *Taenia* spp and Hookworm were 35% and 8% respectively. Most of the helminthes eggs recovered from soil samples are from the samples collected around the toilet areas. This is an indication that open defecation is practiced by the pupils.

Conclusion: Open defecation should be discouraged and there should be a routine deworming exercise for the pupils in the study. The toilet facility in the schools are pit toilets, efforts should be made to provide the schools with water closets.

Keywords: Soil, Helminthes, Pupils, Open defecation, deworming.

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Background of the Study

Soil-transmitted helminth infections (STHs) are among the most widely recognized infections in developing countries. It is estimated that more than one billion of the world's population, including at least 400 million school-age children are chronically infected with soil-transmitted helminths such as *Ascaris lumbricoides*, *Trichuris trichiura*, and the hookworms, *Ancylostoma duodenale* and *Necator americanus* (WHO, 2020). School-age children infected with soil-transmitted helminths usually have malnutrition, growth stunting, intellectual retardation, and cognitive and educational deficits (Bethony *et al.*, 2006). Clearly, soil-transmitted helminth infections remain an enormous public health problem in the 21st century (Ziegelbauer *et al.*, 2012).

Soil-transmitted helminths (STHs) are a group of nematodes (parasitic) worms that afflict humans of infective eggs or contact with larvae. STHs exhibit life cycles that involve no intermediate host or vector (direct life cycle). They infect many animals and humans through soil contaminated with faecal matter containing the eggs/larvae of the parasites, foodstuffs and/or water supplies (Chhabra and Singla, 2009). The morbidity caused by STHs is most commonly associated with infestation or moderate to heavy intensity (Neva and Brown, 1994).

Soil-transmitted helminths are among the leading causes of global health problems especially among the poorest and deprived communities where implementation of control measures is difficult (Mascarini-Serra, 2011). More than a quarter of the world's population is at risk of infection with STHs roundworms (*Ascaris*

lumbricoides and *Strongyloides stercoralis*), hookworms (*Ancylostoma duodenale* and *Necator Americanus*), and whipworms (*Trichuris trichiura*) (Mark *et al.*, 2018). Infections are widely distributed in tropical and subtropical areas, with the greatest numbers occurring in South and East Asia, Sub-Saharan Africa, and the Americas. Approximately 1.5 billion people are infected with soil-transmitted helminths worldwide in 2020 (WHO, 2020). It was estimated that 819 million people were infected with *T. trichiura* in 2010. Over 835 million pre-school-age and School-age children living in areas where these parasites are severely transmitted.

MATERIALS AND METHODS

This study was carried out in Ukum Local Government Area of Benue State, Nigeria, it has an area of 1.514 square kilometers (585 sq mi), it is located on latitude 7°23'0"N and 10°7'0"E.

The research was a survey research The survey method paved ways for the research to make use of interviews, questionnaire and observation or a combination of such methods of data elicitation. The research was done Mbayenge, Mbazungu and Boiko wards of Okum Local Government Area. A total of 60 questionnaire was administered (i.e 20 questionnaire per ward).

Sample Collection

Stool cups, newspaper, and plastic coverings was distributed for faecal sample collection. Instructions on how the fecal material will be collected were properly given and discussed with the parents and guardians. On submission of the fecal specimen, 10% formalin was added immediately on the samples and subsequently transported to the parasitology laboratory, General Hospital Sankera. A total of sixty (60) samples were collected for the study (Endris *et al.*, 2013).

RESULTS

TABLE 1: Frequency of helminthes examined from stool samples in relation to sex among students of L.G.A Primary School Boikyo

Gender	<i>A. lumbricoides</i>	<i>T. trichiura</i>	<i>Taenia spp</i>	<i>N. americanus</i>	<i>Ancylostoma duodenale</i>	Negative Results
Male	9	5	8	4	3	2
Female	7	6	9	2	2	3
Total	16	11	17	6	5	5

The highest number of positive cases was observed for *Taenia spp* (17 cases), followed by *A. lumbricoides* (16 cases), *T. trichiura* (11 cases), *N. americanus* (6 cases), and *Ancylostoma duodenale* (5 cases). Males generally had higher numbers of positive cases for most helminths except for *T. trichiura* and *Taenia spp* where females had slightly higher cases. The number of negative results was low, with a total of 5, indicating a high prevalence of helminth infections among the students sampled.

TABLE 2: Frequency of helminthes examined from stool samples in relation to sex among students of God’s Heritage Nursery and Primary School Jootar (Mbayenge) Among Children

Sex	<i>A. lumbricoides</i>	<i>Taenia spp</i>	<i>N. americanus</i>	<i>T. trichura</i>	<i>A. duodenace</i>	Negative result
Male	9	6	1	5	2	3
Female	7	10	5	5	2	5
Total	16	16	6	10	4	8

The table provides insight into the distribution of various helminth infections among male and female students at God’s Heritage Nursery and Primary School Jootar (Mbayenge). *A. lumbricoides*: *A. lumbricoides* infection is slightly more prevalent among male students. The infection

Collection of Soil Sample

Soil samples were collected in the sexted schools, two sampling sites site were selected which included toilet area and playground which were labelled site A and B. Twenty (20) samples were collected from each sample and we’re weighed to 1g of the soil sample. Formorether technique was used for all laboratory analysis of the soil samples. Formol-ether Concentration Technique, and Kato-Katz Techniques were used in the parasitological analysis.

Identification of Helminth Eggs

Eggs of the parasites were microscopically viewed noting the quantity, shape, and size using a light microscope (Nikon Eclipse Ci), identification of parasites was done based on the morphology of the eggs (Cuomo *et al.*, 2012).

Data Analysis

Estimation employed the combined results of Kato-Katz Method and Formol-ether Concentration Technique (Endris *et al.*, 2013). The density of each helminth parasite was computed by multiplying 24 to the number of eggs observed in a 41.7 mg stool sample (Endris *et al.*, 2013). The prevalence of helminth infection was computed, classified based on helminth parasites and densities, type of infection (single or mixed), and sex and age of study population. Physiologic effects of helminth infections was assessed using differences in the weight values of the grade school children. Values will be reported as frequency count for qualitative variables, and mean standard deviation for quantitative variables. Relative risk, odds ratio (OR), and 95% confidence interval (CI) was computed to examine the proportion differences and to correlate identified risk factors in the study on helminth infections. All statistical analyses was carried at 5% level of significance.

rate is slightly lower among female students. This suggests that *A. lumbricoides* is a common infection among the students, affecting both genders almost equally but with a slight male predominance. *Taenia* spp: Fewer male students are infected with *Taenia* spp compared to female students. This parasite is more common in female students. *Taenia* spp is another prevalent infection in this population, with a higher incidence in females, indicating potential differences in exposure or susceptibility between genders. *N. americanus*: Very few male students are infected with *N. americanus*. Female students have a significantly higher rate of infection. The disparity in infection rates suggests that female students might be more exposed to environments where *N. americanus* is prevalent or there may be gender-specific factors contributing to this difference. *T. trichura*: Equal number of male and female students are I

]nfected.This indicates no gender bias in the infection rate.*T. trichura* affects both genders equally, suggesting uniform exposure and susceptibility among students. *A. duodenace*: Infection rates are low among male students. Similarly low infection rates among female students.*A. duodenace* is less common compared to other helminths in this population, with no gender difference in infection rates.

The data shows some gender differences in the prevalence of certain helminth infections. For instance, female students have higher infection rates for *Taenia* spp and *N. americanus* compared to male students, while *A. lumbricoides* infection is slightly more common in males. *A. lumbricoides* and *Taenia* spp are the most common infections among these students, each affecting 16 students. This might indicate that these parasites are more prevalent in the environment of this school. *A. duodenale* has the lowest infection rate with only 4 students affected, showing it is less of a concern compared to other helminths. *T. trichura* shows equal infection rates among both genders, which might suggest similar exposure levels for both boys and girls. The presence of negative results shows that a portion of the student population does not have any helminth infection, which could be due to good hygiene practices or effective preventive measures.

TABLE 3: Frequency of helminthes examined from stool samples in relation to sex among students of Mbatere Community Primary School Kyado (Mbazum) Among Children

Sex	<i>A. lumbricoides</i>	<i>Taenia spp</i>	<i>N. americanus</i>	<i>T. trichura</i>	<i>A. duodenace</i>	Negative result
Male	5	7	4	4	5	5
Female	7	10	1	3	1	8
Total	12	17	5	7	6	13

There are notable gender differences in the prevalence of certain helminth infections. For example, *Taenia* spp and *A. lumbricoides* are more prevalent in females, while *N. americanus* and *A. duodenace* are more common in males. *Taenia* spp has the highest infection rate among the students, particularly in females, suggesting it is a major concern for public health in this community.*N. americanus* and *A. duodenale* have relatively lower infection rates, but the gender differences in their prevalence are significant. There are no helminths with equal infection rates between genders, indicating varying levels of exposure or susceptibility. More female students had negative stool examinations compared to male students, suggesting better hygiene practices or less exposure to helminth infections among females.

TABLE 4: Total sum of helminth specie from the three (3) selected school under study (stool samples)

S/N	HELMINTHES SPECIE	L.G.A PRI SCH	GOD’S HERITAGE NUR/PRI SCH	MBATEREM COMMUNITY PRI SCH	TOTAL SPECIE	PERCENTAGE PREVALENCE (%)
1	<i>A. lumbricoides</i>	16	16	12	44	29%
2	<i>T. trichura</i>	11	10	7	28	18%
3	<i>N. americanus</i>	6	6	5	17	11%
4	<i>Taenia spp</i>	17	16	17	50	32%
5	<i>A. duodenace</i>	5	4	6	15	10%

A. lumbricoides has a high prevalence across the three schools, with a substantial number of infections in each school. This indicates it is a common helminth in the studied population, requiring targeted intervention strategies. *T. trichura* shows a notable prevalence, particularly in the L.G.A Pri Sch and God’s Heritage Nur/Pri Sch. This suggests that while it is less common than *A. lumbricoides* and *Taenia* spp, it still represents a significant public health issue. *N. americanus* has the lowest prevalence among the helminths listed. Although less common, the consistent presence across all schools suggests it should not be overlooked in public health efforts. *Taenia* spp has the highest prevalence among the helminths studied, indicating a significant issue across all three schools. The high infection rate suggests that interventions focusing on preventing *Taenia* spp infections should be a priority. *A. duodenale* has the lowest number of cases and percentage prevalence. Despite being less common, it is still present and warrants attention in deworming programs.

***Taenia* spp (32%)** and ***A. lumbricoides* (29%)** are the most prevalent helminths, indicating a widespread issue that affects a significant portion of the student population in all three schools. Moderate Prevalence Helminths: *T. trichura* (18%) shows moderate prevalence, suggesting it is a common but not the most pressing helminth infection. *N. americanus* (11%) and ***A. duodenale* (10%)** have the lowest prevalence but are still present in the population, highlighting the need for comprehensive helminth control measures that include all types of infections.

Table 5: Results of Soil Samples Collected from L.G.A Primary School Boikyo

SITE A (Near Toilet)	Helminth Observed	SITE B (Playground)	Helminth Observed
A1	Taenia spp	B1	Ascaris spp
A2	Taenia spp	B2	Ascaris spp
A3	Negative	B3	Necator americanus
A4	Negative	B4	Necator americanus
A5	Negative	B5	Negative
A6	Ascaris spp	B6	Negative
A7	Negative	B7	Negative
A8	Negative	B8	Negative
A9	Negative	B9	Negative
A10	Taenia spp	B10	Negative
A11	Negative	B11	Ascaris spp
A12	Taenia spp	B12	Ascaris spp
A13	Negative	B13	Necator americanus
A14	Negative	B14	Negative
A15	Taenia spp	B15	Negative
A16	Taenia spp	B16	Negative
A17	Negative	B17	Negative
A18	Ascaris spp	B18	Negative
A19	Ascaris spp	B19	Ascaris spp
A20	Ascaris spp	B20	Ascaris spp

The soil near the toilet has a noticeable presence of *Taenia* spp and *Ascaris* spp. The proximity to the toilet likely contributes to the higher contamination levels due to improper sanitation practices or leakage from the toilet area. The playground soil shows a lower contamination level compared to the area near the toilet. However, *Ascaris* spp is still present, indicating that children are at risk of infection even while playing.

The area near the toilet (Site A) has higher instances of helminth contamination compared to the playground (Site B), indicating that sanitation facilities may be a significant source of soil-transmitted helminths. ***Taenia* spp** and ***Ascaris* spp** are the most commonly observed helminths in the soil samples.

Necator americanus is less prevalent but still present, particularly in the playground area.

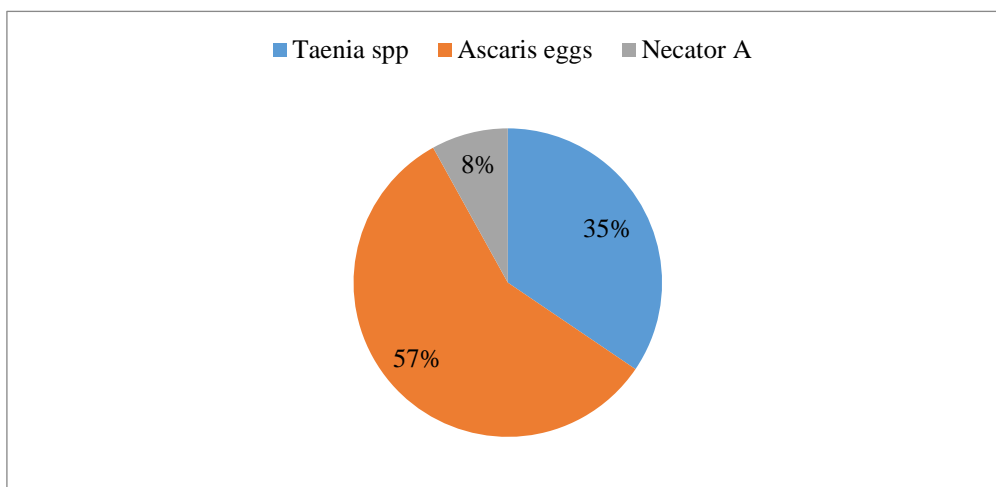


Fig 1: percentage intensity of soil transmitted helminthes from soil samples at LGA primary school Boikyo

The high prevalence of *Ascaris* and *Taenia* spp suggests that soil-transmitted helminth infections are a significant public health issue in the area.

Table 6: Results of Soil Samples Collected from God’s Heritage Nursery and Primary School

SITE A (Near Toilet) Helminth Observed		SITE B (Playground) Helminth Observed	
A1	Negative	B1	Negative
A2	Taenia spp (eggs)	B2	Negative
A3	Taenia spp (eggs)	B3	Negative
A4	Negative	B4	Trichuris trichura
A5	Ascaris spp (eggs)	B5	Trichuris trichura
A6	Ascaris spp (eggs)	B6	Negative
A7	Ascaris spp (eggs)	B7	Negative
A8	Negative	B8	Negative
A9	Negative	B9	Negative
A10	Negative	B10	Negative
A11	Ascaris adult	B11	Negative
A12	Ascaris spp	B12	Negative
A13	Ascaris spp	B13	Negative
A14	Negative	B14	Trichuris trichura
A15	Negative	B15	Trichuris trichura
A16	Ascaris spp	B16	Negative
A17	Ascaris spp	B17	Negative
A18	Ascaris spp	B18	Negative
A19	Negative	B19	Negative
A20	Negative	B20	Negative

The area near the toilet has multiple instances of *Ascaris* spp, both eggs and an adult, indicating a significant contamination. The presence of *Taenia* spp also highlights potential hygiene and sanitation issues. The playground had fewer helminth instances overall, but the presence of *Trichuris trichura* indicates contamination that poses a risk to children playing in these areas.

The area near the toilet (Site A) shows higher contamination with helminths, especially *Ascaris* spp. This suggests that sanitation facilities might be a source of soil-transmitted helminths. The playground (Site B) has fewer helminth instances but still shows contamination with *Trichuris trichura*, which needs addressing.

SUMMARY:

Negative: 25, *Taenia* spp:2, *Ascaris* eggs:9, *Trichuris trichura*: 4

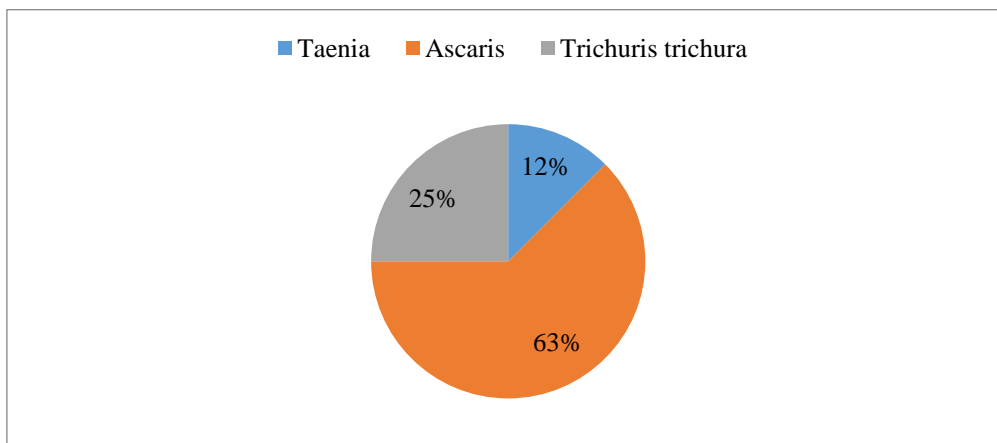


Fig 2: percentage intensity of soil transmitted helminthes from soil samples at God’s Heritage Nursery and Primary school Jootar (Mbayenge)

The pie chart you provided illustrates the distribution of helminth species observed in the soil samples collected from God’s Heritage Nursery and Primary School. Here's the interpretation based on the chart: *Ascaris* spp represents the largest proportion of helminth species observed in the soil samples, making up nearly two-thirds of the total helminths identified.

Implication: *Ascaris* spp is the most prevalent helminth in the soil, indicating a high risk of infection from this species for children in the area. This highlights the need for targeted interventions to reduce the presence of *Ascaris* spp. While *Taenia* spp constitutes a smaller portion of the helminth species observed, representing 12% of the total. **Implication:** While less common than *Ascaris* spp, *Taenia* spp still poses a health risk and should be addressed through improved sanitation and hygiene practices. *Trichuris trichura* accounts for a quarter of the helminth species observed in the soil samples.

Implication: The presence of *Trichuris trichura* indicates significant soil contamination and potential health risks for children, necessitating measures to prevent its spread.

The high prevalence of *Ascaris* spp and the presence of *Taenia* spp and *Trichuris trichura* suggest that soil-transmitted helminth infections are a significant public health issue in the area.

Table 7: Results of Soil Samples Collected from Mbatrem Community Primary School Kyado (Mbazum)

SITE A (Near Toilet) Helminth Observed		SITE B (Playground) Helminth Observed	
A1	Taenia spp (eggs)	B1	Ascaris spp (eggs)
A2	Negative	B2	Ascaris spp (eggs)
A3	Taenia spp (eggs)	B3	Ascaris spp (eggs)
A4	Taenia spp (eggs)	B4	Ascaris spp (eggs)
A5	Taenia spp (eggs)	B5	Ascaris spp (eggs)
A6	Negative	B6	Ascaris spp (eggs)
A7	Negative	B7	Ascaris spp (eggs)
A8	Negative	B8	Ascaris spp (eggs)
A9	Negative	B9	Negative
A10	Negative	B10	Negative
A11	Negative	B11	Negative
A12	Negative	B12	Negative
A13	Negative	B13	Negative
A14	Negative	B14	Negative
A15	Negative	B15	Negative
A16	Negative	B16	Negative
A17	Negative	B17	Negative
A18	Negative	B18	Negative
A19	Negative	B19	Ascaris spp (eggs)
A20	Negative	B20	Ascaris spp (eggs)

The area near the toilet has instances of *Taenia* spp eggs, indicating some level of contamination. However, the majority of samples (15 out of 20) are negative, suggesting that contamination is not widespread in this area.

The playground shows a higher level of contamination with *Ascaris* spp eggs compared to Site A. This highlights a significant risk of infection for children playing in these areas.

The area near the toilet (Site A) showed fewer helminth instances compared to the playground (Site B), indicating a higher contamination level in the playground. The presence of both *Taenia* spp and *Ascaris* spp suggests that both helminths are a concern in different areas of the school.

Ascaris spp is more prevalent in the playground, which poses a higher risk of infection during playtime. **Taenia** spp is found near the toilets, which points to potential issues with sanitation facilities.

SUMMARY: Negative:26, Taenia spp:4, Ascaris:10

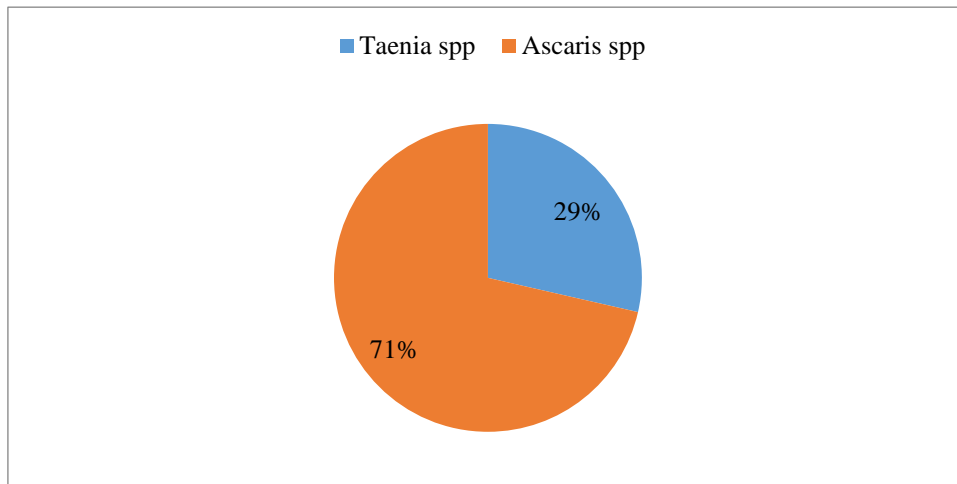


Fig 3: percentage intensity of soil transmitted helminthes from soil samples at Mbaterem Community Primary School Kyado (Mbazum)

The high prevalence of *Ascaris* spp eggs (71%) compared to *Taenia* spp (29%) suggests that *Ascaris* spp is the more prevalent soil-transmitted helminth in this school. This could be due to environmental factors, hygiene practices, or other variables that favor the transmission and survival of *Ascaris* spp in the soil.

Discussion

This study indicated that *A. lumbricoides*, *T. trichiura*, *Taenia* specie, *N. americanus* and *A. duodenace* were intestinal helminths parasitizing school children of I.G.A primary school Boikyo, God’s Heritage nur/primary school and Mbaterem community primary school all in Ukum Local government area of Benue state with varying degree of magnitude (Intensity). Of the 180 examined pupils 154 were infected with one or more of the above mentioned parasites above. However the stool samples of 26 pupils from the total sample population were tested negative of these parasitic soil transmitted helminthes.

With the population tested positive (154), this is an indication for the rampant existence of helminthic infection among elementary school attending population of Jootar town in general and soil transmitted helminthic infection in particular. Despite the existence of high water and latrine coverage in the town, this finding seems to be higher (Jimma Zone administration, 2009). This could be attributed to poor sanitary facility of the school as well as poor personal hygiene practice of the students. With simple observation, students were consuming fruits by their unwashed hands during break time. Possibly this could be the exposing factor for the existing high density and prevalence of helminthiasis in the area. The predominant helminth specie encountered in this prevalence study was *Taenia* spp which accounts 32.0%. This could be as a result of high consumption level of pork meat hence pigs are the major host of *Taenia* parasites. *Ascaris lumbricoides* was the second most frequently encountered parasite in this study with a prevalence rate of 29.0%. This prevalence is almost in agreement to the prevalence of *ascariasis* found in Wonji-Shoa Sugar Estate 22.2% (Woldemichael, 2011). But it is lower and almost equal to the last prevalence rate listed below when compared to the reported prevalence of Wondo Genet, Portoviejo city in Ecuador, Asendabo Elementary and Junior Secondary school, Delta State in Nigeria and South Gondar with prevalence rates of 83.4, 63.0, 56.4, 48.41

and 28.9% respectively. The most probable reason could be due to better personal hygiene practice of L.G.A primary school, God’s Heritage nursery/ primary school and Mbaterem community school children than Wondo Genet, Portoviejo in Ecuador, Asendabo, Delta State in Nigeria, and South Gondar School children (Lemlem, 2010; Egwunyenga, 2005; Ali, 2013). In contrast, it is higher in comparison to previous studies: 6.4% among school children of Adwa, 18.5% among school-age pupils in rural areas of southern China. The possible reason could be that the environment of L.G.A primary school, God’s Heritage nursery/ primary school and Mbaterem community school may be more favorable for completion of the life cycle of the parasite such as fertile soil, humid and wet environment (Lemlem, 2010; Shang *et al.*, 2010).

The third most prevalent parasite encountered in this prevalence study was *Trichuris trichiura* with a percentage density of 18% which claimed to be higher than *A. duodenace* and *A. americanus* from the three selected study areas as clearly shown from the graphs plotted in fig1, fig2 and fig3 respectively. This may be due to the suitable environmental conditions for reproduction. This prevalence was higher than the prevalence obtained in South Gondar Zone 9.5%, Portoviejo in Ecuador 10% Southern China 11.2%, and Delta State in Nigeria 12.39% (Haile, 2009). This is may be due to lack of adequate sanitary facility among the three selected schools which provides conducive environment or soil type for the completion of the life cycle of *T. Trichiura* (Erko, 2003). This specie was not found among the soil samples examined from L.G.A and Mbaterem community primary school only 4 cases were detected from the soil samples of God’s heritage Nur/Pri school. This may be as a result of ineffective use of technique for the detection or it It could be explained by better socio-economic status of these schools environment may be fumigation or use of insecticides to kill insects that are reservoir host of this parasite or host important developmental stages of the parasite.

The least frequent helminthic parasites detected in the study were *N. americanus* and *A. doudenace* with a prevalence rate of 11% and 10% respectively. In fact, the actual prevalence may be higher than those density percentages mentioned above, This is because Saturated Sodium chloride floatation technique by the McMaster method is best to detect ova *A. Lumbricoides* and ova of the three

hookworms; but it is less sensitive to detect ova of other helminthes like *N. americanus* and *A. doudenace* (Monica, 2016). The larvae of these two species of hookworms namely *Ancylostoma duodenale* and *Necator americanus* shares similar environmental conducive conditions for maturation in the soil like that of *Ascarise*, *Taenia* and *Trichuris*, the prevalence obtained in this study is not congruent to that of *Ascaris*, *Taenia* and *Trichuris*. This could be attributed to their mode of transmission, because hookworm infection is acquired through skin penetration by the filariform larvae in contrast to ingestion of embryonated eggs (Al –Meklafi *et al.*, 2006).

Conclusion/ Recommendation

More than half of the school children were infected with at least one STHs and majority of the students had light infection of soil transmitted helminths. Majority of the students had light infection of soil transmitted helminths and none of them had heavy intensity of infection of Trichuriasis and hookworms.

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