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# Prevalence and Risk Factors of Geohelminthiasis in Umuebu Community, Ukwuani Local Government Area, Delta State, Southern Nigeria

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***Authors' contributions***

*This work was carried out in collaboration between all authors. Authors OOO and OP designed the study. Author OP performed the statistical analysis, wrote the protocol and wrote the first draft of the manuscript. Author CAI edited the manuscript, authors CAI and OOO managed the analyses of the study. Authors OOO and OP managed the literature searches. All authors read and approved the final manuscript.*

***Original Research Article***

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## ABSTRACT

**Aims:** The objective of this current study was to determine the prevalence, intensity and associated risk factors of Geohelminthes infections or Soil transmitted helminthes (STHs) among pupils in Umuebu Community, Ukwuani Local Government area of Delta State.
**Study Design:** A cross sectional study was undertaken to assess the status of soil transmitted helminthes infection with respect to prevalence, intensity and associated risk factors among school children in Ebu Primary School Umuebu and the entire community in Ukwuani Local Government Area, Delta State.
**Place and Duration of Study:** The field study was carried out in Ebu primary School, in Umuebu community, Delta State while the laboratory work was carried out at the Department of Zoology and Environmental Biology, Lagos State University, Ojo Nigeria and Queen of the Apostle Catholic Hospital Laboratory, Obiaruku, Delta State all in Southern Nigeria between April and December, 2011.
**Methodology:** Eight hundred and seventy eight (878) children were randomly selected.

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They comprised of 466 (52.76%) males and 412 (47.24%) females between the ages of 5-13 years in the master list of Ebu Primary School, Umuebu. The stool samples were examined for the presence of STHs using direct smear and Kato-Katz techniques.
**Results:** Eight hundred and seven (92.74%) of the subjects were infected with Geohelminthiasis. The overall prevalence by species was *Ascaris lumbricoides* (76.89%), Hookworm (54.60%) and *Trichuris. trichiura* (29.24%). Two hundred and eighty two (39.40%) were infected with two or more STHs. The prevalence and intensity of all species of STHs significantly varied with age *(p>0.05*), with the highest prevalence in age group 5-7 years. The sex related prevalence show that males were more infected for all species of STHs than females, but this was only statistically significant for hookworm (*p>0.05).* Multiple logistic regression analysis for the epidemiological variable showed that licking of fingers, drinking from wells or surface tanks and geophagy were risk factors for *A. lumbricoides* and *T. trichiura* infections while walking barefooted was only risk factor for hookworm infection.
**Conclusion:** Targeted health education on hygienic practices coupled with the establishment of sustainable and regular deworming programmes in the community are advocated considering the high prevalence of STHs reported in this study.

*Keywords: Geohelminthiasis; prevalence; deworming; school children; umuebu; Nigeria.*

## 1. INTRODUCTION

Geohelminthiasis is a major health problem to those who live in areas of poverty in developing countries. Helminthes infections caused by STHs are among the most prevalent afflictions of humans who live in areas of poverty in the developing world [1]. The STHs are a group of parasitic nematode worms causing human infections through contact with parasite eggs or larvae. The life cycle of *Ascaris lumbricoides, Trichuris trichiura* and hookworm follows a general pattern. The adult parasite stages inhabit the gastrointestinal tract (*Ascaris* and Hookworm in the small intestine; *Trichuris* in the colon), reproduces sexually and produce eggs which are passed in human faeces and deposited in the external environment [2]. Globally, children harbor some of the most intense helminthes infections, such as the Geo- intestinal helminthes. *A. lumbricoides*, *T. trichiura*, the hookworm (*Necator americanus*, *Ancylostoma duodenale*) infect a quarter of the world populations including about 400million school age children and the older ages [3]. Infections by geo-intestinal parasites have been classically considered a typical health problem of rural communities [4,5]. Asymptomatic Ascariasis, Trichuriasis and Ancylostomiasis might cause significant alteration in the bacteria flora of the small and large intestines of man. There are several reports from various parts of Nigeria on geo-intestinal helminthes [2,5,6]. However, sufficient attention has not been given to Umuebu community; a remote, rural community where health and environmental facilities and structures are poor, inadequate or altogether lacking. This community reflects the situation of most remote communities in developing countries where the absence of regular and sustained intervention could be detrimental to the well being of growing children. With these prime factors in mind and with the recommendation of the World Health Organization (WHO) that base line survey be carried out among school children to determine the prevalence and intensity of infections, this study becomes paramount. In addition, base line survey provides bases for development of control programmes at national, state and local levels. In Nigeria, various base line surveys have been carried out to estimate the status of STHs [4,5,6].

# 2. METHODOLOGY

## 2.1 Study Area

The study was carried out in Umuebu village in Ukwuani Local Government Area of Delta State, Nigeria. The village is located within latitude 6'10º – 6'18º and longitude 6'10º – 6'15ºE of the Greenwich meridian.

The area is situated within the tropical rainforest belt in Nigeria with relatively high temperatures ranging from 25ºC – 27ºC in the wet season but rises a little between 27ºC-30ºC during the dry season. The village is characterized by a plane landscape with pockets of hills and slope landscape. It experiences heavy flooding during the rainy season resulting in gully erosion in some areas. The major drainage system is Okumeshi River. The village houses are mud walled with wooden and leaf roofs. The inhabitants of this metropolis are a mixture of people from various ethnic groups in Nigeria, although the majorities are the Ukwuani speaking people of Delta state. They are mainly public servants, subsistent farmers, fresh water fisher folks, artisan workers, transport workers anglers and dam dredgers. The sources of water supply in the village are pond water, well, stream, pipe borne (tap water), which run occasionally and borehole water. They mainly depend on various ponds and streams for their water related activities. Latrine facilities include; water closets (by some public servants), pit latrines, while others defecate in the nearby bush, sometimes in well dug out open trenches.

The heavy flooding during the rainy season occasionally increases sanitation problems. This can be attributed to the inadequate roads and hospital facilities.

## 2.2 Informed Consent

Parental consent was obtained through the head teacher of the school, Ebu Primary School Umuebu and Okpala-ukwu (oldest in the community).

## 2.3 Study Subject and Mobilization

The subjects were eight hundred and seventy eight (466 males and 412 females) primary school children between the ages of 5 and 13 years who were randomly selected from the master list of Ebu primary School, Umuebu. This actual survey was conducted between April and December, 2011.

## 2.4 Administration of Questionnaires and Interviews

The structured questionnaire was validated, pre-tested and pilot survey first carried out. The entire school was informed about the purpose of the exercise. The structured questionnaire was developed in English and then translated into the local language (Ukwuani). The questionnaire was developed using past and relevant questionnaires related to this study. For each of the participants, structured questionnaires were completed for demographic and associated risk factors for STHs infection. These were administered by trained interviewers (primary school teachers) using the local language. The majority of the students were unable to read and write, so the questionnaires were filled out with help of the class teachers.

Some of the information provided in the questionnaire were demographic i.e age, sex, parental occupation, family income per month, sources of water supply, toilet facility, licking of finger nail, walking bare footed, eating soil, presence of blood in stool etc.

## 2.5 Collection of Samples

The subjects were educated on the method of stool collection. Data such as age, sex, parent occupation, types of toilet facility and sources of drinking water among others were obtained from each child using the well structured questionnaire. The consent of the student's parent were obtained before the stool sample collection from the selected children. These were collected in wide mouthed plastic containers, sterile with screw caps carrying the appropriate identification number. A wooden spatula was also provided and children were educated on the methods of collection of stools.

## 2.6 Sample Examination

The stool samples were collected in the morning and examined in the afternoon. Physical examination of the stools was recorded as watery, semi formed, formed, bloody or mucoid, dark or brown, offensive or non offensive. Microscopic examination was carried out by direct smear method (wet mount) after concentration. Kato-Katz method was used to identify the number of eggs per gram of faeces [7]. The examinations of samples were carried out at Queen of the Apostles Catholic Hospital laboratory, Obiaruku, Delta state. To ensure consistency of the readings, second reading was performed in 20% of the randomly selected slides [8]. Statistical analysis was done using $\chi^2$ (chi-square) test and simple correlation coefficient to compare differences and for the determination of association respectively. These were performed using SPSS for Window version 11.0 (SPSS inc, Chicago, USA) and Stata version. Differences in the prevalence and intensity were tested using Chi-square and one-way ANOVA tests respectively. Multiple logistic regression analysis was used to determine independent effects of variables on the prevalence of geohelminthiasis.

## 3. RESULTS

Of 878 stool samples, 64.6% were watery, (89.3%) dark, (89.1%) bloody and mucoid and (76.1%) were offensive (Fig. 1). Four hundred and sixty six stool samples (52.76%) were obtained from males and 412 (47.24%) from females. Over all 807 of the 878 children were positive for one or more helminthes infections. This reveals a general prevalence of 92.24%. In all, only three helminthes were determined in the infected stool samples; these include *A. lumbricoides*, hookworm and *T. trichiura*.

Table 1 shows that the prevalence of the predominantly observed STHs parasites was significantly different ($P=0.05$) with age of subject. *A. lumbricoides* infection was the most prevalent parasite among the pupils. Its prevalence though, decreased with age, and pupils within the age 5-7 years had the highest prevalence (90.26%) while those in age group 11-13 years had the least prevalence (68.97%). With respect to hookworm infection, the trend was contrary to that of *A. lumbricoides* as the prevalence increased with age, with the highest prevalence of 78.45% in age group 11-13 years while subjects in age group 5-7 years had the least prevalence of hookworm 44.16%. Similarly, the prevalence of *T. trichiura* followed similar trend with hookworm. Considering the mean egg count for all infected subjects in the various age groups, the prevalence trend was maintained apart from that of *T. trichiura* which revealed a significantly different *($p>0.05$)* egg load with age group.

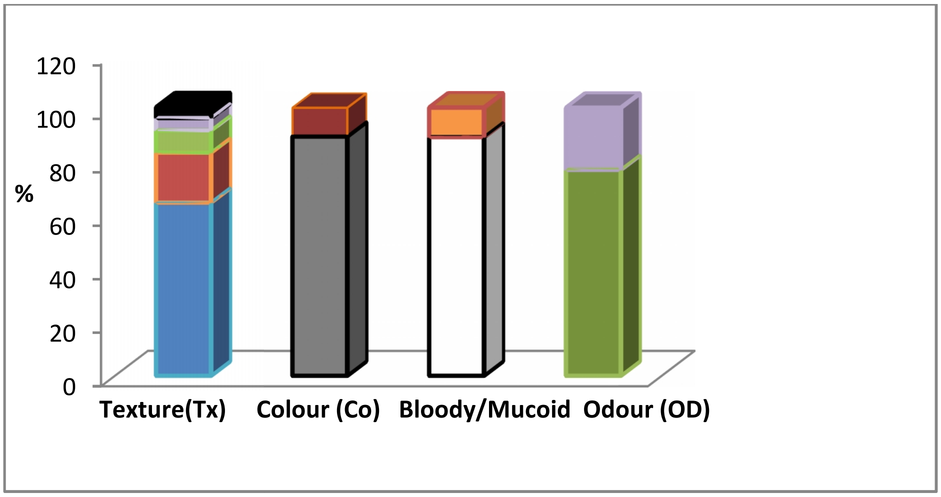


**Fig. 1. The macroscopic examination of feacal samples**

*Tx=Blue (watery), red (hard), green (semi-formed), purple(soft) ,black (formed).C0= Grey (dark), brown (brown). B/M= white (B/M) pink( not B/M). OD= green (offensive), purple (not offensive*

Table 2 further revealed that multiple infection among the subjects was not uncommon as 36.36% of subjects were positive for *A. lumbricoides* also had hookworm while co-infection of *A. lumbricoides* and *T. trichiura* was (10.22%), hookworm and *T. trichiura* (6.13%) and 3.48% of the subjects had a combination of the three parasites.

Table 3 indicates the prevalence and intensity of STHs with respect to sex. The table reveals that the mean prevalence and intensity of STHs infections was relatively higher among male subjects than in females for all STHs infections, though, no significant difference was observed except for the significant prevalence of hookworm (p>0.05) as well as the intensity of *T. trichiura*. The gender related multiple infections showed no significant difference (Table 4).

Table 5 shows the results of multiple logistic regression analysis. The data indicates that the risk of infection with the helminthes parasites was higher for subjects who regularly eat soil (geophagy) and those without toilet facilities in their homes (P-0.001). There was marginal risk of hookworm infection in pupils who are occasionally geophagic (OR 2.09, 95% CL1.17-2.81, P-0.038) and regularly lick or bite their fingernail (OR 1.58, CL 1.04-3.78, P=0.046).

Walking barefoot was identified as the only significant predictor for hookworm infection at regular (OR 4.39, 95% CL 2.59 – 7.45, P-0.001) and occasional (OR 2.24, 95% CL 1.16 – 4.30, P-0.016) levels. There was no association between infections of the three species of geohelminthes and the use of river or stream as sources of drinking water. However, children who use hand dug-wells and tanks as source of drinking water were at significant increased risk of *A. lumbricoides* (OR 0.02, 95% CL 0.007 – 0.008, P-0.001) and *T. trichiura* (OR 0.06, 95% CL 0.02-0.20, P-0.004). Children whose parental occupation is farming were at significantly higher risk of hookworm (OR 0.19, 95% CL 0.11 – 0.32, P-0.001) and *A. lumbricoides* (OR 0.06, 95% CL 0.30 – 0.12, P-0.001) than *T. trichiura* (OR 3.17, 95% CL 1.09 – 2.58, P-0.006).

**Table 1. Prevalence and intensity of STHs by ages of pupils in Umuebu, Ukwuani Community, Delta State, Southern Nigeria**

| | | Parasite | | | | | |
|---|---|---|---|---|---|---|---|
| **Age (Yr)** | **'n** | ***A .lumbricoides*** | | **Hookworm** | | ***T. trichiura*** | |
| | | **No infected (%)** | **Epg±SE** | **No infected (%)** | **Epg±SE** | **No infected (%)** | **Epg±SE** |
| 5-7 | 278 | 278(90.26) | 275.60±131.00 | 136 (44.16) | 66.80±19.40 | 36 (11.9) | 75.80±6.02 |
| 8-10 | 400 | 314 (71.69) | 389.70±197.80 | 216 (49.32) | 120.20±33.60 | 94(21.46) | 92.40±12.06 |
| 11-13 | 200 | 160 (68.97) | 384.30±192.40 | 182 (78.45) | 83.80±39.61 | 156(67.24) | 88.12±717.80 |
| Total | 878 | 752(76.89) | 322.80±133.60 | 534 (54.60) | 93.86±21.02 | 286 (29.24) | 85.0±9.21 |
| $X^2$ | | 29.9 | NS | 35.9 | NS | 110.3 | NS |

*NS = not significant.*

**Table 2. Multiple infection, prevalence and intensity of STHs by ages of pupils in Umubeu, Ukwuani Community, Delta State, Southern Nigeria.**

| | | Parasites | | | |
|---|---|---|---|---|---|
| **Age (Yr)** | **'n** | ***A.lumbricoides* + Hookworm** | ***A.lumbricoides* + *T.trichiura*** | **Hookworm + *T.trichiura*** | ***A.lumbricoides* + *T.trichiura* + Hookworm** |
| | | **No infected (%)** | **No infected (%)** | **Epg±SE** | **No infected (%)** |
| 5-7 | 278 | 112(36.36) | 28(9.09) | 22(7.14) | 12 (3.90) |
| 8-10 | 400 | 174(39.73) | 48 (10.96) | 28 (6.39) | 18(4.11) |
| 11-13 | 200 | 96 (41.38) | 14 (6.03) | 10 (4.31) | 4(1.72) |
| Total | 878 | 382(39.90) | 100 (10.22) | 60 (6.13) | 34 (3.48) |
| $X^2$ | | 58.8 | 133.2 | 146.2 | 169.1 |

*NS = not significant.*

**Table 3. Prevalence and intensity of STHs with regard to sex among pupils in Umuebu, Ukwuani Community, Delta State, Southern Nigeria**

| Parasite | Sex | | | | | | |
|---|---|---|---|---|---|---|---|
| | Male (n = 516) | | Female (n = 462) | | Total (n = 978) | | |
| | No infected (%) | Epg±SE | No infected (%) | Epg±SE | No infected (%) | Epg±SE | $X^2$ |
| *A.lumbricoides* | 396 (76.74) | 337.8± 129.20 | 356 (77.06) | 302.10± 112.30 | 752 (76.89) | 321.0±116.40 | 3.1 |
| Hookworm | 350 (67.83) | 99.80±29.02 | 184 (39.83) | 87.4±23.80 | 534(53.60) | 93.8±25.50 | 38.6 |
| *T.trichiura* | 164 (31.78) | 98.20± 12.60 | 122 (26.41) | 71.10± 9.60 | 286(29.24) | 85.20± 9.02 | 2.5 |

*NS = not significant.*

**Table 4. Multiple infection, prevalence and intensity of STHs with regard to sex among pupils in Umuebu, Ukwuani Community, Delta State, Southern Nigeria.**

| Parasite | Sex | | | |
|---|---|---|---|---|
| | Male | Female | Total | $X^2$ |
| | No infected (%) | No infected (%) | Epg±SE | |
| *A.lumbricoides* + Hookworm | 176(34.11) | 206(44.59) | 382(39.06) | NS |
| *A.lumbricoides*+ *T.trichiura* | 56(10.85) | 44 (9.52) | 100 (10.22) | NS |
| Hookworm + *T.trichiura* | 28 (5.43) | 32 (6.92) | 60 (6.13) | NS |
| *A.lumbricoides*+*T.trichiura* +Hookworm | 16(3.10) | 18 (3.90) | 34 (3.48) | NS |

*NS = not significant.*

**Table 5. Multiple logistic regression analysis for the association between the epidemiological variables and STHs among pupils in Umuebu, Ukwuani Community, Delta State, Southern Nigeria.**

| | *A.lumbricoides* | | Hookworm | | *T.trichiura* | |
|---|---|---|---|---|---|---|
| **Variables** | **Odd ratio (95% CI)** | **P-value** | **Odd ratio (95% CI)** | **P-value** | **Odd ratio (95% CI)** | **P-value** |
| **Eat Soil (Geophagy)** | | | | | | |
| I do not | 1.00 | | 1.00 | | 1.00 | |
| Regularly | 5.77 (2.92-11.41) | <0.001 | 4.18 (1.43-2.24) | 0.009 | 1674 (6.04-46.35) | 0.001 |
| Occasionally | 9.98 (4.61-21.61) | <0.001 | 2.09 (1.17-2.81) | 0.038 | 5.35 (1.45-19.8) | 0.012 |
| **Lick finger/bite nails** | | 0.000 | | 0.046 | | 0.035 |
| I don't | 1.00 | | 1.00 | | 1.00 | |
| Regularly | 1.10 (0.62-3.38) | <0.001 | 1.58 (1.04-3.78) | 0.046 | 2.65 (1.45-4.83) | 0.002 |
| Occasionally | 1.19 (0.49-2.82) | NS | 0.62 (0.37-1.04) | NS | 1.72 (1.07-2.85) | 0.035 |
| **Walk barefooted** | | | | | | |
| I don't | | | | | | |
| Regularly | 1.66 (1.34-3.96) | NS | 4.39 (2.59-7.45) | <0.001 | 0.54 (0.20-1.45) | NS |
| Occasionally | 2.79 (0.52-5.74) | NS | 2.24 (1.16-4.30) | 0.016 | 0.70 (0.40-1.23) | NS |
| **Sites of defaecation** | | 0.041 | 0.000 | | | 0.004 |
| Water closet | 1.00 | | 1.00 | | 1.00 | |
| Pit toilet | 1.66 (1.34-3.96) | 0.041 | 1.90 (0.19-6.59) | NS | 0.64 (0-0.31) | NS |
| Bush / No Toilet | 29.24 (12.58-67.95) | <0.001 | 4.30 (2.19-8.42) | <0.001 | 0.19 (0.06-0.59) | 0.004 |
| **Source of drinking** | | | | | | |
| Surface Water | | 0.000 | | | | 0.000 |
| Bore-hole | 1.00 | | 1.00 | | 1.00 | |
| Wells/tanks | 0.02 (0.007-0.08) | <0.0010 | 0.49 (0.19-1.26) | NS | 0.06 (0.02-0.20) | <0.001 |
| River /stream | 0.085 (0.53-1.36) | NS | 1.21 (0.82-1.79) | NS | 0.78 (0.51-1.21) | 1 |
| **Occupation of parents** | | 0.007 | | 0.039 | | 0.006 |
| Wage earner | 1.00 | | 1.00 | | 1.00 | |
| Farming | 0.06 (0.30-0.12) | <0.001 | 0.19 (0.11-0.32) | <0.001 | 3.17 (1.09-2.58) | 0.006 |
| Trading /self employed | 0.13 (0.69-0.26) | 0.007 | 0.54 (0.35-0.84) | <0.001 | 0.78 (0.51-1.21) | NS |

## 4. DISCUSSION

Soil transmitted helminthes are a great health problem in several tropical and sub-tropical countries [4,8,9]. Infected school children are often physically and mentally compromised by STHs, leading to cognitive deficits, learning disabilities and high school absenteeism. It also leads to high morbidity, mortality and economic loss to the country [10]. Although intestinal protozoan cyst and other parasites were observed in this study, this is beyond the scope of this present study. *Strongyloides* infections were not observed in this study, more so its motile larvae would have died in the afternoon during examination; however this helminth has never been common in Delta State [11]. The study further reconfirmed the triad patterns of *Ascaris*, hookworm and *trichuris* infections common in rural communities in Nigeria and Africa at large. Of all the intestinal helminthes observed, *A. lumbricoides* had the highest prevalence of 96.89%. The prevalence of 29.24% for *T. trichiura* is in contrast to findings made among school children in a study by World Health Organisation (WHO) [12].

The occurrence of multiple infections is consistent with reports in other parts of the country. In a study by Jeffrey et al., *A. lumbricoides* and hookworm had the highest prevalence (39.40%), followed by *A. lumbricoides* and *T. trichiura* (0.22%) [13]. This observation does not agree with reports of Brooker and Michael in which *A. lumbricoides* and *T. trichiura* had the highest prevalence (33.10%) [14]. However, the triad of *Ascaris-Hookworm-Trichiura* infection in Nigeria was further confirmed by the report of WHO that observed a prevalence of 94% in Ondo State an area with same ecological zone with this present study area [1].

On the Contrary, the prevalence in this study is higher than the findings elsewhere in southern Nigeria [5]. This observation is expected because of the differences in study age groups, sampling methods, environmental conditions, degree of dispersion of eggs, low sanitation as a result of indiscriminate defecation and dumping of waste in the communities. Generally, this prevalence has been attributed by several authors to improper hygiene, poverty, poor sanitary conditions and agricultural habits, physical and chemical composition of the soil and degree of human exposure [15].

Although the age group 5-7 years had the highest prevalence of *A. lumbricoides* (90.26%), the prevalence gradually decreased with the age of children while for other helminthes (*T. trichiura* and hookworm) the contrary is the case. Children within this age group 5-7 years probably spend more time playing with infected soil. They often eat indiscriminately sometimes with unwashed hands. As they grow older, the children become more conscious of personal hygiene. So also there is development of resistance through increased immunity. Children become more active and adventurous with age and this might expose them more to *T. Trichiura* and hookworm. The observation made in this study on age differences is in conformity with the findings in Abia, Osun and Ogun States of Nigeria [16]. In this study, Male had higher prevalence than females in the three species of helminthes parasites, no significant differences were observed except in infection with hookworm with *($p>0.05$).* This finding is in consonance with observations in Ondo State, Nigeria where WHO and Oyewole separately reported higher prevalence of helminthes parasites among males [1,5]. This further confirmed that where special male activities such as playing football, sunbathing on soil as well as molding of houses using moist soil, predisposes to infections. Sometimes these activities are carried out bare footed.

The risk of eating soil (geophagy), licking of fingers and drinking well or tank water were significantly higher risks for *A. lumbricoides* and *T. trichiura* infections than hookworm which was only associated with walking barefooted. Other variables like drinking from river and stream had no effect on the transmission of any of the helminthes parasites in this study community. This observation is not in consonance with report by Erko and Medhin, where there was an association between *Ascaris* and drinking tap and stream waters in Ethiopia, East Africa which is a different ecological zone when compared to the present study zone [17].

## 5. CONCLUSION

Findings from this study reveal that the three geohelminthes are common in Umuebu community, Delta state, Nigeria. This is a reflection of the poor state of hygiene and high rate of asymptomatic carriers in the community. The result of this study adds to the store of baseline data on the occurrence of helminthes infections among Nigerian Pupils [18]. Improved sanitation by provision of modern toilet facilities, health education by enlightenment campaigns, school based health programme and regular early deworming of pupils will go a long way in reducing infection. Prospective studies to access the impact of intestinal helminthes in school children as regards their school performance, (intelligence and absenteeism) and growth is advocated.

## CONSENT

All authors declare that written informed consent was obtained from the school authorities, village head, parents and guardian.

## ETHICAL APPROVAL

All authors hereby declare that all experiments have been examined and approved by the appropriate ethics committee of the Catholic hospital where the laboratory work was carried out and have therefore been performed in accordance with the ethical standards laid down in the 1964 Declaration of Helsinki."

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## COMPETING INTERESTS

Authors have declared that no competing interests exist.

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