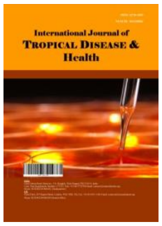

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Soil-Transmitted Helminths Infection and Associated Risk Factors among Primary School Pupils in Omogho and Awa Communities, Anambra State, Nigeria

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Authors' contributions

This work was carried out in collaboration among all authors. Authors AN, ACO, CIN and IVO designed the study, performed the statistical analysis, wrote the protocol and wrote the first draft of the manuscript. Authors KCI, NMO and CIN managed the analyses of the study. Authors AN, KCI, IVO and NMO managed the literature searches. All authors read and approved the final manuscript.

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ABSTRACT

Background: Soil-Transmitted Helminths (STHs) remain a public health problem. Infections are widely distributed in tropical and subtropical areas of the world.
Aim: This study was to investigate the prevalence and intensity of STH infections, the prevalence of STH mixed infections in relation to age and sex, and to identify the risk factors associated with STH infections among pupils in Omogho and Awa rural communities in Orumba North Local Government Area, Anambra State, Nigeria.
Study design: The study was a cross-sectional survey of faecal samples collected from 453 randomly selected pupils from four primary schools.

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Duration of study: The study was conducted between June and September 2017.
Materials and methods: The faecal samples were examined by direct smear and formol ether concentration techniques. Questionnaires based survey was done to determine the risk factors of STH among the pupils.
Results: The overall prevalence of STH infections was 44.2%. Among the schools, Primary School, Awa had the highest prevalence (17.0%) while Daughters of Mary Mother of Mercy Primary School, Omogho, had the least prevalence (5.3%). Others were Community Primary School, Omogho (12.8%) and Community Primary School, Awa (9.1%). There was no significant difference in the prevalence of STH infections among the primary school pupils (p = 0.36, $p > .05$). *Ascaris lumbricoides* (17.2%) was highest while *Strongyloides stercoralis* (2.0%) was the least prevalent. Other STHs observed were hookworms (15.9%) and *Trichuris trichiura* (9.1%). Pupils who do not practice proper hygiene had highest infections. A total of 149(32.9%) who do not wash hands after the use of toilet had more infections than 51(11.3%) who wash their hands. There was significant difference on prevalence of STH with responses on hygiene practices (p = 0.00, $p < .05$).
Conclusion: Absence of good toilet facility and adequate water supply in the schools made it difficult for the pupils to practice good hygiene. An integrated control of STH which should include provision of adequate toilet facilities for pupils, piped drinking water, chemotherapy and health education is recommended.

Keywords: STH; Ascaris lumbricoides; Trichuris trichiura; hookworm.

1. INTRODUCTION

The burden of soil-transmitted helminthiasis has remained a public health problem worldwide. More than 1.5 billion people, or 24% of the world's population, are infected with soil-transmitted helminth infections worldwide [1]. Infections are widely distributed in tropical and subtropical areas, with the greatest numbers occurring in sub-Saharan Africa, South America, China and East Asia and over 568 million school-age children live in areas where these parasites are intensively transmitted [1,2,3,4]. The infections are mainly with hookworm, *Ascaris lumbricoides, Trichuris trichiura* and *Strongyloides stercoralis* [1,5,6]. The highest prevalence occurs in areas where sanitation is inadequate and water supplies are unsafe [7]. In Nigeria, reports have shown that risk factors such as non-use of foot wears, lack of functional toilet facilities, unhygienic feeding and open defecation habits amongst others have been implicated in high prevalence of STH infections [8,9,10].

School age children are the most vulnerable group and they harbour the greatest number of intestinal worms [11,12]. Millions of school age children worldwide are infected with parasitic worms. As a result, they experience growth-stunting and diminished physical fitness as well as impaired memory and cognition. These adverse health consequences combine to impair childhood educational performance and reduce school attendance thereby limiting their ability to access and benefit fully from the education system [13,14]. Studies have demonstrated that children may acquire helminth infections early in life [15,16]. This may also cause organ damage that can remain subclinical for years and may manifest only later in adulthood [17]. It may ultimately results in a generation of disadvantaged adults which compromises the economic development of their communities and nations [18,19].

Implementation of control programmes of STH infections should be based on reliable and up to date information on the distribution of the infection. This study was to provide data with respect to prevalence and risk factors associated with STH infections in the area. The data can be used for monitoring and evaluation of control programmes aimed at improving the health, nutritional status and cognition functioning of pupils in these communities. The specific objectives were to determine the prevalence of STH infections, the prevalence of mixed infections, and the intensity of STH infections among pupils in relation to age and sex and Identify risk factors associated with STH infections among pupils in the study area.

2. MATERIALS AND METHODS

2.1 The Study Area

The study was conducted in Omogho and Awa rural communities in Orumba North Local Government Area, Anambra State, Nigeria between June and September 2017. The area lies between latitudes $5^0 58^{'}$N - $5^0 60^{'}$N and longitudes $6^0 47^{'}$E - $6^0.57^{'}$E. The climate is tropical and the vegetation is predominantly rainforest, characterized by fresh-water swamps. The area has two distinct seasons; rainy (March – October) and dry seasons (November – February). The annual rainfall volume in the area is about 1300mm. The relative humidity is between 60%-80% and temperature between 28^0C-30^0C. The communities lack piped water supply but has a number of lakes, streams and rivers which constitute the major source of water supply to the inhabitants. The inhabitants are mainly of low to middle socio-economic class. Their occupation is mainly subsistence farming, sometimes combined with petty trading. Omogho and Awa has a population of 38, 280 and 17, 335 inhabitants respectively [20]. Omogho has two primary healthcare centres and two nursery and primary schools. Awa has one primary healthcare centre and two nursery and primary schools.

2.2 Study Population

The study population comprised of pupils aged 6 to 15 years from the four (4) primary schools in the study area. In Omogho community, the schools used were Daughters of Mary Mother of Mercy Primary School, Omogho (DMMM, Omogho) and Community Primary School, Omogho (CPS, Omogho). In Awa community, the schools used were Community Primary School, Awa (CPS, Awa) and Primary School, Awa (PS, Awa).

The sample size was 453 pupils which was determined using the formula earlier described [21] as shown below:

$$n= \frac{N}{1+Ne^2}$$

N= Size of the population
n= Size of the sample
e= Level of precision (0.05)

2.3 Study Design

The study was a cross-sectional survey involving laboratory examination of faecal samples together with questionnaire based survey.

2.4 Collection Faecal Samples

A day before the collection of faecal samples, a well-labelled transparent sterile specimen container was given to each of the study participants. An applicator stick and a clean plain paper were also given. The pupils were directed on how to produce the samples early morning the next day which was the samples pick-up day.

2.5 Examination of Faecal Samples for Soil-Transmitted Helminths

2.5.1 Direct smear technique (Wet Mount)

The direct smear technique (wet mount) as described by Chessbrough was employed [22]. A wet saline smear was prepared by placing a drop of saline on the centre of the slide. An applicator stick was used to pick up a small portion of the faecal sample (size of a match head) from the specimen container, and mixed with the drop of saline. A thin smooth preparation was made. The emulsified sample on the slide was covered with coverslip, pressed gently to avoid the formation of air bubbles and was examined under a microscope for soil-transmitted helminth eggs and larvae. The eggs and larvae of soil-transmitted helminthes were identified as described by Chessbrough [22].

2.5.2 Formol ether concentration technique

The formol ether concentration technique as described by WHO [23] was employed. Using an applicator stick, 1g of faecal sample was emulsified in 10ml of 10% formalin in a tube until a slightly cloudy suspension was formed. A gauze filter was fitted into a funnel and the funnel was placed on top of the centrifuge tube. The faecal suspension was passed through the filter into the centrifuge tube until the 7ml mark was reached. The filter was removed and discarded with the lumpy residue. Four (4) ml of ether was added and mixed for a minute. The suspension was centrifuged at 1000g for a minute. The faecal debris was loosened with an applicator stick and the supernatant was poured away by quickly inverting the tube. The tube was placed in its rack and the fluid on the sides of the tube was allowed to drain down to the sediment. It was then mixed properly and a drop was placed on a slide and was covered with coverslip for examination under a microscope. The eggs and larvae of soil-transmitted helminths were identified as described by Chessbrough [22].

2.6 Determination of Risk Factors

Questionnaires were administered to all the study participants. The information contained in the questionnaire include; pupils' bio-data, methods of faecal disposal in school and some hygiene practices in order to identify risk factors associated with STH infections within the study population.

2.7 Data Analysis

Data obtained were analysed using Statistical Package for Social Sciences (SPSS). Level of significance was determined using Chi square and one way Analysis of Variance (ANOVA) at 95% confidence level.

3. RESULTS

The overall prevalence of STH infections was 44.2%. Among the schools, PS, Awa had the highest prevalence (17.0%) while DMMM, Omogho had the least (5.3%). Others were CPS, Omogho (12.8%) and CPS, Awa (9.1%). There was no significant difference in the prevalence of STH infections among primary school pupils in the study area. (p = 0.36, $p > .05$). Four species of the STHs reported were *A. lumbricoides* 17.2%, *T. trichiura* 9.1%, hookworms 15.9% and *S. stercoralis* 2.0% (Table 1).

It was observed that 3.5% out of the 200 faecal samples positive for STH infections had mixed infections (Table 2). *Ascaris lumbricoides* and *T. trichiura* combination had the highest prevalence of 1.5%, followed by *A. lumbricoides* and Hookworm 1.1%, then *T. trichiura* and Hookworm 0.9%. There was no significant difference in the prevalence of mixed infections within the study population (p = 0.082, $p > .05$).

Age group 9-12years had the highest prevalence of mixed infections (2.0%), followed by the 13-15 years (1.1%), while 6-8 years had the least prevalence of 0.4% (Table 3). There was no significant difference in the prevalence of mixed infections among the age groups (p = 0.430, $p > .05$).

Males and females had equal prevalence rate of mixed infection, 1.8% each (Table 4). There was no significant difference in the prevalence of mixed infections between males and females (p = 0.061, $p > .05$).

Age group 9-12 years had the highest single STH infection prevalence of 22.5% followed by the 6-8years (17.4%) while 13-15 years had the least, 4.2% (Table 5). There was significant difference in the prevalence of STH in the age groups (p = 0.040, $p < .05$).

Table 1. Prevalence of soil-transmitted helminth infections among pupils in Amogho and Awa communities, Anambra State

Schools	No. examined	No. (%) infected	*Ascaris lumbricoides* No. (%)	*Trichuris trichiura* No. (%)	*Strongyloides stercoralis* No. (%)	Hookworm No. (%)
DMMM, Omogho	68	24(5.3)	13(2.9)	7(1.5)	0(0.0)	4(0.9)
CPS, Omogho	133	58(12.8)	32(7.1)	17(3.8)	0(0.0)	9(2.0)
CPS, Awa	92	41(9.1)	12(2.6)	5(1.1)	3(0.7)	21(4.6)
PS, Awa	160	77(17.0)	21(4.6)	12(2.6)	6(1.3)	38(8.4)
Total	453	200(44.2)	78(17.2)	41(9.1)	9(2.0)	72(15.9)

Table 2. Prevalence of mixed infections of soil-transmitted helminths among pupils in Omogho and Awa communities, Anambra State

Schools	No. (%) of mixed infections	*A. lumbricoides* + *T. trichiura* No. (%)infected	*A. lumbricoides* + Hookworm No. (%) infected	*T. trichiura* + Hookworm No. (%) infected
DMMM, Omogho	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)
CPS, Omogho	6 (1.3)	4 (0.9)	2 (0.4)	0 (0.0)
CPS, Awa	5 (1.1)	1 (0.2)	3(0.7)	1 (0.2)
PS, Awa	5 (1.1)	2 (0.4)	0 (0.0)	3 (0.7)
Total	16 (3.5)	7 (1.5)	5 (1.1)	4 (0.9)

Table 3. Age-specific prevalence of mixed infections among pupils in Omogho and Awa communities, Anambra State

Age group (years)	No. (%) of mixed infections	*A. lumbricoides* + *T. trichiura* No. (%) infected	*A. lumbricoides* + Hookworm No. (%) infected	*T. trichiura* + Hookworm No. (%) Infected
6-8	2 (0.4)	2 (0.4)	0 (0.0)	0 (0.0)
9-12	9 (2.0)	4 (0.9)	3 (0.7)	2 (0.4)
13-15	5 (1.1)	1 (0.2)	2 (0.4)	2 (0.4)
Total	16 (3.5)	7 (1.5)	5 (1.1)	4 (0.9)

Table 4. Sex-specific prevalence of mixed infections among pupils in Omogho and Awa communities, Anambra State

Sex	No. (%) of mixed infections	*A. lumbricoides*+ *T. trichiura* No. (%) infected	*A. lumbricoides*+ Hookworm No. (%) infected	*T. trichiura*+ Hookworm No. (%) infected
Male	8 (1.8)	6 (1.3)	1 (0.2)	1 (0.2)
Female	8 (1.8)	1 (0.2)	4 (0.9)	3 (0.7)
Total	16 (3.5)	7 (1.5)	5 (1.1)	4 (0.9)

Table 5. Age-specific prevalence of soil-transmitted helminths among pupils in Omogho and Awa communities, Anambra State

Age-group (years)	No. examined	No. (%) infected	*Ascaris lumbricoides* No. (%)	*Trichuris trichiura* No. (%)	*Strongyloides stercoralis* No. (%)	Hookworm No. (%)
6-8	182	79 (17.4)	40 (8.8)	16 (3.5)	0 (0.0)	23 (5.1)
9-12	209	102(22.5)	33 (7.3)	21 (4.6)	5 (1.1)	43(9.5)
13-15	62	19 (4.2)	5 (1.1)	4 (0.9)	4 (0.9)	6(1.3)
Total	453	200(44.2)	78 (17.2)	41 (9.1)	9 (2.0)	72 (15.9)

Age group 9-12 years had the highest intensity of infection while 13-15 years had the least (Table 6). There was significant difference between the age of the children and the intensity of single STH infections among the pupils (p = 0.001, $p < .05$).

The sex-specific prevalence of single STH infections within the study population showed that females had the highest prevalence of 22.7% than males 21.4% (Table 7). The difference between males and females was not significantly different (p = 0.09, $p > .05$).

Table 6. Intensity (Epg±SE) of soil-transmitted helminths in relation to age group of the pupils in Omogho and Awa communities, Anambra State

Age group (years)	*A. lumbricoides*	*T. trichiura*	*S. stercoralis*	Hookworm
6-8	886.7± 3.12	520± 5.19	-	620± 7.25
9-12	720± 10.20	386.7± 5.04	86.7± 1.06	840± 11.85
13-15	80± 0.87	100± 2.48	60± 2.25	146.7± 4.19

Table 7. Sex-specific prevalence of soil-transmitted helminths among the pupils in Omogho and Awa communities, Anambra State

Sex	No. examined	No. (%) infected	*Ascaris lumbricoides* No. (%)	*Trichuris trichiura* No. (%)	*Strongyloides stercoralis* No. (%)	Hookworm No. (%)
Male	221	97 (21.4)	36(7.9)	23 (5.1)	2 (0.4)	36 (7.9)
Female	232	103(22.7)	42 (9.3)	18 (4.0)	7 (1.5)	36(7.9)
Total	453	200(44.2)	78 (17.2)	41 (9.1)	9 (2.0)	72 (15.9)

The intensity of single infection with respect to sex showed that females recorded the highest intensity than males (Table 8). The difference between intensity of STH in males and females was significant (p = 0.003, $p < .05$).

Pupils who defecate in the open had the highest prevalence of single STH infection (23.2%), followed by those that use pit latrines (16.1%). Pupils that use water closet had the lowest prevalence of 4.9% (Table 9). There was significant difference between infection with STHs and methods of faecal disposal by the pupils in school (p = 0.000, $p < .05$).

Those that engage in proper hygiene practices were less infected than those that do not (Table 10). There was significant difference on prevalence of STH with responses on these hygiene practices (p = 0.00, $p < .05$).

4. DISCUSSION

The 44.2% overall prevalence of STH infections observed in this study compares favourably with 44.08% and 44.71% prevalence rates reported among school children in Ozubulu and Uga in Anambra State respectively [24,25]. But the prevalence rate was much lower than 87.7% reported in Ebenebe also in Anambra State [10]. On the other hand, the prevalence rate was much higher than 21.7% observed in some communities in Anaocha Local Government Area, Anambra State [26]. The variation in prevalence rates of STH infections in different localities may be as a result of varying sanitary standards, environmental factors, timing, socio-cultural habits, and level of knowledge on prevention and control of these helminths. Also, availability and utilization of toilet facilities in these communities could be a determining factor. The high prevalence observed in this study may

Table 8. Intensity (Epg±SE) of soil-transmitted helminths in relation to sex of the pupils in Omogho and Awa communities, anambra state

Sex	*A. lumbricoides*	*T. trichiura*	*S. stercoralis*	Hookworm
Male	780± 8.56	486.7± 3.71	26.7± 1.00	920± 14.43
Female	906.7± 4.36	520± 7.47	120± 2.63	686.7± 11.34

Table 9. Prevalence of soil-transmitted helminth infections in relation to methods of faecal disposal by the pupils in Omogho and Awa communities, Anambra State

Toilet facilities	No. examined	No. infected (%)
Open defecation	183	105 (23.2)
Pit latrine	159	73 (16.1)
Water closet	111	22(4.9)
Total	453	200 (44.2)

Table 10. Prevalence of soil-transmitted helminth infections in relation to some hygiene practices by the pupils in Omogho and Awa communities, Anambra State

Hygiene practices	Responses	No. infected n=200	No. non-infected n=253	X^2	P-value
Eating of unwashed fruits	Yes	75(16.6%)	211(46.6%)	66.5	0.00
	No	125(27.6%)	42(9.3%)		
Hand washing after toilet use	Yes	51(11.3%)	201(44.4%)	131.7	0.00
	No	149(32.9%)	52(11.5%)		
Hand washing before eating	Yes	53(11.7%)	164(36.2%)	65.7	0.00
	No	147(32.5%)	89(19.6%)		
Use of footwear in school	Yes	194(42.8%)	35(7.7%)		
	No	6(1.3%)	218(48.1%)	309.1	0.00

be attributed partly to the season (wet season) during which the investigation was conducted. It has been reported that wet damp soil favours the hatching and longevity of helminth eggs which in turn promotes the transmission dynamics of intestinal helminthes [27].

Ascaris lumbricoides, *T. trichiura*, *S. stercoralis* and hookworm observed in this study has been previously reported in other studies [10,24,25,26]. *Ascaris lumbricoides* had the highest prevalence among all the STHs observed. This result agreed with other reports who also observed same in their study [10,28,29]. This highest prevalence may be because *A. lumbricoides* egg is coated with muco-polysaccharides that render it adhesive to a wide variety of surfaces including papers and vegetables amongst others [30]. Also, the eggs of the parasite are also resistant to harsh environmental conditions. This may justify its ubiquitous nature and distribution in all age groups in this study.

The 3.5% prevalence of mixed infections in this study was slightly lower when compared to 6.2% reported in Sapele Local Government Area, Delta State [31]. It was also far lower than the 22.5% reported in some villages of Ijebu Local Government Area, Ogun State [32]. The most common combination encountered in this study was *A. lumbricoides* and *T. trichiura*. The observation agrees with a study [33] but differs from another [34] where *A. lumbricoides* and hookworm was the most common combination.

The age group 9-12 years had the highest prevalence while 13-15 years had the least (4.2%). The low prevalence in the later age group may be because older children practice good hygiene habits than younger ones [35]. Parasite intensity was at its peak within the 9-12 years age group, but decreased with increase in age. This could be because children of younger age group are not mindful of the health risk associated with some unhygienic practices. Also in this study, females had the highest prevalence than males and parasite intensity was more in females than in males. These variation in prevalence and intensity among sexes could be by chance as the difference was not statistically significant.

On risk factors, those that defecate in the open had the highest prevalence. Some schools in the area lack functional toilet facilities. In a few that had, the pupils do not have access to them. In another with toilet facilities for the pupils, the pupils do not make use of them but prefer open defecation. These patterns of defecation are behaviours that allow eggs/larvae of helminths to contaminate the soil and environment [8,9,10]. The responses gathered on some hygiene practices showed that there was significant difference in prevalence of STH infections between those that indulge in unhygienic practices and those that practice good hygiene.

5. CONCLUSION

This study revealed that STH infections is still highly prevalent among primary school pupils in the study area. Also, the risk factors associated with the high prevalence were mainly poor personal and environmental hygiene. The absence of good toilet system and adequate water supply in the schools also made it difficult for the pupils to practice good hygiene necessary for the control of STH infections. An integration of actions aimed at STH transmission control is recommended. This should include provision of adequate toilet facilities for pupils, piped drinking water, chemotherapy and health education.

CONSENT

A letter of introduction obtained from the Department of Parasitology and Entomology, Nnamdi Azikiwe University, Awka was presented to the Education Secretary of Orumba North Local Government Area of Anambra State, the opinion leaders of the two communities and the head teachers of the schools. Consent for the study was obtained after briefing and consultations with the community heads, the head teachers of the schools and the parents of the pupils on the purpose of the study.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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