International Journal of Translational
Medical Research and Public Health (2018), Volume 2, Issue 1, 1-11

IJTMRPH

Available online at www.ijtmrph.org

INTERNATIONAL JOURNAL OF TRANSLATIONAL MEDICAL RESEARCH AND PUBLIC HEALTH
ISSN: 2576-9499 (Online)
ISSN: 2576-9502 (Print)
DOI: 10.21006/ijtmrph.53

ORIGINAL ARTICLE | INTESTINAL HELMINTHIASIS

Risk Factors and Socio-demographic Determinants of Intestinal Helminthiasis among Children in Schools that Implemented the Homegrown School Feeding Program in Ekwulobia, Anambra State, Southeast Nigeria

Ogechukwu B. Aribodor, MSc[1]✉; Chinyelu A. Ekwunife, PhD[2]; Olufemi S. Sam-Wobo, PhD[3]; Dennis N. Aribodor, PhD[2]

[1]Department of Zoology, Nnamdi Azikiwe University, Awka, Nigeria; [2]Department of Parasitology and Entomology, Nnamdi Azikiwe University, Awka, Nigeria; [3]Department of Pure and Applied Zoology, Federal University of Agriculture, Abeokuta, Nigeria

✉**Corresponding author email:** ogearibodor@gmail.com

ABSTRACT

Introduction: Control of intestinal helminthiasis among pupils improves their nutritional status. This study identified the risk factors and socio-demographic determinants of intestinal helminthiasis among children in primary schools that implemented Home Grown School Feeding Program (HGSFP) in Anambra State, Nigeria.

Methods: The study area was Ekwulobia, Anambra State, Southeast Nigeria. A total of 848 consented pupils from Primary (Elementary) classes 1-4 were examined from Community Primary School (270 pupils); Central Primary School (317 pupils); and Nwannebo Primary School (261 pupils). Structured questionnaires were administered to pupils to assess their risks factors for helminthiasis. Fecal samples collected from all pupils were examined using Kato-Katz technique. Data obtained were entered and analyzed using SPSS. Chi-square test and t-test were used to test for level of significance.

Results: Of the 848 pupils, 452 (53.3%) were males, and 396 (46.7%) were females. Assessment of risk factors associated with transmission revealed that toilet type, hand washing habits, and knowledge of the cause of helminthiasis were significantly (p<0.05) related to transmission; however parent's occupation and biting of fingernails habits were not correlated with transmission (p>0.05). There was a very low prevalence of helminths at 0.71% in six stool samples (1 male and 5 females), and prevalence of helminths was not significantly associated (p>0.05) with pupil's sex and age. *Ascaris lumbricoides* was the only helminths species observed in the study population.

Conclusion and Implications for Translation: The low prevalence of intestinal helminthiasis among the study population may be attributable to efforts of HGSFP that was implemented in the study area. There is a need for constant monitoring and surveillance of all public schools and sustenance of the implemented water, sanitation and hygiene practices, and HGSFP so that total elimination of helminths can be achievable in the state.

Keywords: Helminthiasis • Home Grown School Feeding • Pupils • Ekwulobia • Anambra State • Nigeria.

1. Introduction

Intestinal helminths are among the most common chronic infections distributed throughout the world, disproportionately affecting poor populations living in tropical and sub-tropical parts of the world. More than 3.5 billion people are estimated to be infected with intestinal helminths,[1] which in turn is associated with an estimate of 4.98 million years lived with disability.[2] As such, about 300 million people suffer from severe morbidity attributed to intestinal helminths infections, ultimately resulting in 10,000–135,000 deaths annually.[3] Epidemiologic studies have shown that intestinal helminths infections are aggregated, with the majority of people harboring a few of the parasites while a minority of people suffer from heavy infections.[1] It is also known that morbidities associated with intestinal helminths infection such as nutrient mal-absorption, diarrhea, vitamin deficiencies, iron-deficiency anemia, poor growth in children, and poor educational performance are directly related to the intensity of infection. Hence, people who are heavily affected by intestinal helminths, experience the pathological sequels of infection, and it is children and women of child-bearing age are at the highest risk of developing the morbidities associated with intestinal helminths.[4]

While these infections are seen in developing countries in Africa, they are especially a threat to those living in developed countries due to traveling, trade and migration.[5] Developing countries account for 50% of children infected annually with intestinal nematode and orally acquired helminths.[6] Children chronically infected with intestinal parasites lose on average a total of 3.75 IQ points for each intestinal parasite with which they are infected.[7] The consequences of intestinal helminths infections include malnutrition, iron deficiency anemia, impairment of physical and mental development, which ultimately retards educational advancement of children and the economic development of the nation.[8] Nigeria is also among the over 130 countries reported to be endemic with intestinal helminth infection.[9] In Nigeria, the prevalence of infections ranges from 14.4-71.1% depending on the location and the methodology employed.[10] Many authors have recognized intestinal parasites as an important health problem, especially among Nigerian children.[11-14] These studies have shown that intestinal helminths have become a major menace to health of the Nigerian population, as the public health significance of these infections rank highest in morbidity among school-aged children due to their vulnerability to nutritional deficiency and socio-cultural habits.

The distribution of intestinal helminths is influenced by various factors like poor environmental sanitation, lack of personal hygiene, and use of contaminated water,[15] and other factors including age, socio-economic status, and occupation.[16] Poverty and low socio-economic status are among the main factors that contribute to the continuous prevalence of helminths diseases.[17] Sam-Wobo *et al*. reported that the type of occupation and earning power of parents are considerable factors in epidemiological control.[18] Their results showed that the majority (94.6%) of the population who lived in compact and densely-populated single rooms are grossly lacking of basic sanitary facilities. Also, there is low access to toilet facilities at the schools within the semi-urban and rural communities studied. For schools that had latrines, it was observed that their availability was much lower compared to the school population, and in some cases, the latrines were restricted to school staff only. It has been reported that Nigeria has one of the lowest quality sanitary systems and latrine maintenance in the world; hence, intestinal parasites are widespread and cause significant morbidity in children within the country.[19]

Currently, the primary control strategy for intestinal helminths mainly depends on mass drug administration (MDA) provided for populations at risk of the diseases, irrespective of their infection status. This is accompanied by health education, provision of clean water, and sanitary facilities to sustain the effect of MDA.[1] School-based deworming is the most commonly practiced strategy in developing countries. Although deworming does not prevent re-infection, repeated deworming has a considerable impact on maintaining the intensity of intestinal helminths infection to a minimal level, reducing the associated morbidities among infected individuals.[20]

Home Grown School Feeding Program (HGSFP) is an intervention introduced in many developed and developing countries to address the issue of malnutrition, poverty, stimulate school enrollment and enhance pupils' performance. This intervention is especially focused in addressing developing countries where almost 60 million children go to school hungry every day, and of which, about 40% are from Africa.[21] Within developing countries, school-feeding was an important component of school-based health programs designed to address nutrition and health needs of school-age children. Although this feeding program also encouraged school enrollment and attendance, it soon became expensive and difficult to implement. Still, school-feeding became very important in some countries, including Nigeria, where the integration of deworming into the program is now a popular way to address helminth infections among school-aged children.[22]

In 2006, Nigeria recognized the pivotal role of school health and nutrition in terms of achieving health and education for all. Based on the Federal Government's requirements, 17 States have already designed "Models" for HGSFP through their various State-Level Multi-Sector Capacity Building Workshops. Osun State Government was the first to implement HGSFP and has so far provided a meal per day for 129,318 children from Kindergarten to Primary 2 within their 1,352 public schools. To our knowledge, no empirical studies have examined the impact of the program on any State Government's HGSFP. Having met the stipulated Federal Government's guideline for fund assessment, Anambra State kicked off the HGSFP in December 2016 to cater for an estimated 76, 690 pupils from Primary 1-3 in all state public schools within their 21 Local Government Areas (LGAs). The model provides that each pupil receives one daily meal for five consecutive days (Monday to Friday) in every week, and each pupil is dewormed on a quarterly basis. The goal was to control intestinal infections among pupils and maintain their nutritional status, by increasing the nutritive value of the home-grown meals given to them. The present study focused on identifying the risk factors and socio-demographic determinants of intestinal helminthiasis among children in schools that implemented HGSFP in Ekwulobia, Anambra State, Nigeria.

2. Methods

2.1. Study Area and Population

The study area was Ekwulobia, located in Aguata LGA of Anambra, (Nigeria, with coordinates 6° '2' "0" North, 7° '5' "0" East); this is an area with tropical rainforest vegetation (Figure 1). The residents of the Ekwulobia mainly occupy positions within the government, teaching, and the farming and trading industries.

The study population consisted of 848 Primary 1- 4 school pupils enrolled within the following public schools: Community Primary School, Ekwulobia (270 pupils); Central Primary School, Ekwulobia (317 pupils); and Nwannebo Primary School, Ekwulobia (261 pupils). The population studied consisted of Primary 1-3 school pupils currently under HGSFP, and the control subjects were Primary 4 school students.

2.2 Ethical Approval

Ethical clearance was obtained from the Ethical Committee of Anambra State University Teaching Hospital, Uli, Anambra State, Nigeria. Permission for the study was obtained from the Secretary of Education in charge of primary schools in Aguata LGA. Authorizations from School's Headmistresses and parents' consent were sought before start of study. Only pupils whose parents/guardians consented by signing the consent form were recruited into the study. There were preliminary visits to meet with school headmistresses and provide them with detailed explanations and print material about the study. The schools were selected based on their: a) size (where larger schools were selected), and that b) the pupils within the schools had not received deworming treatments in the last 3 months.

2.3. Data Collection and Socio-demographic **Characteristics**

Basic demographics such as name, age, gender were obtained using standard structured study questionnaires. Body weight and height measurements were taken for each child to assess growth and nutritional status. The weight of each pupil was measured without their shoes to the nearest 0.1 kg, using a standardized digital scale. Height was measured to the nearest 0.1 meter using a portable stadiometer. Each pupil was measured in a standing and relaxed position while breathing normally. Body Mass Index (BMI) was calculated as weight (kg) divided by the square of the height (m2) (kg/m2).[23]

2.4. Stool Sample Collection

The process was carried out during school hours with permission of the headmistresses and the help of the teachers. Each pupil was provided with a plastic container with tight lids that was properly labeled with their name and sex, and were given instructions to provide a small quantity of fresh stool. The stool samples were first observed with the naked eye for consistency, for any color differences distortions, or for the presence of worms. The specimens collected were prepared immediately for microscopic examination using the modified quantitative Kato-Katz method,[24] within the school premises. The slides were properly labeled for microscopic examination. The number of eggs of every helminths species counted within the Kato-Katz smear was then multiplied by a factor of 50 for obtaining the number of egg per gram (epg), and estimating the intensity of infection.[25-27] Consistency of the stool and age of each pupil was also used to calculate the final egg per gram for the indirect worm count, as correction factors according to Nawalinski et al.[28]

2.5. Statistical Analysis

The data collected were analyzed using software SPSS Statistics for Windows, version 23 (IBM, Armonk, NY), the results were presented in tables and charts using simple percentage ratio. The relationship between the prevalence and risk factors obtained from the observations and parameters such as age, sex, and socio-cultural background of the respondents were compared using cross tabulations. Chi-square test and t-test were used to test for level of significance (p) which was set at <0.05.

3. Results

From the 848 pupils examined, 452 (53.3%) were males and 396 (46.7%) were females. Fecal samples of pupils examined from the three schools revealed that 6 (0.71%) fecal samples were positive for helminth eggs (1 male and 5 female). Prevalence as presented in Table 1 among males and females was not significant (p>0.05). The eggs of soil-transmitted *Ascaris lumbricoides* were observed in the fecal samples (0.71%). No co-infection was observed in the stool samples examined.

Prevalence of *Ascaris lumbricoides* varied among different age groups (Table 2). Children within the 7-9 years age group had the highest prevalence (1.0%) while those in age groups 4-6 years had the least prevalence (0.00%). The difference in prevalence for *Ascaris lumbricoides* between age groups was not statistically significant (p>0.05). Prevalence of *Ascaris lumbricoides* varied among the three schools (Table 3) and was significant (p<0.05). Their prevalence were Nwannebo Primary School (0.00%), Central Primary School (0.32%) and Community Primary School (1.85%) respectively. The overall prevalence of intestinal helminths among the classes varied among the four classes sampled (Table 4). The prevalence of intestinal helminths was higher in Primary 2 pupils (0.97%) followed by the pupils in Primary 1. The least was among the pupils in Primary 4.

Table 5 shows the mean intensity of infection for *Ascaris lumbricoides*. The difference between the intensity of infection for male (50±0.01) and female pupils (1774.8±805.3) was statistically significant (p<0.05). However, the intensity of *Ascaris lumbricoides* in relation to both sexes falls under Light-intensity infections. The mean intensity of *Ascaris lumbricoides* for the age group 7-9 years was highest (757.8±561.4) and the lowest was for age group 10 years and above (105±0.01). There was no significant difference between intensity of *Ascaris lumbricoides* among the age groups (p>0.05) (Table 6).

3.1. Risk Factors Assessment

Table 7 presents prevalence of helminths infection by toilet type. The prevalence of all helminths species was 0% for pupils who use pit toilet, whereas the prevalence was 1.37% for pupils who use water cisterns. The children who had the habit of not washing their hands after defecation (0.81%) had a higher prevalence than the prevalence of helminths

Table 1: Prevalence of Helminth Parasites among the Pupils by Sex

Sex	Number (No.)	*Ascaris* No. (+ve %)	Hookworm No. (+ve %)	*Trichuris* No. (+ve %)	Co-infection No. (+ve %)	Total No. (+ve %)
Male	452	1(0.22)	0(0.00)	0(0.00)	0(0.00)	1(0.22)
Female	396	5(1.26)	0(0.00)	0(0.00)	0(0.00)	5(1.26)
Total	848	6(0.71)	0(0.00)	0(0.00)	0(0.00)	6(0.71)
		ns	ns	ns	ns	

** = significantly different (p<0.05); ns=not significantly different

Table 2: Prevalence of Different Helminth Parasites among the Pupils of Different Age Groups

Age (years)	Number (No.)	*Ascaris* No. (+ve %)	Hookworm No. (+ve %)	*Trichuris* No. (+ve %)	Co-infection No. (+ve %)	Total No. (+ve%)
4-6	126	0(0.00)	0(0.00)	0(0.00)	0(0.00)	0(0.00)
7-9	497	5(1.00)	0(0.00)	0(0.00)	0(0.00)	5(1.00)
10-above	225	1(0.40)	0(0.00)	0(0.00)	0(0.00)	1(0.40)
Total	848	6(0.71)	0(0.00)	0(0.00)	0(0.00)	6(0.71)
		ns	ns	ns	ns	

** = significantly different (p<0.05); ns=not significantly different

Table 3: Prevalence of Helminth Parasites in the Schools Studied

Schools	Number (No.)	*Ascaris* No. (+ve %)	Hookworm No. (+ve %)	*Trichuris* No. (+ve%)	Co-infection No. (+ve%)	Total No. (+ve%)
Community Primary School	270	5(1.85)	0(0.00)	0(0.00)	0(0.00)	5(1.85)
Central Primary School	317	1(0.32)	0(0.00)	0(0.00)	0(0.00)	1(0.32)
Nwannebo Primary School	261	0(0.00)	0(0.00)	0(0.00)	0(0.00)	0(0.00)
Total	848	6(0.71)	0(0.00)	0(0.00)	0(0.00)	6(0.71)
		**	ns	ns	ns	

** = significantly different (p<0.05); ns=not significantly different

infection observed in children who washed their hands after defecation (0.44%); this was found to be statistically significant ($p<0.05$). Children who did not have the knowledge about the cause of helminths infection (0.71%) had a higher prevalence than those pupils who knew the cause of helminths infection, which was significant ($p<0.05$). However, assessing prevalence of infection by parents' occupation, children of traders (0.89%) had higher prevalence than children of farmers (0.66%), though the association between parents' occupation and prevalence on helminths was not significant. The prevalence of infection among the children who had the habit of biting their finger nails(0.79%) was higher than the prevalence of helminths infection observed in children who did not bite their nails (0.46%).

4. Discussion

The findings indicated that prevalence of helminths infection was low among the pupils in the present study. No co-infection was observed in the fecal samples examined, bringing the overall prevalence of intestinal helminths infection among pupils examined in Ekwulobia to 0.7%, and with *Ascaris lumbricoides* being the only helminths parasite observed in the fecal samples examined. The predominance of *Ascaris*

Table 4: Helminth Parasites in the Different Classes in the Schools Studied

Classes	Number (No.)	Community Primary School No. (%)	Udoka Primary School No. (%)	Central Primary School No. (%)	Total No (%)
Primary 1	232	2 (0.86)	0 (0.00)	0 (0.00)	2 (0.86)
Primary 2	206	2 (0.97)	0(0.00)	0(0.00)	2 (0.97)
Primary 3	221	1 (0.45)	0(0.00)	0(0.00)	1 (0.00)
Primary 4	189	0 (0.00)	0(0.00)	1 (0.53)	1 (0.53)
Total	848	5	0	1	6
		**	ns	ns	

** = significantly different (p<0.05); ns=not significantly different

Table 5: Mean Intensity (Epg±SE) Infection in Relation to Sex of Pupils

Sex	Number (No.)	No. Infected	*Ascaris (Epg±SE)*	*Trichuris (%)*	Hookworm (%)
Male	452	1	50±0.01	0.00%	0.00
Female	396	5	1774.8±805.3	0.00%	0.00%
Total	848	6	1487.33±1007.3	0.00%	0.00%
			**	ns	ns

** = significantly different (p<0.05); ns=not significantly different

Table 6: Mean Intensity (Epg±SD) in relation to age of Pupils

Age (years)	Number (No.)	No. Infected	*Ascaris (Epg±SE)*	*Trichuris (%)*	Hookworm (%)
4-6	126	0	0.00	0.00	0.00
7-9	497	5	757.8±561.4	0.00	0.00
10-above	225	1	105±0.01	0.00	0.00
Total	848	6	806.5±516.4	0.00	0.00
			ns	ns	ns

** = significantly different (p<0.05); ns=not significantly different

observed is consistent with the findings of Aribodor et al.,[12] and Abah and Arene,[29] who also reported *Ascaris* as the most prevalent helminths parasite in their various studies.

The 0.7% prevalence found in the present study is deemed as low when compared to reports for other towns, such as Nimo, Njikoka LGA, which showed a 5.8% prevalence of *Ascaris lumbricoides*,[30] and Uga, Aguata LGA, with a prevalence of 56.2%.[13] Given that our study was carried out six months after the deworming and commencement of HGSFP in the state, it may be plausible to assert that the deworming exercise was effective in reducing the prevalence of intestinal helminthiasis among the pupils studied. Although there was no significant difference ($p>0.05$) between the prevalence of infection with respect to the age groups, the prevalence of infection was higher in the age group 7-9 years (1.00%) followed by the ages 10 and above (0.40%). The prevalence rate in the present study increased with increasing age group, possibly because of nonchalant attitudes and habits towards personal hygiene among older pupils. The pupils in this age group are often treated like adults by teachers and parents and thus, little attention is paid to them with respect to their personal hygiene. It is possible that pupils in the 4-6 years old age group had 0.00% prevalence due to the close supervision of teachers and caregivers.

Table 7: Assessment of Risk Factors and Socio-demographic Determinants

Factor	Number (No.)	No. Infected	*Ascaris* (No. +ve %)	Total (No. %+ve)
Toilet Type				
Pit	410	0	(0.00)	(0.00)
Water Cistern	438	6	6 (1.37)	6 (1.37)
Total	848	6	6 (0.71)	6 (0.71)
Washing of Hands after defecation				
Yes	229	1	1 (0.44)	1 (0.44)
No	619	5	5 (0.81)	5 (0.81)
Total	848	6	6 (0.71)	6 (0.71)
Knowledge to Cause of infection				
Yes	9	0	(0.00)	(0.00)
No	839	6	6 (0.71)	5 (0.71)
Total	848	6	6 (0.71)	6 (0.71)
Mothers Occupation				
Trading	564	5	5 (0.89)	(5 0.89)
Hair dresser	44	0	(0.00)	(0.00)
Tailor	32	0	(0.00)	(0.00)
Cleaner	26	0	(0.00)	(0.00)
Civil Service	38	0	(0.00)	(0.00)
Teacher	42	0	(0.00)	(0.00)
Farmer	154	1	1 (0.65)	1 (0.65)
Total	848	6	6 (0.71)	6 (0.71)
			ns	ns

** = significantly different (p<0.05); ns=not significantly different

Prevalence of *Ascaris lumbricoides* varied among the three schools and was statistically significant ($p<0.05$). Their prevalence were Nwannebo Primary School (0.00%), Central Primary School (0.32%) and Community Primary School (1.85%) respectively. For this study, Community Primary School and Central Primary School had a low prevalence of infection, of which *Ascaris lumbricoides* was the only helminth parasite found, while no infection was observed for Nwannebo Primary School. In Nwannebo Primary School, pupils, have free access to safe water, sanitation, and of hygiene among pupils and teachers were remarkable. This shows that with coordinated control efforts, helminth parasite infection can be eradicated. This result is in agreement with the report of work done by Ekpo *et al.*[31]

The association between finger-nail biting and prevalence of helminth infections showed that the prevalence of infection among the children who have the habit of biting their finger nails was not significant ($p>0.05$). This finding contradicts the findings from observation of Salawu and Ughele,[32] who reported biting/sucking of finger nails as one of the major predisposing factors to *Ascaris lumbricoides* infections among children. The association between toilet type used by the pupils and hand washing habits after defecation and prevalence of helminths infection showed the majority of the pupils in the study did not wash their hands after defecation. The prevalence of infection was higher among the children who have the habit of not washing their hands after defecation (0.81%), than the prevalence of helminths infection observed in children who wash their hands after defecation (0.44%). In addition, no helminth infection was observed for the examined students who use pit toilets, whereas the prevalence of 1.37% was observed for the examined pupils who use water cisterns. This finding was

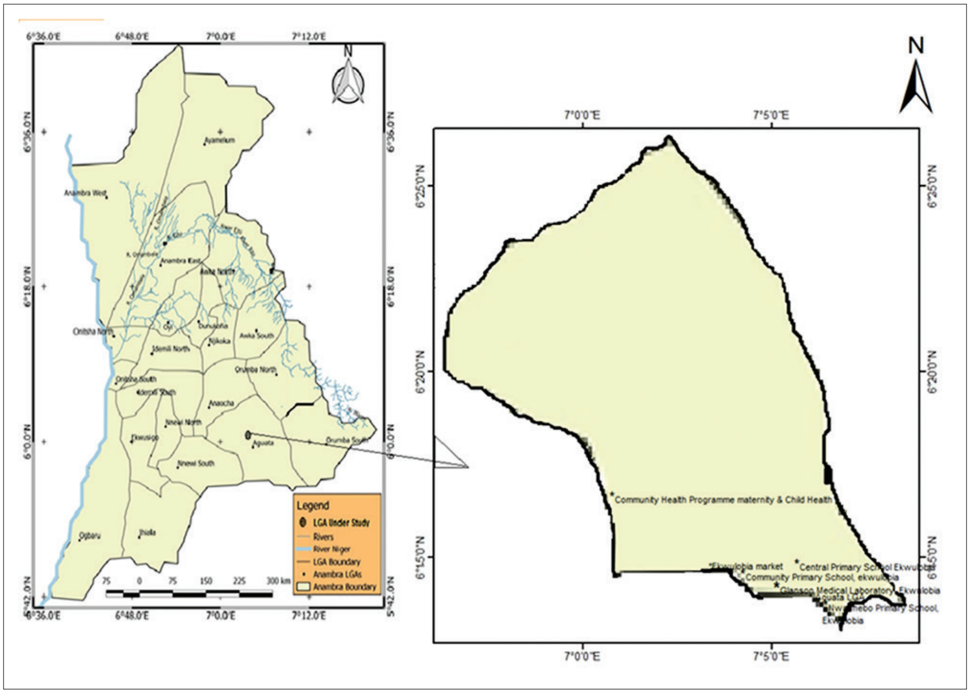

Figure 1: Map Showing the Schools in the Study Area (Source: Ministry of Lands, Anambra State, Nigeria)

statistically significant (*p*<0.05), but also contradicts the report of Shehu et al,[33] who observed a higher prevalence among pupils that used pit latrines (67.8%), than pupils that used water closets (1.5%). The higher prevalence recorded for pupils who use water cisterns is not surprising since the majority of the pupils who tested positive for helminth infections had the habit of not washing their hands after defecation. This could also be attributed to the improper handling and poor sanitation of the toilet, as the water cistern is well known to protect against intestinal helminths. However, if it is not provided with adequate water supply to ensure personal cleanliness and cleanliness of the latrine, the chances of fecal contamination become higher as has been reported by Ali et al.[19]

The association between the pupils knowledge of the cause of helminths infection was statistically significant (*p*<0.05). Pupils who did not have the knowledge of the cause of helminths infection had a higher prevalence (0.71%), than those who knew the cause of helminths infection. This finding is consistent with the observation of Aniwada et al.[34] Knowledge gap is therefore a pre-disposing risk factor to intestinal helminthiasis. Education of the teachers, parents and pupils is paramount to the effective reduction of rate of transmission and re-infection. The findings of the study showed that the mass drug administration (MDA) carried out six months prior to the commencement of HGSFP in public schools may have been effective in Ekwulobia town. The low prevalence of infection recorded can lead to re-infection, and therefore, is of public health importance. There is a need for constant monitoring and surveillance of all public schools to ensure that proper water, sanitation and health practices are implemented, and HGSFP sustained among the pupils in the lower classes, so that elimination of helminths among this age group can be achievable.

Limitations: Initially, pupils and parents were hesitant to participate, but through more advocacy, the level of participation in the study increased. It is thus possible that study participants and self-reports may not be fully representative of the population.

5. Conclusions and Implications for Translation

The low prevalence of infection recorded within Ekwulobia, Anambra State, Southeast Nigeria, was attributable to efforts of HGSFP. There is a need for constant monitoring and surveillance of all Public Schools and sustenance of water, sanitation and hygiene practices, and HGSFP. It is also imperative that these practices and HGSFP are sustained over time to inculcate knowledge within the population. Following these recommendations, the elimination of helminths can be achievable within Ekwulobia, Anambra State, Southeast Nigeria.

Compliance with Ethical Standards

Conflicts of Interest: *The authors declare no competing interests.* ***Financial Disclosure:*** *Nothing to declare.* ***Funding/Support:*** *There was no funding for this study.* ***Ethical Approval:*** *Ethical clearance was obtained from the Ethical Committee of Anambra State University Teaching Hospital, Uli, Anambra State, Nigeria. Permission for the study was obtained from the Secretary of Education in charge of primary schools in Aguata LGA. Authorizations from School's Headmistresses and parents' consent were sought before start of study. Only the pupils that their parents/guardians consented by signing the consent form were recruited into the study.* ***Acknowledgments:*** *The study appreciates the support of Head Teachers, Staff and pupils for their cooperation during the study.* ***Disclaimer:*** *None.*

Key Messages

- Intestinal helminths was most prevalent among school-aged children in Primary 2 followed by children in Primary 1, and was least among Primary 4 children.
- The prevalence of *Ascaris Lumbricoides* varied among children in different age groups with children in the 7-9 years age group having a higher prevalence than children in the 4-6 years age group.
- The low prevalence of intestinal helminths infection recorded among children in the HGSP program areas may be attributable to the HGSP program, indicating that helminths elimination may be achievable.

References

1. World Health Organization. *Soil-transmitted Helminth Infections*. WHO. https://www.who.int/news-room/fact-sheets/detail/soil-transmitted-helminth-infections. Updated May 2015. Accessed May 18, 2017.
2. Pullan R, Smith JL, Brooker S. The health impact of polyparasitism in humans: are we under-estimating the burden of parasitic diseases? *Parasitology*. 2010; 135(135):783-94. doi: 10.1017/S0031182008000346
3. World Health Organization. *Eliminating Soil-Transmitted Helminthiases as a Public Health Problem in Children. Progress Report 2001-2010 and Strategic plan 2011-2020*. WHO. https://www.who.int/publications/i/item/9789241503129. Published June 23, 2016. Accessed May 14, 2017.
4. World Health Organization. *Prevention and Control of Schistosomiasis and Soil-transmitted Helminthiasis: World Health Organization/Unicef Joint Statement.* WHO; 2004. https://apps.who.int/iris/bitstream/handle/10665/68607/WHO_CDS_CPE_PVC_2004.9.pdf?sequence=1&isAllowed=y. Accessed May 10, 2017.
5. Goncalves AL, Beliza´rio TL, Pimenteljde B, Penatti MP, Pedroso Rdos S. Prevalence of intestinal parasites in preschool children in the region of Uberlândia, State of Minas Gerais, Brazil. *Rev Soc Bras Med Trop*. 2011; 44(2):191–193. doi: 10.1590/s0037-86822011005000022
6. Glew RH, Conn CA, Bhanji R, Caideron P, Barnes C, VanderJagt DJ. Survey of the growth characteristics and body composition of Fulani children in a rural hamlet in northern Nigeria. *J Trop Pediatr.* 2003; 49(5): 313-322. doi: 10.1093/tropej/49.5.313
7. Childers KAG, Palmieri JR, Sampson M, Brunet D. Prevalence of gastrointestinal parasites in children from Verón, a rural city of the Dominican Republic. *Res Rep Trop Med*. 2014;5:45-53. doi: 10.2147/RRTM.S64948
8. de Silva NR. Impact of mass chemotherapy on the morbidity due to soil-transmitted nematodes. *Acta Trop*. 2003; 86(2–3):197–214. doi: 10.1016/s0001-706x(03)00035-4.
9. World Health Organization. *Soil-Transmitted Helminthiasis. Progress Report on the Number of*

Children Treated with Anthelminthic Drugs: An Update Towards the 2010 Global Target. WHO. https://www.who.int/publications/i/item/who-wer8327-28. Published July 4, 2008. Accessed May 18, 2017.

10. Nwaneri DU, Omuemu VO. Risks of Intestinal helminthiasis in children living in orphanages in Benin City, Nigeria. *Niger J Paed*. 2012; 39(3):118-123. doi: 10.4314/njp.v39i3.6

11. Opara KN, Udoidung NI, Opara DC, Okon OE, Edosomwan EU, Udoh AJ. The Impact of intestinal parasitic infections on the nutritional status of rural and urban school-aged children in Nigeria. *Int J MCH AIDS.* 2012;1(1):73-82.doi: 10.21106/ijma.8

12. Aribodor DN, Okechukwu PA, Eneanya OA, Etaga HO. Prevalence and associated risk factors of intestinal helminth infections among 5-14 year olds in akpo community, anambra state, Nigeria. *Niger J Parasitol.* 2013; 34(2):1-4.

13. Chioma U, Mbanugo JI, Ezeugoigwe N. Prevalence of intestinal helminthes parasite in stools of nursery and primary schools pupils in Uga, Anambra State, Nigeria. *Sky J Microbiol Res*. 2015; 3(1): 006 – 010.

14. Tyoalumun K, Abubakar S, Christopher N. Prevalence of intestinal parasitic infections and their association with nutritional status of rural and urban pre-school children in Benue State, Nigeria. *Int J MCH AIDS*. 2016;5(2):146-152. doi: https://doi.org/10.21106/ijma.146

15. Maikai BV, Umoh JU, Ajanusi OJ, Ajogi I. Public health implications of soil contaminated with helminth eggs in the metropolis of Kaduna, Nigeria. *J Helminthol*. 2008; 82(2):113-118. doi: 10.1017/S0022149X07874220

16. Nasr NA, Al-Mekhlafi HM, Ahmed A, Roslan MA, Bulgiba A. Towards an effective control programme of soil-transmitted helminth infections among Orang Asli in rural Malaysia. Part 1: Prevalence and associated key factors. *Parasit Vectors*. 2013; 6:27. doi: 10.1186/1756-3305-6-27

17. Nwosu ABC. The community ecology of soil transmitted helminth infections of humans in a hyperendemic area of Southern Nigeria. *Ann Trop Med Parasitol*.1981;75(2):197-203.

18. Sam-Wobo SO, Mafiana CF, Agwuegbo S, Adebanji AO, Agbeyangi O, Idowu OA. Incidence of Ascaris infection among primary school children in Ogun State, Nigeria: a generalised linear model approach. *Niger J Parasitol.* 2008; 29(1): 32-37. doi: 10.4314/njpar.v29i1.37900

19. Ali A. An overview of environmental health status in Ethiopia with particular emphasis to its organization, drinking water and sanitation: a literature survey. *Ethiop J Health Dev.* 2005; 19(2):89. doi: 10.4314/ejhd.v19i2.9977

20. Montresor A, Crompton DWT, Gyorkos TW, et al. *Helminth Control in School-age Children: A Guide for Managers of Control Programmes*. 2nd ed. Oxford, United Kingdom: Springer; 2012: 223-225.

21. Saka MJ, Abdulraheem IS, Akanbi AA, Musa OI. Soil-transmitted helminthiasis in children: evidence from school based epidemiological study in urban Nigerian community. *Niger Med Pract.* 2006; 49(6):145-153. doi: 10.4314/nmp.v49i6.28822

22. de Onis M, Onyango AW, Borghi E, Siyam A, Nishida C, Siekmann J. Development of a WHO growth reference for school-aged children and adolescents. *Bull World Health Organ.* 2007;85(9):660-667. doi: 10.2471/blt.07.043497

23. Martin LK, Beaver PC. Evaluation of Kato thick smear technique for quantitative diagnosis of helminth infections. *Am J Trop Med Hyg*. 1968;17(3): 382-391. doi: 10.4269/ajtmh.1968.17.382

24. Martin LK. and Beaver PC. Evaluation of Kato thick smear technique for quantitative diagnosis of helminth infections. *Am J Trop Med Hyg.* 1968; 77: 382-391.

25. Montresor A, Albonico M, Berhan M, et al. *Helminth Control in School Age Children: A Guide for Managers of Control Programmes*. 2nd ed. Geneva, Switzerland: World Health Organization; 2011:75.

26. Knopp S, Mgeni AF, Khamis IS, et al. Diagnosis of soil-transmitted helminths in the era of preventive chemotherapy: effect of multiple stool sampling and use of different diagnostic techniques. *PLoS Negl Trop Dis.* 2008;2(11):e331. doi: 10.1371/journal.pntd.0000331

27. World Health Organization. *Prevention and Control of Schistosomiasis and Soil Transmitted Helminthiasis*. Geneva, Switzerland: WHO Expert Committee; 2002.

28. Anderson RM, Schad GA. Hookworm burdens and faecal egg counts: an analysis of the biological basis of variation. *Trans R Soc Trop Med Hyg*. 1985; 79(6): 812-825. doi: 10.1016/0035-9203(85)90128-2

29. Abah AE, Arene FOI. Status of intestinal parasitic

infections among primary school children in rivers state, Nigeria. *J Parasitol Res*. 2015;2015:937096. doi: 10.1155/2015/937096

30. Onyido AE, Okoye MM, Irikannu KC, et al. Intestinal helminth infections among primary school pupils in Nimo community, Njikoka local government area, Anambra state, southeastern Nigeria. *J Adv Res Biol Pharm Res*. 2016;2(4):44-48.

31. Ekpo UF, Odoemene SN, Mafiana CF, Sam-Wobo SO. Helminthiasis and hygiene conditions of schools in Ikenne, Ogun State, Nigeria. *PLoS Negl Trop Dis.* 2008; 2(1):e146. doi: 10.1371/journal.pntd.0000146

32. Salawu SA, Ughele VA. Prevalence of soil-transmitted helminths among school-age children in IFE east local government area, Osun state, Nigeria. *FUTA Journal of Research in Sciences*. 2015;1:139-151.

33. Shehu MM, Kabiru A, Abubakar U, Muhammad K. Prevalence of intestinal helminth infections among school children in relation to occupation of parents and toilets facilities in Maru LGA Zamfara State. *J Biol Agric Healthcare*. 2013; 3(19): 87-90.

34. Aniwada EC, Uleanya ND, Igbokwe LN, Onwasigwe C. Soil transmitted helminths: prevalence, perception and determinants among primary school children in rural Enugu State, Nigeria. *Int J Trop Dis Health*. 2016; 15(1):1-12. doi: 10.9734/IJTDH/2016/24501