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CONTAMINATION OF SOME PUBLIC SCHOOLS' PREMISES WITH GEOHELMINTHS' AND *TAENIA* OVA IN AGO-IWOYE, SOUTH-WESTERN NIGERIA

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ABSTRACT
Fecal contamination of the environment of school children makes them readily exposed to infection and reinfection by soil-transmitted helminths (STHs). Soil samples from the premises of selected four public primary schools in Ago-Iwoye, Ogun State, south-western Nigeria were examined, using test tube flotation technique, for ova of human intestinal helminths between July and September 2013 (during rainy season), and in January and February 2014 (during dry season). Overall, 96.4% (108/112) of the soil samples examined were positive for ova of human intestinal helminths, including *Ascaris lumbricoides*, *Trichuris trichiura*, hookworm, and *Taenia* species. *Ascaris lumbricoides* was recorded in all the schools with statistically similar percentage abundance values, which ranged between 98.0% and 100%. *Trichuris trichiura*, hookworm, and *Taenia* had low expression in this study. Fertile *A. lumbricoides* ova, with relative abundance range of 89.6% - 92.0%, were significantly more abundant than infertile ones ($P < 0.001$), and occurred in the toilet, dump site, playing ground, and lunch areas in all the schools. This study has shown a high contamination of the premises of the visited schools with the ova of STHs and *Taenia*. In order to reverse the situation, the use of the schools' premises for socio-cultural, political and religious should be controlled to, at least, minimise human fecal contamination. The school children need being adequately enlightened and monitored by teachers and parents towards adopting hygienic practices at both school and home.

KEYWORDS: *Ascaris lumbricoides*, *Trichuris trichiura*, hookworm, *Taenia* species, fecal contamination, public schools.

INTRODUCTION
Human intestinal helminth infections are common in many parts of the tropics and constitute serious health challenges in many, particularly children. The seriousness of their negative impact is depicted by their unwholesome contribution to the vicious cycle of ignorance, disease and poverty. These intestinal helminths include nematodes, such as *Ascaris lumbricoides*, hookworms (*Necator americanus* and *Ancylostoma duodenale*), *Trichuris trichiura*, *Enterobius vermicularis*, and *Strongyloides stercoralis*, and flatworms, such as *Schistosoma mansoni*, *Taenia saginata* and *T. solium*.[1] *Ascaris lumbricoides*, the human hookworm species, and *T. trichiura* are usually referred to as soil-transmitted helminths (STHs) or geohelminths because they thrive in the environment and are readily transmitted through fecally-contaminated soil.[2] STHs have been incriminated for severe morbidity and high mortality, and cognitive impairment in school-age children in developing countries.[3,4]

Despite some, though often non-concerted, control efforts in many tropical countries, some relatively recent reports revealed varying degrees of persistence of human intestinal helminths, especially STHs, in the region. Such reports from Nigeria include those of Nwalorzie et al.[5], Eze et al.[6], and Sowole et al.[7] while those from some other countries include those of Siza et al.[8], Boko et al.[9], and Darlan et al.[10]. Evidences from literature make it glaring that besides the suitability of the tropical environment, the behavioural and hygiene patterns of the human populations, at individual, household, and communal levels, enhance the continual endemicity of the parasites.[11]

It is common knowledge that school-age children are more predisposed to human intestinal helminth infections than adults. This implies that cleanliness of their immediate vicinities, including when at school, deserves some quantum of attention. Therefore, this study aimed to assess the presence, abundance and distribution of the ova of human intestinal helminths within the premises of some schools in Ago-Iwoye, Ogun State, south-western

Nigeria. It is hoped that the findings of this study will empower the health planners and workers, and schools' authorities in their thirst to provide hygienic learning environment in the study area.

MATERIALS AND METHODS

Study area and schools

The study was carried out in Ago-Iwoye (6˚ 56′55″N, 3˚ 54′ 40″ E), the headquarter town of Ago-Iwoye Local Council Development area, Ogun State, south-western Nigeria. The town lies within the rain forest belt, and is the location town of the Main Campus of Olabisi Onabanjo University. The population of the town is composed of Yorubas (mainly Ijebus), relatively few Ibos and Hausas. Some of the adults engage in farming and trading, while some others are artisans or civil servants. Many undergraduates also reside in the town.

Four public primary schools located in four different quarters of the town were selected for the study. These were St Paul's (Anglican) Primary School, Imososi Primary School, Imere Primary School, and Omo-Edumare Primary School; all are mixed schools. The premises of St Paul's is not fenced, Imere is partially fenced, while those of Imososi and Omo-Edumare are provided with wall fence.

Pre-study protocols and permission

Before the study commenced, interactive meetings were held with the heads and teachers of the selected schools for adequate enlightenment on the purpose and nature of the study. Thereafter, the schools' authorities gave their consent and permission to access the schools' premises for the study.

Soil sample collection and examination

Soil samples were collected from the premises of each of the selected schools between July and September 2013 (during rainy season), and in January and February 2014 (during dry season). In each school, four sampling areas were selected: toilet, dump site, playing ground, and lunch area. Samples were collected from the ground surface to a depth of 2-5 cm, and at a distance of 100 cm to the north, east, south and west of each sampling area. Sampling was done between 8.00 and 9.00 hours using a hand trowel, once in every 2-3 weeks. Each sample was put into a labelled polythene bag and subsequently taken to the laboratory for parasitological analysis, using saline test tube flotation method, within two hours after collection.

In the laboratory, 2g of each sample was put into a test tube, and saline solution was added to ¼ level of the tube. The sample was mixed thoroughly with the saline by stirring and shaking. The test tube was then filled to the brim with the saline, and allowed to stand for 5 minutes. Afterward, a clean glass slide was placed on the upper meniscus of the mixture, carefully removed, and observed for the ova of human intestinal helminths, with the light microscope using 10x and 40x objective lenses. All observed helminth ova were identified using their characteristic morphology, and counted.

RESULTS

Overall, 96.4% (108/112) of the soil samples examined were positive for ova of human intestinal helminths. The prevalence rates of the ova in soil samples in St Paul's (100%, 28/28), Imososi (100%, 28/28), Imere (89.3%, 25/28) and Omo-Edumare (96.4%, 27/28) were statistically similar. The intestinal helminths recorded were *A. lumbricoides*, *T. trichiura*, hookworm and *Taenia* species. *Ascaris lumbricoides* was recorded in all the schools with statistically similar percentage abundance of 100%, 99.2%, 98.1%, and 98.0% in Omo-Edumare, Imososi, Imere, and St Paul's, respectively. *Trichuris trichiura*, hookworm and *Taenia* were also recorded in St Paul's, while Imososi and Imere also had only *T. trichiura* and *Taenia*, respectively.

The monthly relative abundance of intestinal helminths' ova in St Paul's is shown in Table 1. Among the helminths, *A. lumbricoides* had the highest total abundance (χ^2 = 283.7, P < 0.001). *A. lumbricoides* had statistically highest relative percentage abundance in July 2013 (χ^2 = 179.9, P < 0.001), and highest abundance in August 2013 and January 2014 (χ^2 = 90.6 and 93.7, respectively; P < 0.001 in each case). The monthly relative abundance of intestinal helminths' ova in Imososi is shown in Table 2. *Ascaris lumbricoides* had higher total abundance than *T. trichiura* (χ^2 = 96.8, P < 0.001). In Imososi, *A. lumbricoides* had statistically higher percentage abundance in July and September 2013 (χ^2 = 91.0 and 83.9, respectively; P < 0.001 in each case). Table 3 summarizes the monthly relative abundance of *A. lumbricoides* and *Taenia* in Imere School's premises. *Ascaris lumbricoides* had statistically higher total relative percentage abundance than *Taenia* (χ^2 = 92.5, P < 0.001). *Ascaris lumbricoides* also higher relative percentage abundance in July 2013 and February 2014 (χ^2 = 87.2 and 76.7, respectively; P < 0.001). The monthly abundance of *A. lumbricoides* in the premises of Omo-Edumare is shown in Table 4. The highest abundance (32.1%) was recorded in July 2103 (χ^2 = 31.1, P < 0.001).

Table 1: Monthly relative abundance of human intestinal helminths' ova in St Paul's School, Ago-Iwoye, south-western Nigeria.

Month/Year	No. (%) of ova				
	A. lumbricoides	*T. trichiura*	Hookworm	*Taenia* sp.	Total
July 2013	111 (96.5)	0 (0)	2 (1.7)	2 (1.7)	115 (100)
August 2013	41 (97.6)	1 (2.4)	0 (0)	0 (0)	42 (100)
Sept. 2013	62 (100)	0 (0)	0 (0)	0 (0)	62 (100)
January 2014	63 (98.4)	1 (1.6)	0 (0)	0 (0)	64 (100)
February 2014	11 (100)	0 (0)	0 (0)	0 (0)	11 (100)
Total	288 (98.0)	2 (0.7)	2 (0.7)	2 (0.7)	294 (100)

Table 2: Monthly relative abundance of human intestinal helminths' ova in Imososi School, Ago-Iwoye, south-western Nigeria

Month/Year	No. (%) of ova		
	A. lumbricoides	*T. trichiura*	Total
July 2013	42 (97.7)	1 (2.3)	43 (100)
August 2013	94 (100)	0 (0)	94 (100)
Sept. 2013	23 (95.8)	1 (4.2)	24 (100)
January 2014	53 (100)	0 (0)	53 (100)
February 2014	28 (100)	0 (0)	28 (100)
Total	240 (99.2)	2 (0.8)	242 (100)

Table 3: Monthly relative abundance of human intestinal helminths' ova in Imere School, Ago-Iwoye, south-western Nigeria.

Month/Year	No. (%) of ova		
	A. lumbricoides	*Taenia* sp.	Total
July 2013	116 (96.7)	4 (3.3)	120 (100)
August 2013	45 (100)	0 (0)	45 (100)
Sept. 2013	21 (100)	0 (0)	21 (100)
January 2014	64 (100)	0 (0)	64 (100)
February 2014	15 (93.8)	1 (6.3)	16 (100)
Total	261 (98.1)	5 (1.9)	266 (100)

Table 4: Monthly abundance of ova of *A. lumbricoides* in Omo-Edumare School, Ago-Iwoye, south-western Nigeria

Month/Year	No. (%) of ova
July 2013	45 (32.1)
August 2013	49 (35.0)
Sept. 2013	16 (11.4)
January 2014	17 (12.1)
February 2014	13 (9.3)
Total	140 (100)

Table 5 gives the relative abundance of fertile and infertile ova of *A. lumbricoides* in the premises of the visited schools. Fertile ova were significantly more abundant in each of St Paul's, Imososi, Imere and Omo-Edumare (χ^2 = 63.7, 62.7, 70.6, and 64.0, respectively; P < 0.001 in each case). The recorded distribution of fertile ova of *A. lumbricoides* in some parts of the premises of the schools visited is summarized in Table 6. In St Paul's and Omo-Edumare, fertile ova were statistically equally distributed among the toilet, dump site, playing ground, and lunch area. However, fertile ova were most abundant on the playing ground in Imososi and Imere (χ^2 = 15.4, 23.2; P < 0.01, 0.001, respectively).

Table 5: Relative abundance of fertile and infertile ova of *A. lumbricoides* in some schools in Ago-Iwoye, south-western Nigeria

School	No. (%) of ova		
	Fertile	Infertile	Total
St Paul's	259 (89.9)	29 (10.1)	288 (100)
Imososi	215 (89.6)	25 (10.4)	240 (100)
Imere	240 (92.0)	21 (8.0)	261 (100)
Omo-Edumare	126 (90.0)	14 (10.0)	140 (100)

Table 6: Distribution of *A. lumbricoides* fertile ova in parts of some schools' premises in Ago-Iwoye, south-western Nigeria.

School	No. (%) of ova				
	Toilet	Dump site	Playing ground	Lunch area	Total
St Paul's	45 (17.4)	53 (20.5)	88 (34.0)	73 (28.2)	259 (100)
Imososi	67 (31.2)	42 (19.5)	80 (37.2)	26 (12.1)	215 (100)
Imere	43 (17.9)	22 (9.2)	94 (39.2)	81 (33.8)	240 (100)
Omo-Edumare	32 (25.4)	26 (20.6)	34 (27.0)	34 (27.0)	126 (100)

In St Paul's, the *T. trichiura* ovum recorded in August 2013 was from the playing ground, while the one recorded in January 2014 was from the lunch area. Also, in July 2013 (in St Paul's), the dump site area had one hookworm ovum; the playing ground area had one ovum of each of hookworm and *Taenia*; and the lunch area had one ovum of *Taenia*. In Imososi, each of the two *T. trichiura* ova occurred on the playing ground and dump site area in July and September 2013, respectively. In Imere, 3 of the 4 ova of *Taenia* recorded in July 2013 were from the lunch area, while the remainder was from the toilet area; the only one recorded in February 2014 was from the playing ground.

DISCUSSION

The occurrence of the ova of some human intestinal helminths in the premises of the schools visited in this study indicates unacceptable human fecal contamination of the schools' premises. The similar high prevalence rates of intestinal helminths among the visited schools shows high level of human fecal contamination in the schools. The helminths identified had been earlier reported from the soil of some Nigerian schools.[12] The relative dominance of the ova of *A. lumbricoides* in the premises of the schools visited in this study agrees with earlier reports on soil from some schools[12] and vicinities of some freshwater bodies in Nigeria[13], and elsewhere in the tropics.[14] The cosmopolitan nature of ascariasis, especially in developing countries, is an established phenomenon. Many surveys among humans from within Nigeria[5,15,16] and some other countries[9, 17] showed *A. lumbricoides* as having the highest prevalence rates.

The simultaneous presence of *A. lumbricoides*, *T. trichiura* and hookworm in St Paul's corroborates the fact that the STHs generally require essentially similar environmental conditions to thrive,[18] and the simultaneous occurrence of two or all of them had been reported in soil samples[12, 14] and human populations.[8,19] The absence of *T. trichiura* and hookworm in Imere and Omo-Edumare premises was unexpected because some workers reported *T. trichiura* and/or hookworm with higher prevalence rates than *A. lumbricoides* among humans.[10, 20, 21] The variation in the diversity of STHs among the premises of the visited schools may be an index of the species of STHs harboured by the humans (children and adults) responsible for the fecal contamination of the schools.

In this study, *A. lumbricoides* was recorded in all the months of study. July, August and September fall in rainy season, while January and February fall in dry season, in the study area. This possibly implies that the premises of the schools are consistently contaminated with human faeces in both seasons of the year. Over a couple of years, the first author had noted that the premises of the schools visited in this study are frequented by the town inhabitants and visitors for various purposes such as football matches, social ceremonies, political and religious events (unpublished observation). Naturally, during many such activities, the toilets of the schools are not readily available; indiscriminate defaecation and urination have their way. In addition, the first author had noticed instances of some nearby residents using the toilet of a primary school in the area without due authorisation, and even, sometimes, open-defaecate in the premises (unpublished observation). Nevertheless, studies have shown that some school-age children may intentionally refuse using toilet or use it improperly.[19] Therefore, it is not impossible that during school hours, some of the school children, especially those who open-defaecate at home, contribute to fecal contamination of the schools' premises. Improper management of toilet facilities could also discourage a willing school child from using the toilet. During one of the working visits, it was observed that the toilet of one of the schools was littered with human faeces. Some previous workers had posited that school and household water, sanitation and hygiene have some impact on the epidemiology status of STHs.[22]

On the basis of characteristic morphology, the ova of *A. lumbricoides* are easily distinguishable microscopically into fertile and infertile.[1] The fertile ova eventually develop to the infective stage (L_3) which is transmitted without any intermediate host.[23] The high abundance of fertile ova of *A. lumbricoides* in all the schools visited depicts a high possibility of transmission of the parasite within the schools' premises. The recorded high abundance of fertile ova of *A. lumbricoides* in all the examined parts (toilet, dump site, playing ground, and lunch area) of each of the schools' premises indicates that they are all potential transmission points. Similarly, contamination of some parts of the schools with *T. trichiura* and hookworm ova indicate that they could be points of their transmission in the affected schools. This is particularly because the examined parts of the schools' premises are usually frequented by pupils during school hours. Unfortunately, school-age children are known to indulge in many unhygienic practices which readily predispose them to infection and reinfection by *A. lumbricoides* and the other STHs.[19,23] Such unhygienic practices reported among school children include open defaecation, lack of hand washing after defaecation, finger-nail nibbling, walking bare-footed, non-washing of hands, and fruits and vegetables before eating.[5, 24]

The presence of the *Taenia* species in some of the schools visited in this study is in line with previous report of taeniasis in some school children.[21, 24] Even if some of the pupils in the visited schools had contributed to the *Taenia* contamination, incrimination of outsiders is a possibility. *Taenia* is transmitted through improperly cooked beef (for *T. saginata*) and pork (for *T. solium*).[1] The schools with *Taenia* species, being either partially or not fenced, are accessible to cattle and pigs which are the intermediate hosts. This scenario portends the danger of the continuity of transmission of the parasite in the study area.

CONCLUSION

This study has shown the occurrence the ova of STHs and *Taenia* species and high abundance of *A. lumbricoides* in the premises of the visited schools in Ago-Iwoye, Ogun State, south-western Nigeria, due to human fecal contamination. This makes the school children exposed to infection and reinfection by STHs within their school premises. In order to ameliorate the situation, some drastic measures need to be taken. The premises of all the schools should be wall-fenced to make them inaccessible for unauthorized activities, to avoid fecal contamination. Use of the premises of the schools for permitted social, political and religious activities should be under strict and enforced rules and regulations. The school children need being enlightened and monitored by teachers and parents towards adopting hygienic practices at both school and home. The authorities of the schools should ensure adequate cleanliness of the toilet and other areas of the schools' premises.

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