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Prevalence of soil-transmitted helminthiasis among primary school pupils in Ipogun, Ondo State, Nigeria

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The prevalence of Soil-Transmitted Helminthiasis (STH) was investigated among pupils of three selected primary schools in Ipogun, Ifedore Local Government Area of Ondo State, Nigeria. A total of 298 stool samples were collected from pupils across schools and examined for eggs of Soil-Transmitted Helminths (STHs) using concentration method. Results showed that 190 (63.8%) of the 298 pupils were positive for STHs. *Ascaris lumbricoides* was the most prevalent (25.5%) parasite in the pupils (n = 76), followed by *Strongyloides stercoralis,* 19.8% (n = 59) and hookworm, 17.8% (n = 53). *Trichuris trichiura* had the least prevalence of 0.7% (n = 2). Single infestation in the pupils accounted for 160 (84.2%) cases. Of the schools visited, the highest prevalence (74.2%) was recorded in Muslim Nursery and Primary School, followed by St. Jude (70.0%) and Morohunkeji Nursery and Primary School (50.0%). Statistically, there was a significantly lower ($P \leq 0.05$) prevalence of STHs in Morohunkeji School compared to the other schools in the study area. The prevalence (50.0%) recorded in both male and female pupils was the same (n = 95) while the prevalence of single infestation in the male pupils was 50.6% (n = 81), higher than that of female pupils, 49.4% (n = 79). The occurrence of co-infestation (or double infestation) in the female pupils was 53.3% (n = 16), higher than that of the male pupils, 46.7% (n = 14). The prevalence recorded across gender and statuses of infestation were statistically insignificant ($P > 0.05$). As a result of helminth infestation, there is need for routine deworming exercises for school-aged children, maintaining good environmental sanitation, as well as health educating of village dwellers in rural communities for effective control of STH in endemic communities.

Key words: Helminthiasis, prevalence, soil infestation, school pupils, concentration method.

INTRODUCTION

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

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Brown, 1994; Nokes and Bundy, 1994).

Previous research revealed that the main STHs which cause common clinical disorders in man are *Ascaris lumbricoides* (the large roundworm, which causes Ascariasis), *Trichuris trichiura* (the whipworm, which causes Trichuriasis), and the blood-feeding hookworms (*Ancylostoma duodenale* and *Necator americanus*) which cause Ancylostomiasis. There is another species that infect humans; *Strongyloides stercoralis* which causes Strongyloidiasis (Bethony et al., 2006). Recent estimates of global prevalence suggest that *A. lumbricoides* infects 800 million people, while *T. trichiura* and hookworms infect 600 million in sub-Saharan Africa, and majority of people infected were from Nigeria (Ogbe et al*.,* 2002; Hotez et al*.,* 2009; Hotez et al*.,* 2012). This significantly indicates the severity of public health risk among the people.

Remarkably, factors including poverty, poor sanitation, inadequate hygiene, illiteracy, ecosystem differences and overcrowding are directly associated with the infestations arising from the burden of STHs (Crompton, 1999). STH, traditionally endemic in rural areas, are increasingly becoming a public health concern in urban slums of cities present in tropical and sub-tropical developing countries of the world (Bundy et al*.,* 1988; Pullan and Brooker, 2012). The major endemic regions include Southern and Southwestern China, Southern India, Southeast Asia, Sub-Saharan Africa; Central and South America (de Silva et al*.,* 2003). As established in the findings of this study, Savioli et al*.* (2002) had previously reported that school children are more vulnerable to infestation because of their hygiene and play habits. Moreover, in 2006, it was estimated that there were 181 million school-aged children in Sub-Saharan Africa out of which 89 million were infested with one or more parasitic worms (Hotez and Kamath, 2009). Infections arising from STHs among school-aged children result in malnutrition, intellectual retardation, as well as cognitive and educational deficits (WHO, 2005). Profoundly, such infections have insightful effects on school performance, attendance and future economic productivity of infected children (Bleakly, 2003; Miguel and Kremer, 2003). Also, infestations with STHs may increase the hosts' susceptibility to other important illnesses, such as malaria, tuberculosis and HIV infection (Fincham et al*.,* 2003; Le-Hesran et al*.,* 2004).

In addition, hookworm infestations cause pathological blood loss leading pregnant women and their foetus (offspring) to a higher risk of death during pregnancy and delivery (Drake and Bundy, 2001). In most STHs endemic areas, school-aged children suffer the greatest burden; hence, due attention is focused on the health of school children (WHO, 1995). If proper and prompt medical attention is not devoted to curbing STH among school-aged children, infections with STHs can thwart the effort of a country to provide basic education for her children (Partnership for Child Development, 1997; Girum, 2005) thereby working against the realization of the United Nations Sustainable Development Goals (SDGs). It is on these premises that the goal of this research work was established to assess the prevalence of STH infestation among primary school pupils (school-aged children) in the study area.

MATERIALS AND METHODS

Study area

The study was carried out between January and September of 2012 in Ipogun (7° 19^1 N, 5° 5^1 E), a town in Ifedore Local Government Area of Ondo State, Southwestern part of Nigeria. The village is about 14 km away from Akure, the capital city of Ondo State, and lies in the rainforest belt of Nigeria. The language of communication among dwellers is largely Yoruba. The occupation largely practiced by the majority of village inhabitants is farming with cocoa being the major product, while other dwellers engaged themselves in various businesses (trading), and other self-employed occupational practices such as artisanship, privately-owned enterprise; and as state civil service employees. There is a stream called "Aponmu" in the village which serves as a major source of water for domestic and recreational activities due to the inadequacy of potable pipe and borehole sources of water.

Study design

Informed consent and ethical issues

Ethical consent and permission was obtained from the Ondo State Ministry of Health, Akure; village head of Ipogun community, and schools head and teachers in the village before embarking on the collection of faecal samples.

Collection of stool samples

The pupils of Nursery and Primary schools in Ipogun were recruited for the collection of samples. The subjects in the schools located in the community were randomly selected for the study. Faecal samples were collected from 298 pupils in Saint (St.) Jude's, Muslim and Morohunkeji Nursery and Primary schools respectively. All pupils in the schools were screened based on their class registers and their demographic data were documented. The distribution of well labeled, cleaned, and transparent plastic containers with tight-fitting lid was done with the aid of the class register. Instructions were given on how to introduce stool samples into the containers. After the stool collection exercise, the plastic containers with faecal samples were recovered and transported to the Postgraduate Research Laboratory (PRL) of the Parasitology and Public Health Unit, Department of Biology, Federal University of Technology Akure, Nigeria; where they were analyzed for STHs.

Laboratory analysis

The concentration method (Cheesbrough, 1992, 2000; Gupta and Singla, 2012) was used to concentrate helminths eggs in 1 g of stool samples (human faeces) in the postgraduate research laboratory. The 1 g of stool sample collected was placed into a small plastic container and mixed with 10 ml of normal saline using an applicator stick to form a suspension. The suspension was vigorously mixed until the faeces were completely emulsified. It was then filtered with muslin cloth into another clean plastic container. The filtrate was then poured into a test tube to make 10 ml and centrifuged at 2,000 revolutions per minute (rpm) for 3 min. After

Table 1. Prevalence of parasites in the examined pupils.

Parasite species	Positive (%)	Single Infestation (%)	Co-Infestation (%)
Ascaris lumbricoides	76 (25.5)	70 (43.7)	6 (20.0)
Hookworms	53 (17.8)	42 (26.3)	11 (36.7)
Strongyloides stercoralis	59 (19.8)	48 (30.0)	11 (36.7)
Trichuris trichiura	2 (0.7)	-	2 (6.6)
Total prevalence (%)	190 (63.8)	160 (100.0)	30 (100.0)

$P \leq 0.05$.

Table 2. Prevalence of soil-transmitted helminthiasis among primary school pupils in the study area.

Schools	Number examined (%)	Male (%)	Female (%)	Number positive (%)	Significance
Morohunkeji	104 (34.9)	48 (46.2)	56 (53.9)	52 (50.0)	$P \leq 0.05$
Muslim	66 (22.2)	35 (53.0)	31 (47.0)	49 (74.2)	$P > 0.05$
St. Jude	128 (42.9)	69 (53.9)	59 (46.0)	89 (70.0)	$P > 0.05$
Total (%)	298 (100.0)	152 (51.0)	146 (49.0)	190 (63.8)	

centrifugation, the tubes were removed and the supernatant was decanted. About 3 – 4 ml of 10% formol solution was added to the deposit to form a homogenous suspension and the mixture was allowed to stand for 5 min lengthwise. A 3 – 4 ml of diethyl ether was added, shaken vigorously and allowed to stand for 2 min, after which it was then centrifuged at 1,000 rpm for 1 min. The faecal debris from the slide of the tube was detached with the aid of a glass rod (spatula) and the supernatant was discarded while leaving the deposit at the bottom of the centrifuge tube. The deposit was tapped with finger to mix and using a Pasteur pipette, a drop of the deposit was smeared on a clean, grease-free microscope slide mixed with Lugol's iodine, covered with a cover slip and examined using x10 objective lens while the x40 objective lens was used for the identification of parasite eggs (WHO, 1991; Cheesbrough, 1992). As reported by King and Mascie-Taylor (2004), diagnosing soil-transmitted parasites is made possible by identifying their eggs and larvae microscopically in the sampled stool of infected persons.

Statistical analysis

All statistical data obtained were subjected to analysis using Statistical Package for Social Scientists (SPSS) for windows version 21.0. Test of Significance on prevalence of each Soil-Transmitted Helminthic infections among subgroup of positive subjects were determined using the Least Significant Difference (LSD). Statistical differences were assigned at $P \leq 0.05$. The mean difference is significant at the 0.05 level.

RESULTS

Out of the total 298 pupils examined from the schools in the study area, 63.8% (n = 190) were found to be positively infested with one of the parasites listed in Table 1. *A. lumbricoides* had the highest prevalence of 25.5% (n = 76), followed by *S. stercoralis* with prevalence of 19.8% (n = 59), hookworm had 17.8% (n = 53) and the least prevalence rate of 0.7% (n = 2) was recorded for *T. trichiura*. The prevalence of these worms was significantly different in this population ($P \leq 0.05$).

Out of the schools examined, Muslim Primary School had the least examined pupils (male = 35 and female = 31) but had the highest prevalence of 74.2% (n = 49). Saint Jude Primary School had the highest examined pupils (male = 69 and female = 59) and prevalence was 70.0% (n = 89) out of the 128 pupils that were examined. No significant difference ($P > 0.05$) was recorded for prevalence of STHs for both aforementioned schools. Morohunkeji Nursery and Primary School had 104 pupils examined, that is, male (n = 48) and female (n = 56) but showed the least prevalence of 50.0% (n = 52) (Table 2). This is statistically significant ($P \leq 0.05$) from both examined schools above.

As observed in Table 3, total examined male pupils were 152 (51.0%) while examined female pupils were 146 (49.0%). Surprisingly, both male and female pupils shared the same prevalence of 50.0% (n = 95). Interestingly, the prevalence of male pupils (50.6%) with single parasitic infestation was greater than that of the female pupils (49.4%) while the prevalence rate (53.3%) of female pupils (n = 16) with co-infestation was greater than that of the male pupils examined (46.7%) (Figure 1). However, significant difference did not exist between prevalence recorded for both genders ($P > 0.05$).

DISCUSSION

The prevalence of *A. lumbricoides* (25.5%), *S. stercoralis* (19.8%), hookworm (17.8%), and *T. trichiura* (0.7%) were revealed among pupils of three primary schools in the research study area. These findings were in agreement with the work of Eke et al. (2015) who reported that the

Table 3. Prevalence of soil-transmitted helminthiasis in the study area based on sex.

Sex of pupil	Number examined (%)	Number infected (%)
Male	152 (51.0)	95 (50.0)
Female	146 (49.0)	95 (50.0)
Total (%)	298 (100.0)	190 (63.8)

P > 0.05.

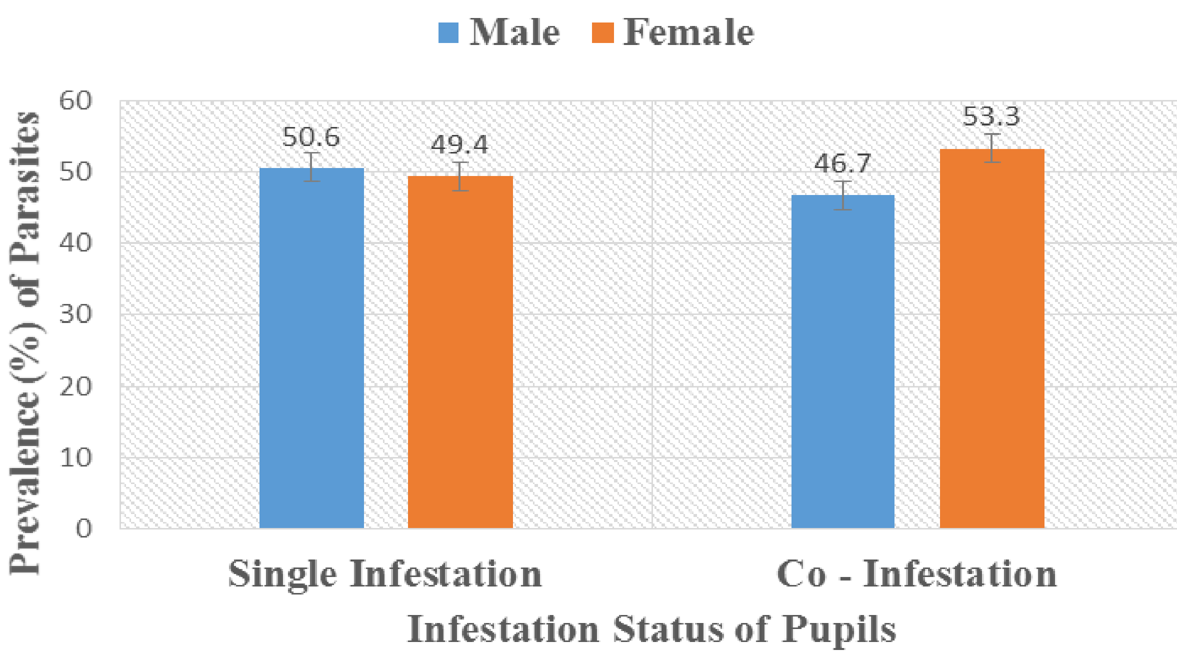

Figure 1. Prevalence of STH parasites based on infestation status of gender (P > 0.05).

prevalence of these four geohelminths (26.46, 9.58, 22.50, and 8.54% respectively) were confirmed in the stool samples of school children of four selected primary schools in Panda Development Area, Karu Local Government Area, Nasarawa State, Nigeria.

In the current research, the overall prevalence of STH among the school pupils was high (63.8%, n = 190) as more than half of the total number of population examined (n = 298) suffered from the parasitic infestation of soil-transmitted helminths either as single infestation or co-infestation. The high rate of prevalence recorded in the study area may be due to factors like improper faecal disposal, poor standard of hygienic living and behaviour; inadequate potable, clean, safe and drinkable source of water and general poor sanitation culture employed by the majority of village dwellers, which were all characteristics of a rural area where previous researches have shown the infestation by soil-transmitted helminths to be endemic (Crompton, 1999; Pullan et al., 2014).

Pupils from Muslim primary school (n = 49) were shown to be the most prevalent (74.2%) for STH parasites among the three schools based on the number of examined pupils, though the school had the least number of examined pupils (n = 66), leaving only 17 pupils negative of STH parasites. The main reason for this may be due to the insanitary environment of the school and her proximity to the refuse, wastes and garbage dumping sites, where some of the school pupils defecate. Moreover, refuse dumps are open dumping grounds where people defecate and that contaminate the soil with eggs/larvae of STHs through run-offs during flooding of rain, thereby predisposing parasites into the environment (Ogbolu et al., 2011; Chacha et al., 2013), and thus prone individuals susceptible to the high risk of STHs infestations. The pupils during break or leisure periods were often seen playing bare-footed with soil close to the waste dumped sites and even go sometimes to the Aponmu River to play and thereafter, probably eat without washing their hands. When faeces are not properly disposed, they may be washed into nearby streams where people frequently visit to meet their needs. Some of the pupils also walk bare footed on infected and contaminated soil during school periods or even at home, making them prone/exposed to larvae of parasites, that penetrate into their body, for example hookworm larvae. It has been posited by Uga et al. (1997) that soil contamination status is the most direct link to risk for STHs infections. Furthermore, the findings in this present study is similar with past research works that reported high contamination rate of STHs in soil samples of Abuja and Ibadan, Nigeria; respectively in 2011 (Mohammed et al*.,* 2011; Ogbolu et al*.,* 2011).

Prevalence of Soil-Transmitted Helminthiasis in the study area based on sex revealed equal prevalence rate (50.0%) for pupils of both genders (male and female) (each has n = 95) infected with STHs parasites. This is in contrary to the findings of Eke et al*.* (2015) who reported that in the examined stool samples of school children of four selected primary schools in Panda Development Area, Karu Local Government Area, Nasarawa State, Nigeria; male had the highest infection rate of 167 (64.33%) while 155 (70.45%) was recorded in female (P > 0.05). Accordingly, female pupils (n = 16) had more co-infestations (53.3%) as compared to the male pupils (n = 14; 46.7%). The male pupils also were recorded to have higher prevalence rate (50.6%) of single parasitic infestation (n = 81) as compared to the female pupils (n = 79; 49.4%). Irregular deworming by the pupils may be a contributive factor towards the observed high prevalence rate. Co-existence of parasites is mostly dependent on the epidemiological factors with similar mode of transmission. Where low unhygienic behaviour thrives, nursery and primary pupils who are weak immunologically are more likely to have helminthiasis even with a low prevalence rate in that area initially.

Conclusion

This study showed high endemicity of STH in primary school pupils of Ipogun town, a rural community in the Ifedore Local Government Area of Ondo State. The sanitation culture of the study area is less commendable and should be improved on. To curb the scourge of STH in the study area, government (local and state) should intensify their efforts by energizing the health educators at the Primary Health Care Authority in prompt awareness to the villagers on tackling the route (source) of transmission of STH. Furthermore, there must be adequate provision of clean, safe and drinkable source of water, provision of public toilets in strategic places by the government (Local/State/Federal) to minimize open defecation, provision of adequate health facilities in the area which will in turn carry out mass health sensitization of the area, adequate deworming exercise and provision of drugs to established primary health care centres. The sensitization at schools of the pupils about washing of hands must be adopted as part of simple preventive strategy for transmitted helminthiasis. Moreover, the parents of pupils should be willing to allow their wards to participate actively in deworming exercises been carried out in schools by both governmental and non–governmental agencies, or endeavour to deworm their children quarterly (4 times in a year). Finally, government (executive, judiciary and legislature) must encourage that those without toilet facilities in their homes should make use of publicly-provided toilet facilities or find possible means of constructing one for their personal use. The security agencies should lawfully implement the Executive Order 009 Bill signed into law by the President of the Federal Republic of Nigeria on open defecation. This will help eradicate open defecation which is largely practiced in the area and environs.

CONFLICT OF INTERESTS

The authors have not declared any conflict of interests.

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