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Prevalence, Pattern and Risk Factors of Soil Transmitted Helminth Infections amongst Children in a Tertiary Institution in South East, Nigeria

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Abstract

Introduction: Soil-transmitted helminthic infection (STHI) is a common public health challenge of children in the most deprived communities in low income countries. In the long-term, STHI can cause developmental and growth disorders leading to future learning defect. **Objective:** Our aim was to determine the prevalence and pattern of soil-transmitted helminthic infection among children attending a tertiary hospital in Imo State, Nigeria. **Patients and Method:** The study involved a cross-sectional survey of 268 children, aged 7 months to 18 years seen in a tertiary health facility in Nigeria; from August to December 2022. Data were collected using a structured questionnaire and stool samples were analyzed for intestinal helminths using the Kato-Katz method. **Results:** The prevalence of soil-transmitted helminthic infection (STHI) was 38.4%. Of all STHIs, *Ascaris lumbricoides* was the commonest geohelminth observed, 81 (62.1%). Multiple infections were noted in 25 (62.4%) of the specimen. The prevalence of soil-transmitted helminthic infection amongst subjects' 5 - 9 years was high and least in children older than 15 years. This difference was not statistically significant (p = 0.3407). Statistically significant relationship was detected between STHI and low socioeconomic class. **Conclusion:** The high prevalence rate of soil-transmitted helminthic infection amongst the subjects is disturbing. This high rate justifies strengthening a structured and routine deworming amongst children in order to improve outcome.

Keywords

Helminthes, Multiple Infections, Children, Deworming

1. Introduction

Soil transmitted helminths (STH) infections, are common infections worldwide affecting the most deprived communities in low income countries. An estimated 1.5 billion people or 24% of world population are infected, with the greatest number occurring in the poorest communities in South of the Sahara [1]. Approximately 267 million preschool children and over 568 million school children live in areas where there is intense transmission of STH [1] [2].

These STHI are caused by macroparasites such as *Ascaris lumbricoides* or round worms, *Trichuris trichuria* or whipworm, *Ancyclostoma duodenale* and *Necartor americanus* or hook worms [1]. Its prevalence is the highest in the tropics and subtropical region of the world [1] [3]. Transmission could be by ingestion of eggs present in human faeces that contaminate vegetable and water [1] [2] or when children put soil contaminated hands into their mouth [1]. Walking on contaminated soil bare footed also, could get children infected by the macroparasite, hook worm [1] [4]. Risk factors for infection with STH are lack of sanitary facilities, lack of safe water supply, low socioeconomic status, malnutrition.

Infected children are nutritionally and physically impaired [1] [4]. STH's feed on host tissues including blood resulting in loss of protein and iron and chronic blood loss [1] [4]. Mal-absorption of nutrients is exacerbated by these worms and importantly *Ascaris lumbricoides* may possibly compete for vitamin A [1]. *Tricuris tricuria* can cause diarrhea and dysentery [1]. STH infections in young children may in the long-term cause developmental and growth disorders that can cause cognitive decline due to impairment of the brain's maturation process, affecting future learning and education [5] [6] [7].

In their study, Odinaka *et al.* [8] put the prevalence of helminths infection amongst school aged children at 30.3%. Other workers found a prevalence rate of 54.8% [3] 55.2% [9], and 42.6% [10] working in different parts of Nigerian. The high burden of STH in Nigeria is a result of poor socioeconomic status of the large portion of the population, lack of access to potable water, pitiable hygienic practices, low literacy rate amongst others. Out of the country's total population, more than 60% are located in areas, where STHs are common. Estimation of burden and risk factors of contracting STHI is important; when one considers the potential risk of mortality and morbidity of STH infection in young children, its detailed study is imperative. We therefore sought to provide information on the risk factors of STH infection in the population of children attending outpatients' clinic in the tropics. We believe that our current study results would further provide supporting data for STH prevention and treatment program.

2. Patients and Method

This was a cross sectional study involving children attending the Imo State University Teaching Hospital paediatric general outpatient clinics.

The study area was Imo State University Teaching Hospital located in Orlu.

Orlu is located in the South Eastern part of Nigeria in Imo state, 30 kilometers from Owerri the capital of Imo state. It is a semi urban town located in the tropical rain forest belt. It lies within latitude 5˚43'45"N to 5˚53'00"N and longitude 7˚7'30"E [11]. It lies within the Awka-Orlu uplands. It is the third largest city in Imo state with a population of 420,000 covering a surface area of 12935.6 km^2 [11]. Annual rainfall varies between 1990 mm and 2200 mm. The mean annual temperature is about 27˚C with relative humidity of 75% [11]. Orlu town has no public water treatment plant and no organized public piped water supply. Topographically, drilling a bore hole is very expensive hence water supply from private bore holes is limited, mainly for the rich. Main source of drinking water is sachet water bought from water vendors and water obtained from deep unprotected wells.

Sample size was calculated using the WHO formula for sample size determination in a finite population *i.e.* < 10,000 [12]. Prevalence for soil transmitted intestinal helminths infection in Owerri, in the South eastern part of Nigeria is estimated to be 16.6% [13].

Where sample size $N_o = \frac{Z^2(p)(1-p)}{d^2}$.

Corrected for a finite population of 200

$$n = \frac{N_o}{1 + \frac{N_o}{N}}$$

Z = Confidence interval of 1.96.

D = Tolerable error, margin fixed at 0.05.

N = Total population of patients attending the paediatric clinic at IMSUTH Orlu = 200

$$N_o = \frac{3.84 \times 0.166 \times 0.834}{0.0025} = 212$$

For a finite population of 200

$$n = \frac{212}{1 + \frac{212}{200}} = \frac{212}{2.06} = 102$$

Correction for 12% Non response

$$\text{No. } 12/100 \times 102 = 12.24$$

Sample size = 102 + 12 = 114.

The minimum sample size for this study was 102. This, however, was raised to 114 to allow for 12% non response rate. Finally, calculated sample size was increased to 268 to increase the power of the study.

2.1. Study Design

The study was carried out over a period of 5 months spanning from November to December 2022. Participants were children (less than 18 years) who attended Outpatient clinic and were recruited consecutively. Information regarding the

objectives of the study and procedures to be followed was given to parents and subjects. The parents/children also had opportunities to ask questions. A structured questionnaire, whose validity was tested by pre testing on patients in the specialist clinic was utilized. It was designed by the authors, containing questions that provided socio-demographic information and relevant clinical data was administered to the parents/caregivers/guardian of the children. The subjects, whose parents consented to the study were enrolled into the study they may or may not have symptoms related to the digestive system. Those who were on/had taken antihelminthes and/or antacids 2 weeks preceding the collection of sample and those whose parents/caregivers did not give consent were excluded from the study. Exclusion did not affect the care provided for the patients.

Fresh stool samples were collected from eligible participants in sterile open mouthed universal containers and analyzed within 4 to 6 hours of collection. Samples were processed and analyzed, using the Kato-Katz method. The slide of the stool sample was read within 4 - 6 hours after taking the sample. A positive sample for helminth infection was one, in which at least one helminth egg was present in the smears.

2.2. Data Analysis

The dataset was analyzed using the Statistical Package for Social Science (SPSS) version 26. Descriptive analysis was used to summarize the socio-demographic variables and presented as frequency and percentages. Tests for statistical associations were used to determine the associations between different variables and soil transmitted intestinal parasitic infections. Results were considered statistically significant if the p-value was less than 0.05. A regression model was used to explore associations between hand washing after defecation, source of drinking water, sewage disposal, wearing foot wears and helminthes infection.

2.3. Ethical Considerations

Ethical approval for the study was sought and obtained from the research and ethical committee of IMSUTH with approval number IMSUTH/CS/121. All participants' guardians/caregivers gave informed consent.

3. Results

3.1. Demographic Characteristics of the Subjects

Table 1 showed the demographic characteristics of the subjects. The age range of the subjects was 7 months to 18 years. The age group 5 to 9 years 94 (35.07%) was the most represented while the age group with subjects greater than 15 years 48 (17.91%) were the least represented.

There were 124 male and 144 female subjects, with a male to female ratio of 1.00:1.06 indicating a slight female preponderance. The middle socio economic class constituted the largest class 102 (38.05%) amongst the subjects while the lower socioeconomic class constituted the least 81 (30.2%).

Table 1. Socio-demographic characteristics of subjects.

Socio-demographic characteristic	N_o (%)
Age	
<4	70 (26.1)
5 - 9	94 (35.1)
10 - 14	56 (20.9)
>15	48 (17.2)
Socioeconomic status	
SEC I	85 (31.7)
SEC II	102 (38.1)
SEC III	81 (30.2)
GENDER	
Male	124 (46.2)
Female	144 (53.7)
Total	268

3.2. Prevalence and Pattern of Helminths Infection in the Subjects

Stool samples of two hundred and sixty eight subjects were examined for soil transmitted helminths infection. One hundred and three (38.4%) of these samples tested positive for soil transmitted helminths infection.

Table 2 and Table 3 show the pattern of soil transmitted intestinal helminths infection amongst the subjects. *Ascaris lumbricoides* was the most prevalent specie (62.14%) of the 3 STH infections noted. Multiple infections were noted in 25 of the specimen, with *Ascaris lumbricoides* occurring more frequently with Hookworm infection.

3.3. Association between Demographic Characteristics and Helminths Infection in the Subjects

Table 4 shows the relationship between the demographic characteristics of the subjects and STH infections. The age group most affected is 5 to 9 years 43 (45.7%). Whilst the least affected age group are those greater than 15 years16 (33.3%). These differences in the proportion of those infected amongst the various age groups were not statistically significant ($\chi^2 = 3.3502$, df = 3, p = 0.3407). Varying degrees of infections were observed amongst the different socioeconomic classes with the lower socioeconomic class been mostly infected by STH 44 (60.5%) These differences in the proportion of infection noted amongst the various socioeconomic classes were statistically significant.

3.4. Association between the Risk Factors and Helminths Infection in the Subject

Of the known risk factors for STHI in children studied, only the mode of sewage disposal, source of drinking water and hand washing practice after defaecation

Table 2. Pattern of soil transmitted helminthes infection in subject.

Type of helminths infection	N_o (%)
Ascaris lumbricoides	61 (62.2)
Hook worm	24 (243)
Trichuris trichuria	13 (13.3)
Total	98 (100)

Table 3. Pattern of multiple soil transmitted helminthes infection in subjects.

Type of multiple helminths infection	N_o (%)
Ascaris lumbricoides/Hookworm	15 (60.0)
Ascaris lumbricoides/ *Trichuris trichuria*	7 (28.0)
Ascaris lumbricoides/Hookworm/ *Trichuris trichuria*	3 (12.0)
Total	25

Table 4. Association between demographic factors and soil transmitted helminthes infection amongst the subjects.

Demographic characteristics	Number of participant tested	Number of participant infected	x^2	p-value
AGE				
<4	70 (100)	24 (35.7)		
5 - 9	94 (100)	42 (45.7)		
10 - 15	56 (100)	18 (33.3)		
>15	48 (100)	14 (33.3)	4.4300	0.2185
GENDER				
Male	124 (100)	45 (43.7)		
Female	144 (100)	58 (56.3)	0.4477	0.5034
SOCIOECONOMIC STATUS				
SES I	85 (100)	28 (32.9)		
SEC II	102 (100)	26 (25.5)		
SEC III	81 (100)	44 (60.5)	16.8842	0.0002
Total	268 (100)	98 (36.6)		

were significantly associated with helminth infection in children in this study. Helminth infection in children was likelier in those who used a water closet system of sewage disposal compared to a surface/bush system (OR 2.53, 95% CI: 1.37 to 4.69) and less likely in those with a pit latrine sewage disposal system compared to surface/bush sewage disposal (OR 0.33, 95% CI: 0.16 to 0.70). The use of sachet water was associated with 4.8 times the odds of helminth infection

in children compared to the use of piped water (OR 4.8, 95% CI: 2.28 to 10.1); there was no significant difference in the odds for helminth infections in children who used well water compared to those who used piped water (OR 1.31, 95% CI: 0.57 to 3.01). On the other hand, regular (OR 0.32, 95% CI: 0.15 to 0.69) and occasional handwashing (OR 0.36, 95% CI: 0.20 to 0.65) was associated with reduced odds of childhood helminth infection compared to non-handwashing. There was no significant association of wearing of footwears to helminth infection in children (**Table 5**).

4. Discussion

The current study demonstrates that there is a high burden of STHI in this tertiary hospital in Orlu, Nigeria a low income community. Our study also demonstrates that there are a large number of participants with multiple infection of STHI. Within each group those between 5 to 9 years were most affected. This buttresses the need for regular deworming of school age children.

The first noteworthy finding of this study is the establishment of the fact that the overall prevalence rate soil-transmitted helminths infection is 38.4%. Some previous studies had demonstrated prevalence rates of 65.2% [3] and 44.7% [14] respectively in Nigeria. This disparity may be due to the fact that one of the studies was done among preschool and school aged children living in urban slums and the other a Meta analysis that included diverse array of subjects. STHI is still a public health problem and a neglected tropical disease especially in resource poor settings.

Another striking finding with respect to age in this study was that the prevalence of STHI decreased progressively with age group, from the school age children to the adolescents. However, the prevalence was high among the preschoolers age group was 35.7%. This may not be unconnected to the fact that these children (preschool) are more likely to be found playing in contaminated soil; defecate on themselves (because they have not fully being toilet trained) and less likely to follow instructions regarding personal hygiene. The attendant lack of portable water worsens their risk. This is akin to findings by other workers in this environment [3] [8] [15]. With respect to gender prevalence for soil-transmitted helminthes infection was high 56.3%, this contrasts with findings by other workers [8] [9] [16] [17]. Though this difference was not statistically significant, the reason for it is unknown. However, any difference could be explained by variations in exposure, socio-demographic characteristics and study setups.

As anticipated, majority of children who were infected with soil-transmitted helminthes infection belonged to the lower socioeconomic class. This is in keeping with findings in other studies done in this environment [18] [19] [20]. These children, whose parents/caregivers belong to the low SEC, live amongst the poorest and deprived communities that lack adequate housing, potable water and adequate sewage disposal means. All these, make implementation of control measures difficult.

Table 5. Relationship between soil transmitted helminthes infection and predisposing factors in subject.

Predisposing factor	Tested negative N_o (%)	Tested positive N_o (%)	Odds Ratio (OR)	95% CI	p-value
Wearing foot wears					
Always	60 (60)	40 (40.0)	1.11	(0.67 - 1.85)	0.684
occasionally	105 (68.5)	63 (31.5)	1		
Sewage disposal					
Water closet	44 (41.1)	63 (58.9)	2.53	(1.37 - 4.69)	0.002
Pit latrine	75 (84.3)	14 (15.7)	0.33	(0.16 - 0.70)	0.002
Surface/bush	46 (63.9)	26 (36.1)	1		
Source of drinking water					
Sachet water	60 (45.5)	72 (54.5)	4.8	(2.28 - 10.10)	<0.001
Well water	61 (75.3)	20 (24.7)	1.31	(0.57 - 3.01)	0.261
Piped water from private bore hole	44 (80.0)	11 (20.0)	1		
Washing hand after defecation					
Always	35 (70.0)	15 (30.0)	0.32	(0.15 - 0.69)	0.002
Occasionally	102 (67.1)	50 (32.9)	0.36	(0.20 - 0.65)	<0.001
Never	28 (42.4)	38 (57.6)	1		
Total	165 (61.6)	103 (38.4)			

In this study, *Ascaris lumbricoides* (62.4%) was the commonest specie among STH, remarkably, this consistent findings was noted in other studies [3] [9] [16] [21]. However, Odinaka *et al.* [8] working in the same area observed that Hookworm was the dominant Helminths infection. These disparity might arise from variation in environmental factors such as climate (dry and rainy season), recognized to favor the growth of one species of STHs over the other.

The rate of multiple infections or polyparasitism is 24.3% of infections with *Ascaris lumbricoides*-hookworm co infection been the commonest. This is consistent with observations by other workers [8] [22]. Similarly, Odinaka *et al.* [8] in their studies noted a lowly prevalence rate of 3.5% for polyparasitism, with Hookworm and *Ascaris lumbricoides* co infection as the commonest. This variation may not be unconnected with weather at the time of the study.

This study also investigated and determined several factors associated with intestinal helminthiasis. It was found that the risk factors of children's habits like not washing hands after defecation, sewage disposal and source of drinking water have a significant association with the incidence of STH infection.

Lack of adequate sewage disposal, sachet water as a source of drinking water and occasionally or never washing hands after defecation were significantly associated with an increased likelihood of infection with soil helminths. The use or non-use of footwears did not show any association with infection with soil helminths in this study.

Children whose parents were of lower SEC (low educational level) had a higher rate of infection moreover, awareness about the transmission routes of intestinal parasites and personal hygiene require education [23] [24] [25]. Therefore, there is need for enlightenment programmes for parents on sanitation routines (e.g., cutting of fingernails, hand washing, latrine facilities, and wearing shoes) and routine use of antihelminths [26]. It is also imperative that policy makers are made aware that the prevalence of STH in children under five years is high to guide interventions while strengthening deworming programmes.

5. Limitation

The study was conducted using a questionnaire that may have introduced recall bias because data was obtained with questions that may have inadvertently provided preferred responses. As with many hospital based studies, only children attending clinic in the hospital participated in the study resulting in a biased sample that may not be representative of all children in this age range in this part of the study area.

6. Conclusion

The prevalence of STH infection in children is still high; socioeconomic status, age, and hygiene factors (washing of hands after defecating, source of water supply, sewage disposal) need to be noted as key contributing factors of the increased susceptibility to STH infection.

Conflicts of Interest

The authors declare no conflict of interest.

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