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RESEARCH **Open Access**

Occurrence of Soil-Transmitted Helminths in Selected Waste Dumpsites in Otuoke Community, Ogbia Local Government Area, Bayelsa State, Nigeria

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ABSTRACT

Background: Soil-transmitted helminths (STH) are global health concerns, particularly in tropical and subtropical regions with poor sanitation. Waste dumpsites contribute to STH transmission, polluting soil, groundwater, and air quality in any location where they are situated. This study was carried out to investigate the occurrence of soil-transmitted helminths in selected waste dumpsites in the Otuoke community, Ogbia Local Government Area, Bayelsa State.

Methods: 46 soil samples were randomly collected from different dumpsites and analyzed using Zinc sulphate floatation, Baermann technique and concentration method. Eggs and larvae of parasites present were identified morphologically by microscopic examination under x4 and x 10 objective lenses using identification keys. The Statistical Package for Social Science (SPSS) version 22 was used to analyze the data at 0.05 significant levels.

Results: The overall rate of contamination was 28.3%. Eggs and larvae of three soil-transmitted helminths were recovered from the soil samples. The species of soil-transmitted helminths encountered in the study were Ascaris spp. 4(8.6%), Hookworm specie 5(10.9%) and Strongyloides spp. 15(32.6%). The most prevalent soil-transmitted helminth recorded in this study was the larvae of Strongyloides spp. Nevertheless, variations in the distribution of soil-transmitted helminths across locations varied significantly ($P = 0.035$; $P<0.05$).

Conclusion: The findings suggest a need for a strategic intervention to improve sanitary status precisely in the locations where parasitic contaminations were present, whereas continuous monitoring and preventive measures should be implemented in the locations with no parasitic contamination to prevent the emergence of soil-transmitted helminths infection.

Keywords: Helminthes, Sanitation, Parasite, Soil, contamination, dumpsites.

1.0 INTRODUCTION

Soil-transmitted helminths (STH) are a group of parasitic worms that pose a significant health risks to human populations, particularly in regions with inadequate sanitation and waste management systems. Waste dumpsites, characterized by improper waste disposal practices and poor hygiene conditions, can potentially contribute to the transmission and spread of STH [1]. Soil-transmitted helminths are a significant global health issue, particularly in impoverished and deprived communities where control measures are challenging to implement [2]. Globally, over one billion people are infected with at least one common helminths species, namely: roundworms (*Ascaris lumbricoides*), whipworms (*Trichuris trichiura*), hookworms (Necator americanus and *Ancylostoma duodenale*), and *Strongyloides stercoralis*. These parasites are most prevalent in tropical and subtropical regions where inadequate sanitation and hygiene practices are common [3]. Warm temperatures and sufficient moisture are crucial for the survival of STH eggs and larvae, including hatching and embryonic development, in the environment [4].

According to Nzeako *et al.* [5], waste dumpsites are open -air dens that often spill over from their boundaries and pollute the soil, groundwater, and air quality of any location where they are situated, which often results in the evacuation of residents and conflicts. In Nigeria, less than half of the wastes generated by the inhabitants are properly collected and disposed of, while about 95% of these wastes are mismanaged at the disposal or collection points [6]. Scavengers, untrained workers who frequently pollute the environment in their quest to extract valuables from the accumulated wastes, particularly at dumpsites, are responsible for the majority of the waste management process in the study area (collection, sorting, and disposal) [7]. The exposure and delay in the disposal of liquid and solid wastes in the Otuoke community expose the locals to acute infections of soil-transmitted parasites like geohelminthes (*Ascaris* spp., Hookworms, *Trichuris* spp., *Strongyloides* spp.) and protozoans (*Eimeria* spp., *Giardia* spp., *Entamoeba* spp., *Acanthamoeba* spp., *Naegleria* spp.) [8-12]. Poor toilets, water access, housing, education, poverty, hygiene issues, inadequate sanitation, and overcrowding contribute to the spread of soil-transmitted helminths (STH). Open defecation is also a problem in Nigerian municipalities [13,14].

Ogwurike *et al.* [15] found that STH infections are closely linked to humid, warm temperatures, shaded areas, and soil contamination with organic matter. Tropical and subtropical regions, with favorable climatic and environmental conditions, are major endemic zones for these infections. These include countries in South and Central America, south and southwest China, India and Southeast Asia, and sub-Saharan African countries [3].

The common roundworm known scientifically as Ascaris lumbricoides, the whipworm or *Trichuris trichiura*, and the hookworms Necator americanus and *Ancylostoma duodenale* are regarded as the three most important STHs because they have the highest prevalence rates, and they cause the most significant health burden [16]. They are major public health problems, with an estimated 135,000 deaths due to them annually. However, their major public health significance lies in the chronic morbidities they cause in their hosts [17]. STH infections affect host nutrition, growth, cognitive development, and lifelong health. Numerous studies reveal their association with malnutrition and anemia, leading to short- and long-term consequences in humans [18,19]. STH infections and malnutrition often occur in the same geographic areas with the same people suffering from both conditions [20]. Stunting and anemia are signs of chronic malnutrition [21].

Soil-transmitted helminth (STH) infections, including hookworms and roundworms, exacerbate malnutrition through blood loss in the intestines, causing iron deficiency anemia and protein loss [16, 22]. Studies indicate improved child growth post-treatment, linking STH to malnutrition. The World Health Organization recommends drugs like albendazole and mebendazole, as well as health education and hygiene for STH control [23]. Community-level drug management relies on an understanding of local epidemiology [24]. Understanding and addressing these factors are crucial for effective STH infection control and the overall health of affected communities. Despite advocacy for improved hygiene, health education, and targeted chemotherapy in high-risk communities to combat soil-transmitted helminth (STH) infections in Nigeria, there is no evidence of national control programs. Existing efforts are sporadic and uncoordinated, primarily funded by politicians and philanthropists. Recent programs focus on mass drug administration in endemic areas, relying on knowledge of STH prevalence for adequate classification. In Nigeria, a resource-constrained country with a large population, ensuring the cost-effectiveness of STH infection control is crucial for efficient resource allocation and impactful outcomes [24].

Therefore, the objective of this study is to provide useful epidemiological information on endemic STH species, their prevalence, and distribution in Otuoke Community, Ogbia Local Government Area, Bayelsa State, to provide a guide for targeted and cost-effective control of STH infections in the community.

2.0 METHODOLOGY

2.1 Sampling Area

Otuoke Town is situated at Lat 4º 49[1] North and Long 6º 20[1] East in the Bayelsa State of Nigeria's Ogbia Local Government Area. Elebele Community, Emeyal I, Kolo, Onuebum, and Otuogori, all in the Ogbia Local Government Area of Bayelsa State, form its northern, eastern, western, and southern borders, respectively. Seasons of rain and drought indicate the region's predominant climatic conditions. The dry season begins in November and lasts until March, with the rainy (wet) season lasting from April to October. All through the year, monthly average temperatures are high. Due to ongoing development projects and the presence of educational and medical institutions, the study area has a complex socio-economic system and a high daily inflow of people. Sub-commercial cropping, swamp fishing, trading, government employment, transportation, and apprenticeships in trades like bricklaying, welding, painting, and carpentry are some of its primary sources of income. Most people access the study area by road. Most farmers who have their farms situated along or near the water courses use the water routes blocked by water hyacinths (Figure 1).

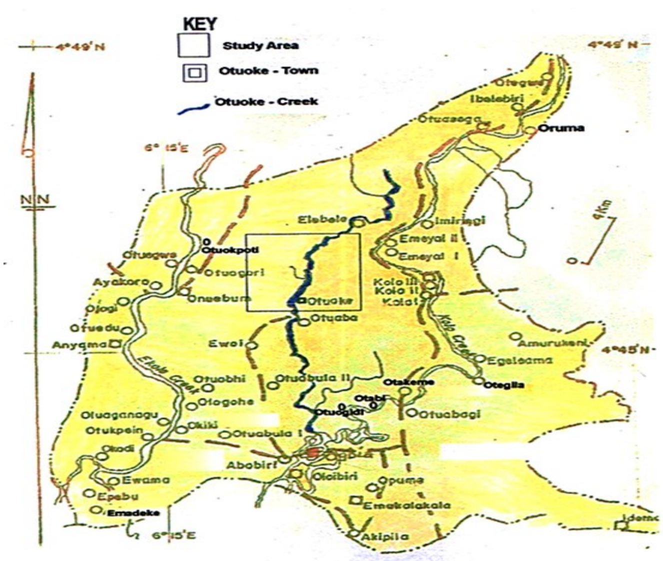

Figure 1. Map of Ogbia Local Government Area showing the Study Area (Otuoke) [25].

2.2 Criteria for Dumpsite Selection

Sixteen (16) waste dumpsites in the Otuoke community were selected for this study based on specific criteria, such as the amount of waste generated, proximity to human settlements, and waste management practices.

2.3 Soil Sample Collection

At the locations of the sixteen (16) different dumpsites selected, soil samples were taken randomly at three (3) different points during the morning hours between 7 am and 10 am. A hand trowel was sterilized with 95% ethanol after each sample collection to avoid cross-contamination. A 100g soil sample was randomly collected at a depth of 2 cm from each point of the various dumpsites. The soil samples were put in a polythene bag and taken to the Biology Department Laboratory of Federal University Otuoke, Bayelsa State, for parasitological analysis to check for the presence of soil-transmitted helminths' eggs or larvae.

2.4 Parasitological Analysis of Soil Samples

2.4.1 Baermann technique

The Baermann Technique was used to extract soil nematodes for Hookworm and Strongyloides larvae [26, 27].

The apparatus consists of a glass funnel with a clamp closure and a short rubber tubing attached to the stem. The funnel was filled with water and held upright in a retort stand. A filter paper was placed on top of wire gauze, and about 20g of soil was added on top of the filter paper. The larvae moved from the filter paper into the funnel's water. After 24 hours, the larvae were collected after gravity had forced them to the bottom of the funnel. Under a microscope, the suspension was examined for the presence of nematodes.

2.4.2 Zinc sulphate solution

The soil samples were also examined using the Zinc sulphate flotation technique according to Ogbolu *et al.* [28]. Every soil sample was sieved to eliminate the trash and larger pieces. 20 grams of each soil were thoroughly mixed with 10 milliliters of distilled water in a test tube, strained, and centrifuged at 1500 rpm for three minutes. After the supernatant was decanted, 10 ml of a 33% weight-to-volume zinc sulphate solution (specific gravity: 1.18–1.20) was added to the sediment in the test tubes, filling them to brim and left to stand for 20 minutes, placing cover slips on top. The coverslips were carefully removed, placed face down on clean glass slides and viewed under a microscope using X10 and X40 objective lenses.

2.4.3 Concentration technique using normal saline

20g of each soil sample was mixed with 15 ml of normal saline, which was then sieved into tubes to remove any large particles before the samples were centrifuged at 1500 rpm for three minutes to concentrate them. The sediment was placed onto slides using a pipette and then examined under a microscope after decanting supernatant [29].

2.5 Identification of Parasites

Eggs and larvae of parasites present were identified morphologically by microscopic examination under x10 and x40 objective lenses using identification keys by Garcia [30] and Cheesbrough [31], with the aid of WHO diagnosis of intestinal parasites bench aids [32]. Strongyloides larvae have short buccal cavities and short, notched tails (slit in the tail), while the hookworm larvae have long buccal cavities and long, pointed tails.

2.6 Statistical Analysis

The Statistical Package for Social Science (SPSS) version 22 (IBM Corp., Armonk, N.Y., USA) [33] was used to analyze the data at 0.05 significant levels. Calculations for mean, standard deviation, and percentage were made on a Microsoft Excel spreadsheet. The formula r = (Number of positive recorded) / (Total samples) x 100 was used to calculate the rate of occurrence of soil sample contamination.

3.0 RESULTS

3.1 Frequency of Occurrence of Soil Transmitted Helminthes in the Soil Samples from the different Dumpsites

Out of 46 soil samples collected from different points of the dumpsites around the community, 13 (28.2%) were positive for eggs and larvae of one or more helminth species (Table 1). Soil samples collected from the Otuaba area recorded the highest contamination (6.5%) with larvae of Soil-transmitted helminth, whereas soil samples from Maccoba, Back of NYSC Lodge, and Nickle Excel had a similar number of soil-transmitted helminths species 2(4.3%). All the soil samples were collected from Fantasy Lodge by FUOtuoke Main School Gate, Federal University Otuoke Engineering Building, Side Corner of Faculty of Science Building Federal University Otuoke, Azikel Road, Back of Admin Block, Katakata Road, P.A. Road, and Opp. Osasuma Plaza was negative for soil helminth (Table 1).

Table 1. Frequency of Occurrence of Soil-transmitted Helminthes in the Soil Samples from the Different Dumpsites

Sample sites	No. of Collection point examined	No. of soil negative (without parasite)	No. of soil positive with parasite (%)	χ	df	P-value
Maccoba	3	1	2 [4.3%]			
Back of NYSC Lodge	3	1	2 [4.3%]			
Anglican Junction	3	2	1 [2.2%]			
Otuaba	3	0	3 [6.5%]			
Dorcas Lodge	1	0	1 [2.2%]			
Nickle Excel	3	2	1 (2.2%)			
Fantasy Lodge by FUOtuoke Main School Gate	3	3	0			
FUOtuoke Engineering Building	3	3	0			
Back of Faculty of Science Building FUOtuoke	3	2	1 (2.2%)			
Side Corner of Faculty of Science Building FUOtuoke	3	3	0			
Azikel Road	3	3	0			
Back of Admin Block	3	3	0			
Opposite Skill Acquisition	3	1	2 (4.3%)			
Katakata Road	3	3	0			
P.A. Road	3	3	0			
Opp. Osasuma Plaza	3	3	0			
Total	46	33	13(28.2%)	26.270	15	0.035

Helminth Parasites Present in Soil Samples from the Selected Dumpsite in Specific Locations in the Otuoke Community

Three helminth were encountered in the study (Table 2). These include *Ascaris* species' eggs, Strongyloides sp. larvae and Hookworm spp. Strongyloides sp. 15(32.6%) was the most frequently observed soil-transmitted helminths in the soil samples, followed by Hookworm larvae 5(10.9%) and then *Ascaris* sp. 4(8.6%). *Strongyloides* sp. larvae were the only parasites recorded in Dorcas Lodge and Back of Faculty of Science Building FUOtuoke (Table 2). Anglican Junction and Nickle Excel had the

Table 2. Helminth Parasites present in Soil Samples from the Selected Dumpsite in specific locations in Otuoke Community

Stage of Parasite encountered.	Locations with parasites (%)																Total N=46
	Maccoba	Back of NYSC Lodge	Anglican Junction	Otuaba	Dorcas Lodge	Nickle Excel	Fantasy Lodge by FUOtuoke Main School Gate	FUOtuoke Engineering Building	Back of Faculty of Science Building	Side Corner of Faculty of Science Building FUOtuoke	Azikel Road	Back of Admin Block	Opposite Skill Acquisition	Katakata Road	P.A. Road	Opp. Osasuma Plaza	No of Helminth parasites Positive (%)
Egg of *Ascaris* sp.	-	1(25)	-	1(25)	-	-	-	-	-	-	-	-	2(50)	-	-	-	4(8.6)
Larvae of *Strongyloides* sp.	1(6.6)	2(13.3)	-	4(26.6)	5(33.3)	1(6.6)	-	-	2(13.3)	-	-	-	-	-	-	-	15(32.6)
Larvae of Hookworm	1(20)	-	1(20)	2(40)	-	-	-	-	-	-	-	-	1(20)	-	-	-	5(10.9)
Total	2	3	1	7	5	1			2				3				24

least parasitic prevalence, while all three parasites were present in soil samples from Otuaba dumpsites. There was a significant difference in the rate of soil contamination across locations (P-value = 0.035).

4.0 DISCUSSION

The current study's overall contamination rate (28.3%) of soil samples indicates the public health risk of STH in the study area. The occurrence rate of soil-transmitted helminths in this study is comparable to the 28.4% previously reported by Dada and Egbunu [34] in Ondo State. This, however, is less than the results obtained in Kogi (50.6%), Ibadan (72.7%), and Calabar metropolises (84%) by Badaki *et al.* [35], Olufotebi *et al.* [36] and Imalele *et al.* [37] respectively. According to Olufotebi *et al.* [36], this variation may be caused by environmental factors such as different hygiene and sanitation policies in different areas, as well as climatic factors on parasite ova. The risk of human infection is highlighted by potentially pathogenic helminth parasites in the environment [28]. The study's findings showed significant risks for people who live and work around Otuaba and Dorcas Lodge due to the high levels of parasite contamination in the soil samples examined from there.

Strongyloides sp. was more prevalent in this study (32.6%), similar to the result of Imalele *et al.* [37], which found the prevalence of *Strongyloides* sp. to be 30%. This pattern resembles earlier reports of high *Strongyloides* sp. prevalence followed by *Ascaris* sp. and hookworm [36]. The moisture films of contaminated soils, according to Hotez *et al.* [38], are favorable conditions for the viability of the eggs up until contact with a suitable host. This might result from the free-living larvae's heterogonic cycle, which doesn't require a host for its proliferation [39]. According to Ghodeif and Jain [40], hookworms, which are frequently known to cause cutaneous larva migrans, may also cause type-1 hypersensitivity reactions during pulmonary migration or severe blood loss during intestinal migration. It is one of the leading global causes of anaemia in young children and pregnant women [18]. Poor hygiene, minimal indiscriminate waste disposal, and the physical and chemical makeup of the soil may have all contributed to the observed prevalence of hookworm in this study.

According to this study, there was a low prevalence of *Ascaris* spp. in the soil samples examined, which may be related to how little human and animal waste (faeces) were dumped on the ground. Due to the zoonotic potential of Hookworm and *Strongyloides* larvae, the occurrence in the soil suggests a serious public risk. According to Adeyeba and Tijani [41], the sanitary practices of locals and climatic variables may be blamed for variations in the rate of occurrence of soil-transmitted helminths at different sampling sites. Nevertheless, there was a significant difference in the rate of soil contamination across sites ($P= 0.035$; $P<0.05$).

The study identified *Strongyloides* sp., Hookworm, and *Ascaris* sp. as prevalent soil-transmitted helminths, with *Strongyloides* sp. being the most common. Given the high prevalence of soil-transmitted helminth (STH) infections in the study area, integrated control efforts are recommended to enhance public health initiatives to combat STH infections, emphasizing the need for tailored strategies based on prevalence patterns. Combining environmental sanitation and health education is essential for effective control, with the potential for long-term transmission elimination through thoughtful interventions in the study areas. Targeted deworming programs are advised, particularly in the Otuaba and Dorcas Lodge axis, while ongoing sanitation and health education efforts should be sustained in Anglican Junction and Nickle Excel. Continuous surveillance and preventive measures are recommended in Fantasy Lodge and various locations, including FUOtuoke Main School Gate, Engineering Building, Faculty of Science Building, Azikel Road, Admin Block, Katakata Road, P.A. Road, and opposite Osasuma Plaza.

Conflicts of Interest

The authors declare that there is no conflict of interests.

Authors' Contributions

COE conceived and designed the study, contributed to data analysis tools, analysis of data and manuscript writing. **MSO** contributed to data collection, data analysis tools, analysis of data and writing of manuscript. All authors approved the final copy o f the manuscript.

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