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Prevalence of Human Infecting Geohelminths in Soil Found around Refuse Dumpsites in Emohua Local Government Area of Rivers State, South-South, Nigeria

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Authors' contributions

This work was carried out in collaboration between all authors. Authors CNE and Omo Oweh designed the study and wrote the first draft. Author Owhoeli Ovutor managed the analyses and literature searches. All authors read and approved the final manuscript.

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ABSTRACT

Background: This study was carried to evaluate the prevalence of geohelminthes in soils found around refuse dumpsites in Emohua, Rivers State, South South, Nigeria and its public health significance.
A total of 240 soil samples were collected randomly from soils found around refuse dumpsites in (Rumuakande, Rumuche, Mgbuitanwo, and Isioducommunites) Emouha Local Government Area. Sixty samples each were collected from each community between July to September.
Methods: Using centrifugal flotation method, soil samples were analysed to determine the presence of geohelminths. Soil parameters also examined were soil texture, colour and pH.
Results: One hundred and twenty-one (50.4%) of the soil samples were found to be positive with human geohelminth eggs or larva, with *Ascaris lumbricoides* accounting for 58 (24.2%),

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Strongyloides spp. 34(14.1%), *Ancylostoma duodenale* 16(6.7%), and *Trichuris trichiura* 13(5.4%) which was statistically significant (P>.05). From the four communities sampled, Mgbuitanwo had prevalence of 36(15%), Isiodu 34(14.2%), Rumuche 26(10.8%), and Rumuakande with 25(10.4%). The prevalence rate in each of the communities was statistically significant (P>.05). Results equally showed loamy soil with mean 2.8 ± 1.1 S.D, sandy soil mean 1.7 ± 1.1 S.D, and clay soil mean 0.04 ± 0.3 S.D. Black soil had total mean 1.7 ± 1.6 S.D, and brown soil with mean 2.2 ± 1.8 S.D. Result from pH reading was mean 6.3 ± 0.6.

Conclusion: People who scavenge should well kitted to avoid risk of being infected by any of the observed geohelminth.

Keywords: Geohelminths; human; dumpsites; Emohua.

1. INTRODUCTION

Geohelminths are group of intestinal parasites belonging to the class nematoda that are transmitted primarily through contaminated soil. They are called soil transmitted helminthes (STH) because they have a direct life cycle which requires no intermediate host or vector, and parasitic infection usually occurs through fecal contamination of soil, food stuffs and water supply [1]. Adult forms are essential parasites of human, but they also infect domesticated animals. Recent estimates suggest that *Ascaris lumbricoides* infects over one billion people, *Trichuris trichiura* 79 million and hookworm 740 million people [2]. Geohelminths infection is most prevalent in tropical and sub-tropical regions of the world, where adequate sanitation is lacking [3]. These infections have a worldwide distribution, being present in almost all geographic and climatic regions, except for those in extreme cold or heat, where survival of infectious stages in the environment is impossible [4].

Helminth infections are the most common infective agents of mankind and are responsible for morbidity and mortality throughout the developing world. Geohelminths infection was ranked highest in morbidity rate among school aged children who are often present with much heavy worm infection because of their exposure to infective stages of the geohelminths [5]. Geohelminths prevalence tends to be highest in warm and moist climate and it is closely correlated with poor environmental hygiene, especially particular lack of adequate excreta disposal and lack of access to health service [6]. The dynamic processes involved in geohelminths transmission, such as free living stages and survival depends on prevailing conditions; therefore free living infective stages present in the environment develop and die at different temperature rates [7]. Dumpsites, being used as the case study for these human geohelminths, have been the most common method of organized waste disposal and remain so in many places around the world, it is the simplest, cheapest and most cost-effective method of waste disposal [8]. In most low to medium income developing nations, almost 100 per cent of generated waste goes into the dumpsites (landfill), even in many developed countries; most solid wastes are disposed in landfill. Some dumpsites are also used for waste management purposes, such as the temporary storage, consolidation and transfer, or processing of waste material (sorting, treatment, or recycling) [9]. Dumpsites may cause a number of problems; damage can include infrastructure disruption, such as damage to access roads by heavy vehicles, pollution of the local environment may also occur [10]. Dumpsites may also become a reservoir of disease causing organisms and disease vectors such as rats and flies, particularly from improperly operated dumpsites, which are more common in developing countries [11].

The information got from this study will help in a better understanding of geohelminth distribution and also serve as a decision making tool for identifying areas of particular risk and environmental factors that put individuals at risk of helminth infection.

2. MATERIALS AND METHODS

2.1 Study Area

The study was conducted in Emouha local Government Area of Rivers state Nigeria. It is located between latitude 4°53'0"N and longitude 6°52'0"E in Rivers State of Nigeria. It has an area of 831 km sq. With a population of 201,901 people at the 2006 census [12]. The people of Emouha are predominantly farmers, because of their large expanse of land, however some of them also engage in fishing activities.

2.2 Sampling Sites

Sampling sites were chosen from communities in Emouha local government area. Four communities were selected for the research; Isiodu, Rumuakande, Rumuche, and Mgbuitanwo based on their open disposal of refuse and other human waste. The soil samples were collected from different dumpsite locations in the communities.

2.3 Collection of Soil Samples

Soil sample collections were collected from various dumpsites for a period of three months, 60 soil samples were collected from each of the four communities from July 2013 to September 2013. Soil samples were collected in the morning from about 7am – 12noon when the larvae of helminthes are still active, An average of 80 samples were collected each month. Sterile soil auger was used to collect soil samples from 15cm depth of the top soil in the study areas. The soil sample collected were placed in sterile labeled polythene bags, and taken to the laboratory for analyses. Fifty grams of each sample was measured into a transparent white plastic container, and 10% formalin added to preserve the eggs and larvae of the helminthes.

2.4 Examination of Soil Samples

2.4.1 Soil texture

The field method of using hands to determine the texture according to [13] of the samples was employed. The sand content was determined by rubbing a small amount of soil in the palm of the hands to determine if sand is under or over 50%, if the sand content is less than 50%, water is to be added to create a soil that is wet enough to roll. The soil was squeezed between the thumb and forefinger to make the longest ribbon possible, a loam soil will form only a short ribbon, while a clay soil will form a much longer ribbon.

2.4.2 Soil pH

A little quantity of soil was put in small plastic containers, and made moist by adding distilled water, and the reference electrode of the Corning's pH meter was inserted into the moist soil, the knob of the pH meter was switched on for about 30 seconds and the value was recorded. The reference electrode was rinsed with distilled water after each reading, and the knob of the pH meter is switched off [14].

2.5 Examination of Soil Samples for Eggs and Larvae of Geohelminths

2.5.1 Centrifugal flotation method

The soil samples are sieved using a fine sieve (Pore size 250 µm) so as to remove larger particles but also allow passage of small size particles including helminth eggs. From the sieved portion, 2 g of soil was collected and placed into a 10 mL test tube containing 3 ml of 30% sodium hypochlorite solution, the test tube was shaken intermittently then 5 ml of concentrated saccharine solution (1000 g of white sugar in 900 mL of distilled water) was added to the test tube and then put in the centrifuge (model HW236) and was set to centrifuge at 1500 rpm for 15 minuites. After the 15 mins timer is out the test tubes are removed from the centrifuge and more saccharine solution is added to raise the meniscus and float the eggs. Cover slips are put on the top of the test tubes and wet them by the surface of the floating solution after allowing standing for 15 min. The cover slips are carefully removed from the top of the test tubes and gently placed on microscope slides, the slides are examined microscopically for presence of helminth larvae or eggs [15].

2.5.2 Identification of eggs and larvae of geohelminths

The eggs and larvae of geohelminths were identified with reference to Atlas of parasitology. Eggs of *Trichuri strichuira* are barrel shaped with mucous plug at each pole and measure 50-53 µm by 22-23 µm in size, the eggs of *Ascaris lumbricoides* is oval or rounded with warty appearance. Larvae of hookworm are not flattened and eggs have grey cells or are dark brown and measure between 50- 60um in size [16].

2.6 Data Analysis

Results obtained from the samples were entered into Ms. Excel 2007 and analyzed using standard deviation and ANOVA analyses was used to assess significant differences in prevalence of infection [17]. Descriptive statistics were calculated and presented in form of tables [18].

3. RESULTS

In this study a total of 240 soil samples were examined, and 121 (50.4%) were found to be positive with human geohelminth eggs or larvae. Total prevalence of *Ascaris lumbricoides* egg accounted for was 58 (24.2%), *Ancylostoma duodenale* 16 (6.7%), *Strongyloides* spp. 34 (14.1%) and *Trichuris trichura* 13 (5.4%) which was statistically significant (p>.05) see Table 1. In the month of July, 80 soil samples were examined and 41 (51.3%) of the samples were positive with geohelminth parasites. *Ascaris lumbricoides* had highest prevalence with 30(37.5%), *Strongyloides* spp. 3(3.8%), hookworm 6(7.5%), and *Trichuris trichura* 2(2.5%). Mgbuitanwo community July had a prevalence 14(70%), Rumuakande 25%, Rumuche 9(45%), and Isiodu 13(65%). See Table 2.

August recorded the least prevalence of 31(38.8%), *Strongyloides* spp. 11(13.8%), *A. lumbricoides* 10 *(*12.5%), *Ancylostoma duodenale* 3(3.7%) and *T. trichiura* 7(8.7%).Mgbuitanwo community in August had prevalence with 10(50%), Isiodu and Rumuakande community had equal prevalence of 8(40%), while Rumuche was least with 5(25%) as shown in Table 3.

The month of September had the highest infection rate for all the months sampled, with prevalence value of 61.2%, from which *A. lumbricoides* accounted for 18(22.5%), *Strongyloides* spp. 20(25%), *Ancylostoma duodenale* 7(8.8%) and *T. trichura* 4(5%). Rumuakande, Rumuche, Mgbuitanwo communities all had equal prevalence rate of 12(60%) each, while Isiodu had highest infection rate with prevalence of 13(65%). see Table 4.

The soil parameters examined from July - September in the four communities were soil texture, soil colour and soil pH. The overall result obtained from soil texture examined were; sandy soil with mean 1.7 ± S.D 1.1, loamy soil with mean 2.8 ± S.D 1.2, and clay soil with mean 0.04 ± S.D 0.3. Soil colours were Black which had mean 1.7 ± S.D 1.6, and Brown with mean 2.2 ± S.D 1.8. Soil pH reading was mean 6.3 ± S.D 0.6. Loamy soil had highest number of 156 samples, sandy soil had 77 samples, and clay had 7 samples. See Table 5.

4. DISCUSSION

From the results obtained, it has been established that four species of human geohelminth eggs and larva can be found in all four communities sampled. Rumuakande community had a prevalence rate of 10.4%, Rumuche 10.8%, Isiodu 14%, and Mgbuitanwo 15%. Table 1 clearly showed mgbuitanwo community having highest prevalence value and Rumuakande with least prevalence value which was statistically significant (p>.05). Mgbuitanwo community having highest prevalence can be attributed to the sanitary level of individuals in the community, where houses are located close to bushes and children go to bushes to defecate which results in the contamination of the soil. In areas where refuse are disposed indiscriminately, and where toilet facilities may not be adequately provided, soil contamination might result from rain splashes, irrigation, and flush of contaminated soil during heavy rainfall [19]. Soil moisture must have favored contamination of the areas and survival of geohelminth parasites. Table1 equally, showed the prevalence of parasites in the soil sample, where *Ascaris lumbricoides* had the highest prevalence value of 24.2%, followed by *Strongyloides* spp. with 14.1%, *Ancylostoma duodenale* with 6.7%, while *Trichuris*spp. had least prevalence of 5.4%. High prevalence of *Ascaris lumbricoides* in this study corroborates findings of other studies in Delta and Anambra states, southern Nigeria [20-22]. *Ascaris lumbricoides* can withstand harsh environmental conditions and can remain in the environment for longer period. The second most prevalent STH from this study was *strongyloides* spp. with prevalence value of 14.1%, *Ancylostoma duodenale* was the third most common parasite identified in this study, with prevalence value of 6.7%, this result is low compared with the values from other studies in various parts of Nigeria. Egwuyenga et al. [22] reported infection rates of 22.5% in Eko Delta state, Ngele, in Ubeyi Ebonyi state [23] recorded 58.3% and Obiukwu et al. [24] in Mbaukwu Anambra state recorded 31.1%. The larva of hookworms are capable of vertical migration up and down in contaminated soil, depending on soil moisture and temperature and they remain in the soil until they come in contact with suitable host [1] *Trichuris* had the least prevalence with 5.4%, this is however low as compared with reports from studies in other parts of the country, Anosike et al. [25] in Imo State reported *Trichuris* spp. prevalence to be 14.0%.

Table 5 shows the parameters used in the study, sandy soil had mean of 1.7 ± S.D 1.1, loamy soil had mean of 2.8 ± S.D 1.2 and clay soil with mean of 0.04 S.D ± 0.3. However, from the results the different soil types had no effect in the

Table 1. Prevalence of geohelminths in Emohua from July – September

Communities	No. soil samples examined	% no. of species				(%) total no. positive
		Ascaris lumbricoides	***Ancylostoma duodenale***	***Strongyloides spp.***	***Trichuris spp***	
Rumuakunde	60	10 (16.6)	10(16.6)	3 (5)	2 (3.3)	25 (41.6)
Rumuche	60	15 (25)	5 (8.3)	4(6.6)	2 (3.3)	26 (43.3)
Mgbuitanwo	60	17 (28.3)	4 (6.6)	9 (15)	6 (10)	36 (60)
Isiodu	60	16 (26.6)	4 (6.6)	11(18.3)	3(5)	34 (56.6)
Total	240	58 (24.2)	16 (6.7)	34 (14.1)	13 (5.4)	121 (50.4)

Table 2. Prevalence of geohelminths in the study area for the Month of July

Communities	No. examined	% no. of species				(%) total no. positive
		Ascaris lumbricoides	***Ancylostoma duodenale***	***Strongyloides* spp.**	***Trichuris* spp.**	
Rumuakunde	20	4 (20)	1 (5)	0	0	5 (25)
Rumuche	20	6(30)	3 (15)	0	0	9 (45)
Mgbuitanwo	20	11(55)	1(5)	1(5)	1(5)	14 (70)
Isiodu	20	9 (45)	1(5)	2 (10)	1(5)	13 (65)
Total	80	30(37.5)	6 (7.5)	3 (3.7)	2 (2.5)	41 (51.2)

Table 3. Prevalence of geohelminths in the study for the Month of August

Communities	No. examined	% No. of species				(%) total no. positive
		Ascaris lumbricoides	***Ancylostoma duodenale***	***Strongyloides* spp.**	***Trichuris* spp.**	
Rumuakunde	20	2 (10)	1 (5)	4 (20)	1 (5)	8 (40)
Rumuche	20	3 (15)	0	1 (5)	1(5)	5 (25)
Mgbuitanwo	20	2 (10)	1(5)	3 (15)	4 (20)	10 (50)
Isiodu	20	3 (15)	1(5)	3 (15)	1(5)	8 (40)
Total	80	10 (12.5)	3 (3.8)	11 (13.7)	7 (8.7)	31 (38.7)

Table 4. Prevalence of geohelminths in the study area for the month of September

Communities	No. examined	% no. of species				(%) total no. positive
		Ascaris lumbricoides	***Ancylostoma duodenale***	***Strongyloides* spp.**	***Trichuris* spp.**	
Rumuakunde	20	4 (20)	1 (5)	6 (30)	1 (5)	12(60)
Rumuche	20	6 (30)	2 (10)	3 (15)	1 (5)	12 (60)
Mgbuitanwo	20	4 (20)	2 (10)	5 (25)	1(5)	12 (60)
Isiodu	20	4 (20)	2 (10)	6 (30)	1(5)	13(65)
Total	80	18 (22.5)	7 (8.75)	20(25)	4 (5)	49 (61.25)

distribution of geohelminths. Although studies suggest that the egg of *Ascaris* spp. develops best in less permeable clay soil, with survivability rate increasing with depth [26], clay soil are also believed to prevent dispersal by water, however well aerated non adhesive sandy soil are particularly conducive to promoting hookworm hatching, development and larval migration [27].

Table 5. Soil parameters conducted from July to September in the study area

Parameters	N	Mean	S.D	S.E
Sandy	77	1.7	1.1	0.4
Loamy	156	2.8	1.2	0.4
Clay	7	0.04	0.3	0.04
Black	98	1.7	1.6	0.4
Brown	142	2.2	1.8	0.4
pH	240	6.3	0.6	0.3

5. CONCLUSION

To reduce the prevalence of geohelminths in refuse dumpsites of Emohua Local Government area, proper packaging and disposal of waste in the communities needs to be emphasized. The local Authorities need to construct safe, functional and easily accessible refuse disposal facilities that will alleviate the hazards faced by the communities. However, knowledge from this research work can be used by health workers in planning and evaluating of health intervention programs.

6. RECOMMENDATIONS

The people in the area should be enlightened on the importance of proper waste disposal practice.

Indiscriminate dumping of waste should be stopped.

People who scavenge should well kitted to avoid risk of being infected by any of the observed geohelminth.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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