



Prevalence of Geohelminths in Garden Soil in Emohua Local Government Area in Nigeria

Adedokun Ambali Amudatu^{1*}, Gboeloh Lebari Barine¹ and Elele Kingsley¹

¹Department of Biology, Ignatius Ajuru University of Education, Port Harcourt, Rivers State, Nigeria.

Authors' contributions

This work was carried out in collaboration among all authors. The authors designed, collected and analyzed samples, wrote and approved manuscript. All authors read and approved the final manuscript.

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ABSTRACT

Introduction: Geohelminths are parasites which perform part of their life cycle in the soil, where eggs are embryonated and then larvae become viable, being in both stages able to infect their hosts, depending on the species and can affect humans.

Aim: This study was aimed to determine the prevalence of geohelminths in garden soil in Emohua Local Government Area, Rivers State in Nigeria.

Methods: Soil samples from the cultivated area of Rumuakunde and Isiodu district were selected for the study. 164 soil samples were examined for a period of April to May 2019. Geohelminth concentration technique was carried out using zinc sulphate floatation technique and under light microscopy. Data analysis was carried out using descriptive statistics and Chi square (X^2) test.

Results: The overall prevalence rate of geohelminths found was 20(12.2%) out of 164 soil samples examined from the selected farm lands. Isiodu Farm F had the highest prevalence of 60% (12/20) followed by Rumuakunde Farm B, C and E of prevalence 20% (4/20), 15% (3/20) and 5% (1/20) respectively. This distribution among the farm lands were found to be statistically significant ($p < 0.05$). Hookworm laevae 70% (14/20) and *Strongyloides stercoralis* 30% (6/20) were geohelminths identified. Other geohelminths were not implicated.

Conclusion: This result of this study has shown that, geohelminths are more prevalent in Isiodu farm lands. The risk of contracting infection is high in these farm locations despite its low prevalence. There is need for zero tolerance to soil contamination.

*Corresponding author: Email: amudatuadedokun@gmail.com; amudatu.adedokun@jaue.edu.ng;

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1. INTRODUCTION

About 1.5 billion people are infected with at least one species of geohelminth worldwide [1]. Geohelminth infections high incidence rate have been reported in the Americas, China, East Asia and Sub-Saharan Africa [2]. Prevalence rate of 92.6% in India [3], 69.9% in Tuvalu [4], 40.2% in China [5] and 15.6% in Thailand [6] were reported from the different parts of the world respectively.

Geohelminthiasis are common in Nigeria. The population densities and life style vary according to the region and ethnic groups, respectively. Hotez et al. [7] and Oluwole et al. [8] reported that Nigeria has the highest infected people with STH in sub-Saharan Africa with children of age 5-14 years at high risk of infection and morbidity. They are among the most prevalent Neglected Tropical Diseases (NTDs) which persist absolutely in the poorest populations [9,10].

Geohelminth comprising of *Ascaris lumbricoides*, *Trichuris trichiura*, the hookworms (*Ancylostoma duodenale* and *Necator americanus*) and *Strongyloides stercoralis*, are the cause of helminthiasis identified as the leading Neglected Tropical Diseases (NTDs) prevalent in the tropics and sub-tropics [11].

The incidence of geohelminth infections is dependent on several factors: socio-demographic sanitary and environmental. The latter comprise the temperature of the soil surface, humidity and precipitation [12,13]. In the transmission cycle of geohelminths, infected humans and animals defecate in the soil, then eggs mature to the infective larvae stage; thereafter, infection could occur on contact with a new host by ingestion or through skin penetration [14,15].

Adult worms of geohelminths can live in human gastrointestinal tract for years. Most studies suggest approximately 70% of the worm population is hosted by 15% of the host population. These few infected individuals are at a higher risk of the disease and are also the prime source of environmental contamination [16,17].

Majority of these geohelminths have been reported with high prevalence rates across Nigeria [18] over the years and there seem to be

no reduction in the rates been reported despite control efforts.

Soil contaminated with geohelminths in both rural and urban settings had significant geographic variability in past field studies [19,20,15,21]. Clearly, geohelminth infections are prevalent in Nigeria and highest burden is seen in the South-West region [22,23].

Several studies in Nigeria has found *Ascaris lumbricoides* to be of high prevalence followed by hookworm and *Trichuris trichiura* [24,25,26,27, 20].

Emohua Local Government Area of Rivers State major occupation of its people is farming with a few other members of the communities engaging in trading and public service. It is imperative to assess the prevalence of geohelminths on cultivated farm land in selected parts of the communities with greater risk of geohelminth infection and thereafter profer recommendations where necessary from this study.

2. MATERIALS AND METHODS

2.1 Study Area

This study was carried out in Rumuakunde and Isiodu district of Emohua local government area, in Rivers State. The area lies within the tropical rainforest which is characterised by eight months and four months of the wet and dry season respectively. The average temperature of the area is between 22°C and 29°C with high humidity and rainfall [28]. Six different farm locations were selected in Rumuakunde with less human activities and dispersed settlements while two farms were selected from Isiodu with more settlements where there are various activities such as schools, healthcare centre, private businesses and other social amenities. The selected farm locations are geographically located between latitude 4°53'3.8868"-4°53'18.222", N and longitude 6°52'6.6"-6°52'11.208" E for Rumuakunde farms while Isiodu geographical location is between latitude 4°53'11.1156"-4°54'56.6128" N and longitude 6°52'25.6908"-6°54'10.692" E (Fig. 1).

2.2 Study Design

A weekly soil sampling was conducted between April-May 2019. Soil sampling was carried out in the early hours of the day between 6.00 and 11.00 am, when the infective stages are still present and fresh in the topsoil [20].

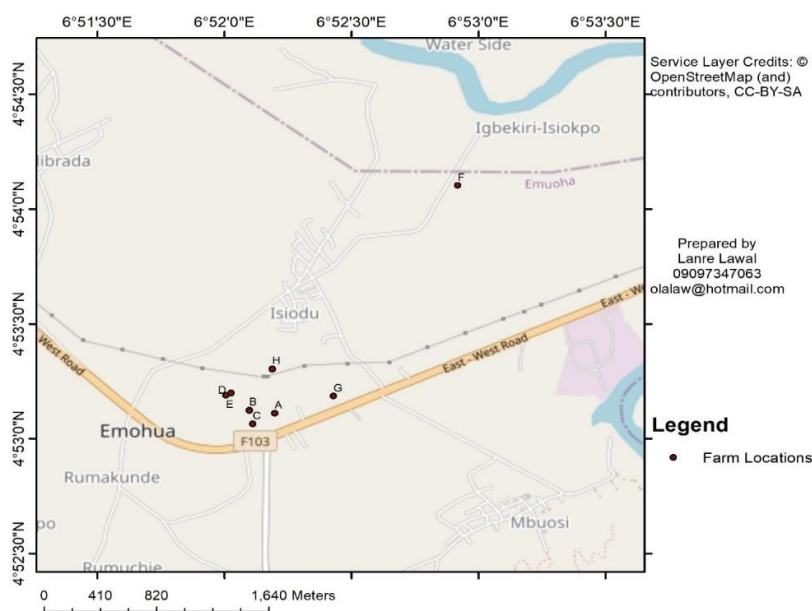


Fig. 1. Soil sampling locations in Rumuakunde and Isiodu in Emohua local government area, Nigeria

2.3 Sample Size

An approximate minimum sample size of 164 was therefore estimated using the formula for a cross-sectional study as recommended by Cochran, [29]; $n = Z^2 \cdot p(1-p) / M^2$, where $n = n$ = sample size for infinite population, $Z = Z$ score (1.96), $p =$ Population proportion (assumed to be 50% = 0.5) and $M =$ Margin of error (0.05).

2.4 Ethical Considerations

Prior to soil sample collection, farm owners' permission was solicited and only those farmers who consented to the request had their farm included for the study.

2.5 Inclusion Criteria

Farm land owners that approved the verbal consent form were included in the study.

2.6 Exclusion Criteria

Farm land whose owners did not give consent were excluded from the study.

2.7 Sample Collection

Approximately 100 g of soil was collected at a depth of 2-3 cm using a meter rule [24,15,21] from different points within the eight sampling sites. Each of samples from each location was stored in properly labeled polythene bag until required for laboratory analysis. A total of 164

samples collected from different sites of each farm in Rumuakunde (farm A and D 16 samples each, farm B and C 15 samples each (see Table 1)), farm was located where there was less human activities with scanty settlements while Isiodu had more settlements with various activities such as schools, healthcare centre and private businesses. Samples were transported to the laboratory between 1-2 hours of collection for examination and analysis.

2.8 Parasitological Examination

About 5 g each of the soil sample were mixed thoroughly with distilled water. The suspension was strained through a sieve mesh size 200 μ m to remove coarse particles. The filtrate was centrifuged at 1000 RPM for 3 min and the supernatant decanted. The resulting sediment was further broken up by shaking and tapping the tube. The sediment was mixed with zinc sulphate solution (Specific gravity 1.2) [19,21], added up to the brim of the test tube and allowed to stand for a few minutes with a cover slip on the tube to collect any floating egg. The cover slip was removed and examined under the microscope at $\times 10$ and $\times 40$ objectives lenses [15]. Reference to Atlas of Medical Helminthology and Protozoology [30] and parasites of man and animal [31] was used to identify the ova or larvae of parasites and any ova or larvae seen were counted and recorded respectively.

2.9 Statistical Analysis

Data obtained were analyzed using SPSS software version 23 for both the descriptive as well as the inferential analysis. Results of the analysis were expressed in percentages and the chi-square test was used to conclude the significance levels between the parameters, with the significant value set at 0.05 or 5% for 95% confidence interval.

3. RESULTS

Out of one hundred and sixty-four (164) samples collected randomly from various sites of each farm, 20(12.2%) were positive for geohelminths while 144(87.8%) were found to be negative. These findings were statistically significant ($p = 0.001$). Isiodu farm location F had the highest prevalence of geohelminths 60% while Rumuakunde farm

location E had the least prevalence 5% (Table 1).

Of the geohelminths implicated, hookworm laevae and *Strongyloides stercoralis* were found to prevalent with different distribution across the farm lands. The prevalence of geohelminths across the different farm lands were not statistically significant ($p = 0.468$). Isiodu farm F had hookworm laevae to be 50% (7/14) while *Strongyloides stercoralis* had 83.3% (5/6) and Rumuakunde Farm E, the least had *Strongyloides stercoralis* 7.1% (1/14) (Table 2).

Other Rumuakunde farm locations A and D and Isiodu farm locations G and H were free from geohelminths.

Isiodu farm locations was found to have high prevalence of geohelminths compared to the farms in Rumuakunde (Fig. 2).

Table 1. Distribution of soil contamination from selected locations

Farm locations	Positive cases	Negative cases	Total sample/location	Chi square (χ^2)	p-value
	Freq (%)	Freq (%)	Freq (%)		
Rumuakunde					
A	0 (0.0)	16 (11.1)	16 (9.8)	32.9069	0.001
B	4 (20.0)	11 (7.6)	15 (9.2)		
C	3 (15.0)	12 (8.3)	15 (9.2)		
D	0 (0.0)	16 (11.1)	16 (9.8)		
E	1 (5.0)	19 (13.2)	20 (12.2)		
Isiodu					
F	12 (60.0)	22 (15.3)	34 (20.7)		
G	0 (0.0)	23 (16.0)	23 (14.0)		
H	0 (0.0)	25 (17.4)	25 (15.2)		
Total (%)	20 (12.2)	144 (87.8)	164 (100)		

Table 2. Prevalence of geohelminths from selected locations

Farm locations	Geohelminths			Chi square (χ^2)	p-value
	Hookworm laevae	<i>Strongyloides stercoralis</i>	Total		
	Freq (%)	Freq (%)	Freq (%)		
Rumuakunde B	3 (21.4)	1 (16.7)	4 (20)	2.5397	0.468
Rumuakunde C	3 (21.4)	0 (0.0)	3 (15)		
Rumuakunde E	1 (7.1)	0 (0.0)	1 (5)		
Isiodu F	7 (50.0)	5 (83.3)	12 (60)		
Total (%)	14(70)	6(30)	20(100)		

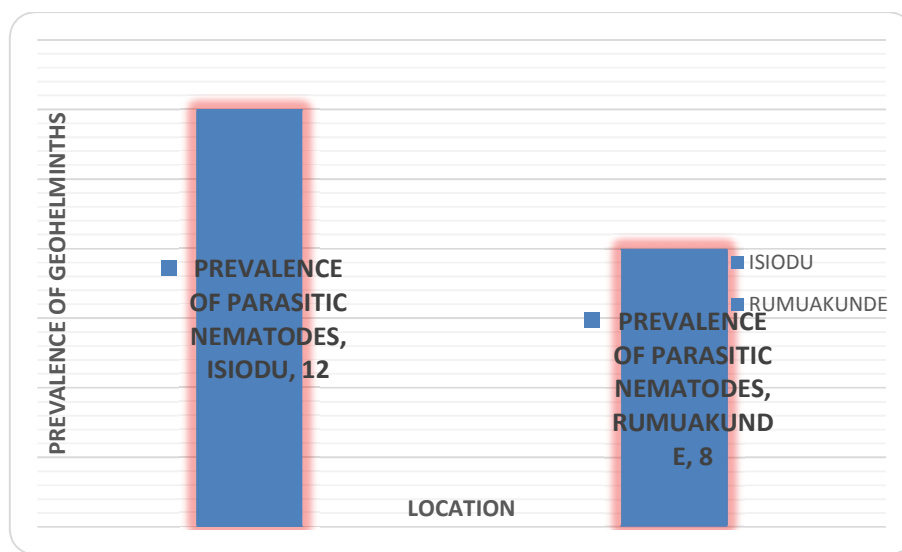


Fig. 2. Prevalence of geohelminths in selected farm location

4. DISCUSSION

Geohelminths are mainly a group of parasitic nematodes causing human infection through contact with parasite eggs or larvae; they survive in the warm and moist soil of the tropical and subtropical countries [32]. The study was carried out to determine the prevalence of geohelminths in selected garden soil in Emohua Local Government Area in Rivers State. A total of 164 soil samples were examined where 20 soil samples were positive for geohelminths and 144 soil samples appeared to be negative for geohelminths.

The study indicated a prevalence of 12.2% geohelminths in the selected farm lands in Emuoha LGA. The result of level of prevalence of geohelminths in this study appears to be low, though was statistically significant ($p < 0.05$). Other relatively less prevalence was implicated in reports by Ngatou et al. [33] and Debalké et al. [34] in Ethiopia had 3.3% and 11.25% while in Nepal by Shrestha et al. [35] had 28.5% soil contamination prevalence. The differences between these rates may be due to environmental factors such as topography, temperature, type of soil, climate, rainfall and the use of human feces as fertilizer for crops [36] and humidity, pH, depth and soil texture can affect the embryonic development, viability, infectivity and eggs size [37].

Human infection due soil contamination with geohelminths may serve as a continuous source

of infection Ogbolu et al. [38]. Comparison of overall prevalence rate across other parts of the Nigeria, 67.1% prevalence rate was recorded in spatial pattern of geohelminths in the south west by Hassan et al. [15]. Ohiolei et al. [39] in Edo State, Oyebamji et al. [21] in Oyo state and Ebonyi state by Agbom et al. [24] had high prevalence of 55.2%, 54.9% and 40.83% respectively in their assessment of soil contamination. Elsewhere in Brazil by Santarém et al. [40] had report of 76.9%. This difference in results may be related to the climate conditions, laboratory techniques (precipitation, temperature and humidity), as well as to the population's habits regarding personal/community hygiene and animal care.

In the current study, hookworm larvae (14/20, 70%) were the most widely distributed geohelminths followed by *Strongyloides stercoralis* had (6/20, 30%). Other geohelminths were not identified. These findings were not statistically significant ($p > 0.05$).

Hookworm causes the highest burden among geohelminths, with detrimental effects on children's physical and cognitive development and agricultural workers' productivity. It also gives rise to hookworm disease, which occurs in cases of high worm load and causes iron-deficiency anaemia that affects infant and maternal mortality and leads to low birth weights [11,41,42,9]. Hookworm infection is of major public health importance in low and middle-income countries, with 439 million cases reported worldwide in 2010 [1].

The result of this study is similar to the reports by Hassan et al. and Oyebamiji et al. [15,21] in southwestern, Nigeria.

S. stercoralis is one of the most neglected of the neglected tropical diseases (NTDs), mostly because its larvae, present in human stool, are not detected by the diagnostic scatological techniques used in endemic countries to screen for helminth eggs [14,43-45]. *S. stercoralis* is very common, it can cause significant dermatological and gastro-intestinal morbidity and is connected with chronic malnutrition in children [46,47]. Furthermore, its capacity to replicate within its host leads to long-lasting infections and potentially fatal dissemination of the parasite [48-50].

Hookworms and *S. stercoralis* are parasitic intestinal nematodes that belong to the group of geohelminths. For both parasites, infection occurs when larvae living in faecally-polluted soil penetrate intact skin. With overlapping geographical distributions, geohelminths are mostly prevalent in rural areas with poor sanitation conditions and a warm and humid climate that favour larvae survival in the environment [11,24].

On the contrary, other studies in Nigeria and elsewhere had *Ascaris lumbricoides* as the most prevalent in the examination of soil contamination of school playgrounds, markets and recreational parks in Kogi state, refuse dump in Rivers state [27,51,28], the prevalence range of *A. lumbricoides* for other studies is between 10-40% in Ebonyi, Enugu and Plateau State [20,24,25,26] and in Kenya by Steinbaum et al. [52].

The study also reported that no geohelminths on some farm lands locations. This reports of geohelminths based on location of the farm is in agreement with the study conducted by Eze et al. [28] which confirm the low prevalence of farm location in Rumuakunde with low prevalence of the geohelminths and is suggestive of very low population density in that area, good sanitary facilities as well as personal and community hygiene were maintained by the inhabitants of this location.

5. CONCLUSION

This result of this study has shown that, geohelminths are more prevalent in Isiodu farm lands. The risk of contracting infection is high in

these farm locations despite its low prevalence. There is need for zero tolerance to soil contamination. These results also have created room for more studies for researchers in relation to the selected farm locations and the prevalence of these geohelminths to humans.

6. RECOMMENDATIONS

With the finding of this study, here are the few recommendations:

1. There should be community awareness on the implication of open defecation.
2. Farmers are advised to improve on personal/community hygiene to reduce the spread of infection.
3. Local community needs to intensify interventions which is aimed at reducing soil contamination rate in their locality.
4. There is room for more studies to be carried out to establish the level of geohelminths in these selected areas.

ETHICAL APPROVAL

Approval was obtained from farmland owners through verbal consent.

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COMPETING INTERESTS

Authors have declared that no competing interests exist.

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