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Original Research Article

Evaluation of Gastrointestinal Parasites in Major Dumpsites and Health Risk Behaviour of Scavengers in Port Harcourt Metropolis

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Abstract: The prevalence of gastrointestinal parasites in major dumpsites and health risk behaviour of scavengers in Port Harcourt metropolis was investigated. Eight dumpsites were randomly selected for the study and 40 samples of soil and household waste material were collected from the dumpsite into sterile containers respectively. The samples were examined and parasites concentrated using zinc sulphate floatation technique. The results showed that a total of 39 parasite species belonging to 5 genera and 16 parasites species belonging to 3genera were isolated from the soil and household waste samples respectively. The parasites isolated from the soil samples included *Ascaris lumbricoides* (28.2%), *Entamoeba histolytica* (5.1%), Hookworm (28.2%), *Strongyloides stercoralis* (35.9%) and *Sarcocytis sp* (2.6%) while *A. lumbricoides* (18.8%), Hookworm (31.3%) and *S. stercoralis* (50.0%) were extracted from the waste samples. The soil samples had high abundance of parasites (70.9%) than the household waste samples (29.1%). The most significantly ($P<0.05$) abundant parasites was *S. stercoralis* while sites 1 and 4 recorded a statistically significant ($P<0.05$) abundance of parasites. Majority of the scavengers neglect the use of safety cloth and cover shoes while a statistically significant number of the scavengers do not hand glove (100%), nose mask (89%), visit the hospital only when sick (71%). The study revealed a significant abundance of gastrointestinal parasites in the dumpsites and high health risk behavior by scavengers in the study area. Deliberate formulation of scientific waste management policies to enhance performance, education of scavengers and execution of relevant legislation will go a long way to cub the impact of these parasites on public health.

Keywords: Dumpsites, Gastrointestinal parasites, Scavengers, Abundance, Port Harcourt.

INTRODUCTION

Dumpsites are designated areas mapped out for disposal and possible treatment of generated waste materials**.** Records indicated that that there is an increase in waste generation rate globally. In 2016, about 2.1 billion tons of solid waste was generated by major cities worldwide, resulting to an average generation rate of 0.74 kilograms per individual every day [1]. With a high increase in population growth rate, urbanization and development, the generation of annual waste is expected to increase by 70% from the recorded level in 2016 to 3.40 billion tons by the year 2050 [1]. The management of waste is a major public health related issue that deserve expertise especially in Africa and other developing countries of the world. Major cities of Africa especially the poor urban regions are more seriously affected by the unsustainable methods of waste management. For instance, Nigeria generates about 43.2 million tonnes of waste annually [2]. These wastes are generated mostly from industrialised cities like Lagos, Onitsha, Aba and Port Harcourt.

Refuse generation in Port Harcourt has reportedly increased due to an upsurge in the population [3] and records indicated that the generated wastes are poorly and inefficiently managed at the various dumpsites where the wastes are disposed [4]. A major factor noticeable at all dumpsites in Nigeria is the presence of scavengers and according to [5], scavengers are major agents of material reuse and recycling in Nigeria whose activities contribute to the informal sector and about 2% of the population in developing countries engage in scavenging as a means of livelihood [6]. The impact of their activities on private and public health cannot be over emphasized [7], reported that

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disease-causing organisms have been found in the blood and vital samples of scavengers.

As obtained in many developing countries, mixed waste ranging from industrial, medical, domestic and other wastes are dumped at these sites without separation and/or treatment. However, the composition of the dumpsites in these countries are mostly materials from domestic and agricultural sources [8]. Besides distortion of the physical aesthetic nature of the environment, these dumpsites create fertile and favourable breeding ground for small vertebrates and arthropods, many of which are vectors of parasitic diseases.

Dumpsites are also known to have high prevalence of gastrointestinal parasites due to the presence of human and animal faecal materials in addition to other pathogens that could be transmitted from animal to man [9]. The presence of parasites, and striving of vectors of parasitic diseases in dumpsites is a public health concern due to the increased risk of transmission of these diseases by the vectors [4].

Studies have shown that refuse from domestic source and sewage sludge harbor gastrointestinal parasites infective to man and animals [10] and dumpsites are a major source of transmission of these parasites [11, 12] many of which have been isolated [13].

Some of the common parasites found in dumpsites included Ascaris lumbricoides, Hookworms, Entamoeba histolytica, Schistosoma sp and Strogyloide sp [10].

Athough several studies have been conducted to as ascertain the prevalence of parasites associated with dumpsites in different parts of Nigeria, there is pulsity of information on the parasite status of dumpsites in Port Harcourt. Hence, this study was conducted to evaluate the prevalence of gastrointestinal parasites in major dumpsites and health risk behaviour among scavengers in Port Harcourt, Rivers State.

METHODS

Study Area

This study was carried out in Port Harcourt metropolis. The metropolis is made up of parts of Port Harcourt City Local Government Area and Obio/Akpor Local Government Area (Fig-1). It is located at about 25 km from the Atlantic Ocean and lies between Latitude 4°45'N and Latitude 4°55'N, and Longitude 6°55'E and Longitude 7°05'E in Rivers State [14, 15]. Port Harcourt metropolis covers an area of about 369 km² with a temperature of about 22°C and 90% humidity. As at 2018, the metropolis had an estimated population of 2,060,000 inhabitants [16].

The metropolis is characterised by a tropical wet climate having lengthy and heavy rain fall. Only the months of December and January can truly be classified as dry season. The highest temperature occurs within the months of April and October while the heaviest precipitation occurs in the month of September with an average rainfall of 367 mm. On the average December is the driest month of the year, with an average rainfall of 20 mm. This study was conducted within June 2019 and January, 2020.

Port Harcourt metropolis is located between Latitude 4°45'N and Latitude 4°55'N, and Longitude 6°55'E and Longitude 7°05'E in Rivers State. It is a city in the Niger Delta region of Nigeria. The city lies at the mouth of River Bonny in Rivers State. It is located at about 25 km from the Atlantic Ocean and is situated between the Dockyard creek/Bonny River and the Amadi creek. It lies at an average altitude of about 12 m above mean sea level. Port Harcourt metropolis spans over two local government areas (LGAs) viz Port Harcourt and Obio/Akpor (Figure 1 and Figure 2).

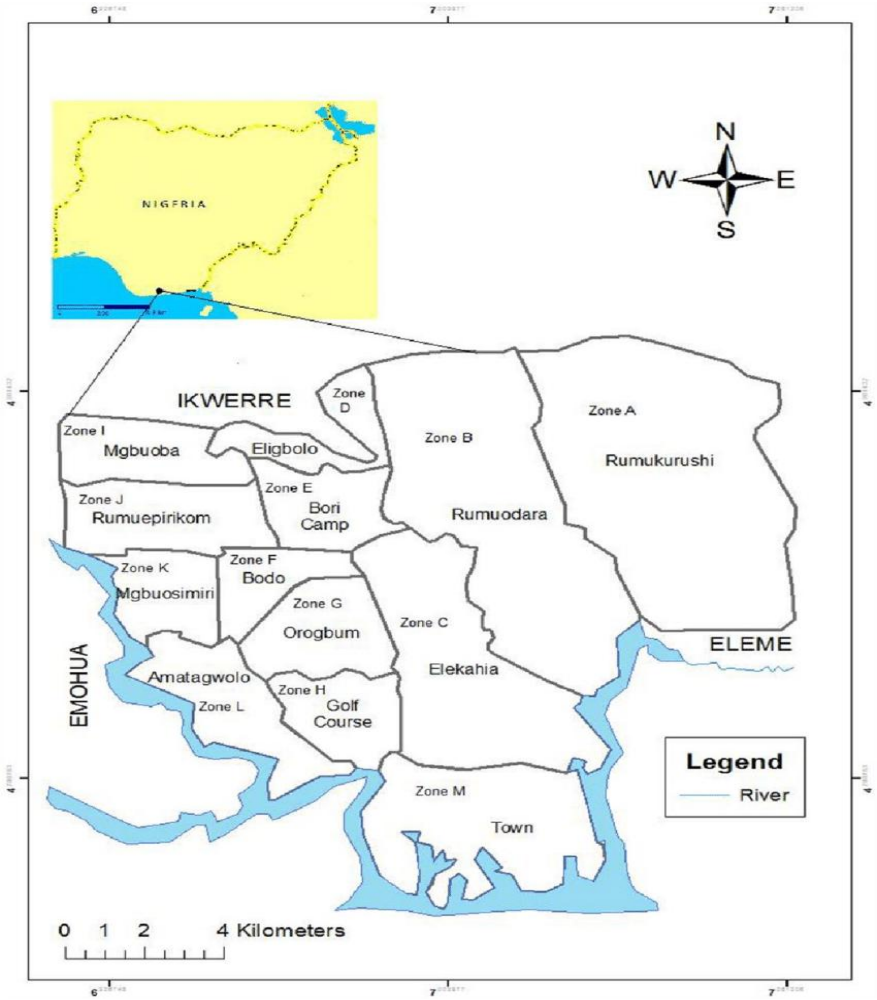


Fig-1: Map of Port Harcourt Metropolis
Source: Akukwe & Ogbodo (2015)

Sampling Sites and Sample collection

A total of 80 samples (40 soil samples and 40 household waste sample) were collected from the eight randomly selected dumpsites within Port Harcourt metropolis. Five soil samples and five household waste was collected from each the dumpsite respectively. The eight dumpsites were designated sites 1-8 (Fig-2). The method of [17] was employed in the collection of the soil samples from a peripheral depth of 3cm using an already sterilized hand trowel (95% alcohol), into well labelled containers. The household wastes were also collected into well labelled sterile polythene bags. All samples were taken to the research laboratory, Department of Biology, Ignatius Ajuru University of Education for laboratory analysis.

Questionnaires

A total of 100 self-structured questionnaires were produced and distributed to the scavengers seen at the dumpsites collecting recyclable materials. The questionnaire was used to obtain information on health risk behaviour associated with scavenging.

Laboratory Examination

A modified zinc sulphate flotation technique by [18] was used in the concentration of parasites for microscopy. 5g of each soil sample was measured into a test tube containing 10ml of distilled water. The content was thorough shaken and mixed. The suspension of the mixture was filtered to into a centrifugal tube and centrifuged at 2000 rpm for 5 minutes. The supernatant was decanted and the sediment was mixed with 15mls of zinc sulphate solution of 33% weight per volume and 1.20 specific gravity. The test tube was gradually filled to the brim and allowed to stand for few minutes with a cover slip superimposed on it to collect floating ova. The cover slip was carefully lifted and placed faced down on a clean glass slide for microscopic examination using X10 and X40 objective lens. The household refused was crushed into bits and passed through similar process as the soil sample.

Statistical Analysis

Data generated was analysed using SPSS version 23. One-way Analysis of Variance (ANOVA) was used to determine the significant difference between variables at 0.05 significant level. The relative

abundance and intensity of parasites were determined using the formula below:

$$\text{Relative abundance of parasites} = \frac{\text{No.of samples with specific species of parasite}}{\text{total no.of samples with parasite}} * 100$$

$$\text{Parasite intensity} = \frac{\text{No of parasites}}{\text{sample per gram}}$$

Fig-2: Dumpsites (Sites 1, 3, 4 and 5) at various part of Port Harcourt Metropolis

RESULTS

Prevalence and abundance of gastrointestinal parasites in soil samples

A total of 40 soil samples were collected from the 8 dumpsites investigated. The results show that almost all the dumpsites had at least one gastrointestinal parasite. A total of 5 species of gastrointestinal parasites were isolated from the soil samples. The parasites included Ascaris lumbricoides 11(21.6%), Entamoeba histolytica 2(5.1%), Hookworm 11(28.2%), Strongyloides stercoralis 14(35.9%) and Sarcocytis spp 1 (2,6%). The parasites were significantly (P<0.05) abundance in site 1 (25.6%) and site 4 (23.1%) compared to other sites. Sites 2, 3, 5,6,7 and 8 had parasite abundance of 10.3%, 7.7%, 12.8%, 0%, 15.4% and 5.1% respectively (Table-1). The most abundant parasite species in the soil samples were S. stercoralis 14(35.9%), A. lumbricoides 11(28.2%) and Hookworm 11(28.2%). S. stercoralis was the most significantly abundant (P<0.05) species in the soil samples.

Prevalence and abundance of gastrointestinal parasites in household waste samples

Table-2 shows the relative parasite abundance in household waste collected from the 8 dumpsites. Out of the 8 dumpsites investigated, only 5 sites (sites 1-31.3%, site 2- 6.2%, site 4-31.3%, site 5-25.0% and site 7-6.2%) were found in household waste harbouring parasites. Sites 1 and 2 had significant (P<0.05) parasite abundance compared to other sites. The parasite species identified include A. lumbricoide 3(18.8%), Hookworm (31.2%) and S. stercoralis 8(50.%).

Overall abundance of gastrointestinal parasites in the dumpsites (soil and household waste) in relation to species of parasite

Out of the 57 parasites isolated from materials collected from the dumpsite, 41(71.9%) and 16(28.1%) of the total isolated parasites were found in soil and household waste respectively (Table 3). The most significantly (P< 0.05) abundant parasite was S. stercoralis (38.5%).

Other parasites that were prevalent in the dumpsites included A. lumbricoide 14(24.6%), E. histolytica 7(12.3%), Hookworm 11(19.3%) and Sarcocysts sp. 3 (5.3%).

Overall intensity of parasites

The overall intensity of the parasites was 4.7, 4.1, 4.0, 2 and 2 for A. lumbricoides, Hook worm, S stercoralis, E. histolytica and Sarcocystis sp respectively (Fig-3).

Health risk behaviour of scavengers

The health risk behaviour of scavengers was assessed using questionnaire. The demographic characteristics of the scavengers indicated that out of the 100 interviewed, 20% and 80% were thin the age range of 5-20years and above 20years respectively. All the scavengers were males while 56% and 44% had only primary and secondary education respectively (Table-4).

The results show that majority of the respondents (81%) use casual cloth while only 19% used coverall during scavenging. 79% used flipflop (slippers) while 16% and 5% used cover shoe and rain/safety boot respectively. None of the scavengers used hand glove while nose mask is used by only 11% of the respondents.

The results also indicated that 71% of the scavengers visit the hospital/clinic only when sick, 21% do not visit the hospital/clinic at all while 8% visits the hospital/clinic regularly (Table-4).

Table-1: Relative abundance of parasites in soil samples (n =40)

Parasites	**Site 1**	**Site 2**	**Site 3**	**Site 4**	**Site 5**	**Site 6**	**Site 7**	**Site 8**	**Total**	**Rel. Ab.%**
Ascaris lumbricoides	2(18.1)	1(9.1)	-	3(27.2)	2(3.9)	-	3(5.9)	-	11	28.2
Entamoeba histolytica	2(100)	-	-	-	-	-	-	-	2	5.1
Hookworm	3(27.2)	1(9.1)	-	3(27.2)	1(9.1)	-	2(18.1)	1(9.1)	11	28.2
Strongyloides stercoralis	3(21.4)	2(14.2)	3(21.4)	2(14.2)	2(14.4)		1(7.1)	1(7.1)	14	35.9
Sarcocytis spp	1(10)	-	-	-	-	-	-	-	1	2.6
Total	**13**	**5**	**3**	**11**	**7**	**2**	**7**	**3**	**39**	
Relative abundance of (%)	**(25.5)**	**(9.8)**	**(5.9)**	**(21.6)**	**(13.7)**	**(3.9)**	**(13.7)**	**(5.9)**		**100%**

P < 0.05

Table-2: Relative abundance of parasites in samples from household waste (n= 40)

Parasites	**Site 1**	**Site 2**	**Site 3**	**Site 4**	**Site 5**	**Site 6**	**Site 7**	**Site 8**	**Total**	**Rel. Abu.%**
Ascaris lumbricoides	1(33.3)	-	-	1(33.3)	1(33.3)	-	-	-	3	18.8%
Hookworms	2(40.0)	-	-	2(40.0)	1(20.0)	-	-	-	5	31.3%
Strongyloides stercoralis	2(25.0)	1(12.5)	-	2(25.0)	2(25.0)	-	1(12.5)	-	8	50.0%
Total	**5**	**1**	**0**	**7**	**4**	**0**	**1**	**0**	**16**	
Relative abundance of (%)	**(31.3)**	**(6.2)**		**(31.3)**	**(25.0)**		**(6.2)**			

P < 0.05

Table-3: Overall prevalence of parasites in soil and household waste collected from dumpsites in relation to species of parasites

Samples	Lumbricoide (%)	E. histolytica (%)	Hook worms (%)	S. stercoralis (%)	S. Sp. (%)	**Total**
Soil	11(28.2)	2(5.2)	11(28.2)	14(35.8)	1(2.6)	**39**
Household waste	3(18.8)	5(31.3)	0(0)	8(50.0)	0(0)	**16**
Total	**14(24.6)**	**7(12.3)**	**11(19.3)**	**22(38.5)**	**3(5.3)**	**55**

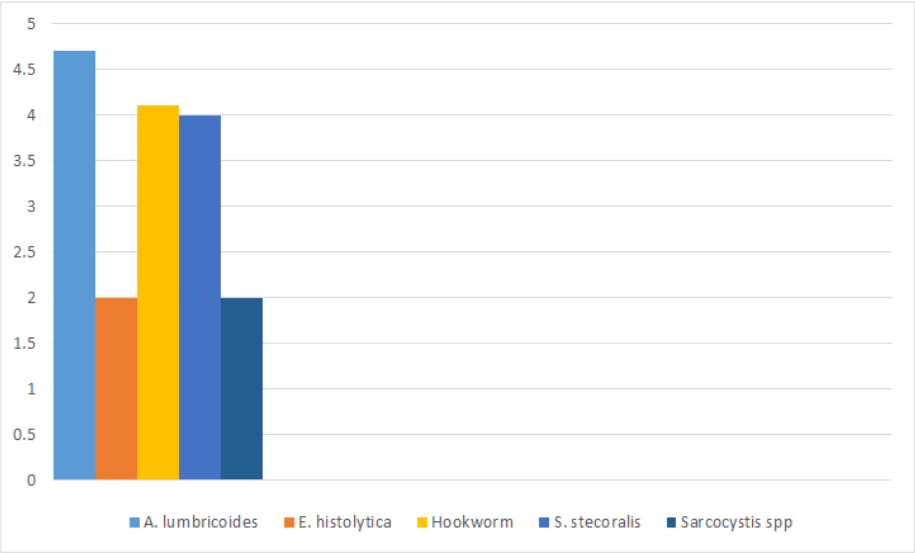


Fig-3: Parasite intensity

Table-4: Health Risk Behaviour of scavengers

Variables	No. of Respondents (%)
Age (yrs)	
5-20	20(20)
20-Above	80 (80)
Sex	
Male	100 (100)
Female	0(0)
Education	
Primary	56(56)
Secondary	44(44)
No school	0 (0)
Use of safety gear	
Coverall	19 (19)
Casual cloth	81(81)
Use of foot wear	
Cover shoe	16(16)
Flipflop	79(79)
Rain/safety boot	5(5)
Use of hand glove	
Yes	0(0)
No	100(100)
Use of nose mask	
Yes	11(11)
No	89(89)
How long have you been a scavenger?	
<1yrs	15(15)
2-3yrs	20(20)
4-5yrs	38(38)
6yrs and above	27(27)
Medical care/Visit to hospital	
I visit often	8 (8)
Only when sick	71 (71)
Don't visit at all	21(21)

DISCUSSION

Parasites of public health importance especially gastrointestinal parasites are often associated with poor sanitary habit, poor personal hygiene, lack of portable water and poverty [19]. This study reveals the influence of poor waste management on the relative abundance of gastrointestinal parasites in the study area. Although the agency (Rivers State Waste Management Agency) responsible for waste management in Rivers state organizes monthly sanitation exercise, this has not impacted positively on the sanitary condition of the state. This development may be partly responsible for the high abundance of gastrointestinal parasites in dumpsites investigated in the study area. The results of our study is in consonance with similar studies in other parts of Nigeria by [20] in calabar [21], in Owerri metropolis [22], in Ado-Ekiti, [23] in Ondo State and [24] in Ibadan. Again, the trend may be responsible for the high prevalence of helminthic infections among school children in the study area as recorded by [25, 26],

The high overall relative abundance of Strongyloides stercoralis (38.5%) observed in our study is higher than the 8% reported in Ibadan by [19], 3.4% recorded in Ondo state by [23] and the 26.7% reported in Owerri metropolis by [21]. The differences in results could be attributed to the waste management practices employed by waste agencies in the different study areas and the age of the dump before treatment. Some agencies disinfect or fumigate the dumpsites while others only set fire (which burn very slowly) on the dumpsites. The high abundance of the parasite could also be attributed to the climatic condition in the study area. In Rivers State, there is regular rainfall, providing a moist soil and temperature necessary for the striving of parasitic eggs prior to contact with the ideal host [23, 25].

A. lumbricoides was also observed to have a high relative abundance of 26.8% and 18.8% in the soil and household refuse respectively. However, this result is lower than the report of [21], who recorded 66.7% and 46.7% of A. lumbricoides in soil and refuse samples respectively. The researchers also reported 56.7% and 40% prevalence rate of Hookworm in soil and refuse samples respectively, as against the 26.8% in soil and 0% in household refuse recorded in our study. The overall relative abundance of 24.6% and 19.3%

recorded for A. lumbricoides and hookworm in our study is higher than the 13.3% and 7.2% recorded for A. lumbricoides and hookworm reported by [5] respectively. The high prevalence of these parasites (A. lumbricoides and Hookworm) recorded in our study may be attributed to fact that feacal samples also disposed alongside with household waste, open defecation. The eggs of these parasites are also known to survive for a long time in the environment [23, 26, 27].

The presence of E. histolytica and Sarcocytic sp recorded in the study is an indication that the poor sanitary habit and waste disposal system in the study area. Similar poor waste management strategy has been observed in other major cities in Nigeria [20] and poor waste management policies may be responsible for the abundance of these parasites, hence high prevalence of parasitic infections in Nigerian communities [28].

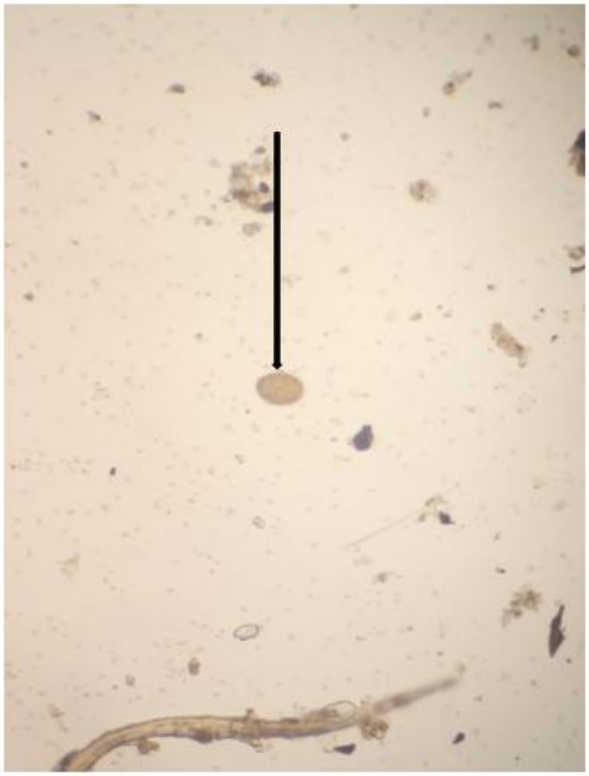
The implication of the high prevalence rate of these parasites on public health could not be over emphasized. Besides the fact that soil transmitted helminths deprives their host of necessary nutrients from digested food [29] and hookworm specifically causes iron deficiency (anemia) in the host by feeding on the blood cells [30, 31] recorded that helminthiasis is associated with the persistent high levels of HIV/AIDS and tuberculosis in Sub-Saharan Africa and the effectiveness in the treatment of helminthiasis also have a corresponding effect on viral load of HIV progression [32].

The study confirmed that only males are involved in scavenging in the study area. This observation is in conformity with the record of [33] who reported that scavengers in Abuja, Nigeria are mainly males. It is however at variance with the record of [34] whose findings indicated that both males and females are involved in scavenging in Pretoria, South Africa. It is also at variance with World Bank report by [35], that majority of the 2% of world population engaged in scavenging are females. Our observation could be attributed to the social stigma attached to female involvement in scavenging but the main reason that could be advanced for male involvement in scavenging is to end income.

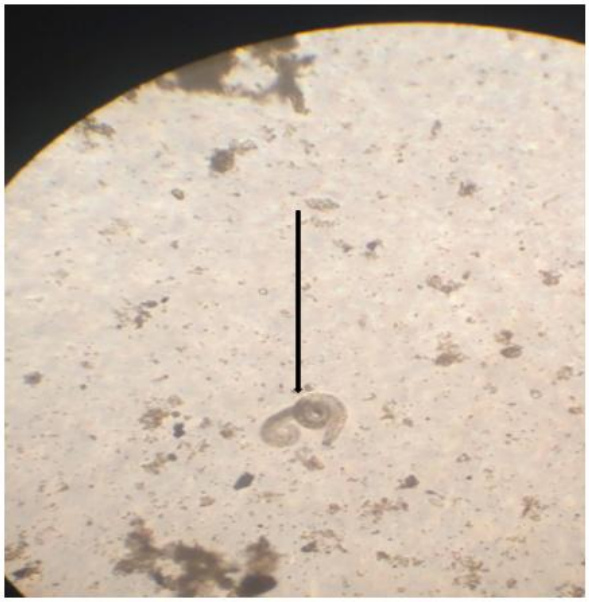
The result also indicated that levels of educational attainment by scavengers were primary and secondary school. This result agreed with the findings of [34] who established that the highest educational attainment of scavengers in Pretoria was high school. However, our result is contrary to the record of [36]. The researchers reported that majority (36%) of scavengers in Democratic Republic of Congo had no formal education. The differences in result could be attributed to the value placed on education and the type of educational system that is operational in the different study areas.

The neglect and non-use of appropriate safety wears by scavengers observed in our study is an issue of serious public health concern. Similar trend was reported by [37] in Thailand and [34] in South Africa. These authors recorded that majority of the scavengers neglect the use of safety boot in their operation. This observation could be as a result of ignorance and poor education on the importance of the use of protective gears. Again, majority of the scavengers are lower income earners and are affected by poverty. They use flipflop instead of safety boot, neglect of the use of hand glove and nose mask by the scavengers as indicated by our findings are health risk behavior that exposed them to infection. Several studies have confirmed the prevalence of communicable diseases including gastrointestinal parasites in dumpsites where these scavengers are found [5, 7, 38, 39]. Another study by [7] recorded serious health abnormal values in hematological and liver function parameters in scavengers. An indication that the health risk behavior of scavengers in their daily activities exposed them to serious health hazard and they are possible carriers of these parasites, hence a concern to public health.

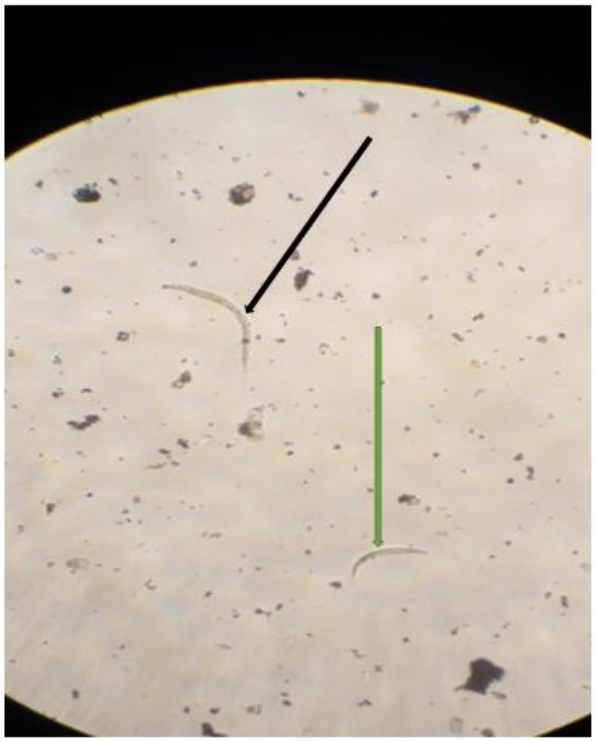
Regular deworming exercise of residence, particularly school-age children, wearing safety gears and physical protection with barrier of designated dumpsite will go a long way to prevent personal contact with these parasites. Government policy aimed at proper and modern waste management strategies and public health enlightenment will certainly reduce the abundance and transmission of these parasites.



Egg of A. Lumbricoides (Arrowed)



Hookworm (Arrowed)



S. stercoralis

CONCLUSION

The study revealed a significant abundance of gastrointestinal parasites in the dumpsites and high health risk behavior by scavengers in the study area. Deliberate formulation of scientific waste management policies by the Rivers State Waste Management Agency (RIWAMA), to high enhance performance, education of scavengers and execution of relevant legislation will go a long way to cub the impact of these parasites on public health. An integrated methods of waste management in which wastes from various sources should be separated and scientifically management accordingly will improve the break in transmission of dumpsites-related parasitic diseases.

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Conflict of Interest: The authors declared that they have no conflict of interest.

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