

Research Article

Occurrence of Geohelminthes in Four Major Markets in Makurdi Metropolis, Benue State, Nigeria

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Abstract

Soil serves as a reservoir for infective stages of helminthes that affect both man and animals. The study surveyed the occurrence of geohelminthes in four major markets in Makurdi, Benue State, Nigeria. Following standard procedures, 50 soil samples each were collected from various sites in the four major markets (Wadata, Wurukum, High-Level and Northbank) in Makurdi metropolis. The samples were processed for helminthes in the Zoology Laboratory of Benue State University, using the zinc sulphate floatation method. Following isolation and identification of helminthes from infected samples, the data were presented using descriptive statistics (Simple percentages). A total of 85/200 (42.50%) helminthes prevalence was documented in the study, and these were: *Taenia* sp 7/85 (8.24%), *Trichuris trichiura* 10/85 (11.76%), *Strongyloides stercoralis* 13/85 (15.30%), Hookworm 16/85 (18.82%) and *Ascaris lumbricoides* 39/85 (45.88%). Location-based prevalence of helminthes included: 5/85 (5.88%) in High-level, 16/85 (18.82%) in Northbank, 30/85 (35.29%) in Wurukum and 34/85 (40.00%) in Wadata markets respectively. The toilet 38/85 (44.71%) area was the most infected, followed by refuse dumps 36/85 (42.35%) and the playground 11/85 (12.94%). Periodical documentation of geohelminthes of public health importance is key to achieving proper control. Helminthes documented in the study calls for concern and studies involving advanced technologies to build on the current data are encouraged.

Keywords

Occurrence, Geohelminthes, Markets, Makurdi, Benue State

1. Introduction

Geohelminths, also referred to as Soil-transmitted helminths (STH) are indicated in diseases of veterinary and public health. The commonest are *Ascaris lumbricoides*, Hookworm (*Necator americanus* and *Ancylostoma duodenale*), *Trichuris trichiura* and *Strongyloides stercoralis* [1]. Infections caused by geohelminths are among the most common worldwide with an estimated 1.5 billion infected people or 24% of the world's population [2]. It is estimated that over one billion people are affected with *Ascaris lumbricoides*, 800 million

people with Hookworm, 770 million people with *Trichuris trichiura* and 600 million with *Strongyloides stercoralis*, particularly in the tropical and sub-tropical regions of the world where sanitary conditions are poor [2, 3]; and school age children are the most inflicted [4].

Soil transmitted helminthic infections are among the most widespread and neglected tropical diseases (NTDs), they make soil their intermediary location before infecting the individual [5]. Risk factors include poverty, poor environ-

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mental hygiene, inadequate facilities for water supply, poor sanitation, illiteracy, inadequate health services and over-population [6]. Factors that enhance helminthes survival and continuous transmission include: optimum temperature, moisture and high fecundity of these species [7]. Human-soil contact is a major predisposing factor in transmission of the STHs but secondary sources such as food, water, vegetables and fruits also serve as modes of transmission through the faecal-oral route [6, 8].

There has been emphasis on the role of proper sanitation and hygiene in control of geohelminths but the relationship between unhealthy practices and STHs infections is poorly understood, particularly in rural villages and slums [9, 10]. Also, the escalating level of poverty in Nigeria is suggested to contribute to the problem of poor environmental sanitation [11]. Hence, ending epidemics of NTDs through the control of the transmission of helminths and the mitigation of risk factors is one of the SDGs (sustainable development goals) [12].

In contrast to advanced countries, geohelminths infections still persist in developing countries, with Nigeria having the highest burden in sub-saharan Africa. Available literature of the infections mostly focuses on human and animal faecal samples [8]. A collaboration between The World Health Organization (WHO) and the London declaration with a commitment from pharmaceutical companies and other organizations is set to achieve a 75% mass drug administration (MDA) coverage in all endemic regions and control or eliminate 10 specific NTDs including STHs by 2030 [12]. Given this, the role of continuous prevalence surveillance is key [13]. In Benue State, there is paucity of data on soil contamination with geohelminthes which informs the current study.

2. Methodology

2.1. Study Area

The study was carried out in Makurdi, the Benue State Capital. The State is geographically located on latitude 7.74° North and longitude 8.51° East and has 104 m elevation above sea level. The mean monthly rainfall ranges from 150 mm to 180 mm, and the mean monthly temperature ranges from 27°C to 38°C (Wikipedia, 2019). Makurdi, is located along the bank of the Benue River, which serves as the predominant water source for anthropogenic activities of its inhabitants. It is characterized by a typical high tropical climate with two marked seasons: rainy season, which is prolonged and starts from April to October and the dry season that begins in late October and ends in March [14]. The favourable climate and rivers promote agricultural activities including fishing, rice farming, vegetable production by the river banks, sugarcane farming and the large-scale production of other food items (potato, cassava, soya bean, yam, groundnut, guinea corn and cowpea). The major ethnic

groups are Tiv, Idoma and Iggede. Samples were collected from some selected markets of Makurdi, Benue State. The majority of the farmers convey their farm products for sale in these markets, and the population depend on these markets for the supplies [15].

2.2. Sample Collection

Soil samples were collected within the four major markets in Makurdi, namely: Wadata, Wurukum, Northbank and High-Level Markets. Also, different sites such as foot paths, refuse dumps, toilet areas and the playgrounds within and around these markets were sampled. Following previously methods, a total of 200 soil samples were collected, 40 soil samples per market. Regardless of type, approximately 50g of soil was collected at a depth of 3-5cm from the surface, placed in a labelled ziploc polyethylene bag [16], transported to Zoology Laboratory of Benue State University for analysis.

2.3. Parasitological Analysis of Soil Samples

Standard procedures as used in a study in Ojo Area of Lagos State [8], were adopted for the study.

Ten (10) grams of each soil sample was collected from each sample using a wooden spatula, and this was replicated thrice. Stones and coarse particles were discarded using a sieve mesh (200 μm), 5ml of distilled water was added and then mixed thoroughly. The mixed sub-samples were allowed to settle overnight in a beaker before examination. The next day, the supernatant was decanted, leaving the sediments at the bottom of the beakers. To the sediments in the beakers, 100ml of 0.5% Tween-20 was added, mixed, and decanted after 10 minutes. A sterile spatula was used to stir and homogenize the mixture, which was further broken up by shaking and tapping. The sediments were transferred into 50ml centrifuge tubes. The beakers were rinsed with sterile water and the rinsed water was added to the centrifuge tubes to ensure complete transfer of the eggs. The sediments in the tubes were centrifuged at 1500 rpm for three minutes. Thereafter, the supernatant was gently poured away and about 150ml ZnSO_4 solution (specific gravity = 1.3) was added to the sediments to allow the eggs to float on the suspension. A sterile spatula was used to stir and homogenize the mixture, which was then subjected to centrifugation again at 1500 rpm for three minutes. The supernatant containing the eggs was decanted into 2 litre beakers, diluted with 1 litre of distilled water and left undisturbed for about three hours. The process of centrifugation was repeated by decanting the supernatant and transferring the sediments into 50ml centrifuge tubes, together with rinses of the 2 beakers. The sediments for each sample were transferred into a centrifuge tube and centrifuged at 1500 rpm for three minutes. A 15 mL acid/alcohol buffer solution (5.16 mL of 0.1N H_2SO_4 in 350 mL ethanol) and about 5 mL ethyl acetate were added to the sediment and shaken, occasionally letting out the gas. The mixture was then centrifuged at 2200 rpm for three minutes. Finally, the diphasic

supernatant was sucked off, as much as possible, leaving about 1ml of sediment for microscopic analysis.

Parasite ova were identified via their morphological fea-

tures such as size, shape, and nature of egg and aligned with standard identification keys.

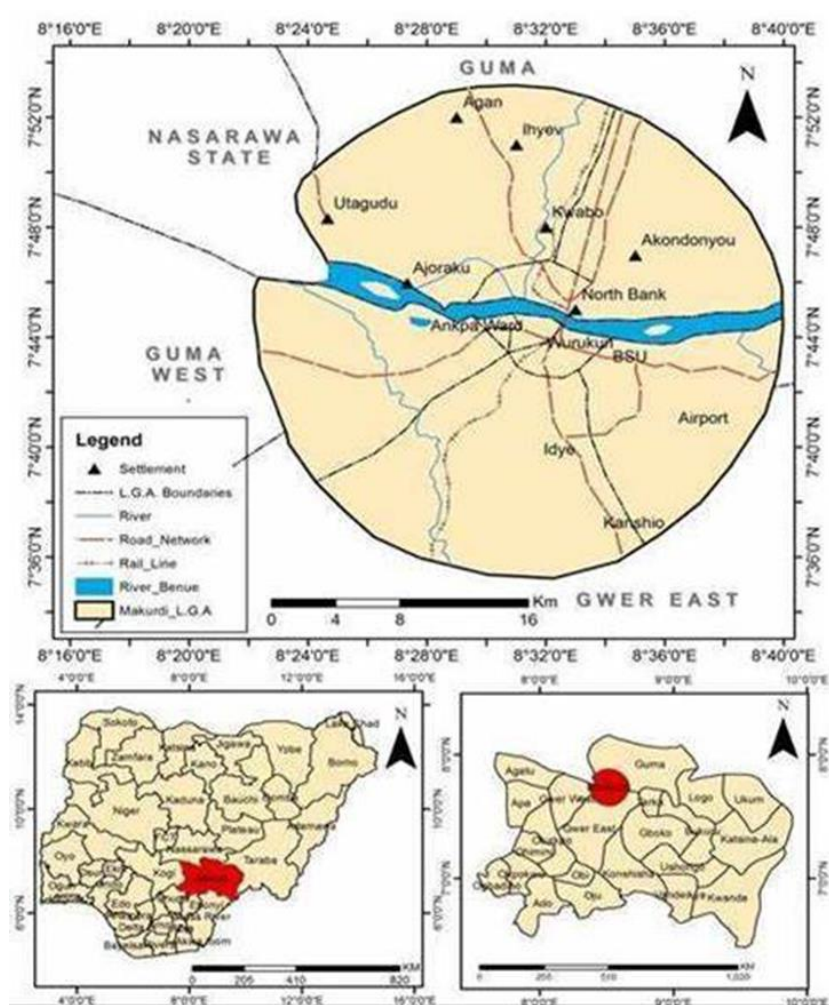


Figure 1. Map of Makurdi showing the sampled sites (Major markets).

2.4. Statistical Analysis

The data in this study analysed and presented in simple percentages.

3. Results

3.1. Percentage Occurrence of Geohelminthes Documented in the Study

A total of 85 different helminthes were recovered from the 200 soil samples analysed. In descending order of prevalence they are: *Ascaris lumbricoides* 39/85 (45.88%), Hook worm 16/85 (18.82%), *Strongyloides stercoralis* 13/85 (15.30%), *Trichuris trichuria* 10/85 (11.76%) and *Taenia* sp 7/85 (8.24%) (Table 1).

3.2. Distribution of Pathgenic Geohelminthes Across the Sampled Markets

Geohelminthes prevalence in the various markets sampled was: Wurukum 30/85 (35.29%), Wadata 34/85 (40.00%), Northbank 16/85 (18.82%) and Highlevel 5/85 (5.88%). also, *Ascaris lumbricoides* had the highest prevalence in all locations, Table 2.

3.3. Geohelminthes Prevalence Within the Sites Sampled

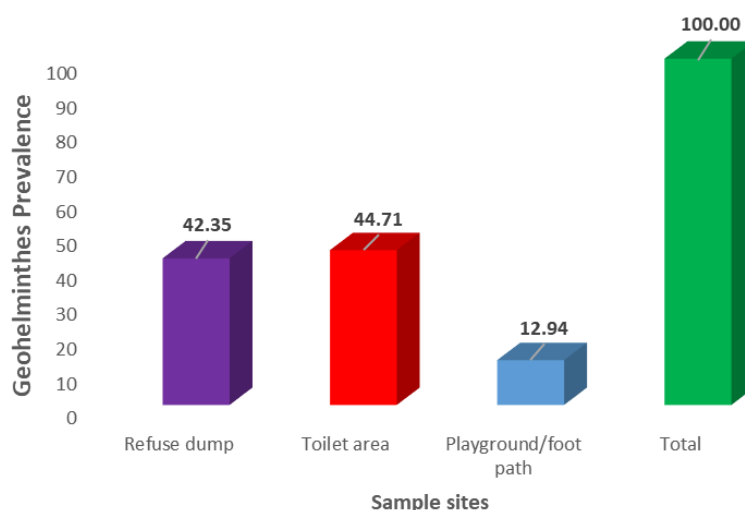
Figure 2 illustrates the distribution of geohelminthes in across the sampled sites. The toilet areas 38/85 (44.70%) was most infected, followed by refuse dumps 36/85 (42.35%) then Playground 11/85 (12.94%).

Table 1. Percentage Occurrence of Geohelminthes documented in the study.

Geohelminthes	Occurrence (%)
Strongyloides stercoralis	13 (15.30)
Trichuris Itrichuria	10 (11.76)
Hookworm	16 (18.82)
Taenia sp	07 (8.24)
Ascaris lumbricoides	39 (45.88)
Total	85 (100.00)

Table 2. Distribution of pathgenic geohelminthes across the sampled Markets.

Geohelminthes	Prevalence (%)				
	Wurukum	Wadata	Northbank	Highlevel	Total
Strongyloides species	4 (13.33)	5 (14.71)	3 (18.75)	1 (20.00)	13 (15.30)
Trichuris sp	2 (6.67)	7 (20.59)	1 (6.25)	0 (0.00)	10 (11.76)
Hookworm	9 (30.00)	2 (5.88)	3 (18.75)	2 (40.00)	16 (18.82)
Taenia sp	3 (10.00)	1 (2.94)	3 (18.75)	0 (0.00)	07 (8.24)
Ascaris sp	12 (40.00)	19 (55.89)	6 (37.50)	2 (40.00)	39 (45.88)
Total	30 (35.29)	34 (40.00)	16 (18.82)	5 (5.88)	85 (100.00)

**Figure 2.** Geohelminthes Prevalence within the Sites Sampled.

4. Discussion

A prevalence of 85/200 (42.50%) was recorded in the study. This is lower than data from Oyo [17], Ibadan [18], Calabar [5,

16], Ojo in Lagos State [8], Ifedore district in Southwest Nigeria [19]. However, prevalence lower than the current study has been reported from other locations such as 30.03% in Ethiopia [20] and 30.30% in Perak [21]. Also, a survey of soil-transmitted helminthes abundance in Slovakia had a prevalence of 26.26% [22]. The disparity in prevalences as

compared to the current study may be accrued to differences in sample size, geographical location, sampling techniques, laboratory techniques employed in parasite isolation, and number of sites sampled.

Five different helminthes (*Strongyloides* sp, *Trichuris* sp, Hookworms, *Taenia* sp, and *Ascaris* sp) were encountered in the study. This strongly corroborates outcomes presented by other locations within Nigeria [6, 8, 16, 19]. Although, contrasting findings have been put forward: *Toxocara* sp was published in Ethiopia [20], Perak [21], Slovakia [22] and Poland [23]. These findings were all presented from regions outside Nigeria and variables such as soil type and climate may have accounted for the disparity. Other opinions suggest that physicochemical properties of the soil such as temperature, conductivity, pH and rainfall, affect the abundance of STH [19]. Opinions from [18] included awareness and perception among citizens and differences in hygiene and sanitation policies across regions. These could support the survival, development, dispersal, and abundance of helminth ova and infective stages. However, purposeful sampling of soil from areas where animals were bred was conducted in Slovakia and this may account for the presence of *Toxocara* sp. Although not investigated in the current study, poor hygienic conditions, access to drinking water, usage of sewerage, sumps usage, and climate strongly correlated with STH occurrence in Slovakia [22].

Ascaris lumbricoides had the highest prevalence amongst the helminthes presented by the study. This is similar to findings in other studies [6, 8, 16, 22]. This occurrence is enhanced by the resistant nature of the parasite's ova which can embryonate in adverse environmental conditions and withstand chemicals that are lethal to other *parasites*' ova [16, 19].

Amongst the locations, highlevel market was significantly least infected. Favourable climate, warm temperature and adequate moisture are essential for helminthes larval development. Although sampling was carried out during the dry season, the proximity of the other locations (Wurukum, Wadata and Northbank markets) to the Benue river encourages the dampness of their surroundings as opposed Highlevel market that is landlocked.

In the study, samples from the toilet areas were most infected and is same with finding by [8]. This result depicts poor sanitary conditions of the toilet areas and possible practices of open air defecation. Most often that not, there are no proper arrangements for fecal waste disposal in Nigerian markets as this responsibility is left at the hands of leadership of market unions. This places the inhabitants of these locations at greater risk of soil contamination that may ensue from surface run-offs during the rainy seasons.

5. Conclusion

The presence of medically important geohelminthes recorded within accessible areas in the study poses great health

risks for the inhabitants. Continuous research involving more sensitive, specific and advanced methods and technologies are encouraged to proliferate data and enhance control efforts in the study area.

Abbreviations

MDA	Mass Drug Administration
NTD	Neglected Tropical Diseases
STH	Soil Transmitted Helminthes
SDGs	Sustainable Development Goals
WHO	World Health Organization
RPM	Revolutions per Minute

Author Contributions

Okita Faith Odije: Conceptualization, Formal Analysis, Funding acquisition, Project administration, Supervision, Writing – original draft

Hosea Zakki Yula: Data curation, Methodology, Project administration, Resources, Supervision, Writing – review & editing

Ekpa Promise Joel: Data curation, Investigation, Methodology, Supervision

Conflicts of Interest

The authors declare no conflicts of interest.

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