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Assessment of Sanitary Condition around CRUTECH Female Hostels, Using *Ascaris lumbricoides* as an Indicator

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Authors' contributions

This work was carried out in collaboration among all authors. All authors read and approved the final manuscript.

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ABSTRACT

Background: Proper sanitation and hygiene are crucial drivers of human development.
Objective: To determine the sanitation status of Cross River University of Technology female hostels, using *Ascaris lumbricoides* as an indicator.
Methodology: This is a cross-sectional observational study that examined water and soil samples around CRUTECH female hostels located at Calabar South Local Government Area of Cross River State, in the Southern part of Nigeria; between March 2024 and May 2024. Approximately 100g of soil was collected randomly at a depth of 2-3cm. **A total of 66 soil and water samples were**

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collected from the sites. Samples were taken from each of the three female hostels. Samples were parasitologically and microscopically examined. Chi-square analysis was used to compare types.

Results: Results revealed an overall positive case of 63.64% for all samples. Water sample was 19.69% positive while soil sample was 43.94% positive for the parasite. Hall I showed the highest intensity of 6.09±6.64. Chi-square analysis showed no significant difference between the location of samples at P<0.05.

Chi-square analysis showed no significant difference between the location of samples at P<0.05.

Conclusion: Sanitary status of Cross River University of Technology is below average. Therefore, there should be continuous educational enlightenment programmes that will promote personal hygiene.

Keywords: Ascaris lumbricoides; hostels; halls; cross river; status; indicator.

1. INTRODUCTION

Proper sanitation and hygiene are crucial drivers of human development, as they significantly impact health and economic status at various levels. Recognizing the importance of hygiene, public health professionals stress that the desired health benefits of improved sanitation infrastructure cannot be achieved without consistent hygiene practices in homes, communities, and institutions. Sanitation encompasses conditions and processes related to public health, particularly water supply systems and waste management processes for human waste [1].

Cambridge Advance learner's Dictionary [2] defines sanitation as a system for removing dirty water and waste products from buildings to protect people's health. In other words, sanitation is the process of ensuring a clean and healthy environment for people by preventing the transmission of disease-causing agents. This is important not only for promoting health and preventing disease, but also for sustainable development. Good hygiene practices and sanitation are essential for health, survival, growth, and development. It is often said that students are lazy and egoistic, and many of them do not take care of their living areas. This leads to dirty hostels, even when cleaners are hired to clean them. For example, students urinating and defecating inappropriately outside the hostel can create a health hazard. Waste generation is a major contributor to the dirtiness of the hostel, due to the large number of students, and improper waste management can cause harm to the environment and the health of the students living there [3].

According to [4] the significance and success of personal and environmental sanitation are emphasized in the following ways: i. By reducing the frequency of illnesses and fatalities associated with poor hygiene practices. ii. By addressing issues such as inadequate sanitation facilities, inadequate understanding of the importance of toilets and sanitation, current poverty levels, and insufficient investment from all levels of government and local communities. iii. By promoting a greater understanding of environmental sanitation and sustainability among both the government and the public, recognizing it as an ongoing process rather than a destination. iv. By reversing the current situation where people are forced to choose between buying water or consuming contaminated water, by increasing the availability of toilets to separate drinking water from wastewater. v. By ensuring a consistent and reliable supply of safe water to all homes, offices, and student hostels, without causing undue stress, in order to promote the well-being of students and staff.

1.1 Indicator Organisms

In analyzing environmental samples, specific types of indicator organisms are used to determine the presence of fecal contamination. For instance, when conducting bacteriological water analysis, Escherichia coli (E. coli) bacteria and non-specific fecal coliforms are commonly utilized indicators. However, for soil, sewage sludge, biosolids, or fecal matter from dry toilets, helminth eggs are a popular choice. In this case, helminth eggs are extracted from the sample and then subjected to a viability test to distinguish between living and non-living eggs. Finally, the viable fraction of helminth eggs in the sample is counted to provide the necessary information.

1.2 Statement of Problem

Given the importance of cleanliness and sanitation for one's health, it is concerning that many university school hostels in Nigeria are dirty. This research aims to assess the extent of contamination in the Cross River University of Technology female hostel environment by examining the sanitary status using *Ascaris lumbricoides* as an indicator. Additionally, this study will explore ways to encourage better hostel sanitation practices among students.

The impact of parasitic infections on individuals' socio-economic well-being highlights the need for a data-driven approach to controlling these infections. To effectively combat parasitic infections in the Cross River University of Technology hostel community, it is necessary to have baseline data on their occurrence. This research focuses on the sanitary status of the Cross River University of Technology female hostel environment using *Ascaris lumbricoides* as an indicator.

The findings of this research will raise awareness among both the general public and students living in tertiary institution hostels about the connection between hostel sanitation practices and health. Furthermore, this research will contribute to the existing body of literature on hostel sanitation practices and their impact on student health, providing a foundation for future research in this area.

This research on the sanitary condition of the Cross River University of Technology female hostel, using *Ascaris lumbricoides* as an indicator, aims to:

1. Determine the prevalence of *Ascaris lumbricoides* in the Cross River University of Technology female hostels.
2. Assess the load of *Ascaris lumbricoides* in the Cross River University of Technology female hostels.
3. Recommend appropriate control measures for the area.

Poor personal hygiene and environmental sanitation are common in most developing nations, making soil-transmitted Helminth (STH) diseases endemic in those communities [5]. Human behavior, hygienic conditions, and environmental pollutants all have a significant impact on how STH infections spread. suggested that a variety of environmental factors, including soil and vegetables from the market, as well as host-related factors contributed to the ongoing active transmission of ascaridis in the region [6]. Morphologically, roundworms, or *Ascaris lumbricoides*, resemble earthworms. With a direct life cycle, it is one of the major parasites that affect both humans and animals [7]. Larvae develop from the L1 to L2 stage in the soil under normal temperature and moisture conditions. The mesenteric lymphatics or venules transport the liberated L2 larvae to the liver when they hatch in the small intestine after being eaten with food or water. Here, the initial molt occurs, and the L3 that are created are subsequently carried by the bloodstream to the right heart and, ultimately, to the lungs by the pulmonary artery. Here, they go through their last molt, and the L4 larva develops in preparation for its eventual eruption into the alveoli from the pulmonary capillaries. They ascend the bronchioles from this point on and enter the glottis, where they are coughed up and reabsorbed. Larvae sexually mature into adult worms in the small intestine. Worms, both male and female, live in the small intestine, particularly the jejunum. When it comes to size, the mature female *Ascaris lumbricoides* (20–40 cm) is at least twice as large and twice as long as the mature male (15–20cm) [8].

Ascaris worms that have just been discharged have an earthworm-like look and are pink in color. Their length ranges from 12 to 35 cm, with a taper at each end. Spicules, or tiny rod-like projections, are seen on the male's curving tail. It has three lips encircling a small mouth. [9] reported that the females deposit unembryonated eggs into the small intestine, which are subsequently expelled together with the feces. Feces often contain fertilized eggs, however unfertilized female worms can also infrequently release sterile eggs. Fertilized eggs are round or oval, 50–70 µm (micrometers) long, and 30–50 µm wide. They are yellow-brown in color. The center granular mass of the shell, which is the unsegmented fertilized ovum, is frequently covered with an irregular albuminous layer (mammilated). It could be a pale yellow or colorless egg with a smooth outer shell. The sterile eggs of A. lumbricoides are darker in colour and have thinner walls and a shell containing more granules. They are also longer than the fertilised eggs, measuring approximately 90–45 µm and containing a central mass of large granules [10].

The prevalence of A. lumbricoides egg contamination is increased by open defecation,

poor sanitation and inadequate water and sanitation facilities [11]. *Ascaris lumbricoides* is distributed worldwide, but the highest prevalence is in tropical regions of Africa.

It is estimated that over two billion people are infected worldwide at any given time. Global distribution is determined by climatic conditions, particularly temperature and humidity.
Optimal conditions for larval development in the eggshell are 22–30°C and a minimum temperature of 40%. At the regional level, prevalence and intensity of infection depend on the level of access to drinking water and sanitation. Ascariasis is generally low but increases as access to these facilities decreases. In such communities. According to Hassan et al. [12] prevalence rates as high as 80% or more are not uncommon in these communities: In terms of age distribution, prevalence is highest between 4 and 14 years of age. It has also been reported that the intensity of infection measured by the number of worms expelled after chemotherapy or by egg excretion per gram of host feces is significantly higher in children than in adults.

In Nigeria, studies assessing soil-transmitted helminth infections in different localities include those of Akinseye et al. [13-27]. They all studied the incidence and prevalence of intestinal parasites in different communities across the country.

However, the overall distribution of worms in any human population is too fragmented, as the majority of individuals in the community carry few or no worms while a few carry the most worms [28]. As a result, young children exposed to high parasite loads are targeted for treatment due to budget constraints; Disease control programs cannot afford mass treatment for all ages. Many factors influence the transmission of helminth infections. Poor personal hygiene and poor bowel habits are the most important factors. Poor menstrual habits, especially the use of unhygienic objects containing human faeces and larvae in soil. The use of unchangeable sanitary napkins. Failure to dispose of wet wipes can lead to autoinfection in children. Other risk factors include the use of unclean and soil-contaminated feeding bottles, plates, cups and other utensils. According to Crompton et al. [29], it is not uncommon to find households where most of the usable items are contaminated with helminth eggs, especially those of *Ascaris lumbricoides* [30]. Cleaning ears and eyes with contaminated fingers and tissues also leads to helminth transmission. Open defecation in rural areas around homes and children's playgrounds increases the likelihood of transmission by increasing the rate of environmental contamination. Eating contaminated fast foods such as smoked fish and meat (suyas), bean cakes, etc. are good sources of infection [31]. Certain types of human behavior have been shown to promote helminth transmission.

Toilet habits are of particular importance: defecating in bushes and other surrounding areas, improper hygiene after using the toilet, not wearing shoes regularly, and eating unwashed vegetables and fruits.

2. MATERIALS AND METHODS

2.1 Study Area

The samples were collected from the different female hostels in the Cross River University of Technology (CRUTECH) Calabar Campus. The Cross River University of Technology (CRUTECH) Calabar Campus is located at Calabar South Local Government Area of Cross River State. Calabar is the capital of Cross River State and it is located in the South-South part of Nigeria.

The Cross River University of Technology (CRUTECH) is easily accessed through roads along Ekpo Abasi. The Cross River University of Technology (CRUTECH) Calabar Campus has three (3) female hostels and each hostel is numbered Hall 1, Hall 2 and Hall 3.

Each female hostel in the institution is made of sixty (60) rooms and each room has only four (4) female occupants. Each wing of the hostel has six (6) rooms and on each wing, there are three (3) bathrooms and three (3) toilets. Two rooms share a bathroom and a toilet. This made it a good location to carry out this study.

2.2 Collection of Samples

A total of 66 soil and water samples were collected from all the sites. Samples were taken from each of the three female hostels. These included 39 soil samples and 27 water samples. Soil sampling was carried out in the morning between 6.00am

and 11.00am. Approximately 100g of soil was collected randomly at a depth of 2-3cm. Each sample was placed inside a properly labeled polythene bag. Samples were transported to laboratory of the Department of animal and environmental biology, Cross River University of Technology, Calabar, Nigeria for examination and analysis.

2.3 Examination of Sample

Water samples were centrifuged and the sediment was examined. Soil samples were studied in the laboratory by centrifugal flotation using saturated MgSO4 solution. Soil samples were dried, filtered and weighed to obtain 2g. Soil samples were first mixed with distilled water, and sieved into tubes to remove large particulates before they were concentrated by centrifugation and decanted. Thereafter, tubes containing the concentrates were refilled with sucrose solution and cover slips placed on the surface of the tubes. Floated eggs/ larvae sticks to the surface of the cover slips and these slips are then placed on slides and examined under the microscope [32]. Using appropriate keys, recovered parasites were identified and also quantified (number of parasites per 2 g of soil) [33].

2.4 Isolation and Concentration of STH Eggs/ Larvae

Ascaris eggs and larvae were extracted using the modified Cobb's Decanting and Sieving Method and modified Baermann method. Eggs were identified with the aid of standard guidelines. The larvae/ova of parasites were identified with reference to Atlas of Medical helminthology and protozoology and Parasites of man and animal. The number found were counted and recorded.

2.5 Statistical Analysis

Variations in the prevalence of *Ascaris* spp were determined using the χ^2 tests from the contingency tables. The percentage prevalence (%) was calculated in each case. Comparative analysis of the results was done using Chi-square (X^2). A p-value less than 0.05 ($p<0.05$) was considered as statistically significant.

3. RESULTS AND DISCUSSION

A total of 66 samples were collected from the three female hostel. There included 39 soil samples and 27 water samples. Out of the 66 samples collected, 42 (63.64%) were positive for *Ascaris lumbricoides*. The water sample collected showed 13(19.697%) *positive* for *Ascaris lumbricoides* while soil sample was 29(43.94%).

Table 1 shows the results of examination of collected soil sample for *Ascaris lumbricoides* egg in relation to location. Hall III had the highest positive occurrence of 25.76%, followed by Hall II with 21.21% while Hall I had the lowest with 16.67%. The different in parasite occurrence in relation to location was statistically not significant.

The results showing the present of *Ascaris lumbricoides* eggs in relation to sample type is presented in Table 2. Soil sample had 43.94 positive of *Ascaris lumbricoides* egg than the water sample with 19.697% positive. The result was statistically significant at ($p<0.05$).

The intensity of *Ascaris lumbricoides* in relation to different soil location is presented in Table 3. Hall I had the highest mean parasite intensity 6.09±6.6, followed by Hall II with 4.49±5.58 while Hall III had the least with 3.47±4.87.

Table 1. Results of examination of collected soil and water sample for *Ascaris lumbricoides* eggs

Location	No. of sample	No. of positive	X^2
Hall I	21	11(16.67)	0.3939
Hall II	20	14(21.2)	
Hall III	25	17(25.76)	
Total	66	42(63.64)	

Table 2. Results for all the sample examination for *Ascaris lumbricoides*

Location	No. of sample	No. of positive	X^2
Soil	39	29(43.94)	1.0911
Water	27	13(19.697)	
Total	66	42	

Table 3. Intensity of *Ascaris lumbricoides* in relation to different soil location

Sample	Mean egg per gram soil
Hall I	6.09 ± 6.64
Hall II	4.49± 5.58
Hall III	3.47 ± 4.87

3.1 Discussion

The contamination of the soil water samples with *Ascaris lumbricoides* eggs was evidence of the true state of the Cross River University of Technology environment. This is in line with the study conducted by [34] on neglected tropical disease, who stated that soil transmitted helminth egg including *Ascaris* egg are agents of contamination in developing countries. The present of *Ascaris lumbricoides* egg around the hostel environment could be attributed to lack of proper public toilet in the school as of proper public toilet in the school as also reported by [12]. This could account for the high parasite intensity that was observed in Hall I which could be attributed open defecation and run-off in the area. This contamination of soil with infected feaces thus pose serious risk to other uninfected person also serve as a source of re-infection particularly in the event of rainfall run-off. Presence of *Ascaris spp* indicates that food and water are contaminated with infective eggs of these parasites by any of a number of routes, or that hand-to-mouth transmission may occur. Food and drinking-water handling equipment may be contaminated if there are no safe and secured human waste disposal methods or hand washing facilities in government owned schools where students defecate around school compounds and are unable to wash their hands because there is no soap and only infrequent water [35]

More than half of the samples collected were positive of *Ascaris* egg as could be an indication of the level of soil and water contaminations.

Many studies were reported on environmental pollution with *Ascaris lumbricoides*. These included [35], Da [36], [6] and [36,37].

From the study, it could be stated that the sanitary status of Cross River University of Technology community is at risk. This is as a result of the level of contamination found in soil and water tested.

The soil parasites recovered from designated points in the study location may not be completed reflection of the reported parasites as soil texture and water constituents could affect egg recovery efficiency.

4. CONCLUSION

The health impact of roundworm *(Ascaris eggs)* contamination in the three female hostels in Cross River University of Technology suggest that every student in all the school was susceptible to acquiring the parasite.

The level of spread of *Ascaris spp* in the study act as a threat to the Cross River University of Technology community. The result obtained in the study will help in planning targeted control and intervention programme. Hence, activities, activities to monitor prevailing condition for the development of survival of *Ascaris spp.* in the soil is significant.

There should be laudable improvement in the sanitary and water facilities in public schools. There should also be continuous educational enlightenment programmes that will promote personal hygiene.

Toilet facilities should be provided so as to reduce or eliminate indiscriminate defecation around hostels in Nigerian Universities.

DISCLAIMER (ARTIFICIAL INTELLIGENCE)

Author(s) hereby declare that NO generative AI technologies such as Large Language Models (ChatGPT, COPILOT, etc) and text-to-image generators have been used during writing or editing of this manuscript.

CONSENT

It is Not applicable.

ETHICAL APPROVAL

It is Not applicable.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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