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# Assessement of Geohelminth Contamination of Playground and Sanitation Compliance among Primary Schools in Akwa Ibom State's Rural Area

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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

The study was carried out to assess the level of geohelminth contamination in playgrounds of six Government Primary School (GPS) randomly selected within the three districts of Akwa Ibom State and also their state of compliance on sanitation in order to ensure a child-friendly learning environment. Soil samples were collected and analyzed using the zinc sulphate floatation method and the Baermann technique while sanitation facility compliance was assessed using structured checklist which was subjected to Water Access, Sanitation and Hygiene (WASH) grading criteria for

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sanitation. Out of 300 soil samples analyzed, a 22% contamination rate was recorded, with *Ascaris lumbricoides* being the most encountered. *Toxocara canis* and *Taenia sp.* were also encountered in the study which are associated with visceral larval migran and cysticercosis, respectively. Sanitation compliance rate recorded was 68.8% which revealed that the existing facilities in the public primary schools in the area need improvement. A high level of improper fecal disposal and also the potential risk of geohelminthiasis and zoonotic diseases among pupils in the schools were revealed in the study as such, health education and awareness is advocated alongside strategies for the provision and sustainable use of sanitation facilities in schools.

*Keywords: Sanitation facilities; geohelminth; school; WASH.*

## 1. INTRODUCTION

Faecal contamination of soil is an important risk factor for both humans and animals intestinal parasitic infections. These parasites have been recognized as an important public health problem, gastrointestinal parasites. The majority of these helminths have been reported with high prevalence rates across Nigeria [1] and there seems to be no reduction in the rates been reported despite control efforts. Inadequate and poor sanitary facilities and practices have been reported to be responsible for the distribution of helminthic parasites especially in the tropics and subtropics [2]. Also free range farming by herbs men and substantial animal farmers in the rural communities has significantly contributed to the transmission of most helminthiasis as they tend to litter most public areas (such as recreational parks, playgrounds and markets) with eggs and larvae of the parasites, which serves as potential reservoirs thus, suggested as a key factor in it steady presence in the human populations especially among children despite the ongoing mass chemotherapy exercise in Nigeria and most developing countries [3].

In comparison to other infections, geohelminth infection does not have a high mortality and morbidity rate. However, it still has serious consequences, especially for young children, including malnutrition (due to insufficient nutrient absorption), diarrhea, anemia, growth retardation, negative effects on mental health, and occasionally death [4]. Good sanitation procedures in schools, according to Amadi et al [5], enhance learning, boost school attendance, particularly among females, and also work to promote household sanitation/hygiene practices, particularly in developing countries [6,7]. Several research reports have shown that anywhere there is poverty or inadequate sanitary facilities, four geohelminthes of notable public health importance are present in the population which are: *Ascaris lumbricoides, Trichuris trichiura, Ancylostoma sp.,* and *Taenia sp*. [8].

Globally, over one billion people are estimated to be infected annually with one or more of these. During the COVID-19 pandemic, provisions were made to address both sanitation and hygiene issues, but unfortunately, most of the school still lacks provisions, which may be related to corruption, beurocracy, a lack of sustainability, etc.

This study was undertaken to assess the status of geohelminth contamination of playground and sanitation compliance in primary schools as the presence of geohelminth egg serves as an indicator of faecal contamination and also represent a major risk to children's health as they have been reported to negatively impact the physical fitness and cognitive performance of the pupils [9].

**The objectives are:** To assess the level of geohelminth contamination of some primary school playgrounds in the rural area of Akwa Ibom.

To determine the status of sanitation compliance with regards to facilities and usage of some primary schools in the rural area of Akwa Ibom.

## 2. MATERIALS AND METHODS

### 2.1 Study Area

The study was carried out in Akwa Ibom state, Nigeria which lies between latitude $4^0$ 32' and $5^0$ 53' North and longitude $7^0$ 25' and $8^0$ 25' East with total land area of 7.249km$^2$. It is bounded to the north by Abia state, to the east by Cross River State, to the west by Rivers State and south by the Atlantic Ocean. The state contains 31 Local Government Areas inside its borders as

shown in Fig 1, with Uyo serving as its administrative center. The local governments are found in three zones otherwise known as the geopolitical zones namely: North East Zone (Uyo district) comprising of nine (9) local government areas ( Etinan, Ibesikpo Asutan, Ibiono Ibom, Itu, Nsit Ibom, Nsit Atai, Nsit Ubium, Uruan, and Uyo), North West Zone (Ikot Ekpene district) comprising of ten (10) local government areas (Abak, Essien Udium, Etim Ekpo, Ikono, Ikot Ekpene, Ini, Obot Akara, Oruk Anam, Ukanafun), South Zone (Eket district) comprising of twelve (12) local government areas ( Eastern Obolo, Eket, Esit Eket, Ibeno, Ikot Abasi, Mbo, Mkpat Enin, Okobo, Onna, Oron, Udung Uko, Urue Offong Oruko). It features a 129 km long shoreline from Oron to Ikot Abasi covered in a vegetative region of trees and plants. The region has two seasons: the dry season, which lasts from November to March, and the wet season, which lasts from April to October and ranges in temperature from 23 to 31 degrees Celsius and it has a population estimate of 7,000,000 based on a 3.4% annual growth rate. Ibibio, Annang, Oro, Pidgin, and English are the languages spoken, and the inhabitants are employed in farming, fishing, trapping, hunting, woodcarving, raffia work, blacksmithing, pottery making, iron working, and art and craft creation. They are hardworking, creative, kind, and educated [10]. The study randomly selected rural areas within each of the districts for sampling.

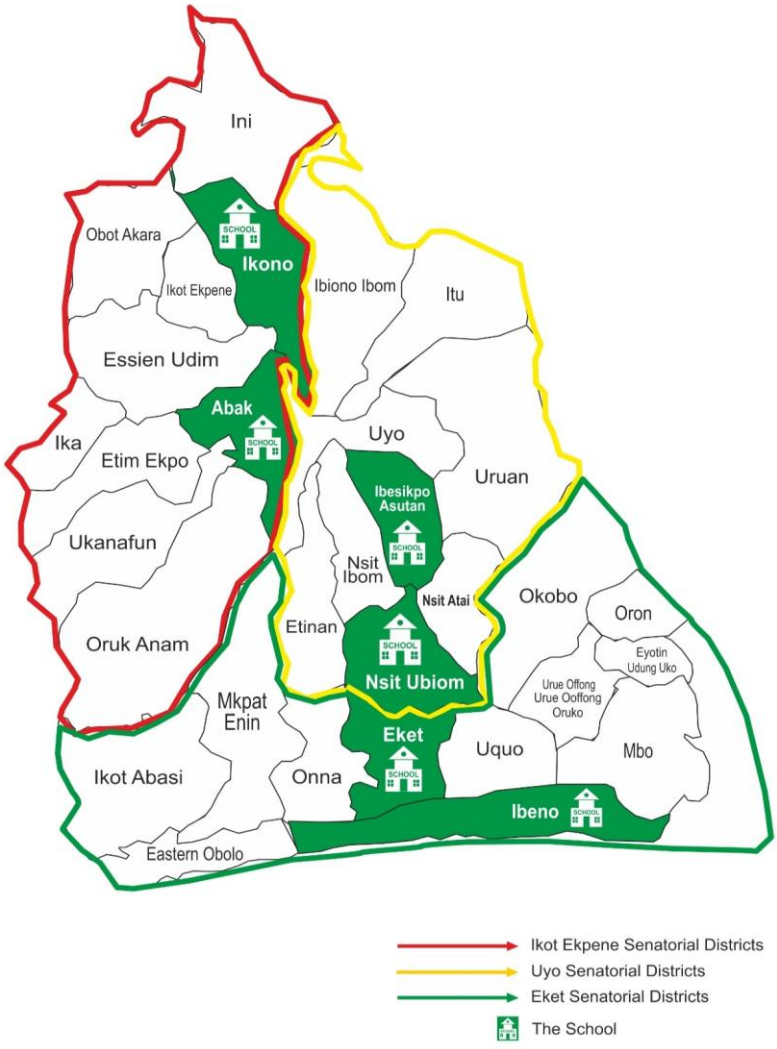


**Fig. 1. Map of Akwa Ibom state showing the local government areas randomly selected for the study**

## 2.2 Study Design

Systematic random sampling was used to choose public primary schools within the three districts in Akwa Ibom State for the study.

## 2.3 Ethical Clearance

Ethical Clearance was obtained from the Ministry of Health, Akwa Ibom State and also the school ethical committee.

## 2.4 Study Population

The study population was made up of all public primary schools within the three districts of Akwa Ibom state, Nigeria.

## 2.5 Sample Collection

Soil samples were collected within the school playground. Each sample was made up of 20g of soil collected at the depth of 3-7cm in an area of $10cm^2$ without vegetation and transported in sealed plastic bags to the laboratory [11].

School WASH compliant data was determined using a structured checklist and questionnaires in accordance with WHO questionnaire standard for WASH assessment in schools /households [12].

## 2.6 Laboratory Analysis

### 2.6.1 Soil sample analysis

Soil samples were analysed using modified zinc sulphate floatation method according to Badaki et al. [11] and Baermann funnel method [13]. Five grams of each soil sample was placed in a centrifuge tube, suspended in tap water and centrifuged at 1500rpm for 5 minutes. The supernatant was discarded and the sediment was resuspended in zinc sulphate solution and centrifuged again at 1500rpm for 5minutes and then transferred to a test tube stand, where the solution was added to form a meniscus and a coverslip placed on it for 10 to 20 minutes. The coverslip was removed and placed on a slide and examined microscopically at 10x and 40x objectives respectively.

In the Baermann funnel method, Ten grams of each soil samples was weighed and placed on a sieve. Clean funnels with rubber tubes and squeezer clips was set up on a retort stand, labeled and then filled with water to the rim while avoiding air bubbles. The soil sample in the sieve was then placed on the funnel such that it touched the water surface, allow the soil to remain wet throughout the experiment. It was then allowed to stand for 24-72 hours after which the suspension was tapped by opening the squeezer clip and emptied into a labeled beaker. It was then allowed to settle and then decant. All eggs and larvae encountered were identified using Soulsby [14] and Otubanjo [15] and counted.

## 2.7 Statistical Analysis

All data obtained were subjected to analysis using Microsoft Excel and SPSS Version 21 data packages. WASH variables were subjected to WASH grading criteria for Data Analysis (modified) according to Graffan et al. [16] and WHO/UNICEF [17]. Data was analysed and presented using descriptive statistics (mean and Percentages) and Chi-square test was used to compare differences based on the level of statistical significance of $P \geq 0.05$ with 95% confidence interval according to the methods of Ubom [18] and Mbong et al. [19].

# 3. RESULTS AND DISCUSSION

Out of the 300 soil samples examined from the six schools, the result as shown in Table 3 shows that 22% were contaminated with goehelminth eggs or larvae. Contamination with single parasite was recorded in 53 (77.95%) soil samples, while contamination with double parasites was recorded in 15 (22.05%) of the samples (Table 4) with the combination of *Ancylostoma sp* and *Ascaris lumbricoides* being the most encountered (10.29%) as shown in Fig 2. The highest (44%) geohelminth contaminated soil samples were recorded in Government School Ntafre, Ibeno while the least prevalence (12%) was obtained from Government Primary School Ikot Efre, Ikono. With regard to the species of parasites, *Ascaris lumbricoides* had the highest occurrences of contamination in the soil with 11.6% and the least was *Taenia sp*. with 0.3% occurrence. There was no significant statistical difference in the occurrence of geohelminth contaminant in the soil samples. Mean intensity of parasites in the soil samples (which has to do with the arithmetic mean of the number of individual parasite species per infected host in a sample) showed that *Taenia sp*. recorded the highest of 5.0, followed by *Ascaris lumbricoides* with (4.48), *Ancylostoma*

*duodenela* (3.91), *Trichuris trichuira* (3.77), *Strongylodies stercoralis* (3.00) and *Toxocara canis* (2.00) as shown in Table 5. Parasite mean intensity with regards to the schools (which has to do with arithmetic mean of all the parasites species encountered in all the infected samples in a particular location) revealed that GPS Ikot Udota, Eket had the highest mean intensity of 5.30 as shown in Table 6 followed by GPS Ntafre, Ibeno (4.59) and GPS Afaha Essang, Abak (4.57), while the least was recorded in GPS Ndukpoise, Nsit Ubium (2.25).

Parasitological analysis of soil samples from schools playground revealed a high level of occurrence of *Ascaris lumbricoides* (4.48%) which agrees with the work of Nkouyep et al. (2017) and Badaki et al. [11] who also report a high level of *Ascaris lumbricoides* contamination in the school soil samples. The finding revealed a high level of improper disposal of feaces within the school surroundings and is attributed to inappropriate use/non-usage of the sanitation facilities present in the schools which could be as a result of non-functionality, inaccessibility and non-sanitary condition of the facility. The presence of *Toxocara canis* and *Taenia sp* eggs in the soil samples reveals a high potential for zoonotic diseases namely visceral larva migran (VLM) and cysticercosis, due to contamination of the school playground with dog and cattle faeces.

**Table 1. WASH grading criteria for data analysis (sanitation facility and usage)**

| Variable | Service Level | Composition | Code |
|---|---|---|---|
| Presence of toilet | | Absent | 0 |
| | | Present | 1 |
| Type of toilet | Unimproved | Open defecation, pit latrine without slab and ventilation, bucket latrine, hanging latrine | 0 |
| | Improved | Pour flush, water closet, pit latrine with slab and ventilation, improved latrine | 1 |
| Status/Availability/accessibility of toilet | Non-functional | Absence and not functional at the time of survey | 0 |
| | Functional | Always functional and accessible at any time | 1 |
| Condition of the toilet | Unsatisfactory | Difficult to use, dirty and with user's uncertainty | 0 |
| | Satisfactory | Clean and with user's satisfaction | 1 |
| Gender separate toilet | Absent | | 0 |
| | Present | | 1 |
| Anal cleaning material | Unsatisfactory | Use of leaves, and other natural materials, use of hard papers, water and it is not readily available in the toilet | 0 |
| | Satisfactory | Use of toilet tissue, water with soap and it is readily available in the toilet | 1 |

**Table 2. Overall status/service grading in percentage and their implication**

| Status/service grade | Grade in percentage (%) | Implication |
|---|---|---|
| Appropriate/Advance | 81 and above | Existing facilities are acceptable and sufficient. Little or no improvement is needed |
| Basic | 61-80 | Existing facilities are acceptable but not sufficient |
| Limited | 41-60 | Existing facilities are reasonable but would benefit from improvement |
| Unimproved | 21-40 | Existing facilities are poor as such urgent improvement is required |
| No service | Less than 10-20 | No facilities as such provision is the highest priority |

**Table 3. Overall prevalence of geohelminth contamination in selected schools in Akwa Ibom State**

| Schools/Location | Number Examined | Number of Contaminated Soil Samples (%) | *Ascaris lumbricoides* (%) | *Toxocara canis* (%) | *Ancylostoma duodenale* (%) | *Taenia* sp (%) | *Strongyloides* sp (%) | *Trichuris trichiura* (%) |
|---|---|---|---|---|---|---|---|---|
| **Eket District** | | | | | | | | |
| GPS, Ikot Udota, Eket | 50 | 10 (20.0) | 5 (10.0) | 1 (2.0) | 4 (8.0) | 0 (0.0) | 0 (0.0) | 2 (4.0) |
| GPS, Ntafre, Ibeno | 50 | 22 (44.0) | 10 (20.0) | 0 (0.0) | 9 (18.0) | 0 (0.0) | 2 (4.0) | 3 (6.0) |
| **Ikot Ekpene District** | | | | | | | | |
| GPS, Ikot Efre, Ikono | 50 | 6 (12.0) | 5 (6.0) | 0 (0.0) | 2 (4.0) | 0 (0.0) | 0 (0.0) | 1 (2.0) |
| GPS, Afaha Essang, Abak | 50 | 14 (28.0) | 7 (14.0) | 2 (4.0) | 6 (12.0) | 1 (2.0) | 1 (2.0) | 1 (2.0) |
| **Uyo District** | | | | | | | | |
| GPS, Ndukpoise, Nsit Ubium | 50 | 8 (16.0) | 3(6.0) | 0 (0.0) | 3 (6.0) | 0 (0.0) | 1 (2.0) | 2 (4.0) |
| GPS, Akpa Utong, Ibesikpo Asutan | 50 | 8 (14.0) | 5 (10.0) | 2 (4.0) | 3 (6.0) | 0 (0.0) | 1 (2.0) | 0 (0.0) |
| **Total** | **300** | **68 (22.6)** | **35 (11.6)** | **5 (1.6)** | **27 (9.0)** | **1 (0.3)** | **5 (1.7)** | **9 (3.0)** |
| Chisquare | | 6.733 | 1.714 | 5.068 | 1.320 | 5.017 | 3.03 | 2.487 |
| Df | | 5 | 5 | 5 | 5 | 5 | 5 | 5 |
| p Value | | 0.241ns | 0.887ns | 0.408ns | 0.933ns | 0.414ns | 0.695ns | 0.779ns |

*ns - Not significant at p>0.05*

**Table 4. Single and multiple parasitism encountered among soil samples in the schools**

| Type of Infection | Number Infected | Prevalence (%) |
|---|---|---|
| Single infection | 53 | 77.95 |
| Double infection | 15 | 22.05 |
| **Total** | **68** | **100.00** |

**Table 5. Stages and mean intensity of goehelminth parasites encountered in the school soil samples**

| Parasites | Number of Soil Samples Examined | Number of Contaminated Soil Samples (%) | Egg(s) Encountered (N) | Larval Stage Encountered (N) | Total Number of Parasites Encountered | Mean Intensity |
|---|---|---|---|---|---|---|
| *Ascaris lumbricoides* | 300 | 25 (8.3) | 112 | 0 | 112 | 4.48 |
| *Toxocara canis* | 300 | 5 (1.6) | 10 | 0 | 10 | 2.00 |
| *Ancylostoma sp* | 300 | 23 (17.7) | 30 | 60 | 90 | 3.91 |
| *Taenia* sp | 300 | 1 (0.3) | 5 | 0 | 5 | 5.00 |
| *Strongyloides stercoralis* | 300 | 5 (1.7) | 0 | 15 | 15 | 3.00 |
| *Trichuris trichiura* | 300 | 9 (3.3) | 34 | 0 | 34 | 3.77 |

**Table 6. Mean Intensity of geohelminth parasites encountered in the schools (soil samples)**

| Schools/Location | Number Examined | Number of Contaminated Soil Samples (%) | Total Number of Parasites Encountered | Mean Intensity |
|---|---|---|---|---|
| **Eket District** | | | | |
| GPS, Ikot Udota, Eket | 50 | 10 (20.0) | 53 | 5.30 |
| GPS, Ntafre, Ibeno | 50 | 22 (44.0) | 101 | 4.59 |
| **Ikot Ekpene District** | | | | |
| GPS, Ikot Efre, Ikono | 50 | 6 (12.0) | 15 | 2.50 |
| GPS, Afaha Essang, Abak | 50 | 14 (28.0) | 64 | 4.57 |
| **Uyo District** | | | | |
| GPS, Ndukpoise, Nsit Ubium | 50 | 8 (16.0) | 23 | 2.25 |
| GPS, Akpa Utong, Ibesikpo Asutan | 50 | 8 (14.0) | 20 | 2.50 |
| **Total** | **300** | **68 (22.6)** | **266** | |

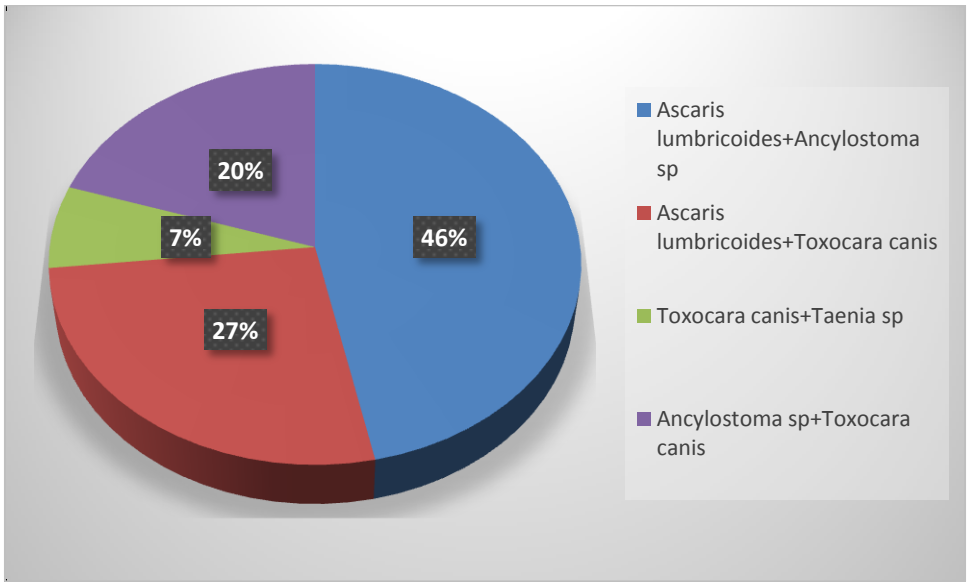


**Fig. 2. Polyparasitic contamination of school playground**

**Table 7. Sanitation status in selected primary schools in Akwa Ibom**

| School | Sanitation facilities and usage | | | | | | |
|---|---|---|---|---|---|---|---|
| | Types of Toilet | Functionality | Accessibility | Condition | Gender Separate Toilet | Anal Cleaning Material | Total (%) |
| Government Primary School Ikot Udota, Eket | 1 | 1 | 1 | 1 | 1 | 1 | 6(100) |
| Government Primary School Ikot Efre, Ikono | 1 | 1 | 1 | 1 | 1 | 1 | 6(100) |
| Government Primary School Ndukpoise-Ubium | 1 | 1 | 0 | 0 | 1 | 1 | 4(66.6) |
| Government Primary School Ntafre, Ibeno | 1 | 0 | 0 | 0 | 1 | 0 | 2(40) |
| Government Primary School Afaha Essang, Abak | 1 | 0 | 0 | 0 | 1 | 0 | 2(40) |
| Government Primary School Akpa Utong, Ibesikpo | 1 | 1 | 0 | 0 | 1 | 1 | 4(66.6) |
| Total | 24 (68.8) | | | | | | |
| Mean | 4 | | | | | | |
| Df | 5 | | | | | | |
| Chi-square | 23.67 | | | | | | |
| Pvalue | 0.0013 | | | | | | |

*1-present, 0-absent, significant, P>0.05*

The overall school sanitation compliance with JMP/WHO modified standard among the schools was 68.8% (which implies that the existing facilities were acceptable but not sufficient) as shown in Table 7. With regards to each of the schools, advance sanitation status (100%) was recorded in GPS Ikot Udota and GPS Ikot Efre, Ikono, while basic sanitation status (66.6%) was recorded in GPS Ndukpoise, Nsit Ubium and GPS Akpa Utong, Ibesikpo. Unimproved services with percentage of 40% were reported in GPS Afaha Essang Abak and GPS Ntafre, 100% of the schools had toilet facilities which ranged from water cistern to pit latrine but the accessibility and condition (cleanliness) of the toilet hindered the usage of the facilities in four schools (GPS Ntafre, Ibeno, GPS Afaha Esang Abak, GPS Ndukpoise, Nsit Ubium and GPS Akpa Utong, Ibesikpo) while two schools (GPS Ikot Udota, Eket and GPS Ikot Efre, Ikono) had 100% compliance to all the criteria used in assessing the school sanitation. The differences in compliance among the schools was statistically significant at p>0.05. These findings agrees with

the report of Tadege et al. [20] who also reported a poor status of sanitation facilities among schools in Jimma , Ethiopia.

The study revealed that sanitation facilities in schools which encompass their presence, functionality and accessibility influenced the level of faecal contamination resulting in increased prevalence excreta related diseases such as geohelminth infectivity among pupils, such that pupils whose schools had a non-functional and accessible toilet are likely to have a higher odds of infection as well as those that practice open defecation. This finding agrees with the works of Olukanni [21], Freeman et al*.* [22] and Zeleke et al*.* [23] who in their reports acknowledged the role of sanitation facilities accessibility and functionality in STH infectivity among children [24].

## 4. CONCLUSION

The study revealed 22% level of geohelminth contamination of soil samples and 68.8 % status of sanitation facility presence and usage among the six schools used in the study, with *Ascaris lumbricodies* being the most encountered. This reveals the need for increased provision of culturally acceptable toilet facilities in the school and also health education and awareness among the children in order to help reduce the rate of diseases fostered by inappropriate disposal of faeces which include but are not limited to geohelminthiasis.

## COMPETING INTERESTS

Authors have declared that no competing interests exist.

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