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ENTERIC HELMINTH PARASITES CONTAMINATION OF SURFACES IN SELECTED PUBLIC RESTROOMS IN BENIN CITY, NIGERIA

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ABSTRACT

Public restroom surfaces in selected markets, motor parks and students' hostels in Benin City, Edo State, Nigeria were investigated for enteric helminth parasites contamination. Out of the 160 swab samples used, 33(20.6%) were positive. Four types of surfaces: toilet seats, toilet flush handles, restroom floor and door handles in female and male restrooms were assessed. Toilet seats recorded the highest enteric helminth parasites contamination (37.5%) while the restroom floor had the least (10%) contamination ($p<0.05$). Although there were more positive samples from female restrooms (23.7%) than male restrooms (17.5%), the difference was not significant ($p>0.05$). The location of restrooms had a significant association with enteric helminth parasites contamination ($p<0.01$). Restroom surfaces in markets recorded the highest rate of positive samples (31.3%) while students' hostels had the least positive samples (5%). The recovered intestinal helminth parasites contaminants were: *Ascaris lumbricoides* (Hookworms), *Trichuris trichiura*, *Strongyloides stercoralis*, *Trichinella spirals*, *Taenia* sp., *Hymenolepis nana*, *Enterobius vermicularis* and *Schitosoma mansomi*. *Ascaris lumbricoides* has the highest contamination of samples (18.2%) while *Schistosoma mansoni* was the least contaminant (3%). A significant difference was observed in the prevalence of helminth parasites ($p<0.01$). The recovery of these helminth contaminants indicated that the public restroom surfaces were unsanitary and the cleaning method was inadequate. These unhygienic restroom surfaces could serve as potential sources of parasites' transmission to individuals or communities. Recommendations are summarized for measures to make public restrooms hygienic and safer for users.

KEYWORDS: Public restrooms, Helminth parasites, Contamination, Samples, Hygienic surfaces

INTRODUCTION

Enteric or intestinal helminth infections constitute one of the most important public health problems, especially in the tropical and subtropical regions of the world, where good water supply and sanitation are inadequate (Brooker, *et al*., 2006; Singh *et al*., 2013). The most widely distributed intestinal helminth infections include those caused by trematodes e.g. taeniasis and echinococcosis; and

nematodes e.g. ascariasis, hookworm disease, enterobiasis, strongyloidiasis and trichuriasis (Ascaolu and Ofoezie, 2000). Although mortality from such infections is low, intestinal helminthes infections interfere with the nutrition, growth and development of school-age children, as well as with the work and productivity of adults (WHO, 1987; Crompton, 1999; Singh *et al*., 2013).

The adult parasite stages inhabit different parts of the human intestine, reproduce sexually and produce eggs, which are passed in human faeces and deposited in the external environment. Transmission of intestinal helminth parasites occurs through infective stages such as eggs by accidental ingestion or larvae by direct penetration of the skin. Transmission of pathogens for these non-vector borne human infections that pass from one person to another commonly do so through contaminated environmental media such as soil, air, water, food, hands and fomites (Li, *et al*., 2009; CDC,2 013).

Public restrooms have been described as "away from home" toilets (Fowler, 2001). These public conveniences are often provided near or in markets, transport termini, busy centers, streets and public institutions, to allow people meet their sanitary needs. In public restrooms, complete strangers mix and use the same sanitary facilities, with all the related risks of bodily fluid exchange, contamination and organism transmission (Greed, 2006). Human secretions and wastes are easily deposited on restroom surfaces, namely: toilet seats, flush handles, sinks, floor and door handles. Any restroom surface, therefore, is a potential carrier of pathogens (Osterholm, 1995).

Faecally-borne pathogens especially infective eggs and larvae of intestinal helminths deposited on these indoor surfaces could readily be transmitted from one person to another by touching or contact with insufficiently cleaned restroom surfaces (Burges *et al*., 2009). The risk of intestinal helminth infection could increase with the frequency of use and routine contact with contaminated restroom surfaces. Frequent touching of these surfaces could result in the transfer of parasites from hand to the mouth or hand to food. Unfortunately, some public restrooms are often beset by inadequate safe water supply, even for the regular cleaning and routine flushes. Consequently, users can hardly wash their hands after usage, thereby carrying pathogen contaminants from such public conveniences.

Fears about contracting helminthiasis and other diseases often expressed by visitors, tourists and residents in recent years, have led to the renewed concerns with public restrooms hygiene and sanitation. There is paucity of literature on the hygiene standard of local public restrooms. In consideration of the daily large number of users, this study was undertaken to investigate the occurrence and distribution of intestinal helminth parasites contamination of public restroom surfaces in selected markets, motor parks and students' hostels in Benin City, Nigeria.

MATERIALS AND METHODS

The Study Area

The study was carried out in Benin City, the capital of Edo State southern Nigeria. The City is located within Latitudes 6° 06′ N, 6° 30′ N and Longitudes, 5° 30′ N, 5° 45′ E and has a population of about 1.5million (Wikipedia, 2015). Benin City is an important commercial, educational and cultural centre.

The restroom sites used in the study are located in each of the four Local Government Areas of Oredo, Egor, Ikpoba-Okha and Ovia-North-East within the metropolis. Benin City lies in the tropical rain forest zone, with two seasons, rainy and dry. The rainy season occurs between April and September, while the dry season extends from October to March.

Sample Collection

Four surfaces, namely: toilet seats, toilet flush handles, floor and door handles in four make and four female public restrooms located in selected markets: Uselu (UMR); Oba by King's square (OMR); motor park: Big Joe, Ikpoba Hill (BJR), and students' hostels, Benson Idahosa University, Ugbor (SHR) in Benin City were sampled.

Restroom surfaces were sampled by wiping with sterile normal saline-moistened cotton tipped swabs. A total of 160 swab samples were collected during the study. Thirty two (32) swab-samples were collected on each of the five (5) days randomly chosen for the investigation, between 2pm and 4pm on each day of sampling. Swab samples were kept in capped bottles containing 10ml formol-saline and adequately labelled to indicate the location, gender (male/female), site (type of restroom surface) and date of collection, before being taken to the laboratory.

Laboratory Analysis

Two methods were used in the isolation and identification of helminth eggs, larvae or adults.

Formol-ether Concentration Method

Each sample bottle was capped and shaken vigorously to dislodge the swab contents into the formol-saline. Cotton wool not used in swabbing restroom surfaces served as control. About 3-4 ml of diethyl ether was added to each sample bottle, mixed for 1 min. and then centrifuged at 3,000 rpm for 1 min. The supernatant was decanted. The sediment was stirred and a drop of it was placed in a clean glass slide. A drop of Lugol's iodine was added and then covered with a cover slip. The sediment was examined microscopically using X10 and x40 objective lenses for helminth eggs and larvae. Each parasite stage: egg larva, adult was identified using its morphological features as described by Neva and Brown, (1994) and Cheesbrough (2004).

Floatation Method

The sterile, normal saline moistened cotton swab of each sample was placed in a flat bottomed vial containing one quarter full of saturated sodium chloride solution and shaken vigorously to dislodge the swab contents. The vial was kept in a vertical position and more saturated salt solution was added to ensure that the vial was filled to the brim. A clean cover glass was placed on top of the vial and left undisturbed for 45 minutes to give time for the helminth eggs and larvae to float. Then, the cover glass was carefully lifted from the vial by a straight pull upwards. The

cover glass was placed face downwards on a slide. A drop of iodine was placed under the cover glass. The entire preparation was examined microscopically using x10 and x40 objective lenses. The helminth eggs, larvae or adults were identified as described by Neva and Brown, (1994) and Cheesbrough, (2004).

Data Analysis

Data were analysed using SPSS version 16 for descriptive statistics and Chi-square test was used to compare prevalence of variables. Statistical significance was achieved when the p-value obtained was less than 0.05.

RESULTS

Table 1: The prevalence of enteric helminth parasites (eggs/larvae/adults) contamination of samples collected from female and male public restrooms.

Gender	Numbers of samples examined	Number of positive for enteric helminth parasites (%)
Females	80	19 (23.8)
Males	80	14 (17.5)
Total	160	33 (20.6)

Out of the 160 swab samples collected from public restroom surfaces, 33(20.6%) were positive for intestinal helminth parasites (eggs/larvae/adults) contamination (Table 1). Although more positive samples were obtained from female restrooms (23.8%) than male restrooms (17.5%), the difference was not significant ($x^2 = 1.171$, df =1, p = 0.19).

Table 2: The prevalence of enteric helminth parasites contamination of samples collected from the different surfaces inside public restrooms.

Type of restroom surface	Number of samples examined	Number positive for enteric helminth parasites (%)
Toilet seats	40	15 (37.5)
Toilet flush handles	40	7 (17.5)
Restroom floor	40	4 (10.0)
Door handles	40	7 (17.5)
Total	160	33 (20.6)

Toilet seats recorded the highest rate of samples contaminated with helminth parasites, 15 (37.5%), while the restroom floor had the least, 4 (10.0%) (Table 2). The difference was highly significant. ($x^2 = 17.42$, df = 2, p = 0.00).

Table 3: The distribution and positivity of samples with enteric helminth parasites contamination according to the location of public restrooms. .

	Markets (UMR + OMR)	Motor Parks (BJR)	Students' Hostels (SHR)
Numbers of samples examined	80	40	40
Number of positive samples for enteric helminth parasites	25	6	2
Percentage	31.3	15	5

UMR = Uselu Market Restrooms
OMR = Oba Market Restrooms
BJR = Big Joe Motor Park Restrooms
SHR = Students' hostels Restrooms

Public restroom surfaces in markets recorded the highest positive samples with intestinal helminth parasites in the students' hostels had the least, 2/40 (5%) (Table 3). The location of public restrooms had a highly significant association with intestinal helminth parasites contamination. ($x^2 = 20.23$, df = 2, p = 0.00).

Table 4: Enteric helminth parasites contaminants recovered from public restroom surfaces

Helminth parasites	Form of helminth parasite isolated	Number of positive samples	Percentage of positive samples
Ascaris lumbricoides	Eggs	6	18.2
Hookworms	Eggs, larvae	5	15.2
Trichuris trichiura	Eggs	4	12.1
Trichinella spiralis	Adults	4	12.1
Strongyloides stercoralis	Larvae	4	12.1
Taenia sp.	Egg, segments	4	12.1
Hymenolepis nana	Egg, adults	3	9.1
Enterobius vermicularis	Eggs	2	6.1
Schistosoma mansoni	Egg	1	3.0
Total		33	100

Nine intestinal helminth parasites contaminants of the restroom surfaces were recovered. These were: *Ascaris lumbricoides*, Hookworms, *Trichuris trichiura*, *Trichinella spiralis*, *Strongyloides stercoralis*, *Taenia* sp., *Hymenolepis nana*, *Enterobius vermicularis*, *Schistosoma mansoni* (Table 4).

Ascaris lumbricoides, was the most common (18.2%) among the positive samples with *Schistosoma mansoni*. was the least (3%) ($p<0.01$). Two adult helminth parasites, *Trichinella spiralis* and *Hymenolepis nana* were isolated during the study.

DISCUSSION

Out of the 160 swab samples used to assess the level of enteric helminth parasites contamination of selected public restroom surfaces in Benin City, 33 (20.6%) were positive (Table 1). This figure is higher than the 6.25% and 5.43% positive samples of helminth parasitic contamination of public restrooms reported by Sobrinho *et al*. (1995), Coelho *et al*. (1999) and Borges *et al*. (2009) in Sorocaba and Uberlandia, Brazil, respectively.

The difference could be due to geographical location, human behavior, culture and available facilities. For instance Borges *et al*. (2009) reported that the city of Uberlandia offered 100% treated water and more than 90% sewage treatment. The high rate of intestinal helminth parasites contamination observed in this study could be attributed to inadequate maintenance and ineffective cleaning of the restroom surfaces.

Although, the female restroom surfaces recorded higher positive samples of intestinal helminth parasites contamination than the male restrooms, 23.75% and 17.5%, respectively, the difference was not significant. This finding is consistent with an earlier report of Borges *et al*., (2009) who found that there was no statistically significant difference between the positivity from the female and the male public restrooms. This observation might simply show equal gender exposure to intestinal helminth parasites and cleaning routines. However, it was observed that more females utilized these public restrooms than males especially in the markets.

The type of restroom surface significantly affected the rate of helminth parasites contamination. Out of the four restroom surfaces assessed, toilet seats recorded the highest rate of positive samples (37.5%) (Table 2). This finding is similar to the report of Borges *et al*., (2009). It has been reported that even after flushing, some water containing intestinal helminth parasites' eggs/larvae could spill over and contaminate the toilet bowel wall and toilet seats. Therefore, the difference observed in the rate of helminth parasites contamination of restroom surfaces could be due to the level of exposure to faecal matter.

In relation to location, a highly significant difference was observed in the prevalence of helminth parasites contamination of restroom surfaces ($p<0.01$). Restroom surfaces in markets recorded the highest rate of contamination (31.3%) of samples with intestinal parasites (Table 3). This was expected as heaps of refuse were left lying about the environment. Previous reports had shown that the risk of intestinal helminth parasites infection was higher where there was inadequate garbage disposal and clean water supply, poor sanitation and overcrowding (WHO, 1987, Crompton and Savioli, 1993; Brooker *et al*., 2006; Raina *et al*., 2013, Singh *et al*., 2013). Conversely samples in students' hostels were the least contaminated (5%). This could be due to the more effective cleaning and a better environmental sanitation and personal hygiene.

Nine intestinal helminth parasites were recovered as contaminants of the restroom surfaces. These were: *Ascaris lumbricoides*, Hook worms, *Trichuris*

trichiura, *Trichinella spiralis*, *Strongyloides stercoralis*, *Taenia* sp., *Hymenolepis nana*, *Enterobius vermicularis*, *Schisfosoma mansoni*. (Table 4). These helminth parasites cause major and widespread helminthiases such as ascariasis, hookworm disease, trichinosis, strongyloidiasis, taeniasis, schistosomiasis, etc, which constitute important social problem and public health concern (WHO, 1987; Brooker *et al*., 2006; Borges *et al*., 2009; Singh *et al*., 2013.

The observed contamination of public restroom surfaces by diverse helminth parasites is concerning because pathogens could readily be transmitted between individuals by contact with or toughing of restroom surfaces considering the high frequency of use by people with different hygienic routines.

The dominance of soil transmitted helminths (STH) in this study shows that they are cosmopolitan in the tropics as they have featured consistently in previous studies (Crompton and Savioli, 1993; Crompton, 1999; Brooker *et al*., 2006; Borges *et al*., 2009). *Ascaris lumbricoides* was the most common intestinal helminth parasites contaminant (18.2%). This finding is consistent with the report of Coelho *et al*. (1999) and Borges *et al*., (2009). Overall, the findings in this study have shown the inadequacy of the cleaning and decontamination methods of the selected public restrooms in Benin City.

CONCLUSION

The recovery of nine intestinal helminth parasites contaminants on public restroom surfaces despite daily cleaning, represents potential risk to individual users, who may acquire helminthiases from infected persons through routine body contact with these indoor surfaces. Furthermore, these contaminated restroom surfaces could also serve as potential reservoirs for community acquisition of helminthiases.

The method adopted in this study could be used not only to monitor or test the hygienic standard of public restrooms but also possibly serve to identify an at-risk population with helminth related morbidity.

RECOMMENDATIONS

In order to ensure hygienic public restrooms and safeguard public health, it is recommended that:

- Effective regular maintenance and improved cleaning methods be implemented in public restrooms.
- People should be encouraged to wash their hands after using the restrooms. According to CDC (2013), clean hands save lives.
- Public health education campaigns should be intensified and newer technologies be introduced to ensure better personal hygiene and environmental sanitation in the study area.

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