Evaluation of Water Sanitation and Hygiene (WASH) Facilities and Its Association with Urinary Schistosomiasis in Selected Settlements of Osun State, Nigeria

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Abstract

Background: Urinary schistosomiasis is a debilitating Neglected Tropical Disease (NTD) spreads when infected people urinate close to a water source, contaminating it with the larvae of the parasite, it is associated with lack of access to water, sanitation and hygiene (WASH) facilities in rural and semi-urban settlements. This study was conducted to evaluate the availability of WASH facilities and its impact on the prevalence of schistosomiasis among school-aged children in Ota-Efun (Semi-urban) and Ilie (Rural) communities of Olorunda LGA of Osun State, Nigeria between June and October, 2019

Methods: Two hundred and forty-three participants from the two communities provided urine samples which were examined for Schistosoma haematobium cyst using FLOTAC filtration device and microscopy. Using structured questionnaires, information on the demographic, hygienic practices, and availability of WASH facilities in participants homes was obtained

Results: Results showed a cumulative urinary schistosomiasis prevalence of 46% (51/110) in Ilie (rural) compared to 0% (0/133) in Ota Efun (Urban) settlement. In Ilie community, highest prevalence (19.1%) was recorded among participants within the age group (11-13 years) and lowest (7.3%) among age class 14 and above. When compared with the prevalence results, majority (61%) of residents in Ilie lacked access to toilet facilities while 64% were regularly involved in water contact activities such as swimming, bathing and washing of clothes by the river. Conversely, in Ota-Efun, majority (87.2%) of participants had access to pipe-borne water with controlled access to the stream (4.5%).

Conclusion: The results of this study suggest ongoing transmission of schistosomiasis in Ilie community and that frequent water contact activities including swimming and bathing are risk factors for infection. We recommend that WASH facilities should be effectively integrated into ongoing health policy for the control of neglected tropical diseases in Osun State in order to ameliorate the devastating effects of schistosomiasis in the affected communities

Keywords: WASH, S. haematobium, Rural and Urban settlements, Osun State, Nigeria.
1.0 INTRODUCTION

Schistosomiasis is a common neglected tropical disease affecting millions of people globally with the highest burden occurring in sub-Saharan Africa, the Americas, China and East Asia [1, 2]. It is ranked among the most prevalent waterborne parasitic diseases in rural communities and disadvantaged urban populations with reliance on streams and rivers for domestic and agricultural purposes [3]. Schistosomiasis due to *Schistosoma haematobium* is widespread, occurring in all the States in the country, and is caused by the digenetic trematode of the genus *Schistosoma* [4, 5]. With its preference to settle in the lower pelvic venous system, especially the vesical plexus, eggs of *S. haematobium* are usually emptied in urine and detected by urine microscopy [6]. Their exit causes micro-perforations in the bladder wall with concomitant passage of venous blood, either as macrohaematuria or microhaematuria the latter only detectable by reagent strips [6]. The cysts that fail to exit the body become trapped, causing an immuno-inflammatory response and create a ‘classic’ lower/upper urinary pathology as well as progressive damage in other internal organs [7, 8].

Infection with the disease constitutes public health and developmental challenges in most developing tropical and subtropical regions of the world as its socio-economic and public health consequence is tremendous. The distribution is focal and, in most cases, associated with water resources and development schemes such as irrigation projects, rice/fish farming and dams [9]. Children and women are the most predisposed, its pathological effects have been implicated in underlying fibrosis of the bladder and ureter, and in more advanced cases, in kidney damage [10]. The World Health Organization (WHO) recommends that all school aged children (SAC) and “high risk” adults should receive praziquantel (PZQ) annually in communities highly endemic (prevalence ≥ 50%), biennially in communities moderately endemic (prevalence ≥ 10% and <50%) [11] and triennially for SACs only in low endemic communities (prevalence < 10%), [12]. The drug for many endemic countries has been made available freely through international drug donation programmes [13, 14].

To achieve an extensive control and eventual elimination of schistosomiasis, an integrated approach involving the use of preventive chemotherapy, snail control, behaviour modification, water, sanitation and hygiene (WASH) improvements will be required [15]. WASH in itself is a component of the World Health Organization approach to achieving the Sustainable Development Goal (SDG) 3 [16]. It is hinged behavioral change (prevention of infection, disposal of human waste) and to access to clean water where provision of required infrastructure is ultimate). To achieve this much-desired expectation and also ensuring no one is left behind, the social inclusion of the communities ravaged by NTDs involves adequate planning for annual treatment with preventive chemotherapy, disease management and the provision of sustainable water infrastructures [17]. The burden of NTDs can be greatly reduced or influenced by change in attitude and practice of people living in endemic communities. To progressively influence this change in behavior, improved hygiene and sanitation practices at community, household and individual levels is important and needs to be studied, this will provide an understanding of the epidemiology of the infection and also assist to measure progress made in disease surveillance [17, 18].

In Nigeria, the burden of schistosomiosis has been reported across all states with the increase in both prevalence and incidence owing to the construction of dams for agricultural irrigation and hydro-electric power generation to serve the national grid. These dams serves as suitable breeding environment for vector intermediate host snails [19]. In Osun State South Western Nigeria, Olorunda Local Government Area (LGA) is one of the schistosomiasis highly endemic LGAs for schistosomiasis [19]. The Osun river focus and the associated dams in Osun Erinle has been related to with schistosomiasis transmission. The need for updated information on the WASH resource available in communities to mitigate the spread and transmission of schistosomiasis is important. Therefore, this study was conducted to assess the current status of schistosomiasis endemicity in rural and semi-urban areas of Olorunda LGA; availability of WASH facilities in households, and its overall impact on schistosomiasis prevalence in the study area.

2.0 METHODOLOGY

2.1 Study Area

The school-based cross-sectional study was conducted between June and October 2019 among primary school pupils between the age of 5-16 in Ota Efun, a semi-urban community and Ilie, a rural community located in Olorunda LGA, Osun State, Nigeria. Osun is a culturally inclined inland state located in the south-western part of Nigeria. Its capital is Osogbo. It is bounded in the north by Kwara State, in the east partly by Ekiti State and partly by Ondo State, in the south by Ogun State and in the west by Oyo State, occupation range from farming, fishing and
an array of government and private establishment. Purposeful sampling was employed in the selection of schools in communities with close proximity to the Erinle and Eko-Ende dams. Each school is front-line to a stream traversing the study communities. The streams serve as viable means for fishing and domestic use in the study areas.

2.2 Ethical Approval

Ethical clearance for the study was obtained from the Ministry of Health, Osogbo, Osun State. Field permissions were also obtained from Osun State Ministry of Education through the State Universal Basic Education (SUBEB). Prior to collection of samples, advocacy visits were made to selected communities and community leaders were sensitized about the study objectives and procedures. Further visitation were made to selected schools, and parents were sensitized using parents-teachers forum. Only children whose parents gave written consent were invited into the study. Participation was voluntary.

2.3 Estimation of Sample Size and Selection of Participants

School-aged children between the age group of 5 and 16 were selected for the study. This age group is the most pre-disposed to schistosomiasis. The pupils were stratified according to their educational level (Primary 1 to 6) for easy conduct. Participation was voluntary. The sample size (n) was estimated using the single population proportion: 

\[
\text{n} = \frac{Z^2 r (1-r)}{d^2}
\]

Where \( Z \) = 1.96, \( r \) = (73.9%) average prevalence of schistosomiasis from previous study [20], \( d \) = 0.05. This gave a sample size of 317.

2.4 Collection of Urine Samples

The A black sterile labeled container with a unique identification number was given to each selected pupil. Middle and terminal urine samples were collected between the hours of 10.00 and 14.00 based on the knowledge from past literature that the highest concentration of ova is released within these periods [21, 22].

2.5 Examination of Urine Samples for the Presence of Schistosoma haematobium ova

The urine samples were analyzed for the presence of schisto ova using FLOTAC filtration device. Each sample was observed following urine filtration procedure by passing 10 mL of urine through a syringe with an O-ring rubber seal and 13 mm polycarbonate membrane filter to capture \( S. \ haematobium \) eggs. The filter was transferred to clean grease-free glass slides and observed under a light microscope for \( S. \ haematobium \) ova. The infection intensity was classified as light (1-49 eggs/10 ml) or heavy (≥ 50 eggs/ml) [19].

2.6 Administration of Survey Form

A survey form, through direct interview, was used to obtain information on the demographic (sex and age) and hygienic practices from the pupils. The form also contained information on WASH facilities available to each participant in their home. With the aid of classroom teachers, and research assistants, each participant was invited for an interview in a separate room provided by the school. This was done to minimize interference from their classmates.

2.7 Data Analysis

Individual data was entered and coded in Microsoft Excel 2013 (Microsoft Corp, Redmond, WA, USA) and analyzed using SPSS version 20.0 (IBM Corp, Armonk, NY, USA). Frequencies and percentages were used to group variables while variation and association between variables were analyzed using Pearsons chi-square test statistics and logistic regression, Confidence interval was set at 95%.

3.0 RESULTS

3.1 Demographic Characteristic of Study Participants

A total of 133 pupils participated in the study in Ota Efun, comprising (21.8%) 29 males and (78.2%) 104 females. The highest number of pupils examined (66.9%) 89 were within age-group 11-13 years, followed by age group 14-16 years which had (21.8%) 29 pupils. Pupils within the age-
group 8-10 were the least sampled. One hundred and ten (110) pupils participated at Ilie community comprising (48%) 53 males and (52%) 57 females. The highest number of pupils examined (39%) 43 were within age group 11-13 years, followed by age group 8-10 years which had (29%) 32 pupils. Pupils within the age-group 14-16 were the least sampled (Table 1).

3.2 Prevalence of Schistosoma Infections by Age and Gender in Ota Efun and Ilie

The overall schistosomiasis prevalence of (46.4%) 51/110 was recorded at Ilie while zero prevalence (0%) was recorded at Ota Efun. Prevalence by age showed that pupils within the age bracket of 11-13 had the highest while age 5-7 recorded the least prevalence (Table 2). There was a significant difference in prevalence of schistosomiasis among the age groups ($p=0.000$). Generally, male pupils (51%) 27/53 were more infected than females (42%) 24/57. However, across the different age groups females of age above fourteen years and between the age 8 to 10 years were more infected than their male counterparts. Gender was found not to have a statistical significance to prevalence of schistosomiasis ($p=0.063$) (Figure 1).

3.3 Information on Access to Water, Water Contact Activities and Prevalence of Schistosomiasis in Ota Efun and Ilie community Primary School

All students who participated in the parasitological examination provided answers to the structured questionnaires. Study showed that 87.2% of study participants in Ota Efun had multiple access to pipe borne or clean water from different sources, while 36% of participants in Ilie had at least one source to pipe-borne or clean water Table 3. Participants at Ota Efun had access to the following water sources, rainwater (12%), protected dug-well (99.2%), pipe-borne water (82%), water-tanker (3%) and stream (4.5%). There source of water for pupils was found to be a significant risk factor for schistosomiasis infection (OR= 2.6, 95% CL = 1.7- 3.9 $p=0.051$). Majority (64%) of pupils in Ilie usually utilize the water from streams or dam for domestic activities while the remaining either sourced from rain water or protected dug well but no government piped water. Prevalence of schistosomiasis following the different source of water showed that community members in Ilie who visited the streams/

**Table 2.** Prevalence of *Schistosoma* infections by age among school children in Ilie and Ota efun

<table>
<thead>
<tr>
<th>Community</th>
<th>Ilie</th>
<th>Ota efun</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age in years</td>
<td>Number examined</td>
<td>Number Positive (%)</td>
</tr>
<tr>
<td>5-7</td>
<td>23</td>
<td>9 (39.1)</td>
</tr>
<tr>
<td>8-10</td>
<td>32</td>
<td>13 (41)</td>
</tr>
<tr>
<td>11-13</td>
<td>43</td>
<td>21 (19.1)</td>
</tr>
<tr>
<td>$\geq$ 14</td>
<td>12</td>
<td>8 (49)</td>
</tr>
<tr>
<td>Total</td>
<td>110</td>
<td>51 (46.4)</td>
</tr>
</tbody>
</table>

**Table 3.** Community source of water and prevalence of schistosomiasis

<table>
<thead>
<tr>
<th>Community</th>
<th>Ota Efun</th>
<th>Ilie</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sources of Water</td>
<td>Response</td>
<td>% Prevalence</td>
</tr>
<tr>
<td>Rain</td>
<td>16</td>
<td>0</td>
</tr>
<tr>
<td>Protected dug well</td>
<td>132</td>
<td>0</td>
</tr>
<tr>
<td>Pipe borne water</td>
<td>109</td>
<td>0</td>
</tr>
<tr>
<td>Water Tankers</td>
<td>4</td>
<td>0</td>
</tr>
<tr>
<td>Streams/dam</td>
<td>6</td>
<td>0</td>
</tr>
</tbody>
</table>
dams most often had the highest prevalence 60%(42/70) followed by those who usually utilize rain 43%(17/40) and protected dug well 18%(5/28). There was no significant difference in prevalence and water sources (Table 3).

3.4 Information on Use of Toilets and Prevalence of Schistosomiasis

All pupils provided information on the different types of toilet design available in their homes. Majority of the pupils 94%(125/133) in Ota Efun had functional toilets ranging from pit latrine with slabs 7%(9), ventilated improved pit 3%(4) and flush/pour toilet 84%(112) while 6%(8) practiced open defecation. In Ilie, 39%(43/110) of the participants had functional toilets ranging from pit latrine with slabs 11%(12), ventilated improved pit 12% (13) and flush/pour toilet 16%(18) while 61%(67) lacked toilet and practiced open defecation. Information on schistosomiasis prevalence showed that highest occurrence was among pupils who engage in open defecation 52%(35) while flush/pour toilets had the lowest 16.7%(3)

Table 4. Information on toilet designs available to pupils in their homes

<table>
<thead>
<tr>
<th>Toilet design in homes</th>
<th>Community</th>
<th>Ota Efun</th>
<th>% Prevalence</th>
<th>Ilie</th>
<th>% Prevalence</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pit latrine with slabs</td>
<td>9</td>
<td>0</td>
<td>12</td>
<td>8(67)</td>
<td></td>
</tr>
<tr>
<td>Ventilated improved pit</td>
<td>4</td>
<td>0</td>
<td>13</td>
<td>5(39)</td>
<td></td>
</tr>
<tr>
<td>Flush/Pour toilets</td>
<td>112</td>
<td>0</td>
<td>18</td>
<td>3(16.7)</td>
<td></td>
</tr>
<tr>
<td>Open defecation</td>
<td>8</td>
<td>0</td>
<td>67</td>
<td>35(52)</td>
<td></td>
</tr>
</tbody>
</table>

4.0 DISCUSSION

There has been an international interest and obligation to control and if possible, eliminate neglected tropical diseases in endemic countries by 2020 [23]. The high prevalence of the infection in rural setting is alarming and calls for urgent action. Using parasitological data, this study presents hope and possibility of elimination of urban schistosomiasis in Osun State provided the WASH component of implementation is fully integrated into households, the high prevalence of the infection in rural settling is alarming and calls for urgent action. This is very important at this time because information on deficiency in hygiene, sanitation and overall impact of WASH in the control of schistosomiasis infections has not been well studied [24]. Osun State is a beneficiary in the UNICEF assisted WASH resources at the community and school level but lack of safe water and sanitation coverage rates still persist in many communities [25]. The present study is part of integral epidemiological studies designed to identify high-risk communities for urinogenital schistosomiasis in Osun State in order develop suitable interventions and policy briefs for the State’s NTD Control Programme. The zero-prevalence rate recorded in Ota Efun, a peri-urban area of Olorunda LGA could be attributed to the multiple access to clean and safe water sources in the area. Conversely, majority of the participants in Ilie depend solely on water from the stream/dam, hence the high prevalence. Frequent contact with the rivers/ dam for swimming. Some of the participants at Ilie, 26%(28/110) urinate into the stream while swimming. Most of the participants (78%) at Ilie had also experienced blood in urine, however, 20%(22/110) attributed it to onset signs of puberty while others had no idea of the cause. All the pupils interviewed admitted to have received health education as regards proper use of toilets and the implication of going to swim at the streams in the past from their teachers and parents at home.
The prevalence by age showed that pupils between the age of 11 and 13 recorded the highest which may be associated with adventurous tendencies of this age group due to onset of puberty. This age is most often found around the river for swimming, recreational activities and game fishing. This observation is agreement with earlier studies on schistosomiasis in Osun State and elsewhere [19, 28]. Gender plays a significant role in disease dynamics, and in the case of schistosomiasis, level of exposure to cercaria infected rivers/streams play major roles in prevalence distribution among sexes. In the present study, even though more males than females were infected, the difference was not statistically significant. This shows that both sexes probably have equal exposure to cercaria infected river/dam. This is expected as questionnaire survey showed that majority of the pupils (irrespective of sexes) do frequently visit the dam for swimming and other purposes. This observation is in agreement with similar study conducted in Ethiopia [29].

Findings from this study conducted on the WASH facilities available to pupils at home was at variance with previous study conducted in Osun State [30]. The study showed that implementation of WASH at that time did not impact the transmission of Soil Transmitted Helminths which is a hygiene deficient disease like schistosomiasis. Nevertheless, our findings from present study has shown good potentials for the WASH, thus there is a need to further strengthen WASH interventions in schools and homes. It also implies that infection with schistosomiasis within Ota Efun community which borders the Osogbo LGA metropolis is at zero prevalence. Recent studies within the Osogbo metropolis also indicated zero cercaria shedding in snail intermediate host of schistosomiasis [31]. Therefore, provision of WASH facilities at homes and schools in both urban and rural areas will be effective at reducing and possibly facilitating the elimination of schistosomiasis in Osun State if effectively implemented by the Government and other stakeholders.

This study has demonstrated that incorporating WASH strategy into the daily life and use of residents in Ota Efun appeared to have greatly improved the hygiene practice in the area unlike Ilie community where WASH facilities were not available when this study was conducted. The transmission of schistosomiasis is still ongoing unabated. It is recommended that the State Government and other partners such as UNICEF should carry out impact assessment of WASH activities across the state and its impact on health status of the benefiting communities. This, we believe, will serve as fulcrum for the expansion of the programme to other rural communities (such as Ilie) that are being ravaged by hygiene-based infections such as schistosomiasis and soil-transmitted helminthiasis. In the interim, we recommend urgent provision of component of WASH facilities (such as motorized bore-holes, and modern toilet facilities) and implementation of public health education at Ilie and other adjoining communities to mitigate continuous transmission and burden of schistosomiasis in the area.

**Study Limitations**

The proposed sample size of 317 was not met because some participants refused to participate while some were absent on the day of data collection. Repeated visits could not be made to Ilie community due to its peculiarity as a hard to reach area.

**Acknowledgements**

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**Conflict of Interest**

The authors declare that there is no conflict of interest.

**Authors Contribution**

OAS conceived and designed the study, collected data, contributed to data analysis tools, analysis of data and manuscript writing; ORA, TEO contributed to data collection; MAR, CFM, SOS-W contributed to data analysis tools and manuscript writing; MAA contributed to study design, data analysis tools and manuscript writing.

**References**


