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# Prevalence and Risk Factors of Urinary Schistosomiasis in the Ikata-Likoko Area of Southwest Cameroon

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***Authors' contributions***

*This work was carried out in collaboration between all authors. Authors CBE, HKK, IUNS and LGL conceived the study. Authors CBE, HKK, IUNS and JEY performed the field and laboratory work. Author CBE analyzed the data. Authors CBE, HKK, IUNS and LGL contributed material for the study. Author CBE wrote the manuscript. Authors HKK, IUNS and LGL supervised and revised the manuscript. All authors read and approved the final manuscript.*

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## ABSTRACT

**Aims:** This study aimed at determining the prevalence, parasite density and risk factors associated with urinary schistosomiasis (US) in the Ikata-Likoko area, Cameroon.
**Study Design:** It was a cross-sectional study.
**Study Site and Duration:** The study was carried out in the Ikata-Likoko area, Cameroon from June to July 2014.

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**Materials and Methods:** The study included 516 participants of both sexes aged 2-76 years. A structured questionnaire was used to collect information on socio-demographic data, clinical history of the disease and environmental factors concerning potable water supply in the community. Urine samples were collected to detect and quantify *Schistosoma haematobium* eggs using the filtration method. Proportions and means were compared appropriately and the logistic regression model was used to determine risk factors of urinary schistosomiasis (US).

**Results:** The overall prevalence and parasite density of US were 34.3% and 31 eggs/10 mL of urine respectively. US prevalence was significantly (V=0.252, $P \le .001$) highest in participants from Mile 14 (48.3%) and least in those from Bafia (18.0%) while egg load per 10 mL of urine was significantly (H=8.283, $P$ =.041) highest in Bafia (50, range: 1-400) and least in Likoko (20, range: 1-200). Risk factors associated with US included: locality (OR: 4.370, 95% CI: 2.424-7.881, $P \le .001$), haematuria (OR: 7.387, 95% CI: 3.087-17.681, $P \le .001$), river as source of tap water (OR: 1.364, 95% CI: 0.623-2.985, $P$=.001) and lesser number of used water bodies (OR: 1.137, 95% CI: 0.397-3.255, $P$=.041). The presence of tap water was found to be protective (OR: 0.690, 95% CI: 0.477-0.998, $P$=.026) against US.

**Conclusion:** The Ikata-Likoko area is endemic for US. Provision of pipe-borne water, and inclusion of all age groups in the control strategies may reduce the prevalence of the disease in this area.

*Keywords: Urinary schistosomiasis; prevalence; parasite density; risk factors; Ikata-Likoko.*

## 1. INTRODUCTION

Schistosomiasis is the second most common parasitic disease on the globe [1]. Blood flukes of the genus *Schistosoma* are responsible for the disease which occurs in two forms: intestinal schistosomiasis caused by *S. mansoni, S. japonicum* and *S. intercalatum*; and urinary (urogenital) schistosomiasis (US) caused by *S. haematobium* [2,3].

It is estimated that 20,000-200,000 people die of schistosomiasis each year [4]. Globally, up to 261 million people required treatment for schistosomiasis in 2013, but only 40 million received it [4]. WHO [1] reported that, up to 3,308,582 people required treatment against the disease in Cameroon and 2,818,604 people were treated.

A study on primary school children showed an average prevalence of 9.3% urinary schistosome infection in the South West Region of Cameroon [5] although the prevalence could be higher where the disease foci exist. Studies in some foci in the same region reported prevalence values of 78% [6] and 40.27% [7] in Munyenge and 43.3% in Kotto Barombi [8]. The Ikata-Likoko area is a locality in the Mount Cameroon region where environmental and socio-economic characteristics are likely to favour the transmission of Schistosomiasis. The disease has been associated with a poor socio-economic status and is reported to occur in areas where people make constant contact with cercariae infested water bodies due to lack of pipe-borne water [1]. People get infected when the infective cercarial larvae shed by infected *Bulinus* snail hosts penetrate the skin during contact with water [9,10].

So far the major control measure for the control of US in Cameroon is the current community directed strategy based on the distribution of praziquantel to school children as advocated by WHO and other non-governmental partners. However, this strategy usually leaves out individuals who are not of school going age and so those leaving in communities in foci of the disease without pipe borne water like the Ikata-Likoko area are continually exposed to infection.

Prevailing environmental conditions such as presence of streams especially near homes, climatic conditions such as high rainfall, occupations such as farming and fishing as well as inaccessibility to health care services and a seemingly low level of education of the inhabitants of the Ikata-Likoko area could put them at risk of US. Although reports have been made on US in other foci around the Mount Cameroon area [6-8, 11-13], none has specifically focused on the Ikata-Likoko area. Against this background, the aim of this study was to determine the prevalence, parasite density and risk factors of US in the Ikata-Likoko area.

Findings from this study will be of additional value for the study area and the country as a whole and will thus help health policy makers to take informed decisions on control strategies against US in the country especially in foci of the disease.

## 2. MATERIALS AND METHODS

### 2.1 Study Area

The study was carried out in the Ikata-Likoko area which is comprised of four rural communities, Ikata, Bafia, Mile 14 and Likoko in the Muyuka Health District of southwest Cameroon. Mile 14 and Likoko communities make up one village, but are separated by a distance of about two kilometres. Ikata is located between longitudes 9.363 E and 9.352E, latitudes 4.329 N and 4.328 N and between 87m and 132m above sea level. Bafia is between longitudes 9.324E and 9.311E, latitudes 4.350N and 4.363N and is 229 m to 256 m above sea level. Mile 14 is located between longitudes 9.302E and 9.292E, latitudes 4.396N and 4.401N and between 157m and 168m above sea level. Likoko is located between longitudes 9.319E and 9.320E, latitudes 4.399N and 4.393N and is between 108m and 116m above sea level. Access to these villages from Muyuka is through an untarred, stony road that is usually muddy and sometimes almost impassable in the rainy season. In the dry season, it is dusty with several potholes. The topography of the area is characterized by hills and valleys. Most of the valleys are riverbeds that overflow their banks in the rainy season. Rainfall averages 3126.7 mm annually while temperatures vary between 23℃ and 33℃ with an annual average of about 26.2℃. Two major seasons exist in the area, the rainy (March to October) and dry (November to February) seasons. The vegetation is mainly the tropical forest type. The main occupation here is farming with cocoa as the main cash crop. Each of the villages has a primary school. Bafia and Ikata each have a secondary school and a government owned Integrated Health Centre (IHC). Bafia has another health centre put in place by the Cameroon Baptist Convention. The main religion practiced there is Christianity. Likoko and Bafia have pipe-borne water, though not all parts of the villages are connected to it, besides its supply is limited to part of the rainy season. All the villages have streams which are used by the populations for their daily needs even where tap water is available.

### 2.2 Study Population

Participants in this study were inhabitants of Ikata, Bafia, Mile 14 and Likoko villages of the Muyuka Health District in the South West Region of Cameroon who had spent at least two months in the study area and were at least one year old. Using the prevalence of 78% *S. haematobium* reported in primary school children in Munyenge in the Mount Cameroon region by Ntonifor *et al.* [6], the sample size was determined using the formula $n = Z^2pq/d^2$ [11] where n = the sample size required, Z = 1.96: confidence level test statistic at the desired level of significance, p = 78.0 %: proportion of US prevalence, q = 1-p: proportion of schistosome negative children and d = acceptable error willing to be committed. The minimum sample size was estimated as n = 264. This was adjusted to an optimum of at least 500 samples taking into consideration the recently reported decline in *S. haematobium* parasite prevalence [8].

### 2.3 Study Design

This cross-sectional survey was carried out between June and July 2014. After obtaining administrative and ethical clearances, visits to the village authorities permitted us to explain the procedures, benefits of the study as well as plan dates and collection sites for the study to the village inhabitants. A structured questionnaire was used to collect data on socio-demographic, clinical and risk factors of US. Urine samples were collected and transported to the Malaria Research Laboratory of the University of Buea for parasitological analyses.

### 2.4 Ethical Approval

An ethical approval was obtained from the University of Buea Faculty of Health Sciences Institutional Review Board after an administrative authorisation had been obtained from the Regional Delegation of Public Health for the South West Region, Cameroon. Authorisation was also obtained from the village heads. Informed consent forms carrying information about the procedures were issued on the spot during the study and only those who gave their consent were admitted into the study. Assent for minors was approved by parents or legal guardians. All participants who were positive for US were freely treated with praziquantel tablets in collaboration with the local health authorities except for pregnant women who were referred to the Muyuka District Hospital for adequate care.

### 2.5 Administration of Questionnaire

A structured questionnaire was used to collect data on the socio-demography, clinical history of the participants and factors that influence endemicity of US. Socio-demographic data included age, sex, highest level of educational attainment, religion and profession. The clinical history comprised of signs and symptoms of urinary schistosomiasis. These included, abdominal pains, urine colour, haematuria and dysuria. Factors that influence the prevalence and endemicity of US were; supply of tap water, source of tap water, site of bathing, number of water bodies used in the locality and distance from the nearest stream used. A case report form was used to record clinical parameters and laboratory results. Questionnaires were administered in English and exceptionally in Pidgin English where necessary.

### 2.6 Sample Collection

Labelled 50 mL containers were given to participants for the collection of urine samples. Urine collection was done between 10 am and 2 pm which is the period corresponding with the peak excretion of schistosome eggs [14]. Immediately after collection, the samples were tested for blood (haematuria) using urine test strips (Medi test Combi 9). The urine containers were properly corked and transported in cool boxes to the Malaria Research Laboratory of the University of Buea.

### 2.7 Laboratory Analyses

Ten (10) mL of each urine sample were analysed for *Schistosoma haematobium* eggs using the syringe filtration method [14]. Filtration was done by passing 10 mL of urine through a filter (STERLITECH Corporation, USA) which retained the schistosome eggs. The filter was placed on a microscope slide and examined under x10 objective of the light microscope (Olympus NY-USA). The number of eggs counted was reported per 10 mL of urine. Eggs detected were tested for viability by adding a drop of methylene blue on every positive slide. Viable eggs remained colourless while non-viable eggs were stained blue [14].

### 2.8 Statistical Analysis

Data was entered into Excel version 2013 and analysed using IBM Statistical Package for Social Sciences (IBM SPSS) version 20 (IBM Inc. 2012). Data was summarised into proportions and means. Proportions were compared using the Cramer's V, the Mann-Whitney U test was used to compare mean egg loads for two groups whereas the Kruskall-Wallis H test was used to compare mean egg loads of more than two groups. The logistic regression model (LRM) was used to determine risk factors of urinary schistosomiasis. The level of significance was set at $P< .05$.

## 3. RESULTS

### 3.1 Socio-demographic Characteristics of the Study Population

From the four localities in the Ikata-Likoko area, 516 participants were admitted into the study (Bafia: 122, Ikata: 126, Likoko: 117, Mile 14: 151). Out of these, 273 (53%) were females while 243 (47%) were males. The age range was 2-76 years with a mean age of 23.8±17.5 years. A majority of the participants (299, 57.9%) had completed primary school and 3 (0.6%) had attained a tertiary educational level. In terms of occupation, most of the participants (259, 50.2%) were pupils/students, while 23 (4.5%) were housewives (Table 1). A majority of the participants (99.4%) were Christians. Overall, 34.3% of the participants were positive for *S. haematobium* eggs with an overall mean egg load per 10 mL of urine of 31 (range: 1-400). All eggs detected were viable. None of the participants had taken anti-schistosomal treatment before the commencement of the study.

### 3.2 Prevalence and Density of *S. haematobium* with Respect to Socio-demographic Factors

The prevalence of urinary schistosomiasis was comparable among all age groups ($V=0.03$, $P=.76$) in the study population. The mean egg load per 10 mL of urine was highest in the <5 years age group (40, range: 1-300) while that of the >15 years age group (25, range: 1-400) was the least, but the difference was not statistically significant ($H=4.07$, $P=.13$). Prevalence and parasite density were also comparable for gender, level of education and occupation.

With respect to localities, a statistically significant difference in prevalence ($V=0.252$, $P<.001$) was observed and the highest prevalence of *S. haematobium* occurred in participants of Mile 14 (48.3%) while the least was recorded in those of Bafia (18%). On the contrary, the parasite density was highest in Bafia (50, range: 1-400) while the least was in Likoko (20, range: 1-200) and the difference was statistically significant ($H= 8.283$, $P=.04$) as shown in Table 1.

**Table 1. Prevalence and parasite density of *S. haematobium* in the Ikata-Likoko area of southwest Cameroon**

| Characteristics | Category | Number of participants examined (%) | Prevalence (%) | Egg load/10 mL of urine (range) |
|---|---|---|---|---|
| Age group (years) | <5 | 71 (13.8) | 26 (36.6) | 40 (1-300) |
| | 5-15 | 151 (29.3) | 54 (35.8) | 36 (1-200) |
| | >15 | 294 (57) | 97 (33.0) | 25 (1-400) |
| Level of significance | | | **V=0.032, *P*=.765** | **H=4.07, *P* =.130** |
| Mean age±SD[a] (years) | | | **23.8±17.5** | |
| Sex | Male | 243 (47) | 86 (35.4) | 33 (1-400) |
| | Female | 273 (53) | 91 (33.3) | 28 (1-300) |
| Level of significance | | | **V=0.022, *P*=.623** | **U=3721.50, *P*=.573** |
| Highest level of school attainment | No formal education and primary | 382 (75) | 132 (34.6) | 31 (1-400) |
| | Secondary and tertiary | 134 (25) | 45 (33.6) | 30 (1-200) |
| Level of significance | | | **V=0.009, *P*=.838** | **U=2676.50, *P*=.321** |
| Occupation | Semi-skilled worker | 30 (5.8) | 7 (23.3) | 15 (4-50) |
| | Farmer | 195 (37.8) | 66 (33.8) | 25 (1-400) |
| | Housewife | 23 (4.5) | 6 (26.1) | 30 (5-50) |
| | Pupil/student | 259 (50.2) | 95 (36.7) | 34 (1-300) |
| Level of significance | | | **V=0.076, *P*=.56** | **H=4.407, *P* =.319** |
| Locality | Bafia | 122 (23.64) | 22 (18.0) | 50 (1-400) |
| | Ikata | 126 (24.41) | 34 (27.0) | 48 (2-300) |
| | Likoko | 117 (22.67) | 48 (41.0) | 20 (1-200) |
| | Mile 14 | 151 (29.26) | 73 (48.3) | 23 (1-50) |
| Level of significance | | | **V=0.252, *P*<.001** | **H=8.283, *P* =.041** |
| Prevalence of *S. haematobium* | | | 177 (34.3) | |
| Overall mean egg load/ 10 mL of urine (range) | | | 31 (1-400) | |

*V: Cramer's V test, H: Kruskall-Wallis test; U: Mann-Whitney U test, a: Standard deviation*

### 3.3 Risk Factors of Urinary Schistosomiasis

Table 2 shows the logistic regression analysis with urinary schistosomiasis as dependent variable and socio-demographic, clinical and environmental factors as independent variables. Locality was depicted as a risk factor of *S. haematobium* (OR: 4.4, 95% CI: 2.42-7.88, *P*≤.001) with Mile 14 having the highest prevalence (48.3%). Participants from Mile 14 were 4.4 times more likely to be infected with US than their corresponding equivalents.

With respect to clinical factors, prevalence of US was significantly higher among individuals without lower abdominal pain (37.9%, OR: 0.640, 95% CI: 0.26-1.57, *P*=.022) and haematuria (100%, OR: 7.39, 95% CI: 3.08-17.68, *P*=.000) than their respective counterparts.

With reference to environmental factors, individuals who did not have tap water within their vicinities had a significantly higher prevalence of US (38.1%, OR: 0.690, 95% CI: 0.47-0.99, *P*=.026) than those who had (29.8%). In like manner, participants with stream as the main source of water used were at odds of being infected with *S. haematobium* (100%, OR: 1.36, 95% CI: 0.62-2.98, *P*=.001) than their counterparts. US prevalence was significantly higher among individuals who used ≤3 water bodies (35.3%, OR: 1.137, 95% CI: 0.397-3.255, *P*=.041) when compared with those using more than 3 water bodies (32.8%).

**Table 2. Risk factors of urinary schistosomiasis in the Ikata-Likoko area of southwest Cameroon**

| Factor | Category | Number of participants examined | Prevalence (%) | OR (95% CI) | *P*-value (LRM) |
|---|---|---|---|---|---|
| **Socio-demographic factors** | | | | | |
| Sex | Male | 243 | 86 (35.4) | 1.386 (0.624-3.078) | 0.423 |
| | Female | 273 | 91 (33.3) | | |
| Age | <5 | 71 | 26 (36.6) | 0.924 (0.437-1.954) | .837 |
| | 5-15 | 151 | 54 (35.8) | | |
| | <15 | 294 | 97 (33.0) | | |
| Highest level of school attainment | No formal education and primary | 382 | 132 (34.6) | 1.037 (0.392-2.742) | .941 |
| | Secondary and tertiary | 134 | 45 (33.6) | | |
| Occupation | Semi-skilled worker | 30 | 7 (23.3) | 0.903 (0.556-1.465) | .680 |
| | Farmer | 195 | 66 (33.8) | | |
| | Housewife | 23 | 6 (26.1) | | |
| | Pupil/student | 259 | 95 (36.7) | | |
| Locality | Bafia | 122 | 22 (18.0) | 4.370 (2.424-7.881) | ≤.001 |
| | Ikata | 126 | 34 (27.0) | | |
| | Lykoko | 117 | 48 (41.0) | | |
| | Mile 14 | 151 | 73 (48.3) | | |
| **Clinical factors:** | | | | | |
| Dysuria | Yes | 120 | 36 (30.0) | 0.510 (0.169-1.539) | .262 |
| | No | 392 | 140 (35.7) | | |
| Lower abdominal pain | Yes | 206 | 61 (29.6) | 0.640 (0.261-1.569) | .022 |
| | No | 306 | 116 (37.9) | | |
| Urine colour | Black | 6 | 2 (33.3) | 1.496 (0.951-2.354) | .081 |
| | Colourless | 12 | 4 (33.3) | | |
| | Brown | 4 | 2 (50.0) | | |
| | Red | 64 | 25 (39.1) | | |
| | Yellow | 429 | 144 (33.6) | | |
| Haematuria | Positive | 60 | 60 (100) | 7.387(3.087-17.681) | ≤.001 |
| | Negative | 429 | 99 (23.1) | | |
| **Environmental factors** | | | | | |
| Presence of tap water | Yes | 235 | 70 (29.8) | 0.690 (0.477-0.998) | .026 |
| | No | 281 | 107 (38.1) | | |
| Knowledge of source of tap water | Yes | 218 | 67 (30.7) | 0.801 (0.065-9.938) | .863 |
| | No | 17 | 3 (17.6) | | |
| Source of water used | Spring | 97 | 41 (42.3) | 1.364 (0.623-2.985) | .001 |
| | Borehole | 109 | 21 (19.3) | | |
| | River | 3 | 3 (100) | | |
| | Stream | 9 | 2 (22.2) | | |
| Number of water bodies used | ≤3 | 380 | 134 (35.3) | 1.137 (0.397-3.255) | .041 |
| | >3 | 122 | 40 (32.8) | | |
| Site of bath | House | 132 | 27 (20.5) | 1.277 (0.233-7.308) | .576 |
| | Stream | 384 | 150 (39.1) | | |
| Distance to nearest stream used (m) | <100 | 199 | 33 (27.7) | 1.344 (.649-2.782) | .412 |
| | 100-499 | 176 | 167 (38.1) | | |
| | 500-1000 | 70 | 23 (32.9) | | |
| | >1000 | 81 | 29 (35.8) | | |

## 4. DISCUSSION

Urinary schistosomiasis like other neglected tropical diseases exerts a great burden on public health and affects especially populations with low socio-economic status in rural communities. It has a focal distribution due to prevailing environmental factors that favour the development of its snail intermediate host. Control measures could be more effective if the characteristics and risk factors of the disease in a focus are established.

The overall prevalence of *S. haematobium* in the Ikata-Likoko area was 34.3%. This value is lower than prevalence values of over 40% [7-8] and above 50% [11-13] reported in other parts of southwest Cameroon. Generally, the trend has shown a decrease in parasite prevalence over time. It is worth noting that in 2007, Cameroon launched a nationwide deworming program using praziquantel that targeted schoolchildren and it has been done periodically. This might have helped to reduce the transmission rates of the parasites and consequently the level of endemicity of the infection in the general population. The mean egg load (31 eggs/10 mL of urine) was higher in this study than in the previous studies. It is possible that exposed individuals make several contacts with the source of infection resulting in repeated infections thus resulting in high egg loads. The method of diagnosis used in this study (filtration) might be better at detecting schistosome eggs than the sedimentation method used by previous researchers in the same region.

The prevalence and egg load of US were slightly higher in males (35.4% and 33 eggs/10 mL of urine respectively) than females (33.3%, 28 eggs/10 mL of urine respectively). This could be due to the fact that many males in the area carry out fishing in the streams and equally accompany their fathers to fetch water from the streams to mix with pesticides for the spraying of their cocoa crops. These activities therefore expose them to contact and consequently infection with schistosome cercariae. This is in accordance with the reports of Geleta et al. [15] in Ethiopia (male: 43.2%, female: 28.2%) and by Sady et al. [16] in Yemen (male: 33.6%, female: 29.0%). However, this observation is different from the reports of Ntonifor et al. [7] where parasite prevalence was higher in females (45.46 %) than males (34.31%) and Kimbi et al. [8] where they were also higher in females (56.5%) than males (43.5%) in southwest Cameroon.

The highest prevalence (36.6%) and mean egg load (40 eggs/10 mL) was observed among children <5 years. This was not the expected observation. This may be due to the fact that streams are quite near houses and schools in the study area especially in Mile 14 and Ikata. As such, children including young ones often go to play in the streams and therefore get exposed to the infection. Although varied results have been reported with respect to age and highest prevalence, infection intensities have not shown a particular pattern both locally and elsewhere. In southwest Cameroon, Sama et al. [17] reported the highest prevalence of infection (54.1%) among children 10-14 years; whereas Ntonifor et al. [6] recorded the highest parasite prevalence among children aged 9-12 years old (87.5%). Elsewhere, Oniya and Jeje, [18] in Nigeria reported the highest prevalence among children aged 11-15 years old (61.11%), whereas Chipeta et al. [19] in Malawi reported the highest prevalence among children 6-15 years old. It is worth noting that the current distribution of praziquantel by health authorities in Cameroon targets only schoolchildren, leaving out other age groups and they are therefore faced with the difficulty of receiving treatment and may consequently have schistosome parasites persisting among them.

Schistosome parasite prevalence was similar ($V = 0.009$, $P = .838$) in all categories of levels of educational attainment although they were higher in individuals with no formal or primary education (34.6%) than their counterparts who had attained secondary or tertiary education (33.6%). Parasite density depicted a similar tendency (31 eggs/10 mL and 30 eggs/10mL of urine respectively) though not statistically significant ($U = 2676.50$, $P = .321$) with respect to level of educational attainment. This could be due to the fact that the more educated participants might have had some level of knowledge about the transmission mode of the infection and could therefore be more cautious while carrying out water contact activities.

Although pupils and students had the highest prevalence (36.7%) and mean egg load (40 eggs/10 mL), there was however no significant difference in prevalence ($V = 0.076$, $P = .56$) and egg load ($H=4.407$, $P=.319$) between participants of different occupations. It is possible that the necessity for water used to prepare for school and household chores may cause this group of individuals to be in greater contact with water on a daily basis [20]. This group of children is known to spend time on recreational activities such as swimming which exposes them to infection by cercariae [1]. Also, farmers who were the second most infected group had the highest egg load (up to 400 eggs/10 mL urine). It is known that most of the farmers in the area produce cocoa and so they use water from the streams and rivers for spraying. This increased frequency of contact with these water bodies is likely to lead to an increased transmission rate and consequently an increase in the infection rate as well as the egg load. This observation is similar to that reported by Bala et al. [21] in Abama District in Nigeria.

With respect to localities, the prevalence of US was significantly highest (V=0.252, *P*<.001) in Mile 14 (48.3%). This might have been as a result of the complete absence of tap water and health facility in the locality, leaving the inhabitants with the streams and rivers as the main source of water and self-medication or traditional healers as a source of health care. Report from a study in Senegal [22] also found a significant variation in US prevalence between localities.

Variation of prevalence with respect to village of residence could also be explained by the difference in prevailing environmental characteristics that are peculiar in the localities including climatic conditions, presence of water bodies and closeness of water bodies to residents and schools.

Clinically, haematuria was associated with US (OR: 7.387, 95% CI: 3.087-17.681, *P*<.001). Participants with haematuria were 7 times more likely to be positive for US than their haematuria negative counterparts. The association of haematuria, a common manifestation of chronic US with the prevalence of urinary schistosomiasis is an indication that the detection of haematuria is a fair measure for the diagnosis of US as reported by Ibironke et al. [23] where a 100% sensitivity and 80% specificity of haematuria in US diagnosis was observed.

The presence of tap water was a protective factor (OR: 0.690) against US as individuals without access to tap water had a significantly higher prevalence of US (38.1%) than those with access to tap water (29.8%). The absence of tap water could eventually expose inhabitants to cercariae since there is increased contact with the streams and rivers. Similar observations were made in some Nigerian communities (60.00%, *P*=<.01) [24], and in Niakhar District of Senegal (71.4%) [21], where higher prevalences of US were reported among people with no access to tap water.

The prevalence of US varied significantly with the source of water used (*P*=.007) with individuals using river having the highest prevalence (100%) when compared with those using water from other sources. Using water from the river for domestic purposes in the rural communities might have been the only source available or closest to the population. Most of the time the water is used for their daily activities such as bathing, washing of kitchen utensils and clothes, fishing and swimming and they eventually get exposed to the cercariae and get infected.

The significantly higher prevalence of US among individuals who used lesser number of water bodies (35.3%), could be explained by an increased activity in these water bodies due to fewer choices whereas with more water bodies the activity in each water body could likely reduce as well as the contamination and transmission rates of US.

Some limitations of this study include the fact that analyses of these data depended on only one specimen per participant. Considering that the egg release rate of schistosomes is generally irregular [14], there is a possibility that some infections might have been missed. Some participants were unable to give up to 10mL of urine. However, this was compensated for by dividing the number of eggs in a positive case and multiplying the value by 10.

## 5. CONCLUSION

Findings from this study reveal that urinary schistosomiasis remains a public health challenge in the Ikata-Likoko area. The relatively higher mean egg load recorded in this study than those reported in neighboring areas gives a picture of a possible focus for the disease in the area. The provision of tap water, health care facilities in all the villages and the distribution of praziquantel treatment to all age groups alongside community awareness campaign may significantly reduce the prevalence of the disease in this area.

## INFORMED CONSENT

All participants gave their informed consent before being admitted into the study. Minors were admitted into the study only after the assent of their parents or legal guardians.

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## COMPETING INTERESTS

Authors have declared that no competing interests exist.

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