Detection of Urinary Tract Pathology in Some Schistosoma haematobium Infected Nigerian Adults

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1. Introduction

An estimated 207 million cases of human schistosomiasis have been reported worldwide and about 90% of these live in Sub-Saharan Africa, with Nigeria having the highest prevalence [1]. Schistosoma infections cause significant morbidity and mortality with peak prevalence and intensity of infection occurring between the ages 10 and 20 years and subsequent decline by age 65 years [2].

Chronic human circulatory system infection by Schistosoma haematobium is reported to affect the urinary bladder and is a possible risk factor in the aetiology of cancers of the bladder and the urinary tract system [3]. S. haematobium infection has been linked with the development of squamous cell carcinoma of the bladder [4, 5]. S. haematobium associated bladder damage has been closely linked to the immune reaction elicited against the parasite egg deposited in the bladder which eventually induces chronic inflammation related granulomatous injury [6].

Schistosomiasis and bladder cancer share common symptoms such as haematuria, dysuria, and pain with micturition. This may prevent early diagnosis of bladder cancer and the resultant severe bladder damage particularly in people living in S. haematobium endemic areas.

In Nigeria, most studies have focused on the epidemiology of S. haematobium infection [3, 7, 8] particularly in school-age children, with limited information about the morbidity resulting from urinary schistosomiasis in adults.

This study was therefore aimed at determining the prevalence of schistosomiasis and associated bladder pathology in adults living in Eggua, Yewa, North Local Government Area, Ogun State, Nigeria.
2. Materials and Methods

The study was carried out in Eggua, a rural agrarian community, between August 2012 and May 2013. It is one of the wards that make up Yewa North Local Government Area as previously described [9]. Eggua lies between latitude 7°4.811’N and longitude 2°52’43.776’E in a derived savanna zone. The area is largely dominated by Yoruba speaking people. It consists of settlements at Sagbon, Imoto, Tata, Agbon-Ojodu, and Igan Alade. It shares boundaries with Igbugila, Ilaro, Ijoun, and Benin Republic.

Two major rivers (Yewa and Iju) flowing through the area serve as the main water source, resulting in high water contact by the inhabitants. These rivers are used for religious, domestic, and entertainment activities which enhance the transmission of schistosomiasis.

A cross-sectional study design was employed for this study. Participants aged 30 to more than 60 years old from the community were enrolled for the study. Children were excluded from the study in line with the objective of the study to determine the effect of chronic urinary schistosomiasis on adult members of the community.

2.1. Ethical Considerations. Informed consent was obtained from each participant under a protocol approved by the Local Government and local health officials. Ethical approval for the study was also obtained from the Ogun State Ministry of Health.

2.2. Sample (Biofluid) Collection. Blood (5 mL) and urine specimens were collected from each study participant. The urine samples were collected between 10:00 and 14:00 hours to ensure maximum egg yield. Packed cell volume (PCV) was determined from the blood collected.

2.3. Sample Analyses. The urine samples (10 mL) were processed for microscopic examination and egg count [3, 10]. The eggs were quantified by counting under the microscope and classified as light infection if there were ≤50 (1–49) eggs/10 mL urine and heavy infection if there were >50 eggs/10 mL urine [3].

2.4. Ultrasound and Pathology. A blind ultrasound examination was carried out on each participant approximately 1 h after drinking potable water (0.1–1.5 litre depending on the age of the participant) to distend the bladder. The classification of bladder pathology or damage was based on the definition of the WHO [11, 12] and Shiff et al. [5]; the abnormalities assessed included abnormal bladder shape, bladder wall irregularities, bladder masses, presence of polyps, calcification, and presence of hydronephrosis in the kidneys. Bladder lesions were considered severely abnormal when four of the above conditions or three conditions as well as hydronephrosis were present in a single individual. Lesions were considered moderate if fewer conditions were seen and negative when no specific lesions were observed.

2.5. Sociodemographic Data Collection. A structured, pre-tested questionnaire was used to obtain information about participants’ habits regarding smoking and alcohol consumption, which are determinants of bladder cancer. Sociodemographic information was also recorded for each of the participants.

Statistical analysis of data obtained was done using SPSS version 20.0 (P < 0.05).

3. Results

A total of 257 (79 males and 178 females) participants aged 30–90 years were screened for _S. haematobium_ infection and associated bladder pathologies. The mean age of participants was 48 ± 12.2 years. The overall prevalence of _S. haematobium_ in the sampled population was 25.68% (66/257), 21 (31.8%) in males and 45 (68.2%) in females. The highest prevalence of infection was observed in participants over 60 years old (Table 1). The majority (56/66) (84.8%) of those positive for _S. haematobium_ had a light intensity of infection with the egg mean intensity of 16.7 eggs/10 mL urine. The Yewa river was the main source of water for most (49/62) (79.0%) of the participants infected with _S. haematobium_ (Table 4).

Bladder pathologies were observed in 33.9% (87/257) of the sample population and included abnormal bladder wall thickness (39/66) (59%), abnormal bladder shape (10/66) (15.2%), bladder wall irregularities (15.2%), bladder masses (1.5%), and bladder calcification (1.5%) (Table 2). Bladder wall thickness, the most common abnormality, was recorded in 46/79 (58.2%) males and 90/178 (50.6%) females (Table 3). Among the participants, 56 (84.8%) with bladder pathologies also had an existing schistosomiasis infection, 48 (87.3%) of which were light intensity and 8 (72.7%) of which were heavy intensity: $\chi^2 = 267.5, P = 0.001$ (Table 5). Thus, there was an association between urinary tract pathology and the intensity of _S. haematobium_ infection ($\chi^2 = 375.4, P = 0.001$, Table 2). Among the participants with light and heavy intensity of _S. haematobium_ infections, bladder wall thickness was the most common bladder structural pathology identified in 33/56

| Table 1: Prevalence and intensity of _S. haematobium_ by sex and age group in Eggua, Nigeria. |
|-----------------------------------------------|
| Light | Heavy | Total |
|-------|-------|-------|
| **Sex** | | |
| Male | 18 (27.3) | 3 (4.5) | 21 (31.8) |
| Female | 38 (57.6) | 7 (10.6) | 45 (69.2) |
| **Total** | 56 (21.8) | 10 (3.9) | 66 (25.68) |
| $\chi^2$ = 2.514, $P = 0.113$ |

| Table 2: Bladder pathology distribution between sex and age group in Eggua, Nigeria. |
|-----------------------------------------------|
| Light | Heavy | Total |
|-------|-------|-------|
| **Age group** | | |
| 30–34 | 2 (3.6) | 1 (10) |
| 35–39 | 9 (16.1) | 1 (10) |
| 40–44 | 8 (14.3) | 1 (10) |
| 45–49 | 9 (16.1) | 1 (10) |
| 50–54 | 6 (10.7) | 2 (20) |
| 55–59 | 6 (10.7) | 2 (20) |
| 60 and above | 16 (28.6) | 2 (20) |
| $\chi^2$ = 2.514, $P = 0.113$ |
Table 2: Distribution of bladder pathology with intensity of S. haematobium infection.

| Pathology                  | Light (%) | Heavy (%) | Total |
|----------------------------|-----------|-----------|-------|
| Bladder wall thickness     | 33 (58.9)| 6 (60.0)  | 59%   |
| Bladder shape              | 8 (14.3) | 2 (20.0)  | 15.2% |
| Bladder wall irregularity  | 8 (14.3) | 2 (20.0)  | 15.2% |
| Bladder mass               | 0 (0)     | 1 (10.0)  | 1.5%  |
| Calcification              | 0 (0)     | 1 (10.0)  | 1.5%  |
| Polyps                     | —         | —         | —     |
| Hydronephrosis             | 6 (10.7)  | 0 (0)     | 9%    |

Table 3: Distribution of bladder pathology among genders.

| Pathology                  | Male     | Female   |
|----------------------------|----------|----------|
| Bladder wall thickness     | 46 (58.2)| 90 (50.6)|
| Bladder shape              | 7 (8.9)  | 6 (3.4)  |
| Bladder wall irregularity  | 7 (8.9)  | 6 (3.4)  |
| Bladder mass               | —        | 1 (0.6)  |
| Calcification              | —        | 1 (0.6)  |
| Polyps                     | —        | —        |
| Hydronephrosis             | —        | 6 (3.4)  |

(58.9%) and 6 (60.0%) participants with light and heavy S. haematobium infections, respectively (Table 5). Abnormal bladder shape and bladder wall irregularity were seen in 8/56 (14.3%) and 2 (20%) participants with light and heavy infections, respectively (Figures 1–3). Hydronephrosis was present in only one participant with light infection, while calcification was identified in only one participant with heavy infection. No bladder polyp was detected. Mild bladder pathology was more common than severe bladder pathology in this study and was found in 48 of the participants (Table 5). There was a higher incidence of bladder pathologies among female participants (Table 3); bladder mass and hydronephrosis were also seen only in female participants.

There was no significant relationship between cigarette smoking and bladder pathology in the study (Table 6). Among participants with bladder pathology, 29 (33.3%) admitted consuming alcohol while 58 (66.7%) said that they had never consumed alcohol (Table 7).

4. Discussion

The overall prevalence rate (25.98%) of adults with S. haematobium infection recorded in this study was slightly higher than 20.8% and 20.0% reported in Yewa North Local Government, Ogun State, and Owan East Local Government, respectively, in Nigeria [3, 13].

Most (81.3%) of the participants depended solely on the S. haematobium contaminated river water, which could account for the higher S. haematobium prevalence; and little or no schistosomiasis control (drug) intervention targeted to adults has been recorded in this area. The higher frequency of light intensity S. haematobium infection observed in this study could be explained by some level of acquired protected immunity by adults in that community due to chronic exposure to schistosomiasis. Shiff et al. [5] found that the proportion of egg-positive individuals falls progressively with age and is a feature in populations with lifelong exposure to the parasite. Therefore, chronicity of infections in older
Table 4: Relative risk estimates of schistosomiasis with sources of water.

| Sources of water use | Status of *S. haematobium* infection |
|----------------------|-------------------------------------|
|                      | Positive | Negative |
| Rivers               | 49 (79.0) | 160 (88.9) |
| Others               | 11 (17.7) | 15 (8.1)   |
| Rivers and others    | 2 (3.2)   | 11 (5.9)   |
| Total                | 62 (100.0) | 186      |

\[ \chi^2 = 4.789, df = 2, P = 0.091 \]

Table 5: Relation between intensity of bladder pathologies and intensity of *S. haematobium* infection.

| Intensity of *S. haematobium* infection | Intensity of bladder pathology | Total |
|----------------------------------------|---------------------------------|-------|
|                                        | Mild (\% N)                     | Severe (\% N) |
| Heavy                                 | 6 (9.09)                        | 2 (3.0) |
| Light                                 | 42 (63.63)                      | 6 (9.1) |
| Total                                 | 48 (69.69)                      | 8 (12.1) |

\[ \chi^2 = 267.5, P = 0.001 \]

Table 6: Relative risk estimates of bladder pathology associated with cigarette smoking.

| Cigarette smoking | Pathology | Total |
|-------------------|-----------|-------|
|                   | Present (\% N) | Absent (\% N) | |
| No response       | 5 (5.7)       | 12 (71.1)       | 17 (5.8) |
| Yes               | 4 (4.6)       | 5 (2.9)         | 9 (12.1) |
| No                | 78 (89.7)     | 153 (90.0)      | 231 (82.1) |
| Total             | 87 (33.9)     | 170 (66.1)      | 257 |

\[ \chi^2 = 0.67, P = 0.880 \]

Table 7: Relative risk estimates of bladder pathology associated with alcohol consumption.

| Alcohol consumption | Bladder pathology | Total |
|---------------------|-------------------|-------|
|                     | Present (\% N)    | Absent (\% N) | |
| Yes                 | 29 (33.3)         | 72 (42.4)     | 101 (39.3) |
| No                  | 58 (66.7)         | 85 (50)       | 143 (55.6) |
| No response         | 0 (5.7)           | 13 (7.6)      | 13 (5.1)   |

\[ \chi^2 = 3.549, P = 0.170 \]

People will more likely be difficult to ascertain using egg count method. The higher frequency of mild bladder pathology observed in this study was also similar to another study [14] which observed a higher incidence of mild bladder than severe bladder pathology. This result could be explained by the low number of participants who smoked cigarettes and consumed alcohol; these conditions may serve as promoting factors either in progression of bladder pathology to cancer or in making the bladder pathology more severe (Table 4). In addition, this lifestyle could buttress the possibility of *S. haematobium* being the principal cause of the reported bladder structural pathology in the study population.

The close relationship between the intensity of *S. haematobium* infection and the presence of bladder abnormalities was similar to previous reports [3, 14–16]. The presence of hydronephrosis in participants with light infection is however at variance with the report of Nmorsi et al. [3] although hydrocalycosis (a condition mostly mistaken for hydronephrosis) was observed in some patients with heavy infection, indicating the likely contribution of this infection to kidney pathology. Females (64.7%) had more structural bladder pathology compared to males (35.3%). This may be due to higher water contact by females and also to the higher number of female study participants than an indication of a female predilection to bladder pathology. However, since hydronephrosis and bladder mass or bladder calculi were found together in a female participant, female predilection to bladder pathology may not completely be ruled out. The structural changes to the bladder recorded in this study were in consonance with observations in West Madagascar [14] and Nigeria [3, 15] where bladder irregularities and bladder wall thickness were identified as the most common pathologies in individuals infected with *S. haematobium*.

In conclusion, there is evidence that *S. haematobium* infections may be associated with bladder pathology, on ultrasound examination. Individuals with bladder pathologies could have heavy or light intensity of schistosomiasis infection or have no existing infection at all. However, a long term exposure to schistosomiasis is necessary for the development of bladder cancer. Further research on the determinants and progress of the bladder pathologies seen in this study population is needed.

**Competing Interests**

The authors declare that they have no competing interests.

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