

An Assessment of *Schistosoma haematobium* infection and urinary tract bacterial infection amongst school children in rural eastern Nigeria

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Abstract

Urinary schistosomiasis and UTI caused by bacteria are very common occurrences among children in the tropics. Both conditions were assessed among school children in two rural areas of Ebonyi State Nigeria (Ezza-North and Ngbo-West local government areas LGAs) using standard techniques. In Ngbo-West LGA, 6.3% of the children had *S. haematobium* infection while 79.4% in Ezza-North LGA were infected with *S. haematobium*. Up to 48.3% of the children in Ngbo-West LGA and 98.3% in Ezza-North LGA had significant bacteria growth ($\geq 10^4$ cfu/ml) in their urine specimens indicating presence of UTI. *Staphylococcus aureus* was the commonest bacteria isolates associated with UTI in both localities. All the children with *S. haematobium* infection in both LGAs, were among those who had UTI. There is the need to incorporate antibiotics in mass schistosomicidal treatment programmes in urinary schistosomiasis endemic areas along with other public health interventions such as access to safe water, improved sanitation, health education, health communication, and appropriate case management

INTRODUCTION

Urinary schistosomiasis an important parasitic disease caused by *Schistosoma haematobium* constitutes a major public health problem in the African continent [1], and in some tropical and sub-tropical regions of the world [2]. Although infection with schistosomes does not always result in clinical disease, and many infections are asymptomatic, *S. haematobium* infection however could cause haematuria, dysuria, nutritional deficiencies, lesion of the bladder, kidney failure, an elevated risk of bladder cancer and in children- growth retardation [3,4]. Accordingly the estimates for morbidity and mortality in affected populations are high with school age children usually presenting with the highest prevalence and intensity of infection [5,6]. Urinary schistosomiasis affect 66 million children throughout 76 countries and in some villages in Africa, over 90% of the children are infected by the diseases [5]. Extreme poverty, the unawareness of the risks, the inadequacy or total lack of public health facilities plus the unsanitary conditions in which millions of people lead their daily lives especially in the rural areas of developing tropical countries are all factors contributing to the risk of infection [2,5].

Urinary tract infection UTI is a pandemic disease that is

responsible for much illness and contributes significantly to the cost of providing health globally, leading to a number of deaths either from acute infection or from chronic renal failure [7]. UTI defines a condition in which the urinary tract is infected with a pathogen causing inflammation [8]. Though the etiology and clinical presentation of infections are similar in industrialized and developing countries, it is evident that persons with these infections in resource-constrained tropical areas of the world including most African countries, often present for care with more severe illness and often only after complications have developed [9].

The incident of urinary tract infections is greatly influenced by age and sex and by predisposing factors that impair the defense mechanism that maintain the sterility of the normal urinary tract [10]. Infection in children is often hard to recognize because of the variable symptomatology and the difficulty of obtaining suitable specimens of urine in the very young, but they are of particular importance as causes of permanent damage to the developing kidney [11]. In man, the urinary tract is the second commonest site, after the respiratory tract, for bacterial infection; consequently, urethritis cystitis, and pyelonephritis are the infections of

urinary tract which can be caused by bacteria like *Staphylococcus saprophyticus*, *Escherichia coli*, *Enterococcus* spp., *Proteus* spp., *Pseudomonas* spp., and *Klebsiella* spp. etc [10].

In this present report, we present the findings from the assessment of urinary schistosomiasis and urinary tract bacteria infection among school children in two localities of south-eastern Nigeria, with the view to providing more insights on the relationship between *S. haematobium* infection and bacteria causing UTI and highlighting the public health and socio-economic implications of the concurrent infection in a typical resource poor setting of the tropics.

MATERIAL AND METHODS

STUDY AREA AND POPULATION

This study was conducted from January 2006 to February 2008 in parts of Ebonyi State south-eastern Nigeria. The climate is tropical and the vegetation characteristic is predominantly the rain forest with an average annual rainfall of about 1600mm and average atmospheric temperature of 30°C. There are two distinct seasons, the wet and the dry season. The former takes place between April and October, while the latter occurs from November to March. The study took place in selected primary schools in the rural communities in two local government areas (LGA) within Ebonyi State. The first LGA was Ezza-North and the schools were Community Primary School CPS Ugalaba, and Community Primary School CPS Achiagu. The major sources of water supply in these communities are rivers, streams and ponds. The second LGA was Ngbo-West and the school used was Community Primary School CPS Ukpeshi. The major sources of water supply in this community are wells and boreholes. Systematic schistosomicidal treatment had never been applied in both LGAs. Primary school pupil were selected for this study because: (i) schools are accessible without much difficulties, (ii) the peak of prevalence of schistosomiasis is to be found in this group [12] and (iii) experience shows that there is general good compliance from children and parents [13].

ETHICAL CONSIDERATION

This study protocol was approved by the Department of Medical Microbiology/Parasitology, Faculty of Clinical Medicine Ebonyi State University. The study was also approved by the Ezza-North and Ngbo-East Local Government Council Authorities, the Local Government

Health Departments and the Parent-Teachers Association (PTA) of each of the schools used for the studied. Informed consent was obtained from each of the pupils before inclusion in the study. Demographic information such as age and water contact activities was obtained by interview from each participant.

SAMPLING TECHNIQUE

About 20ml of clean-catch, midstream urine samples were collected in 50ml capacity, autoclaved, wide-mouthed, leak proof universal containers by subjects themselves, who were previously carefully instructed with illustration aids. This was to avoid any possible contamination during collection. Samples were obtained during school hours, between 10:00hrs and 14:00hrs [14], from pupil whose last micturation was at least 2 hours old [15] to accommodate bacteria analysis. Samples with visible haematuria were noted. Each sample collected was divided into two fractions. About 10ml of each urine sample (fraction A) was investigated for the presence of *S. haematobium* ova. The remaining 10ml (fraction B) was investigated for bacteriuria. The specimens were appropriately labeled with identification numbers and placed in a cold box with ice packs, immediately after collection. They were processed 2-3hrs of collection [14,16].

LABORATORY INVESTIGATIONS

The urine sedimentation technique described previously [16] was used to detect the presence of *S. haematobium* ova in the urine samples Fraction A, and to determine the intensity of the infection in each case. Intensity was reported as the number of ova/10ml of urine and was categorized as light (≤ 50 ova/10ml of urine) and heavy (≥ 50 ova/10ml of urine). A few drops of saponin solution were added to samples with visible haematuria to enhance clarity in microscopy [16].

Fraction B of the urine samples were aseptically cultured (immediately they were identified) on blood agar (BA) medium and cystine lactose electrolyte deficiency (CLED) medium according to standard protocol as described previously [10]. The pairs of culture plates were incubated aerobically at 37°C for 24 hours. Colonial characteristics, gram reaction, catalase and coagulase tests, haemolysis on BA medium, lactose fermentation on CLED medium and other biochemical tests such as indole production, citrate utilization, urase activity, triple sugar iron (TSI) agar test (for glucose, sucrose, and lactose fermentation), gas and hydrogen sulphide production and oxidase test were

conducted as described previously [10], for bacterial isolation and identification. The presence of UTI was described as bacteria count of equal or greater than 10^4 colony forming units per ml of urine (cfu/ml).

STATISTICAL ANALYSIS

Differences in proportion were evaluated using the Chi-square test. Statistical significance was achieved if $P < 0.05$.

RESULTS

A combined total of 803 persons participated in the study from the two LGAs. Of the 400 children studied in Ngbo-West LGA, 25(6.3%) had *S. haematobium* infection while 320 (79.4%) of the 403 children screened in Ezza-North LGA were infected with *S. haematobium* (Table 1).

Figure 1

Table 1. Prevalence of infection amongst children in Ezza-North and Ngbo-West LGAs of Ebonyi State Nigeria

Sex	No. examined	No.(%) infected
Ezza North LGA		
Male	241	200 (82.9)
Female	162	120 (74.1)
Total	403	320 (79.4)
Ngbo West LGA		
Male	238	17 (7.1)
Female	162	8(4.9)
Total	400	25(6.3)

In both LGAs, the male children were more infected with *S. haematobium* than the females, the difference was statistically significant in Ezza-North LGA ($\chi^2 = 4.67$, $df=1$, $P<0.05$) but was not in Ngbo-West LGA ($\chi^2 = 0.782$, $df=1$, $P<0.05$). Laboratory findings indicated that 191 (48.3%) of the children in Ngbo-West LGA and 396 (98.3%) in Ezza-North LGA had significant bacteria growth ($\geq 10^4$ cfu/ml) in their urine specimens indicating presence of UTI (Table 2 and Table 3). In Ezza-North LGA, the prevalence of UTI was almost the same amongst the male and female children. In Ngbo-West LGA, the males were more infected than the females (58.1% vs 49.4%) but the difference was not statistically significant ($\chi^2 = 4.50$, $df=1$, $P<0.05$). In Ezza-North LGA, the prevalence of UTI increases with age but in Ngbo-West LGA, the prevalence of UTI decreases with age, however in both cases the differences were not statistically significant ($\chi^2 = 0.225$, $df=1$, $P<0.05$ and $\chi^2 = 2.0$, $df=1$, $P<0.05$ respectively) (Table 2 and Table 3).

Figure 2

Table 2. Prevalence of UTI among School Pupils in Ezza-North LGA of Ebonyi State Nigeria

Age (years)	Male		Female		Total	
	No. examined	No(%) with UTI	No. examined	No(%) with UTI	No. examined	No(%) with UTI
< 6	57	55(96.5)	27	27(100.0)	84	82(97.6)
7-10	133	130(97.7)	106	105(99.1)	239	235(98.3)
11-14	55	55(100.0)	25	24(96.0)	80	79(98.8)
Total	245	240(98.0)	158	156(98.7)	403	396(98.3)

Figure 3

Table 3. Prevalence of UTI among School Pupils in Ngbo-West LGA of Ebonyi State Nigeria

Age (years)	Male		Female		Total	
	No. examined	No(%) with UTI	No. examined	No(%) with UTI	No. examined	No(%) with UTI
< 6	24	13(54.2)	10	4 (40.0)	34	17 (50.0)
7-10	184	85 (47.3)	110	60 (54.6)	294	145 (49.3)
11-14	30	13 (43.3)	42	16 (38.1)	72	191 (47.8)
Total	238	111(58.1%)	162	80 (49.4)	400	191 (47.8)

Staphylococcus aureus, *Pseudomonas aeruginosa* and *Enterococcus faecalis* were the commonest bacteria isolates associated with UTI in Ezza-North LGA (Table 4), while in Ngbo-West LGA the commonest bacteria isolates included *Escherichia coli* and *Staphylococcus aureus* (Table 5). All the children with *S. haematobium* infection in both LGAs, were among those who had UTI.

Figure 4

Table 4. Prevalence of Bacteria Isolates among School Children in Ezza-North LGA of Ebonyi State

Bacteria agents	No (%) of Isolates
<i>Staphylococcus aureus</i>	126(31.8)
<i>Pseudomonas aeruginosa</i>	98(24.7)
<i>Enterococcus faecalis</i>	52(13.1)
<i>Escherichia coli</i>	35(8.8)
<i>Proteus species</i>	32(8.1)
<i>Klebsiella species</i>	27(6.8)
<i>Staphylococcus saprophyticus</i>	26(6.6)
Total	396 (98.3)

Figure 5

Table 5. Prevalence of Bacteria Isolates among School Children in Ngbo-West LGA of Ebonyi State

Bacteria agents	No (%) of Isolates
<i>Staphylococcus aureus</i>	58(14.5)
<i>Pseudomonas aeruginosa</i>	12(3.3)
<i>Enterococcus faecalis</i>	6(1.5)
<i>Escherichia coli</i>	76(19.0)
<i>Proteus species</i>	16(4.3)
<i>Klebsiella species</i>	16(3.5)
<i>Staphylococcus saprophyticus</i>	9(2.3)
Total	191 (47.8)

DISCUSSION

The result of this study which showed *S. haematobium* infection prevalence of 79.4% in Ezza-North LGA of the Ebonyi State Nigeria, falls within the WHO classification as endemic [5]. A number of previous reports have indicated that *S. haematobium* is endemic in many parts of Nigeria particularly among school children [17-19]. It is however interesting to note that a higher prevalence of UTI was observed among children in Ezza-North LGA the locality where *S. haematobium* infection was considerably higher compared to Ngbo-West where *S. haematobium* infection prevalence of 6.3% was recorded. Some earlier studies have evaluated the prevalence of UTI caused by bacteria and the relationship with urinary schistosomiasis in different epidemiological, clinical and experimental studies and suggested a possibility of a link between the two conditions [19-22].

Although this present study did not clearly demonstrate that urinary schistosomiasis predisposes infected individuals to UTI caused by bacteria, this possibility can not however be overruled. This is because an earlier study noted that despite the fact that bacteria UTI prevalence values vary from one area to another and even from one report to another in the same country, they are generally much higher than those documented in the area with no *S. haematobium* endemic infection [23]. Another previous report had suggested that schistosomiasis appears to enhance the susceptibility of infected persons to bacteria causing UTI [20]. Reports from Egypt indicated that some 39 to 66% of subjects with schistosomiasis were found to have a bacteria infection in the urinary tract [21,24]. However, the subjects were solely hospitalized patients. Other reports particularly from community-based epidemiological surveys revealed bacteria prevalence of 25.8% in Egypt [25], 10.0% in Tanzania [26], and 75.4% in South-western Nigeria [22] among persons with *S. haematobium*.

The reasons why individuals with *S. haematobium* infection appear to be more susceptible to UTI or the mechanism by which this occurs remain obscure. Nevertheless, some studies [27,28] have noted that the association between schistosomal and bacteria infection could result from a relationship (possibly symbiotic) in which the bacteria either become fixed on the cutaneous surface of the worms in clearly defined place or, colonize the caecum of the parasite as observed by Otteens and Dickerson [29]. This is in addition to the finding in a urinary schistosomiasis low

endemic area of Malumfashi North-western Nigeria, where it was concluded that the lack of association between urinary bacterial infection and schistosomiasis in their study probably reflects the low intensity of *S. haematobium* in the area [23].

The commonest bacterium isolated in the UTI cases in this study which was *Staphylococcus aureus* was also a common occurrence in some related studies [30-32]. *Staphylococcus* is a nitrate-reducing bacterium [33], and is thought to play a significant role in the endogenous formation of carcinogenic alkylating agents, eg, N-nitrosamines, which greatly increase the risk of urinary bladder cancer and other cancers [25].

In conclusion, it is pertinent to state that since the potential exist for possible interaction between *S. haematobium* infection and bacteria UTI in urinary schistosomiasis endemic areas, further studies are urgently required using the more sophisticated molecular and immunological tools to clearly elucidate this association. There is also the need to incorporate antibiotics in mass schistosomicidal treatment programmes along with other public health interventions such as access to safe water, improved sanitation, health education, health communication, and appropriate case management. These strategies will improve the health of children in endemic areas.

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