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Outbreak of Urinary Schistosomiasis among School Children in Riverine Communities of Delta State, Nigeria: Impact of Road and Bridge Construction

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Following frequent reports of haematuria among school children in Ndokwa-East Local Government Area of Delta State, Nigeria, a longitudinal pre-control survey of urinary schistosomiasis was conducted in 10 riverine communities of the local government area from March 2003 to February 2005. School children aged between 5 and 12 years were examined for *Schistosoma haematobium* ova in their urine. Of the 580 and 1032 children examined in the first and second year of study respectively, there was a significant ($p<0.05$) increase in prevalence from 21.9% to 91.4%, geometric mean intensity of infection increased significantly ($p<0.05$) from 14.4 to 26.0 eggs^{-1} 10 mL urine, while macrohaematuria also increased from 1.2% to 56.5%. Prevalence and intensity of infection were significantly ($p<0.05$) higher in males than in females. There was a seasonal variation in prevalence, which was significantly ($p<0.001$) higher in dry season than rainy season. Four species of snails were encountered with *Bulinus* (*physopsis*) *globosus* predominating. The road and bridge construction project which created a favourable environment for snail growth and proliferation in addition to poor sanitary habit, lack of potable water and ignorance of the inhabitant of these riverine communities may have contributed to the recent outbreak.

Key words: *Schistosoma haematobium*, outbreak, prevalence, bridge constructions, Delta State, Nigeria

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INTRODUCTION

Schistosomiasis is a water-borne parasitic disease that affects 200 million people and poses a threat to 600 million in more than 76 countries including Nigeria (Ekpo and Mafiana, 2004). The disease is caused by a parasitic trematode worm of the genus Schistosoma. It has been documented that both urinary and intestinal schistosomiasis caused by *S. haematobium* and *S. mansoni*, respectively are endemic in Nigeria with vast distribution (Ozumba *et al*., 1989; Adewunmi *et al*., 1991, Opara *et al*., 2001). *Schistosoma haematobium* is however more widespread and the incidence is believed to be on the increase (Ejezie *et al*., 1999; Okoli and Odaibo, 1999; Ekpo and Mafiana, 2004). The construction of dams, bridges and the establishment of irrigation projects, the extensive human water contact activities with concomitant population and lack of political will for a concerned national control initiative have collectively increased the potential danger for the transmission of the disease (Fajewonyomi and Afolabi, 1994).

Although, schistosomiasis is a known widespread disease in the country, the epidemiology, distribution and complication are inadequately documented; many areas remain unidentified and/or unstudied. It is known that schistosomiasis affects up to 50% or more of people in some areas of Nigeria, but the total number of affected persons is unknown (NSCP, 1999). The lack of national baseline data on the epidemiology of the disease has hampered control initiatives.

In Ndokwa-East local government area of Delta State, the communities have never experienced any outbreak of schistosomiasis before now. However, following reported cases of blood in the urine of some primary school children in the communities, this study was therefore conducted to document the immediate and remote causes of the current outbreak of urinary schistosomiasis in these riverine communities using primary school children as tracers.

MATERIALS AND METHODS

Study site: The study was conducted in Ndokwa-East Local Government Area (LGA) of Delta State, Nigeria. The LGA is bounded in the East by River Niger and West by the Ase Creek (Fig. 1). Delta State lies between longitudes 5°00 and 6°45 E and latitudes 5°00 and 6°30 N. The entire Delta state is a region built up by the sedimentation of the Niger Delta and consists of the delta in various stages of development. The River Niger drains the eastern-flank of the State and discharges into the sea through its several distributaries. The climate is tropical, rainfall is about 266.5 mm in the coastal areas and 190.5 mm in the extreme north, with maximum precipitation occurring in July. The two main seasons in this area include the rainy season (April to October) and the dry season (November to March). Fishing and subsistence farming are the major occupations of these communities; rice, yam and cassava are extensively cultivated by the inhabitants. The people in these communities make use of perennial and intermittent streams/rivulets as their sources of water supply for daily needs due to the absence of pipe-borne water. These streams and rivulets empty into the Ase Creek and River Niger, the main River in the state. The government has embarked on massive road network and bridge construction across Ase creek and through the riverine communities; this study reports the outbreak of urinary schistosomiasis in riverine communities of Ndokwa-East local government due to these construction projects.

Ethical consideration: The village head of each of the communities was briefed about the study before its commencement. Following their consent the headmaster and teachers of each of the school were also briefed and incorporated into the research team. The consent of parents were sought and obtained through the village head. The Delta State Ministry of Health approved of the study.

Sample collection: The study was conducted in 10 communities in Ndokwa-East Local Government Area of Delta State, Nigeria between March 2003 and February, 2005. Urine samples were collected from 1612 children aged between 5 and 12 years. The samples were collected in 20 mL universal containers between 10.00 and 14.00 hours, when maximum egg excretion occurs (Chen and Mott, 1988).

Detection of ova: Prevalence of urinary schistosomiasis was done using centrifugal sedimentation method and parasitological demonstration of schistosome eggs in 10 mL of urine as described by Richard *et al.* (1984). The frequency of visible haematuria (macrohaematuria) was also recorded.

Snail survey: Snails were collected manually or with kitchen sieve net method (Adewumi *et al*., 1990).

Data analysis: Data collected were analysed using the chi-squared test, variation in mean values were tested with students t-test.

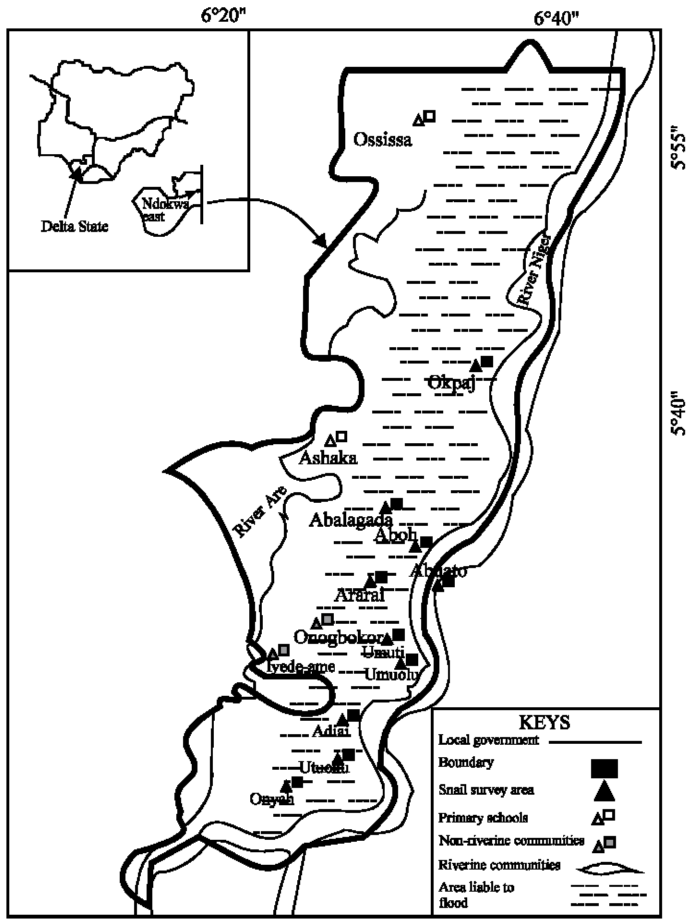

Fig. 1: Map of Ndokwa-East showing the surveyed schools and snail sampling sites

RESULTS

Out of the 580 subjects examined for urinary schistomiasis in the 10 primary schools, during the first year of study (2003-2004), 126 (21.7%) were infected with *S. haematobium* (Table 1); prevalence in individual schools ranged from 10.0% in Umuti to 38.5% in Abuator primary school. There was a significant variation (χ^2 = 28.36; df = 9; p<0.05) in prevalence between schools. The absolute egg count (intensity) ranged from 1 to 320 eggs^{-1} 10 mL urine. The overall geometric mean intensity was 14.4 eggs^{-1} 10 mL urine. There was considerable variation in the number of *S. haematobium* eggs in the urine samples (p<0.05). Macrohaematuria varied from 1.1% in Ogwezi primary school to 3.0% in Abuator primary school.

Out of 1032 subjects examined, 91.4% were positive for eggs of *S. haematobium* in urine samples. Prevalence in individual school ranged from 89.1% in Obodoyibo primary school to 95.1% in Umuolu primary school. There was no significant (χ^2 = 1.93; df = 9; p>0.05) variation in prevalence between schools. The absolute eggs counts ranged from 1 to 700 egg^{-1} 10 mL of urine. The overall geometric egg count was 26.0 egg^{-1} 10 mL of urine. Macrohaematuria ranged from 37.7 to 76.8% (Table 2).

More males (23.7%) were infected than females (19.3%) (χ^2 = 50.58, p<0.001). The intensity of infection was significantly (p<0.001) higher in males (9.5 eggs^{-1} 10 mL urine) than in females (4.2 eggs^{-1} 10 mL urine). The infection rate was highest in the 11-13 years age group (30.0%) followed by 8-10 years age group (27.0%). The highest infection intensity of 8.2 eggs^{-1} 10 mL of urine was recorded in the 8-10 years age group (Table 3).

More males (94.9%) were infected than females (87.8%) (χ^2 = 16.03; p<0.001). The intensity of infection was also higher in males (28.3 eggs^{-1} 10 mL of urine) than in females 21.3 eggs^{-1} 10 mL of urine). The infection rate was highest in the 8-10 years age group (97.4%), followed by 5-7 years age group (86.2%). The highest infection intensity of 14.3 eggs^{-1} 10 mL urine was recorded in 8-10 years age group (Table 4).

Table 1: Prevalence, mean intensity and percentage macrohaematuria of *S. haematobium* (1st year) infection in 10 primary school in Ndokwa-East LGA of Delta State, Nigeria

Community/ primary school	No. of examined	No. of infected	Prevalence (%)	Geometric mean intensity (eggs/10 mL)	No. with macro haematuria	Infected (%)
Obodoyibo P/S, Okpai	60	14	23.3	15.0	1	1.7
Ogwezi P/S, Aboh	90	12	13.3	11.2	1	1.1
Abuator P/S, Abuator	65	25	38.5	18.4	2	3.0
Abalagada P/S, Abalagada	65	16	24.6	12.6	1	1.5
Adaiwai P/S, Adaiwai	50	14	28.0	16.3	0	0.0
Akarai P/S, Akarai	50	8	16.0	12.2	0	0.0
Umuolu P/S, Umuolu	50	17	34.0	15.4	0	0.0
Onyah P/S, Onyah	50	9	18.0	14.1	1	2.0
Umuoku P/S, Umuoku	50	6	12.0	14.3	0	0.0
Umuti P/S, Umuti	50	5	10.0	13.2	1	2.0
Total	580	126	21.7	14.5	7	1.2

Table 2: Prevalence, mean intensity and percentage macrohaematuria of *S. haematobium* infection (2nd year) in 10 primary School in Ndokwa-East LGA of Delta State, Nigeria

Community/ primary school	No. of examined	No. of infected	Prevalence (%)	Geometric mean intensity (eggs/10 mL)	No. with macro haematuria	Infected (%)
Obodoyibo P/S, Okpai	183	163	89.1	24.2	69	37.7
Ogwezi P/S, Aboh	102	93	91.2	29.0	64	62.7
Abuator P/S, Abuator	164	151	92.1	31.1	83	50.6
Abalagada P/S, Abalagada	100	93	93.0	26.3	56	56.0
Adaiwai P/S, Adaiwai	114	104	91.2	24.2	61	53.5
Akarai P/S, Akarai	98	89	90.8	28.1	54	55.1
Umuolu P/S, Umuolu	82	78	95.1	27.0	63	76.8
Onyah P/S, Onyah	71	65	91.5	25.4	52	73.2
Umuoku P/S, Umuoku	65	59	90.8	21.3	45	69.2
Umuti P/S, Umuti	53	48	90.6	25.2	36	67.9
Total	1032	943	91.4	26.2	583	56.5

Table 3: Prevalence, mean intensity and percentage of *S. haematobium* infection by age and sex (1st year)

	Male				Female				Total			
Age (years)	No. Exa.	No. Inf.	% Inf.	Mean int. (eggs/10 mL)	No. Exa.	No. Inf.	% Inf.	Mean int. (eggs/10 mL)	No. Exa.	No. Inf.	% Inf.	Mean int. (eggs/10 mL)
5-7	131	22	16.8	2.2	125	16	12.8	1.1	256	38	14.8	3.1
8-10	160	47	29.4	6.3	151	37	24.5	2.0	311	84	27.0	8.2
11-13	7	2	28.6	1.1	3	1	33.3	1.0	10	3	30.0	2.3
> 13	2	0	0.0	0.0	1	0	0.0	0.0	3	0	0.0	0.0
Total	300	71	23.7	9.5	280	54	19.3	4.2	580	125	21.6	14.4

Table 4: Prevalence, mean intensity and percentage of *S. haematobium* infection by age and sex (2nd year)

	Male				Female				Total			
Age (years)	No. Exa.	No. Inf.	% Inf.	Mean int. (eggs/10 mL)	No. Exa.	No. Inf.	% Inf.	Mean int. (eggs/10 mL)	No. Exa.	No. Inf.	% Inf.	Mean int. (eggs/10 mL)
5-7	232	218	93.9	11.3	225	176	78.2	8.2	457	394	86.2	10.4
8-10	280	273	97.5	15.4	275	268	97.5	12.1	555	541	97.4	14.3
11-13	9	6	66.7	1.1	5	1	20.0	1.1	14	7	50.0	1.2
> 13	4	1	25.0	1.0	2	0	0.0	0.0	6	1	16.7	1.1
Total	525	498	94.9	28.3	507	445	87.8	21.3	1032	943	91.4	26.0

Prevalence increased significantly from 21.7% in the first year to 91.4% in the second year, giving an overall increase of 76.3% (range 57-89.6%) ($p<0.05$) Intensity increased from 14.4 $eggs^{-1}$ 10 mL urine to 26.0 $eggs^{-1}$ 10 mL urine, giving an increase of 46.2% (range 33.3-57.1%) ($p<0.05$). Macrohaematuria increased from 1.2 to 56.5% giving an increase of 97.9% (range 0-98.2%) ($p<0.05$) (Table 5).

Prevalence was found to be significantly ($p<0.05$) higher in the dry season (12.9%) than in the rainy season (8.7%) in the first year of study (Table 6). In the second year the prevalence increased to 51.9% in the dry season and 39.4% in the rainy season (Table 7).

Snail survey revealed the presence of *Bulinus* (*physopsis*) *globosus*, *B. truncatus*, *B. forskali* and

Table 5: Summary of the relative increase in prevalence, intensity and macrohaematuria

Community	Prevalence			Intensity			Macrohaematuria		
	1st year	2nd year	Increase (%)	1st year	2nd year	Increase (%)	1st year	2nd year	Increase (%)
Obodoyibo	23.3	89.1	73.9	15.2	24.3	37.5	1.7	37.7	95.5
Ogwezi	13.3	91.2	85.3	11.1	29.2	62.1	1.1	62.7	98.2
Abuator	38.5	92.1	57.9	18.4	31.3	41.9	3.0	50.6	94.1
Abalagada	24.6	93.0	73.5	12.5	26.4	53.8	1.5	56.0	93.3
Adaiwai	28.0	91.2	69.2	16.4	24.3	33.3	0.0	53.5	0.0
Akarai	16.0	90.8	82.4	12.3	28.4	57.1	0.0	55.1	0.0
Umuolu	34.0	95.1	64.2	15.3	27.1	44.4	0.0	76.8	0.0
Onyah	18.0	91.5	80.4	14.2	25.3	44.0	2.0	73.6	93.3
Umuoku	12.0	90.8	86.8	14.2	21.4	33.3	0.0	69.2	0.0
Umufi	10.0	90.6	89.0	13.4	25.5	48.0	2.0	67.9	89.7
Total	21.7	91.4	76.3	14.4	26.0	46.2	1.2	56.5	97.9

Table 6: Seasonal variation in prevalence of urinary schistosomiasis in primary school children in ten communities in Ndokwa-East (first year of study)

Community, primary schools (P/S)	No. of examined	No. (%) infected in dry season	No. (%) infected in rainy season	Haematuria (%)
Obodoyibo P/S, Okpai	60	8 (13.3)	6 (10.0)	1 (7.1)
Ogwezi P/S, Aboh	90	6 (6.7)	6 (6.7)	1 (8.3)
Abuator P/S, Abuator	65	15 (23.1)	10 (15.4)	2 (8.0)
Abalagada P/S Abalagada	65	10 (15.4)	6 (9.2)	1 (6.3)
Adaiwai P/S, Adaiwai	50	8 (16.0)	5 (10.0)	0 (0)
Akarai P/S. Akarai	50	5 (10.0)	3 (6.0)	0 (0)
Umuolu P/S Umuolu	50	10 (20.0)	7 (14.0)	0 (0)
Onyah P/S, Onyah	50	6 (12.0)	3 (6.0)	1 (11.1)
Umuoku P/S, Umuoku	50	4 (8.0)	2 (4.0)	0 (0)
Umuti P/S, Umuti	50	3 (6.0)	2 (4.0)	1 (10.0)
Total	580	75 (12.9)	50 (8.7)	7 (5.6%)

Table 7: Seasonal variation in prevalence of urinary schistosomiasis in primary school children in ten communities in Ndokwa-East (second year of study)

Community, primary schools (P/S)	No. of examined	No. (%) infected in dry season	No. (%) infected in rainy season	Haematuria (%)
Obodoyibo P/S, Okpai	183	89 (48.6)	74 (40.4)	69 (41.1)
Ogwezi P/S, Aboh	102	53 (51.9)	40 (39.2)	64 (68.8)
Abuator P/S, Abuator	164	95 (57.9)	56 (34.2)	83 (54.9)
Abalagada P/S Abalagada	100	51 (51.0)	42 (42.0)	56 (61.5)
Adaiwai P/S, Adaiwai	114	55 (48.3)	49 (42.9)	61 (58.7)
Akarai P/S. Akarai	98	51 (52.0)	38 (38.8)	54 (60.7)
Umuolu P/S Umuolu	82	43 (52.4)	35 (42.6)	63 (84.0)
Onyah P/S, Onyah	71	35 (49.3)	30 (42.3)	52 (80.0)
Umuoku P/S, Umuoku	65	37 (56.9)	22 (33.9)	45 (76.3)
Umuti P/S, Umuti	53	3 (6.0)	21 (39.6)	36 (75.0)
Total	1032	536 (51.9)	407 (39.4)	583 (62.1%)

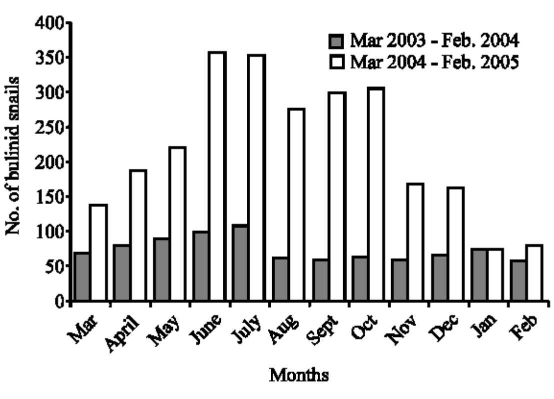

Fig. 2: Monthly and seasonal distribution of bulinid snails in Ndokwa east LGA first and second year of study

B. senegalensis with *B. globosus* dominating, (Fig. 2). The snail population was highest during the rainy season than in the dry season.

DISCUSSION

This present study shows that *S. haematobium* is actively being transmitted within the study area and the disease must have assumed a public health problem status within the communities. The high prevalence of 91.4% observed during the second year of study is similar to that reported by Ofoezie *et al.* (1991), they recorded 80% prevalence of urinary schistomiasis outbreak due to construction of a reservoir in Abeokuta, Nigeria. The overall prevalence and intensity of infection are higher than those previously reported in major studies in Nigeria (Okoli and Odaibo, 1999; Useh and Ejezie, 1999; Ekpo and Mafiana, 2004). The high prevalence of *S. haematobium* in the area might be due to abundance of surface water, which enhances the development of high snail population, human water contact behaviour and environmental factors that affect snail population favourably (Jordan, 1972). An abundance of bulinid snail, schistosome intermediate host was observed. This could partly be responsible for the high rate of schistosome infection recorded in this study. According to Brown (1980), high number of snail signifies a high number of cercariae shed and this invariably increases the incidence of infection.

The higher infection rate among males than females can be attributed to greater water contact behaviour. Similar findings have been reported by Egwuyenga *et al.* (1994). The higher prevalence rate observed in males in this study conforms to patterns found in most endemic areas and reflects the greater opportunities of male to exposure (Okoli and Odaibo, 1999). The higher infection rate among pupils in the 8-10 years age group could be attributed to exposure factors. The tendency is that at the tender age of 6 years and below, children make less water contact than the older age group. On the other hand, older age groups 11 years and above find other alternative means of recreating especially on reaching the age of puberty and becoming more conscious of their social and reproductive development (Fajewonyomi and Afolabi, 1994). These observations might have accounted for the low prevalence rate recorded in the age group 11-13 years and >13 years. There was a remarkable increase in prevalence, intensity and macrohaematuria in the study area, however, these varied from one community to another. The factors that may account for these remarkable increase in infection observed include the absence of community-based control programme, the absence of mass or targeted health education and the communities continuous reliance on cercariae infested freshwater bodies (Useh and Ejezie, 1999).

There was seasonal variation in the prevalence of urinary schistosomiasis in the present study. Prevalence was found to be significantly higher in the dry season than in the rainy season. The River Niger and Ase Creek are far from the inhabitants of these communities. The closest source of water to them during the dry season are the bulinid snail infested water bodies like ponds and lakes where they go for drinking water, swimming, washing of clothes and fishing, thereby maintaining frequent contact with these infested water bodies. Though, snails were more abundant during the rains, infection of humans was higher during the dry seasons. The high number of snails collected during the rains is probably peculiar to the riverine nature of the communities. Furthermore, the abundance of bulinid snail may have been encouraged by the road, culvert and bridge construction project across Ase Creek and through the communities. This project might have created a favourable environment for the proliferation and growth of the bulinid snail. The high rate of proliferation of snail in the rainy season during the construction of roads, culvert and bridges might have resulted in high rate of schistosome infection in the following dry months. Similar results have been documented by Taylor and Makura (1985) and Okoli and Odaibo (1999). However, in the rainy season because of the flood, the small ponds and lakes are merged with the River Niger and Ase Creek, forming an almost continuous body of water around the communities. As a result of the increased volume of water, inhabitants are scared of swimming and fishing. Direct contact of inhabitants with the river is reduced; also during the rainy season, there is little or no reason to go to the river for water related activities since rainfall is usually heavy to meet these needs. Consequently, infection with schistosome is less during the rainy season.

This investigation has shown that the immediate cause of the reported outbreak of schistosomiasis in the riverine communities in Ndokwa-East is the road, culvert and bridge construction project through the riverine communities. It was observed in the study area that during these construction projects, most of the intermittent streams/rivulets within the communities were either displaced and/or dammed to form pools of water, ponds and lakes, thereby creating favourable environment for the proliferation and growth of bulinid snail. The remote cause of the outbreak includes lack of potable water, poor sanitary habits, poverty and ignorance of the construction workers and inhabitants of the communities. Since it is generally accepted that eradication of transmission is an impracticable task, we therefore recommend that public enlightenment on schistosomiasis should emphasize its effects, mode of transmission and avoidance of water contact with bulinid snail infested water bodies.

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