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Prevalence, intensity of infection and risk factors of urinary schistosomiasis in pre−school and school aged children in Guma Local Government Area, Nigeria

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ABSTRACT

Objective: To determine the prevalence and intensity of infection and the risk factors associated with urinary schistosomiasis in pre−school and school aged children in Guma Local Government Area of Benue State, Nigeria. **Methods:** Urine filtration technique using polycarbonate membrane filters was employed to process urine specimens and to determine presence of *Schistosoma haematobium* eggs in urine. Questionnaires were also administered to children to collect information on socio−demographic data and water−contact activities. **Results:** An overall prevalence of 55.0% (165/300) was recorded out of the 300 urine samples examined. Prevalence of infection varied between 36.0%−64.0% with a significant difference (χ^2= 11.59, *P*=0.041) between the different communities visited. Males were more infected (60.6%, 103/170) than females (47.7%, 62/130) with a significant difference (χ^2= 4.95, *P*=0.026). The age−related prevalence showed higher prevalence (70.5%, 36/52) in the 11−15 year old children than that in the 1−5 year old ones (44.9%, 53/118). A significant difference was observed in the prevalence between the age groups (χ^2=10.56, *P*=0.014). The prevalence of light intensity of infection (1−49 eggs/10 mL of urine) (86.6%) was significantly higher than that of heavy intensity of infection ($\geqslant$50 eggs/10 mL of urine) (13.3%) in the area (*t*=16.48, *P*=0.000). Water contact activities of the children revealed that children that were involved in irrigation and those that went swimming in water bodies were observed to be at higher risk of becoming infected with urinary schistosomiasis in the area with odd ratios (risk factors) of 2.756 (1.334−5.693) and 2.366 (1.131−4.948) respectively at *P*<0.05 level. **Conclusions:** The study revealed the hyperendemicity of urinary schistosomiasis in the pre−school and school aged children in Guma Local Government Area. It is therefore recommended that praziquantel should be administered to children in the area and systematic epidemiological studies should be undertaken in the whole Local Government Area and the State at large to discover new foci of infection.

1. Introduction

Urinary schistosomiasis is a parasitic disease caused by the larval forms of blood flukes (schistosomes) acquired from infested freshwater snails of the *Bulinus* species. The disease can lead to chronic ill health condition and is considered as a major public health concern mostly in rural dwellers of tropical and sub−tropical regions of the world.

Currently, about 436 million people are at risk of infection and 112 million are infected with urinary schistosomes in sub−Saharan Africa[1]. This number underestimates the total burden, because several endemic foci are yet to be discovered. Nigeria is one of the highly endemic countries with an estimated 101.3 million at risk of infection and 29 million of the people being infected[2].

In Benue State, Nigeria, urinary schistosomiasis is considered to be a serious public health problem and no reasonable effort has been made by the stakeholders to control the disease particularly in rural communities that are deprived from health infrastructures and potable drinking water. However, the lack of this latter commodity forces rural dwellers to completely rely on ponds, streams and rivers for their daily chore activities. Previous and recent studies reported prevalence varying from 42.8%−46.6% in Benue State[3−6].

Guma Local Government Area (LGA) neighbors Makurdi

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LGA, the capital city of Benue State, Nigeria. Based on current records from its local hospitals, clinics and health centers, the area is reported to be endemic for urinary schistosomiasis. Reports obtained from the interviews of the population and several health officials revealed that neither epidemiological survey nor control intervention was undertaken in the area. This study was therefore undertaken to determine the prevalence and intensity of infection and the risk factors associated with the disease in pre–school and school aged children known as the vulnerable groups. This can be used as baseline data to later expand the study and plan strategies for control program in accordance to the World Health Organization (WHO) recommendations.

2. Materials and methods

2.1. Study area

The study was conducted in Guma LGA located at latitude $7^o 30'–8^o 03'$ E and longitude $8^o 04'–9^o 02'$ N. The area is bounded to the south by Tarka, Makurdi and Buruku LGAs, to the east by Logo LGA and to the north and west by Nasarawa State. Six communities, namely, Daudu, Mgbam, Uikpam, Unenge, Ukohol and Ortese, were visited. These communities were located at about 18 km for the shortest and 35 km for the farthest distance from the north of Makurdi LGA, the capital city of Benue State. Health facilities are found to be dilapidated with grossly inadequate trained staff in the area. The area is drained by streams, ponds and rivers and has a monthly temperature varying between 27.0–28.0 ℃ and may go up to a maximum of 30.1–38.1 ℃ during the hottest period. The area receives 900–1 000 mm of rainfall annually with two distinct seasons. The dry season starts in late October and usually ends by April, while the rainy season lasts from mid–April to early October. The rainy season is the period of intensive agricultural activities when the indigenous people mainly Tivs are engaged in fishing and farming of crops like yams, guinea corn, maize, rice, sesame and cassava which are the principal food and cash crops.

2.2. Study population

Prior to the commencement of the investigation, ethical approval was obtained from the Ministry of Health, Makurdi. Thereafter, visits were made to the various communities, and consultations/discussions were held with officers in charge of health centers who assisted in mobilizing pre–school and school aged children the following day. Parents of these children were also mobilized and educated about the importance of the study. Informed consents of both parents and enrolled children were obtained.

2.3. Sampling technique

The study was cross–sectional in nature. Three hundred urine samples (50 from each community) from pre–school and school aged children were collected during 3 weeks in the month of September 2012. Participants were selected randomly and we did not use sample size calculation based on the baseline nature of the study. Information on the age, sex and water contact activities of children was collected using structured questionnaires. About 20 mL of urine was collected in 20 mL capacity universal bottles by children themselves who were carefully instructed. Mothers of children ≤5 years were directed to collect urine of their children and they were also interviewed on the water contact activities of these children. All collections were done between 10:00 am and 2:00 pm within the premises of each community health center. The specimens were preserved in a cooler and then transported within 30 minutes to the laboratory for analysis.

2.4. Laboratory investigations and classification of infection intensity

The standard parasitological method, the filtration technique using a 10 mL syringe, swinney filter holder (13 mm diameter) and polycarbonate membrane filters (12.0 μ m porosity and 13 mm diameter), was employed to recover *Schistosoma haematobium* (*S. haematobium*) eggs in the laboratory[7,8]. The ×10 and ×40 objectives were used to systematically examine the filters for eggs of *S. haematobium*. The number of eggs was then counted and reported as eggs per 10 mL of urine: 0 egg/10 mL of urine was reported as negative, 1–49 eggs/10 mL of urine as light intensity of infection and ≥50 eggs/10 mL of urine as heavy intensity of infection[8].

2.5. Statistical analysis

Data were double entered in Microsoft Excel and Predictive Analysis Software version 18.0 to perform data analysis. The Pearson chi–square (χ^2) was used to compare differences in prevalence between sex and age groups, while the student t–test was used to compare the difference between light and heavy intensities of infection. Association between water contact activities and prevalence of infection was determined using univariate analysis. A P value <0.05 was considered to be significant.

3. Results

3.1. Prevalence of urinary schistosomiasis in pre–school and school aged children in Guma LGA of Benue State, Nigeria

Table 1 describes the age, sex and communities related

prevalence among the pre–school and school aged children in Guma LGA of Benue State, Nigeria. An overall prevalence of 55.0% (165/300) was recorded out of the 300 urine samples collected from the children. Prevalence of infection varied between 36.0%–64.0% in the different communities visited, with Uikpam community having the lowest prevalence (36.0%, 18/50) and Ukohol and Ortese communities having the highest (64.0%, 32/50). A significant difference was observed in the prevalence of urinary schistosomiasis between the different communities (χ^2=11.59, *P*=0.041). Sex related prevalence showed that the males recorded higher prevalence (60.6%, 103/170) than the females (47.7%, 62/130) with a significant difference (χ^2=4.95, *P*=0.026). Age related prevalence varied between 44.9%–70.5%, with the age group 1–5 years having the lowest prevalence (44.9%, 53/118) and the age group 11–15 years having the highest (70.5%, 36/52). A significant difference was observed in the prevalence of urinary schistosomiasis between the age groups (χ^2=10.56, *P*=0.014).

Table 1

Age, sex and communities related prevalence of urinary schistosomiasis among pre–school and school aged children in Guma LGA, Benue State, Nigeria.

Category	Number examined	Number infected (Prevalence, %)	χ^2	*P*–value
Overall	300	165(55.0)		
By community			11.59	0.041
Daudu	50	25(50.0)		
Mgbam	50	18(36.0)		
Uikpam	50	32(64.0)		
Unenge	50	18(36.0)		
Ukohol	50	32(64.0)		
Ortese	50	30(60.0)		
By sex			4.95	0.026
Male	170	103(60.6)		
Female	130	62(47.7)		
By age (years)			10.56	0.014
1–5	118	53(44.9)		
6–10	131	76(58.0)		
11–15	51	36(70.5)		

3.2. Intensity of S. haematobium eggs among infected pre–school and school aged children in Guma LGA of Benue State, Nigeria

Table 2 describes the intensity of urinary schistosomiasis among the infected pre–school and school aged children of Guma LGA, Benue State, Nigeria. Light intensity of infection (86.7%) was observed to be higher than heavy intensity of infection (13.3%) with a significant difference (*t*=16.48, *P*=0.000). In relation to sex, no significant variations were observed in eggs excretion between the males and females in both light (85.4% *vs* 88.7%) and heavy (14.6% *vs* 11.3%) intensities of infection (χ^2= 5.29, *P*=0.071). In relation to age, light intensity of infection varied between 72.2%–92.1% with the age group 11–15 years having the lowest rate (72.1%) and the age group 6–10 years having the highest (92.1%). Heavy intensity of infection varied between 7.9%–27.8% with the age group 6–11 years having the lowest rate (7.9%) and the age group 11–15 years having the highest rate (27.8%). However, a significant variation was observed in *S. haematobium* eggs excretion in both light and heavy intensities of infection between the age groups of the infected children (χ^2= 21.15, *P*=0.002).

Table 3 summarizes the prevalence of urinary schistosomiasis in relation to water contact activities of the pre–school and school aged children in Guma LGA of Benue State, Nigeria. The children that went swimming and did the laundry in water bodies and those that were involved in irrigation had the highest prevalence of 60.8% (141/232), 60.7% (111/183) and 60.1% (149/248), respectively. The children that were involved in irrigation and those that went swimming in water bodies were observed to be at higher risk of becoming infected with urinary schistosomiasis in the area with odd ratios (risk factors) of 2.75 (1.33–5.69) and 2.36 (1.13–4.94), respectively.

Table 2

Intensity of urinary schistosomiasis among infected pre–school and school aged children in Guma LGA of Benue State, Nigeria.

Category	Number infected (Prevalence, %)		*t*–test	χ^2	*P*–value
	Light intensity	Heavy intensity			
Overall	143(86.7)	22(13.3)	16.48		0.000
By sex				5.29	0.071[ns]
Male	88(85.4)	15(14.6)			
Female	55(88.7)	7(11.3)			
By age (years)				21.15	0.002
1–5	47(88.7)	6(11.3)			
6–10	70(92.1)	6(7.9)			
11–15	26(72.2)	10(27.8)			

Light intensity of infection, 1–49 eggs/10 mL of urine; Heavy intensity of infection, ≥50 eggs/10 mL of urine. [ns]Not significant.

Table 3
Risk factors for urinary schistosomiasis among pre–school and school aged children in Guma LGA of Benue State, Nigeria.

Risk factors	Number examined	Number infected (Prevalence, %)	Odd ratio	Confidence interval	χ^2	P–value
Closeness to water bodies			0.75	0.29–1.91	0.36	0.55[ns]
Yes	273	152(55.7)				
No	27	13(48.1)				
Irrigation			2.75	1.78–6.43	7.85	0.00
Yes	248	149(60.1)				
No	52	16(30.8)				
Laundry			1.22	0.70–2.12	0.48	0.48[ns]
Yes	183	111(60.7)				
No	117	54(46.2)				
Playing			0.56	0.22–1.92	0.59	0.44[ns]
Yes	268	153(57.1)				
No	32	12(37.5)				
Swimming			2.36	1.31–5.69	5.40	0.02
Yes	232	141(60.8)				
No	68	24(35.3)				

[ns]Not significant.

4. Discussion

4.1. Prevalence of urinary schistosomiasis in Guma LGA of Benue State, Nigeria

The burden of urinary schistosomiasis in the area (55.0%) falls within the WHO classification as hyperendemic[8]. This hyperendemicity was observed in four of the villages surveyed (Daudu, Uikpam, Ukohol and Ortese). These villages were observed to have ponds and streams where children and women spend most of their time playing, bathing, swimming, washing and fetching water for domestic purposes. The lack of potable water and dilapidated health infrastructures in the area might have also contributed greatly to this hyperendemicity. The prevalence reported in this study corroborates the findings of other studies which reported high prevalence of urinary schistosomiasis in rural areas of Nigeria: 75.6% in Ogbesi–Ekiti, Ekiti State[9], 72.0% in Dutsinma, Katsina State[10], 83.3% in Odau community in the Niger–Delta[11] and 65.0% in a rural community of Edo State[12]. High prevalence of urinary schistosomiasis has also been reported in Sudan (51.4%)[13] and Mali (61.7%)[14] which are developing as well as sub–Saharan countries like Nigeria. The prevalence in this study contrasts to those reported in earlier studies in other LGAs of Benue State: 42.6% in Ogbadibo LGA[4], 44.6% and 42.6% in Buruku and Katsina LGAs respectivley[5,6] and 46.2% in 10 villages of four LGAs (Katsina–Ala, Gboko, Kwande and Logo)[3]. Lower prevalence (42.2%) than that in the present study has also been reported in a rice farming community in Biase LGA of Cross River State, Nigeria[15].

Males were reported to be more infected than females; this could be due to the higher tendencies of water contact activities among males through swimming, playing and laundry besides the primary domestic activity of fetching water which exposes both sexes to infection. Kanwai *et al*. reported similar findings with males more infected than females in Igabi LGA of Kaduna State, Nigeria[16]. This study disagrees with studies conducted in rural areas of South–west and South–south, Nigeria and Kwazulu–Natal, South Africa which reported females to be more infected than males[17–19].

The age related prevalence showed that children aged 6–10 years and 11–15 years had the highest prevalence. This trend has been reported in several previous studies which explained that factors like swimming, washing, fishing and playing in infested water bodies contribute to the high prevalence of urinary schistosomiasis in children aged 7–16 years[20,21]. These various activities have also been reported among children examined in this study.

Children $\leq$5 years were considerably infected (44.9%) with urinary schistosomiasis in the area. These children were observed to be taken along with their mothers to ponds for their bath. The children were also observed to be kept by the pond edges by their mothers in basins filled with water fetched from the ponds to make these ones not interfere with their activities. These children could also get infected through the learning process of swimming when they follow their older ones to water bodies. This age group seems to be always neglected in most epidemiological studies while they can be potential source of transmission in areas where successful control programs have been implemented. It was until recently that the WHO has considered this age group as a high risk group in areas endemic for schistosomiasis and validated a report on their inclusion during control program[1]. Studies conducted in Nigeria and other sub–Saharan countries like Ghana, Mali, Niger, Uganda, Sudan, and Zimbabwe reported prevalence in pre–school children ranging from 18.0%–63.0%[22–26].

4.2. Intensity of S. haematobium eggs in infected pre–school and school aged children in Guma LGA of Benue State, Nigeria

The findings of this study show that a greater proportion (86.7%) of the children was found with light intensity of infection and just a small proportion having heavy intensity of infection. This could be simply explained by the differences in water contact activities among the children. However, this difference could be explained by some genetic factors which play important roles in the susceptibility to disease[27,28]. The high rate of light intensity of infection can also reflect high transmission rate in the area. Reports of studies from various parts of Nigeria also reported people with urinary schistosomiasis having light intensity of infection was more than those having heavy intensity of infection[10,19,20,29,30]. The rate of heavy intensity of infection observed (27.5%) has to be considered as a strong public health concern, because this could reflect the worm burden and if not stemmed on time will have an increasing effect on egg excretion that will directly affect the physical conditions and cognitive fitness of the children.

Males and females did not show any significant difference in the excretion of S. haematobium eggs. The slight difference in light intensity of infection between males and females could be explained by the differences in the social and occupational roles taken up by the females who could often follow their mothers to water bodies for fetching or other daily chore activities like washing. The slightly higher rate of light intensity in females than in males corroborates reports of a study on gender–related differences in the impact of tropical diseases on women[31]. Similar results were also reported in southeast and southwest Nigeria and these explained that women are more exposed to water when they assume typical men roles[32–34].

Intensity of S. haematobium eggs by age showed lower rate of heavy intensity of infection in the age groups of 1–5 and 6–10 years. This could be explained by the reduced worm burden in these children which has led to less excretion of eggs. The higher rate of heavy intensity of infection in the older children is not surprising, because in areas endemic for urinary schistosomiasis this age group always carry the heavy burden of the disease mostly because of their increased water contact activities and possibly the high fecundity rate of the parasite. Adolescents with heavy intensity of infection have also been reported in endemic areas of southeast and northern Nigeria[26,35].

4.3. Risk factors for urinary schistosomiasis among pre–school and school aged children in Guma LGA of Benue State, Nigeria

Water contact activities like swimming and laundry are reported to put children at higher risk of infection in the area. This could be due to the complete lack of political will of the stakeholders to finalize some of the pipe–borne water projects seen in some of the communities. The lack of that commodity obliges inhabitants to completely rely on streams and ponds, therefore exposing them to infection. However, these children could also become infected when they follow their parents to irrigate rice farms in swampy areas. Moreover, the high illiteracy and negligence levels of the parents, mostly farmers, observed in the area, can lead to the non–education of preventive measures to their children, therefore influencing transmission pattern.

The prevalence of urinary schistosomiasis among the pre–school and school aged children in Guma LGA was found to be hyperendemic. Light intensity of infection was reported to be more predominant in the area than heavy intensity of infection. Water contact activities like swimming and irrigation were considered as risk factors that could put children at higher risk of infection with urinary schistosomiasis in the area.

Based on the above results, the followings are therefore recommended: (i) Treatment program using praziquantel and systematic epidemiological studies should be undertaken in the whole LGA and the State at large. (ii) Pre–school children should be regarded as high risk group in the area and they should be taken into consideration during treatment program. (iii) There should be provision of safe water supply and development of recreational water bodies in the area so as to avoid contact with existing infested water bodies. (iv) There is the need to identify and embark on the control of snail vectors in the area and the State. (v) There is a need of public awareness and education regarding urinary schistosomiasis in the area and the State. (vi) Campaign for urinary schistosomiasis should be included among other public health interventions such as malaria, HIV/AIDS and tuberculosis. (vii) Geographical information system should be used in future studies to show the exact location of the affected areas, which will help in focalizing control program in the endemic areas.

Conflict of interest statement

The authors declare that they have no competing interests.

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