

Leave No Preschool-Aged Children Behind: Urogenital Schistosomiasis in Four Communities of a Metropolitan City in Central Nigeria

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Abstract

There have been several demands for preschool-aged children to get prophylactic chemotherapy, such as praziquantel, first due to a presumed schistosomiasis among this age group. In order to determine the prevalence and risk variables related to urogenital schistosomiasis infection among preschool-aged children, this study conducted surveys in four areas inside a major city in Central Nigeria. A total of 240 preschool-aged children were randomly selected from the four areas surveyed. Demographic data and their knowledge on the transmission of urogenital schistosomiasis were obtained by administering questionnaire to mothers and caregivers, urine samples of the recruited subjects were collected using a sterile sampling bottles and were tested for hematuria using Urino-Combi-11 reagent test strip (ACON laboratories). Subsequently, samples were screened in the laboratory for *Schistosoma haematobium* infection. Of the 235 preschool-aged children that returned their sample bottles, only 8.51% (20/235) were infected with urogenital schistosomiasis. Four years old subjects were the most infected 13.95% (6/43) followed by age two 10.56% (2/19) then age five with 8.93% (10/112), age three 3.70% (2/54) while no age one child was infected 0% (0/7), although variations in prevalence across the ages showed no significant difference ($P > 0.05$). The overall geometric mean intensity (GMI) was 1.03526 eggs/10ml of urine. The prevalence of the infection among preschool-aged children in relation to locations as well as sex showed no significant difference ($P > 0.05$). About 52% (122) of the preschool-aged children bath in water bodies, but only 51.1% (120) are aware that some freshwater snails are harmful. In conclusion, preschool-aged children in the metropolitan city of Lafia should not bath, wash or swim in water bodies around. More awareness should be created on the risk factors associated with the disease. Also, the government should provide sufficient potable water in the city, and prioritization of treatment of preschool-aged children with preventive chemotherapy to curb urogenital schistosomiasis prevalence among the age group is very necessary and cannot be overemphasized.

Keywords: Urogenital Schistosomiasis, Geometric mean intensity, Preschool-aged Children, Mothers and Caregivers, Risk Factors, Lafia metropolis

Introduction

Schistosomiasis or bilharziasis, is a parasitic disease caused by blood flukes (trematode) in an infected definitive host. The parasite infects its definitive host during routine domestic, agricultural, recreational activities etc. These activities expose the definitive host to infested water containing the cercariae where they get infected (World Health Organization [WHO], 2022). Two forms of the disease exist in Africa, intestinal and urogenital caused by *Schistosoma mansoni* and *Schistosoma haematobium* respectively (Nduka *et al.*, 2019). Symptoms of the disease are mostly caused by the body's reaction to the eggs of the parasite. Many infections are asymptomatic, although symptoms such as fever, cough, abdominal pain, diarrhea, hepatosplenomegaly and eosinophilia are common (Center for Disease Control and Prevention [CDC], 2022).

Based on the scaling up of preventative chemotherapy, the model by Kokaliaris *et al.* (2022) discovered a decrease in the prevalence of schistosomiasis among school-aged children in sub-Saharan Africa. However, the illness is among the most common human parasitic diseases, ranking second only to malaria in terms of its significance for socioeconomic development and public health in tropical and subtropical regions (Chitsulo, 2000). It is also one of the neglected tropical diseases (NTD), which have a negative impact on the health of more than 200 million people in Africa (WHO, 2021). The urogenital form of the disease caused by *S. haematobium* is endemic in Nigeria (Nduka *et al.*, 2019; Ajakaye *et al.*, 2022), and more specifically in Lafia metropolis of Nasarawa State (Ombugadu *et al.*, 2022).

Preschool-aged children are those under 7 years of age. The infection have been recorded across sub-Saharan African countries in the less focused infants and preschoolers groups with wide implication for control (Ekpo *et al.*, 2010; Garba *et al.*, 2010; Dabo *et al.*, 2011; Ekpo *et al.*, 2012; Faust *et al.*, 2020). With prevalence over 50% in many of these reports, the World Health Organization is exploring ways for

development of infants' formulation and inclusion of treatment of infants and preschooler in endemic countries (WHO, 2022).

As part of effort by WHO to fight NTD they launched new guideline for the control and elimination of human schistosomiasis. The new guidelines include expansion of preventive chemotherapy to preschool-aged children (WHO, 2022). This study aimed at justifying the inclusion of preschool-aged children in the new guideline for the control of schistosomiasis by assessing the prevalence and associated risk factors influencing urogenital schistosomiasis in preschool-aged children in four selected communities in a metropolitan city in Central Nigeria.

Materials and Methods

Study Area

The study was carried out in Lafia metropolis, Nasarawa State, Nigeria. Lafia is the state capital of Nasarawa State. The major occupations of people in Lafia are civil servants, traders, artisans etc. The major language spoken is Hausa language. Nasarawa State is located in the north central region of Nigeria.

Ethical Approval

Ethical approval to conduct the survey was obtained from Lafia Local Government Council with the Code: LLG/TRA/6/0.1/XX on 2nd December, 2015. Ethical approval was also obtained from the heads of the four communities and consents of parents or guardians whose children were recruited into the study were sought. However, children whose parents did not consent were not recruited into this study.

Questionnaire Administration

Well-structured questionnaire was administered to each subject in order to obtain information on their socio-demographic data (e.g. age, sex), knowledge, attitude and water contact practices.

Parasitological Data Collection

Selection of Participants

Sampling of subjects for the study was carried out according to WHO guideline

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(WHO, 2002) for schistosomiasis intervention survey. A total of 240 preschoolers were sampled across four districts in Lafia. Mothers and caregivers were duly informed about the objective of the study in order to seek their consent. Only mothers and caregiver's children that consent to the study were admitted for the study.

Collection of Samples

The children were given dark (sterile) plastic universal containers with a unique identification label to collect their urine samples between the hours of 10a.m and 2p.m hours (Mafiana *et al.*, 2003). Urine samples were tested for hematuria using Urino-Combi-11 reagent test strip (ACON laboratories). The strip was dipped in the urine for 5 seconds. Subsequently samples were screened in Zoology laboratory of Federal University of Lafia for *Schistosoma haematobium* infection. In the laboratory, 10 ml of each urine sample were centrifuged at 5000 revolution per minutes for 5 minutes. The supernatant was discarded to leave the sediment, which was placed on a clean glass slide and covered with a cover slip. The slides were observed under a light microscope at x40 objective lens for the presence of eggs of *S. haematobium*. The intensity of *S. haematobium* eggs were determined and recorded as eggs/10 ml of urine.

Statistical Analysis

Data obtained were analyzed using R Console software (Version 2.9.2). Proportions of prevalence rate of urogenital schistosomiasis in preschool-aged children in relation to age, locations as well as sex was compared using Pearson's Chi-square test. Level of significance was set at $P < 0.05$.

Geometric Mean Intensity

The geometric mean, by definition, is the n th root of the product of the n units in a data set. The geometric mean is well defined only for sets of positive real numbers

(www.sengpielaudio.com/calculator-geommean.htm).

$$\bar{x}_{\text{geom}} = \sqrt[n]{\prod_{i=1}^n x_i} = \sqrt[n]{x_1 \cdot x_2 \cdot \dots \cdot x_n}$$

Results

Age-Wise Prevalence of Urogenital Schistosomiasis in Preschool-Aged Children

A total of 235 preschool-aged children were examined and the overall prevalence rate of urogenital schistosomiasis within the selected communities in Lafia, Nasarawa State was 8.51% (20/235) as shown in Table 1. The four years old subjects were the most infected 13.95% (6/43) followed by age two 10.56% (2/19) then age five 8.93% (10/112), age three 3.70% (2/54) and interestingly, no child was infected 0% (0/7) among age 1 subjects. Although no significant difference ($\chi^2 = 3.2947$, $df = 4$, $P = 0.5098$) was observed in the prevalence rate of urogenital schistosomiasis in relation to the ages of the preschool-aged children. The overall geometric mean intensity (GMI) was 1.03526 eggs/10ml of urine. Age 5 had the highest GMI of 1.07177 while ages 1 - 4 had the same GMI of 1 egg/10ml of urine (Table 1).

The varying prevalence rate of urogenital schistosomiasis in relation to the subjects' locations showed no significant difference ($\chi^2 = 4.6323$, $df = 3$, $P = 0.2008$), nevertheless a very high prevalence was recorded in Lili (11.67%), followed by Tudun Kauri (10.34%) then Kofan Kaura (8.77%) while the least infected community was Andre (3.3%).

The 11.67% (7/60) infection recorded in Lili (Table 1) mostly affected ages four and five years subjects having 29.4% (5/17) and 6.67% (2/30) prevalence respectively, but none (0%) of ages one, two and three years subjects were infected. In Tudun Kauri, the prevalence rate of 10.34% (6/58) spreads across age four subjects 20.0% (1/5), followed by age five 12.12% (4/33), age three 8.33% (1/12) whereas ages one and two years subjects were uninfected (Table 1). The 8.7% infection rate in preschool-aged children in Kofan Kaura was recorded among ages two, three and five years subjects respectively with 14.29% (1/7), 6.67% (1/15) and 12.5%

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(3/24) prevalence, yet no child was infected in the age categories for one and four years old subjects. Furthermore, the minimal prevalence of the infection in Andre community 3.3% (2/60) was strikingly

observed in only ages two and five subjects represented by 20% (1/5) and 4%(1/25) prevalence respectively, while no child was infected among those in ages one, three and four years categories.

Table 1: Age-Wise Prevalence Rate of Urogenital Schistosomiasis in Preschool-Aged Children in Relation to Ages in Lafia Metropolis, Nasarawa State, Nigeria

Age (years)	Tudun kauri		Lili		Andre		Kofan Kaura		Total No. examined	Total No. infected (%)	Geometric Mean Intensity
	No. examined	No. infected (%)									
1	2	0 (0)	1	0 (0)	1	0 (0)	3	0 (0)	7	0 (0)	1
2	6	0 (0)	1	0 (0)	5	1 (20.00)	7	1 (14.29)	19	2 (10.56)	1
3	12	1 (8.33)	11	0 (0)	16	0 (0)	15	1 (6.67)	54	2 (3.70)	1
4	5	1 (20.0)	17	5 (29.41)	13	0 (0)	8	0 (0)	43	6 (13.95)	1
5	33	4 (12.12)	30	2 (6.67)	25	1 (4.00)	24	3 (12.5)	112	10 (8.93)	1.07177
Total	58	6 (10.34)	60	7 (11.67)	60	2 (3.3)	57	5 (8.77)	235	20 (8.51)	1.03526

Sex-Wise Prevalence of Urogenital Schistosomiasis in Preschool-Aged Children

No significant difference ($\chi^2 = 0.065018$, $df = 1$, $P = 0.7987$) in the prevalence of urogenital schistosomiasis in preschool-aged children in relation to sex, nonetheless males were more infected 10.37% (14/135) than females 6% (6/100)

as shown in Table 2. The prevalence of urogenital schistosomiasis in preschool-aged children in Tudun Kauri, Lili and Kofan Kaura respectively was higher in males than females in a ratio of 10.8% (4/37):9.5% (2/21), 13.5% (5/37):8.69% (2/23), and 14.71% (5/34):0% (0/23) but it was a vice versa outcome in Andre community in which it was a ratio of 6.60% (2/33):0% (0/27) for females to males.

Table 2: Sex-Wise Prevalence rate of urogenital schistosomiasis in preschool-aged children in Lafia Metropolis, Nasarawa State, Nigeria

Sex	Tudun kauri No. examined	No. infected (%)	Lili No. examined	No. infected (%)	Andre No. examined	No. infected (%)	Kofan Kaura No. examined	No. infected (%)	Total No. examined	Total No. infected (%)
Male	37	4 (10.8)	37	5 (13.5)	27	0 (0)	34	5 (14.71)	135	14 (10.37)
Female	21	2 (9.5)	23	2 (8.69)	33	2 (6.60)	23	0 (0)	100	6 (6.00)
Total	58	6 (10.3)	60	7 (11.66)	60	2 (3.33)	57	5 (8.77)	235	20 (8.51)

Risk Factors Influencing the Prevalence of Urogenital Schistosomiasis Among Preschool-Aged Children in Lafia, Nasarawa State

From the sampled population, 51.9% (122/235) of the preschool-aged children take their bath in the water bodies, 65.5% (127/235) reside at a distance less than 1 km to the water bodies while 43.8% (103/235) of the subjects do wash at the water bodies. Also, 43.4% (102/235) mothers and caregivers take their children along with them when going to a water body around. Lastly, 51.9% (122/235) of

the sampled population had seen freshwater snails around water bodies in their areas (Table 3).

Knowledge, Attitude and Practices of the Mothers and Caregivers about Urogenital Schistosomiasis in Lafia, Nasarawa State

A 92.8% (218/235) of mothers and caregivers have heard of urogenital schistosomiasis. However, only 51.1% (120/235) are aware that some freshwater snails are harmful. Only 9.36% (22/235) of mothers have seen blood in the urine of their children (Table 4).

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Table 3: Risk Factors Influencing the Prevalence of Urogenital Schistosomiasis Among Preschool-Aged Children in Lafia Metropolis, Nasarawa State, Nigeria

Factor	Response	Lili	Tudun Kauri	Kofan kaura	Andre	Total (%)
Bathing in water body	Yes	58	2	2	60	122 (51.9)
	No	2	56	55	0	113 (48.1)
Distance from water	<1km	31	25	50	21	127 (65.5)
	1-5km	29		7	39	57 (29.4)
	>5km		10		0	10 (5.2)
Wash cloth in water	Yes	39	3	1	60	103 (43.8)
	No	21	55	56	0	132 (56.2)
Take child to water body	Yes	41	0	1	60	102 (43.4)
	No	19	58	56	0	133 (56.6)
Fresh water snail around water bodies	Yes	7	8	47	60	122 (51.9)
	No	53	50	10	0	113 (48.1)

Table 4: Knowledge, Attitude and Practices of the Mothers and Caregivers about Urogenital Schistosomiasis in Lafia, Nasarawa State

Knowledge of Respondents	Response	Lili	Tudun Kauri	Kofan kaura	Andre	Total (%)
Have you heard of urogenital schistosomiasis before?	Yes	59	56	43	60	218 (92.8)
	No	1	2	14	0	17 (7.2)
Are you aware that some freshwater snails are harmful because of their ability to transmit schistosomiasis	Yes	6	5	49	60	120 (51.1)
	No	54	53	8	0	115 (48.9)
Have you notice blood in your urine in the last one month?	Yes	7	1	14	0	22 (9.36)
	No	53	57	43	60	213 (90.6)

Discussion

The findings from this study is an indication that the preschool-aged children urogenital schistosomiasis continues to be a serious health issue in the four communities within Lafia metropolis. The prevalence of the infection is not surprising due to the high abundance of snail intermediate hosts in Lafia water bodies based on the report by Abe *et al.* (2017). Pam *et al.* (2021) documented that the availability of the intermediate host in water bodies in endemic locations accounts for high chances of schistosomiasis transmission. The trematodes thrive fast in the snail host and spread due to continued neglect, poor hygiene condition and absence of qualitative infrastructures such as lack of access to potable water and inadequate sanitation facilities (Gryseels *et al.*, 2006; Stothard *et al.*, 2009; Utzinger *et al.*, 2011;

Griswold *et al.*, 2022; WHO, 2022). Also, our finding concurs with the fact that no age group should be left behind most especially the preschool-aged children which have been accounted to incur significant morbidity but are systematically left or skewed out of current treatment programmes; in which their inclusion will be of public health benefits at both short- and long-term (Faust *et al.* 2020). Early childhood schistosomiasis infection could lead to a long term clinical impact and severity of the disease before such children are eligible for treatment (Ekpo *et al.*, 2012). In endemic areas of the world preschool-aged children are at high risk of infection with urogenital Schistosomiasis because they are not included in the mass treatment program of human schistosomiasis (Lime *et al.*, 2020). Ajakaye *et al.* (2022) reported high prevalence of

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urogenital schistosomiasis among children as a result of frequent contacts with water bodies containing the parasites in pastoral communities surrounding three Ramsar wetlands in Nigeria. Sequel to series of research on the prevalence of urogenital schistosomiasis in preschool-aged children in several part of the world where the disease is endemic and the need to include these age groups in mass treatment programs by WHO for the control and elimination of human schistosomiasis, the result of this study (8.5% prevalence) is comparable with similar studies in preschool-aged children in various African countries who recorded a prevalence of 11.2%, 51.2%, 10.7% and 8.5% respectively in Ghana (Bosompem *et al.*, 2004), Mali (Dabo *et al.*, 2011), Malawi (Poole *et al.*, 2014) and Zimbabwe (Osakunor *et al.*, 2017). On the contrary, our previous studies of urogenital schistosomiasis in school-aged children in Lafia metropolis was higher 20% (Ombugadu *et al.*, 2022).

The very high prevalence of the infection among four years old subjects may be due to their very explorative developmental stage which prompts them to most likely have contact with possibly infected water bodies that harbors cercariae. This finding is consistent with the report of Kibira *et al.* (2019), who reported that preschool-aged children had the highest prevalence of schistosomiasis infection in Uganda as a result of frequent contact with the water bodies by the age group. On the other hand, a previous literature on prevalence of the infection among preschool-aged in Mali showed that the infection did not increase with age (Dabo *et al.*, 2011).

The overall geometric mean intensity recorded in this study of 1.03526 eggs/10ml of urine is low compare to that of Dabo *et al.* (2011) who reported 18.41 (13.59-24.92) eggs/10 ml of urine geometric mean intensity of infection in their study of urogenital schistosomiasis among preschool-aged children in Sahelian rural communities in Mali. Similarly, Uguochukwu *et al.* (2013) and Naphtali and Ngwamah (2019) also recorded high geometric mean intensity of 10.1 eggs /10ml of urine and 513±0.05 eggs/10 ml of urine respectively. The low geometric mean

intensity from this study might be as a result of several factors which includes but not limited to immunity of the subjects, and also density of infected snails in the water bodies (Ekpo *et al.*, 2010; Pam *et al.*, 2021).

The lack of variation in the prevalence of the infection in the four locations clearly shows that all the water bodies in Lafia metropolis are very good potential sites for breeding success of snail vectors which may possibly translate to high transmission risk. Also, the no difference in the prevalence of infection across communities in this study may likely be attributed to equal habits or practices of the caregivers on their children such as bathing the children in the water bodies and using the water bodies as source of domestic water supply (Sacolo-Gwebu *et al.*, 2019). This does not concur with the report by Dabo *et al.* (2011) who observed a significant variation of both prevalence and intensity of the infection between communities of the preschool-aged children in Mali. Similarly, Ajakaye *et al.* (2022) also reported differences in prevalence of schistosomiasis between pastoral communities surrounding three Ramsar wetland in Nigeria. Naphtali and Ngwamah (2019) recorded high difference in the prevalence of the infection between locations in a study of urogenital schistosomiasis in Adamawa State, Nigeria.

Preschool-aged males were highly infected (10.37%) than their female counterpart (6%), this is probably as a result of frequent contact with the water bodies around by the males when compared to the females. This is in tandem with the work of Ajakaye *et al.* (2022) who opined that males were more infected than females in Dagona Sanctuary wetland. Likewise, Obadiah *et al.* (2018) and Naphtali and Ngwamah (2019) also pointed out higher prevalence of urogenital schistosomiasis in males than females expressed in ratio 24.1%:18.6% in parts of Benue and 25.5%:20.8% in Adamawa State respectively. This disagrees with the work of Kibira *et al.* (2019) who reported higher prevalence in female preschool-aged group than their male counterparts. In another study, no difference was observed in the infection rates between boys and girls (Dabo *et al.*, 2011).

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Over 50% of the subjects bath in the water bodies around which implies very high likelihood for transmission to occur resulting in a huge public health burden on the entire population within Lafia metropolis in the event that most or all of children get infected. This agrees with the finding of Mutapi *et al.* (2011) who reported that preschool-aged children can serve as a major reservoir for the infection since the mass treatment of the disease focus on adults and school-aged children. If nothing is done for the control of urogenital schistosomiasis among preschool-aged children the effort to control and eliminate human schistosomiasis by WHO might be impeded (Ekpo *et al.*, 2012; Kibira *et al.*, 2019; Faust *et al.*, 2020).

Majority (65.5%) of the subjects reside at a distance less than 1 km to the water bodies which accounts for why more than half of the sampled population have access to water bodies. This agrees with the report by Kibira *et al.* (2019) who showed that the water bodies and its surroundings are paramount for the survival of most individuals because it is the source of their livelihood.

About half of the preschool-aged children wash their cloths in the water bodies; 43.4% of the mothers and caregivers take their children to the water bodies. This validates Pam *et al.* (2021) findings which stated that anthropogenic activities such as washing, fishing, swimming, etc. in freshwaters containing the intermediate (freshwater snails) hosts of the parasites can facilitate the transmission of the parasite. More than half of the sampled population have seen freshwater snails around water bodies in the areas. The information's obtained on the risk factors influencing the prevalence of the disease in this study is in agreement with report by WHO (2022) which stated that cercariae infects the definitive host at the course of people's daily activities in surrounding water bodies. Similarly, Ombugadu *et al.* (2022) reported that individuals are exposed to water bodies due to lack of access to potable water sources which predisposes them to urinary schistosomiasis infection. This is based on some risky activities such as open

defecation and urination in and near the water bodies that shows lack of proper sanitation and facilitate the transmission of the disease in endemic areas (Kibira *et al.*, 2019).

The knowledge of mothers and caregivers about urogenital schistosomiasis being over 92% may possibly accounts for the low prevalence obtained in this study because children might have been told the consequences of playing in and around water bodies. Among the whole population sampled, only 51.1% of the mothers and caregivers are aware that some freshwater snails are harmful. About 10% of them have seen blood in the urine of their children. This indicates that a lot of individuals indulge in the risk factors which predisposes them and their children to the disease despite having an idea about the disease, this might be as a result of them not having access to potable water so they tend to make use of the water bodies around for their daily activities.

Conclusion

According to this study, urogenital schistosomiasis in young children continues to be a significant public health issue in settlements in Lafia metropolis of Nasarawa State, Central Nigeria. The subjects that were four years old were the most infected. The geometric mean intensity for the entire sample was 1.03526 eggs/10ml of urine. There was no substantial difference in the prevalence of infection rates between communities. Although more than 51% of preschoolers are aware that some freshwater snails can be dangerous, more than 51% still take a bath in the nearby bodies of water. Surprisingly, only 51.1% of mothers and caregivers are aware that some freshwater snails are dangerous, despite the fact that over 92% of them are knowledgeable with urogenital schistosomiasis. To this purpose, authorities and nongovernmental organizations should start routinely including preschool-aged children in schistosomiasis current preventive chemotherapeutic treatment programmes. Additionally, there is a pressing need to raise awareness of the illnesses' risk factors and to supply communities with enough potable water.

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