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Original paper

Morbidity indicators of urogenital schistosomosis and risk factors in school children in three Senatorial Districts of Cross River State, Nigeria

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ABSTRACT. The morbidity indicators and risk factors of urinary schistosomosis in school-age children were ascertained in three Senatorial Districts of Cross River State (CRS). A cross-sectional study conducted between April 2015 and March 2016. Seven hundred and seventy-seven (777) urine samples were randomly collected from selected children and examined for ova of *Schistosoma haematobium*, using a modified filtration system. Commercial reagent strips were employed for the detection of haematuria and proteinuria. Chi-square test was used to determine the statistical differences between the data in subgroups and the results from specimen examinations. *S. haematobium* ova was observed in 13 (1.7%) of the 777 participants examined. Ninety (11.6%) children showed haematuria, and 137 (17.6%) showed proteinuria. Infection varied significantly across the age-groups ($P<0.05$). Males 11 (2.4%) were more infected than females 2 (0.6%) ($P<0.05$). The age group 9–12 years accounted for the highest mean ova count (7.33±2.1) in urine samples analysed. Female participants had a higher mean ova count (7.50±0.71) than male participants (6.18±1.66). Age, gender and the habit of fetching water from streams were significant risk factors for urinary schistosomiasis. It is evident from this study that *S. haematobium* infection is still endemic in the three Senatorial Districts of CRS, despite periodic chemotherapy.

Keywords: urinary schistosomosis, *Schistosoma haematobium*, morbidity, school children, Cross River State, Nigeria

Introduction

Schistosomosis is a disease of tropical climates and it occurs predominantly in rural communities [1]. Schistosomosis is an important water-related disease with serious health and socioeconomic implications [2]. The epidemiology of schistosomosis is linked with the practice of releasing *Schistosoma* eggs via urine and faeces into water bodies [1]. Water bodies such as ponds, streams, lakes, rivers, and dams, must harbour suitable molluscs which serve as intermediate hosts for the parasites. *Schistosoma japonicum* is transmitted by *Oncomelania* snails, *S. mansoni* is transmitted by *Biomphalaria* snails while *S. haematobium* is transmitted by *Bulinus* snails [3]. The pathology of schistosomosis is related to the type, stage and intensity of the disease [1]. In urinary schistosomosis, proteinuria and haematuria are characteristic features which are related to the intensity of infection and is most common in children [4].

Schistosoma haematobium cause urinary schistosomosis in many African countries. Humans play a pivotal role in schistosomosis transmission by passing urine indiscriminately, thereby contaminating water bodies with the ova of schistosomes. Globally, approximately 900 million people have no access to safe water sources, while 50% of all inhabitants of third world countries do not have access to adequate sanitation [5]. People living in poor and rural farming communities that lack good water sources depend on streams which may be contaminated with cercariae for their socioeconomic needs and in so doing expose themselves to schistosomosis. The economy of Cross River State is mainly agriculture-based and this provides an enabling environment for the intermediate snail host of *S. haematobium* to thrive, hence the high prevalence of the disease in the State [6].

Persons of all ages who make contact with fresh water contaminated with cercariae are highly likely to be infected with the disease [7]; children are more prone to this infection compared to adults [8]. Activities such as farming, fishing [9], playing and bathing by the side of fresh water bodies enhance human contact with the snail vector and play a role in spread of the infection [10,11]. Active spread of the disease is promoted by high incidence of snail vectors and intense human activities along fresh water bodies in endemic areas [12].

This study therefore sought to analyse urinary schistosomosis among school children in the three Senatorial Districts of Cross River State. The study also provides a reliable data on water-contact activities which may predispose school children to *Schistosoma haematobium* infection.

Materials and Methods

Study area and population

This study was carried out in the three Senatorial Districts (North, South and Central) of Cross River State. Cross River state is located in Southern Nigeria and is bordered to the east by Cameroon. The state is located within the tropics, between longitude 7°50' and 9°28'E and latitudes 5°32' and 4°27'N. Along the coastal area, there is an all year round rainfall of about 350 mm. In the hinterland, rainfall ranges from 120 to 200 mm annually. Peak precipitation occurs in July and September. Daily temperatures all through the year range between 22.4°C and 33.2°C, and relative humidity is ranges from 60% to 93%. Cross River State has a tropical climate except for the Obudu Plateau where the climate is temperate [13]. The state has an area of 23,072,425 square kilometres with a population of about 2.8 million people [14].

Urine samples were obtained from school children and adolescents in the three Senatorial Districts and were analysed at the University of Calabar Teaching Hospital (UCTH), Calabar. The study population consisted of children/adolescents aged 5–20 years attending primary and secondary schools in the study area.

Inclusion criteria

Children/adolescents between the ages of 5–20 years. Children/adolescents with informed consent from parents/guardians. Children/adolescents attending primary or secondary schools in the area of study. Children/adolescents who must have lived within that community for a minimum of six months.

Exclusion criteria

Children/adolescents below the age of 5 or above 20 years. Children/adolescents who had recently taken deworming drugs for schistosomosis. Any female menstruating during the period of urine collection. Any female who must have recently done genital circumcision. Any child who has not lived up to six months in the study area. Children/adolescents without informed consent from parents/guardians. Children/adolescents not attending primary or secondary schools in the area of study.

Sampling method and sample collection

This was a cross-sectional study conducted between the months of April 2015 and March 2016. A total of 777 urine samples were obtained from randomly-selected children and adolescents in primary and secondary schools in the study area. A systematic sampling method was used to select one out of every four pupils or students within the range of study. Seven hundred and seventy-seven (777) clean, well-labelled universal containers were given to the selected children and adolescents for collection of urine samples. The samples were collected between 10.00 am and 2.00 pm on each collection day to guarantee maximum yield of schistosome eggs. Participants were instructed to include the last drops of urine [4]. The samples were preserved with 2 drops of 10% formalin [15] and transported to the parasitology laboratory, University of Calabar Teaching Hospital, Calabar, for parasitological examinations.

Detection of haematuria and proteinuria

Commercial reagent strips were utilized for the detection of haematuria in the field (Hemastic,

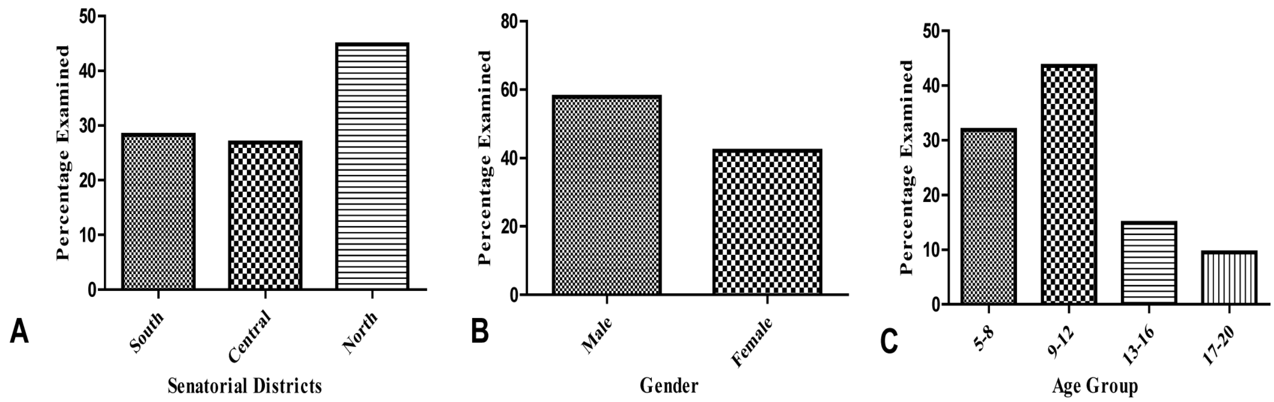

Figure 1. Demographic distribution of subjects in the study area according to Senatorial Districts (A), gender (B) and age-group (C)

Boehringer Mannheim, Germany). The results were read and recorded immediately. Haematuria was calibrated as 5–10 ery/µl (+), 50 ery/µl (++), 250 ery/µl (+++). Proteinuria as trace (10 mg protein/dl), 30 mg/µl (+), 100 mg/µl (++) and 500 mg/µl (+++). After vigorously agitating the urine, 10 ml was transferred into a universal container containing 5 ml of 1% aqueous carbol fuchsin for preservation and staining of eggs [10]. The specimens were then transported immediately to the laboratory for further analysis.

Parasitological examination

A modified filtration system developed by Useh and Ejezie [10] was used in this study. Briefly, a funnel holding a triangular folded Whatman No. 1 filter paper, was suspended in a conical flask to be used as the filtration system. The vigorously-agitated sample was allowed to pass through the filtration system. Using a blunt-ended pair of forceps, the filter paper was removed with great care, unfolded and placed on a slide. The filter paper was placed facing upwards (eggs on surface) on the slide using ×10 objective lens, with the condenser iris sufficiently closed to give a good contrast. A systematic examination of the entire filter paper was conducted for *Schistosoma haematobium* ova. Any urine sample with ova was recorded as positive. The number of eggs counted was recorded per 10 ml of urine sample collected.

Data analysis

Descriptive statistical analysis was used to calculate the prevalence and intensity of infections. All analyses were performed using the SPSS package (version 22). Chi-square test was used to test the differences between the data on subgroups and the results from specimen examinations. Differences were considered significant at a *P*-value less than 0.05 ($P<0.05$).

Ethical consideration

Enrolment of participants for this study was conducted only after due approval for the study was granted by the Cross River State Health Research Ethics Committee (REC No.: RP/REC/2016/423). The heads of the villages within the study area were duly consulted and school heads gave their approval for their pupils and students to be enrolled after written (sometimes verbal) informed consent was obtained from parents and guardians of the study participants.

Results

Demographics

Seven hundred and seventy-seven (777) school children systematically selected from eight schools in the three Senatorial Districts of Cross River State were screened to determine the current status of urinary schistosomosis in these districts. The Northern Senatorial District had the highest number of participants (348; 44.8%). The lowest was recorded in the Central Senatorial District (209; 26.9%). According to gender, 450 (57.9%) males and 327 (42.1%) females were involved in the study. Age group 9–12 years had the highest number of participants 339 (43.6%) and the lowest number of participants was found in age group 17–20 years 74 (9.5%) (Fig. 1).

Prevalence of Schistosoma haematobium infection

Figure 1 shows the prevalence of *Schistosoma haematobium* infection by microscopy and morbidity

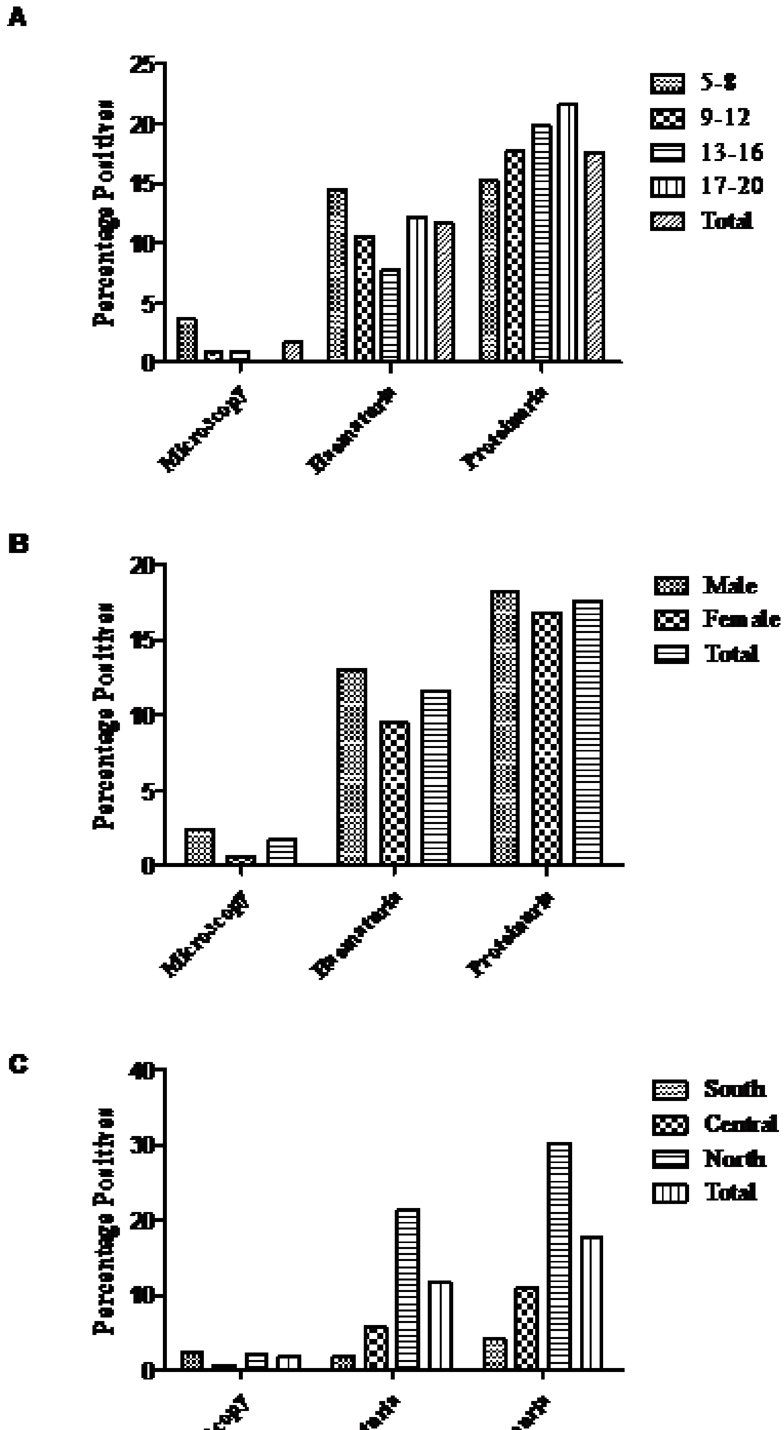

Figure 2. Prevalence of *Schistosoma haematobium* infection by microscopy and morbidity indicators among school children by age-group (A), gender (B) and Senatorial Districts (C)

indicators among participants with respect to age, gender and Senatorial Districts. Overall, ova of *S. haematobium* was detected in 13 (1.7%) of urine samples examined using microscopy; 90 (11.6%) had haematuria while 137 (17.6%) had proteinuria. According to microscopy, the highest prevalence of infection occurred in participants aged 5–8 years (3.6%) while participants aged 17–20 years recorded no infection. Haematuria was highest in age group 5–8 years (14.5%) and lowest in age group 13–16 years (7.8%) while proteinuria was highest in age group 17–20 years (21.6%) and lowest in age group

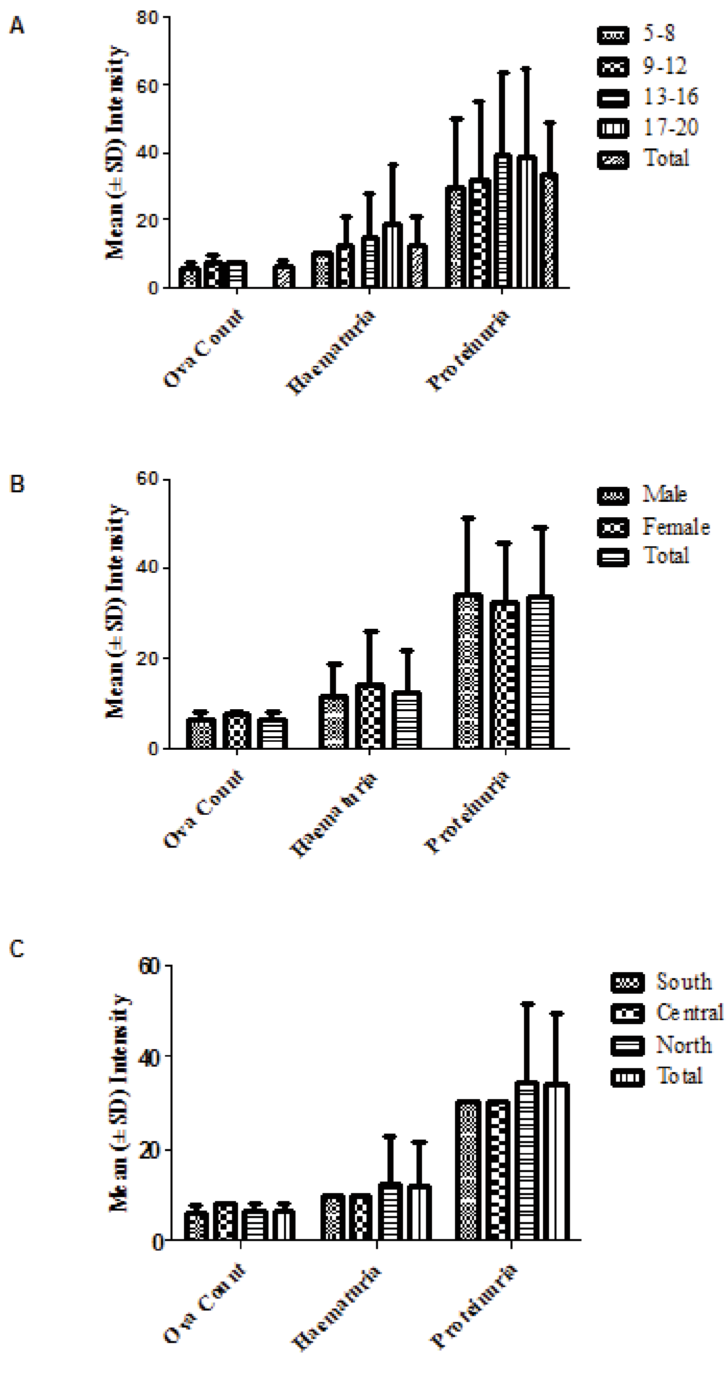

Figure 3. Mean intensity of *Schistosoma haematobium* infection by microscopy and morbidity indicators among school children by age-group (A), gender (B) and Senatorial Districts (C)

5–8 years (15.3%). There was statistical significant influence of age on prevalence of infection (*P*<0.05).

Males 11 (2.4%) recorded more infection than females 2 (0.6%) and this difference was statistically significant (*P*<0.05). Haematuria and proteinuria were also higher in males than in females, but there was no statistically significant influence of gender on presence of morbidity indicators (*P*>0.05).

According to microscopy, the highest prevalence of infection occurred in the Southern Senatorial District (2.3%), while the lowest occurred in the Central Senatorial District (0.5%) (*P*>0.05).

Table 1. Intensity of *S. haematobium* infection by weight and height of school children

Variable	No. examined by microscopy	No. (%) infected by microscopy	Mean ova count ± SD eggs/10 ml urine	Mean haematuria ery/µl	Mean proteinuria mg/µl
Weight (kg)					
11–20	112	3 (2.7)	5.67±0.577	10.0±0.00	30±0.00
21–30	367	8 (2.2)	6.25±1.75	10.0±0.00	31.3±9.7
31–40	191	1 (0.5)	9.00±0.00	17.1±15.7	36.5±20.6
41–50	84	1 (1.2)	7.00±0.00	16.7±15.6	38.7±23.9
51–60	22	0 (0.0)	0.00±0.00	10.0±0.00	30.0±0.00
61–70	1	0 (0.0)	0.00±0.00	0.0±0.00	0.0±0.00
Total	777	13 (1.7)	6.38±1.61	33.6±15.5	12.2±9.2
P-value			0.362	0.023	0.214
Height (cm)					
81–90	2	0 (0.0)	0±0.00	0±0.00	30.0±0.00
91–100	48	0 (0.0)	0±0.00	10.0±0.00	30.0±0.00
101–110	44	2 (4.5)	6.50±0.71	10.0±0.00	30.0±0.00
111–120	99	0 (0.0)	0±0.00	10.0±0.00	30.0±0.00
121–130	227	8 (3.5)	6.63±1.9	11.6±8.0	34.1±16.7
131–140	145	1 (0.7)	5.0±0.00	11.4±7.8	34.2±16.9
141–150	115	1 (0.9)	5.0±0.00	12.9±10.7	35.4±19.0
151–160	88	1 (1.1)	7±0.00	21.4±19.5	37.8±23.3
161–170	9	0 (0.0)	0±0.00	10.0±0.00	30.0±0.00
Total	777	13 (1.7)	6.38±1.61	12.2±9.2	33.6±15.5
P-value			0.883	0.304	0.940

Haematuria was highest in the Northern Senatorial District (21.3%) and lowest in the Southern Senatorial District (1.8%) ($P<0.05$). Similarly, proteinuria was highest in the Northern Senatorial District (30.2%) and lowest in the Southern Senatorial District (4.1%) ($P>0.05$).

Intensity of Schistosoma haematobium infection

Figure 3 shows the intensity of *Schistosoma haematobium* infection by microscopy and morbidity indicators. The age group 9–12 years accounted for the highest mean ova count (7.33±2.1) compared to other age-groups in the study ($P>0.05$). Females had the highest mean ova count (7.50±0.71) than males (6.18±1.66). This difference was however not statistically significant ($P>0.05$). The Central Senatorial District had the highest mean ova count (8.0±0.0), while the Southern Senatorial District had the lowest mean ova count (6.0±1.5) ($P>0.05$).

Table 1 shows the intensity of *Schistosoma haematobium* infection by microscopy and morbidity indicators according to weight and height. The highest prevalence of infection occurred among participants with body weight between 11 and 20 kg (2.7%), but the weight range 31–40 kg accounted for the highest mean ova count (9.00±0.00). There was no statistical significant influence of weight on intensity of infection ($P>0.05$). The highest prevalence of infection occurred among subjects

Table 2. Prevalence of *S. haematobium* infection with respect to water contact activities of school children

Activities	No. examined (%)	No. (%) infected	χ^2	*P*-value
Fetching	197 (25.4)	7 (3.6)	12.148	0.791
Swimming	161 (20.7)	2 (1.2)		
Farming	40 (5.2)	1 (2.5)		
Fishing	38 (4.9)	2 (5.3)		
Washing	44 (5.7)	0 (0)		
Fetching and washing	90 (11.6)	0 (0)		
Fetching and swimming	79 (10.2)	0 (0)		
Fetching and fishing	2 (0.3)	0 (0)		
Fetching and farming	2 (0.3)	0 (0)		
Washing and swimming	16 (2.1)	0 (0)		
Washing and farming	3 (0.4)	0 (0)		
Swimming and farming	6 (0.8)	0 (0)		
Fetching, washing and swimming	74 (9.5)	1 (1.4)		
Fetching, washing and fish	1 (0.1)	0 (0)		
Fetching, washing and farming	3 (0.4)	0 (0)		
Fetching, swimming and fishing	7 (0.9)	0 (0)		
Fetching, swimming and farming	13 (1.7)	0 (0)		
Washing, swimming and fishing	1 (0.1)	0 (0)		
Total	777	13 (1.7)		

whose height fell within the range of 101–110 cm (4.5%). The height range of 151–160cm accounted for the highest mean ova count (7.00±0.00) ($P>0.05$).

Prevalence of Schistosoma haematobium infection with respect to water contact activities

The prevalence of *Schistosoma haematobium* infection with respect to water-contact activities of respondents is shown in table 2. Water-contact habits/practices included fetching water (25.4%), swimming (20.7%), washing clothes (5.7%), farming (5.2%) and fishing (4.9%). Participants also engaged in various combinations of water-contact habits and practices such as fetching water and washing clothes (11.6%); fetching water and swimming (10.2%); and fetching water, washing clothes and swimming (9.5%). About 25% of respondents had the habit of fetching water from streams; the highest prevalence of *S. haematobium* infection (3.6%) was observed in this category of respondents.

Discussion

Sub-Saharan Africa bears most of the global burden of urogenital schistosomosis. It is one of the neglected tropical diseases occurring frequently in sub-Saharan Africa where 85% of those infected worldwide live [16,17]. The disease is inextricably linked to poverty, more especially in rural areas where contact with parasite-infested freshwater frequently expose the community dwellers to infection and re-infection [16].

The overall prevalence (1.7%) recorded in this study is lower than that reported by other researchers in Nigeria. Damen et al. [18] reported a prevalence of 18.7% in North Central Nigeria. Kabiru et al. [19] and Hassan et al. [20] all reported higher prevalence in other parts of Nigeria. This prevalence confirms exposure to cercaria-contaminated water bodies. Prevalence of *Schistosoma haematobium* varied significantly across age groups ($P<0.05$) with the least (0%) and highest (3.6%), recorded in age group 17–20 and 5–8 years respectively. This is similar to previous reports in Biase and Yakurr Local Government Areas (LGAs) by Adie et al. [21] but disagrees with other findings which recorded highest infection rates occurring in age bracket 12–15 years [22] and 10–14 years [23]. The prevalence of urinary schistosomosis varied significantly with age in this study which is in contrast to findings in other studies [24], while it was supported by Sam-Wobo et al. [25].

There was gender difference in infection pattern. More male participants (2.4%) were infected than female participants (0.6%). This deviates from other studies that reported no significant difference in gender-related prevalence. Bala et al. [26], Kabiru et al. [19] and Morenikeji et al. [22], all reported both genders to be equally at risk. However, similar findings were reported by Ladan et al. [27]. This difference may be explained by the fact that male children are more involved in water contact activities than female children due to social inhibitions like being restricted from activities such as fishing, public bathing and swimming.

The mean output of 6.38±1.61 ova per/10mL urine observed in this study is far lower than the mean output of 21.89 ova/10ml urine reported by Inyang-Etoh et al. [28] in Adim as well as the mean output of 197 ova/10ml urine reported by Adie et al. [21] in Biase and Yakurr Local Government Areas (LGAs) in Cross River State (CRS). Ladan et al. [27], Bala et al. [26] and Morenikeji et al. [22] all reported higher mean output of *Schistosoma* ova in urine of infected persons in separate studies conducted in Nigeria. However, the result from this study is corroborated by the report of the mean output of 12 mean ova/10ml observed by Adie et al. [21] in Biase and Yakurr LGAs of CRS. All the infected participants in this study harboured low egg loads; eggs are shed intermittently and in lower amounts in light-intensity infection [29]. Age of participants did not significantly determine intensity of infection in this study ($P>0.05$), though age-group 9–12 years had the highest mean ova count of 7.33±2.1. This can be attributed to both the high fecundity rate of the worm and high worm burden in children due to their naive immunity [30]. The zero percent prevalence and zero mean ova count recorded in age-group 17–20 years may be attributed to the fact that there is a possibility of developing concomitant immunity in schistosomiasis [26] and probably due to the fact that schistosomosis morbidity decreases with increase in age [31].

The low prevalence of haematuria (11.6%) and proteinuria (17.6%) does not agree with reports elsewhere [32,22]. This could be as a result of the mass chemotherapy with praziquantel which has been going on in the State since 2012 [21]. Since praziquantel acts on the adult worm, while artesunate acts on the juvenile stages, it is possible that combination chemotherapy may increase cure rate, reduce morbidity indicators and the possibility of drug resistance development by the parasite [28,33]. Haematuria and proteinuria are indicators of damage in the urinary tract and kidney [32]. Inconclusive evidence has suggested that *S. haematobium* is associated in glomeruli pathology. Damage to the glomeruli lead to leakage of red blood cells and protein into the urine [34]. Though a high prevalence of glomerulonephritis has been reported in urogenital schistosomosis endemic areas, its relationship to the diseases is unclear [34].

The present study confirms the *Schistosoma haematobium* endemicity in the three Senatorial Districts (Biase, Yakurr and Bekwarra LGAs). According to Useh [35], the extensive, unrestrained and unchecked increase in irrigation and other water confinement schemes, and also the widespread ignorance of schistosomosis in the majority of endemic areas has elevated the disease to a very serious health predicament in sub-Sahara part of the continent including Nigeria. In CRS, the agrarian population and suitable conditions that enable the snail intermediate host to thrive has added to the prevalence of schistosomosis [6].

Several authors who have worked on the relationship between human water contact patterns and schistosomosis in endemic areas reported various patterns of contacts to water bodies [36] with respect to frequency and duration of water contact activities. Economic and personal activities were found to be the principal activities for both males and females and are therefore considered as risky behaviour [36]. School-age children and teenagers as well as young adults aged 20–24 years have been shown to have the highest frequency of contact as reported elsewhere in Tropical Africa

[37]. In the study, all respondents were involved in one water-contact activity or the other. Those that were engaged in fetching water were highest. The different, prolonged water-contact activities expose them to the risk of being infected. These findings corroborate other reports [26].

It is evident from this study that *Schistosoma haematobium* infection is still endemic in the three Senatorial Districts of CRS, despite periodic chemotherapy which has been a method of choice for short-term control of the disease. Provision of potable water supply for schistosomosis-endemic communities is key to breaking the cycle of re-infection necessary for sustaining widespread infection. Studies should therefore be extended to cover both out-of-school children and adults as these categories of persons could serve as a source of reinfection in the various communities.

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