

Research Article

Urogenital Schistosomiasis among Schoolchildren and the Associated Risk Factors in Selected Rural Communities of Kwara State, Nigeria

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Urogenital schistosomiasis is a chronic parasitic disease that causes severe morbidity among schoolchildren in many poor-resource communities in Nigeria. We investigated the prevalence, intensity, and risk factors of the infection in three communities of Kwara State to ascertain the current status of the disease. Of the 724 urine samples screened, using filtration method, 332 (45.6%) school-aged children were infected with average intensity and mean population eggs load of 127.9 eggs/10 ml of urine and 0.794, respectively. Prevalence and intensity of infection varied with communities: high in Ajase-Ipo (57.1%; $X = 100.7 \pm 23.01$ eggs/10 ml) and low in Shonga (37.5%; $X = 91.4 \pm 78.0$). Infection was significantly ($P < 0.05$) higher in males (50.8%) than the females (42.4%). Similarly, infection significantly ($P < 0.05$) increased with increasing age. Multivariate logistic analysis of risk factors revealed that lack of portable drinking water (adjusted odd ratio (aOR) = 4.76; 95% CI = 2.64–5.98), unemployment (aOR = 2.23; 1.87–2.294), lack of knowledge of infection (aOR = 2.16; 0.59–3.83), and frequent contact with contaminated water bodies (aOR = 2.01; 1.45–2.70) were important predictors of urinary schistosomiasis. Therefore, continuous evaluation of the intervention strategies that address risk factors must compliment Mass Drug Administration to curtail the transmission and debilitating health consequences of infection in endemic settings.

1. Introduction

Urogenital schistosomiasis is a common neglected tropical disease in many rural communities in African countries, with patches of infection in the Eastern Mediterranean Region [1–3]. Globally, an estimated 239 million people are currently infected, with burden estimated at more than 3.5 million disability-adjusted life years (DALYs) [4, 5]. In many endemic areas, severely infected individuals may suffer fibrosis of the bladder, kidney damage, bladder cancer, and death if untreated [3]. This, however, depends on several factors such as host-parasite genetics, degree and length of exposure, intensity of infection, host immune response to the parasites, and coinfections with other tropical diseases such as malaria and HIV-1 [6].

In Nigeria, urinary schistosomiasis is a serious health problem with about 29 million infected cases and 101 million people at risk of infection [7–9]. Recent reports showed unabated increase of infection in all the geographical zones of the country, particularly among the schoolchildren [10–12]. Epidemiological studies in many endemic communities have attributed sustained infection to many factors including routine agricultural practices, human behavior, and failed water projects to meet the needs of people [9].

Currently, information on the status of infection in Kwara State is still scanty and the epidemiological knowledge is rudimentary; the baseline data for control interventions is non-existent. Therefore, this survey investigates the prevalence, intensity, and risk factors of urinary schistosomiasis among

the schoolchildren in three rural communities of Kwara State, Nigeria.

2. Materials and Methods

2.1. Study Areas. The study was conducted in three selected rural communities of Kwara State, namely, Ajase-Ipo (located on Lat. 8° 13' 60 N and Long. 4° 49' 0 E), Bacita (Lat. 9° 4' 59.99''N and Long. 4° 57' 0.0''E), and Shonga (Long. 9° 1'0''N and Lat. 5° 9' 0 E) between March 2015 and July 2016. The ecological, behavioral, and population characteristics of these communities are similar, and the climate is tropical, with distinct dry (November–March) and rainy (April–October) seasons. Maximum temperature ranges between 25.7 and 33.7°C. The indigenous people of our study areas, majorly Nupe and Yoruba ethnic groups, are predominantly petty traders and subsistence farmers. Basic infrastructural facilities such as water supply, electricity, and health care services are grossly inadequate, and school enrolment is low with considerable number of school dropout. Environmental and personal hygiene are precarious as human wastes are indiscriminately dumped around human habitation, and animals roam freely in streets. Inhabitants largely depend on contaminated open dug wells, pristine stream, and rivers for domestic water supply.

3. Ethical Consideration

The study protocol was approved by the University of Ilorin Research and Ethical Committee (Ref. number UERC/ASN/2014/011). The traditional leaders and an ad hoc ethical committee of Local-Government Authorities gave approval before the commencement of the study. Finally, informed written consent was obtained from each adult subject and the parents/caregivers of each child before enrolment in the study.

4. Study Sample

Primary and secondary schoolchildren, aged 4–18 years, were randomly recruited for this study in all the study areas. Menstruating females and individual who had stayed less than 6 months in the communities were exempted from study.

5. Urine Sample and Data Collection

Randomly recruited volunteers in each community were given prelabelled clean plastic screw capped bottles to be fully or partially filled with their urine samples between 11.00 and 15.00 hours. At the point of collection of sample questionnaire was given to obtain information on biodata (age, sex, occupation of parents, and duration of stay in community), source of water supply, frequency of water contact, and other risk-related factors of schistosomiasis. Thereafter, all collected urine samples were transported to the Parasitology Laboratory, Department of Zoology of University of Ilorin, for parasitological analysis. Infected individuals were

immediately recommended for treatment after another visit to the study areas and laboratory processing of the urine samples were done.

6. Sample Processing

All urine samples were collected and preserved in each community and transported to the parasitology laboratory of Department of Zoology, University of Ilorin. Microscopic examination of each urine sample for detection of *S. haematobium* eggs was performed using filtration method. In brief, 10 ml of each urine sample was drawn into a syringe and passed through a Millipore filter (12 µm polycarbonate filter) to recover the eggs. The filter was carefully examined and eggs counted at ×10 objective of a light microscope.

7. Data Analysis

All data were double entered using SPSS version 16.0 for Windows (SPSS Inc., Chicago, IL, USA). Differences in proportions were tested by chi-square tests, either for trend or for independence, as appropriate. The mean population eggs load were evaluated and transformed to $\log_{10}(x + 1)$ values to normalize the distribution for statistical analyses. Differences between means were tested using independent samples *t*-test and one-way ANOVA. Logistic regression analysis was performed, using backward elimination, to assess the independent associations between prevalence of infection and selected risk factors.

8. Result

A total of 724 participants were enrolled in this study, with 50.8% male and 42.4% female. The average age group was 11.3 years. Overall prevalence and mean intensity of infection were 45.6% and 127.9 eggs/10 ml of urine, respectively. The mean population egg load was high in Ajase-Ipo (1.274) and low in Shonga (1.060) (Table 1). Prevalence of infection was age- and sex-dependent in all the communities except in Shonga. Age group 11–14 years had a significant higher prevalence ($P < 0.05$) in the communities, but prevalence with sex was consistently higher in males than females (Table 2). Intensity of infection paralleled the prevalence rates with significant higher intensity in males than females (325.7 versus 139.6 eggs/10 ml of urine) except in Ajase-Ipo and Shonga communities where intensity of infection was slight (Table 3).

The results of the univariate analysis of risk factors for the infection are presented in Table 4. Frequency of water contact, source of water supply, unemployment, and lack of knowledge of infection were the major significant risk factors observed in the study. In the multivariate logistic regression analysis (Table 5) source of water supply (adjusted odd ration (aOR) of 4.76; 95% CI = 2.64–5.98) and unawareness of infection (aOR = 2.16; 95% CI = 0.59–3.83) were significantly associated with infection.

TABLE 1: Overall prevalence and intensity of urinary schistosomiasis in the selected study communities.

| Locations | Number examined | Number infected | Percentage infected (%) | Mean intensity \pm std. deviation | Mean population egg load transformed into $\log^{(x+1)}$ |
|-----------------|-----------------|-----------------|-------------------------|-------------------------------------|--|
| Overall | 724 | 332 | 45.6 | 127.9 \pm 67.13 | 0.794 |
| Bacita | 205 | 106 | 51.7 | 130.5 \pm 12.34 | 1.239 |
| Ajase-Ipo | 212 | 121 | 57.1 | 100.7 \pm 23.01 | 1.274 |
| Shonga | 307 | 115 | 37.5 | 91.4 \pm 78.00 | 1.060 |
| <i>P</i> values | | | 0.014 | 0.018 | 0.039 |

TABLE 2: Infection pattern with respect to the age and sex of the study participants.

| Locations | Bacita (%) | Ajase-Ipo (%) | Shonga (%) | Total (%) |
|------------------|---------------|---------------|---------------|----------------|
| <i>Age group</i> | | | | |
| ≤ 5 | 5/2 (40.0) | 6/2 (33.3) | 0/0 (0.0) | 11/4 (36.4) |
| 6–10 | 85/44 (51.8) | 5/3 (60.0) | 28/9 (32.1) | 118/56 (47.5) |
| 11–14 | 66/37 (56.1) | 125/79 (63.2) | 157/56 (35.6) | 348/172 (49.4) |
| ≥ 15 | 49/23 (46.9) | 76/37 (48.7) | 122/50 (41.0) | 247/110 (44.5) |
| <i>P</i> value | 0.001 | 0.031 | 0.045 | 0.001 |
| <i>Sex</i> | | | | |
| Male | 111/67 (60.4) | 119/74 (62.2) | 185/70 (37.8) | 415/211 (50.8) |
| Female | 94/39 (41.5) | 93/47 (50.5) | 122/45 (36.9) | 309/131 (42.4) |
| <i>P</i> value | 0.011 | 0.046 | 0.180 | 0.047 |

TABLE 3: Egg counts of the *S. haematobium* in 10 ml of urine of the infected study populations.

| Locations | Bacita (mean \pm std.) | Ajase-Ipo (mean \pm std.) | Shonga (mean \pm std.) | Total (mean \pm std.) |
|------------------|--------------------------|-----------------------------|--------------------------|-------------------------|
| <i>Age group</i> | | | | |
| ≤ 5 | 42.7 \pm 16.21 | 64.5 \pm 7.81 | 0.0 \pm 0.0 | 56.9 \pm 34.60 |
| 6–10 | 53.5 \pm 13.50 | 50.3 \pm 19.42 | 41.2 \pm 10.11 | 68.5 \pm 15.71 |
| 11–14 | 77.7 \pm 39.73 | 61.9 \pm 29.25 | 76.1 \pm 55.19 | 73.8 \pm 21.94 |
| ≥ 15 | 139.5 \pm 85.64 | 309.3 \pm 220.27 | 89.6 \pm 345.93 | 147.4 \pm 67.68 |
| <i>P</i> value | 0.001 | <0.001 | 0.091 | 0.008 |
| <i>Sex</i> | | | | |
| Male | 459.6 \pm 43.70 | 265.4 \pm 91.45 | 101.1 \pm 34.81 | 325.7 \pm 50.66 |
| Female | 212.3 \pm 98.51 | 206.8 \pm 23.76 | 45.8 \pm 54.40 | 139.6 \pm 88.73 |
| <i>P</i> value | <0.001 | 0.531 | 0.092 | 0.004 |

9. Discussion

This study presents one of the few baseline epidemiological data of urogenital schistosomiasis in schoolchildren in resource-poor communities in Kwara State, Nigeria. Our results indicate that urogenital schistosomiasis is a common parasitic disease and major cause of morbidity among Nigerian children and other tropical countries [13–15]. The overall prevalence of 45.6% in our study area is threefold higher than the national Nigerian average of 13% [16], and the mean intensity of 127.9 eggs/10 ml suggests a long-term transmission, which underscores the public health importance of this chronic disease in Kwara State, Nigeria. These findings are comparable to several reports from many endemic regions

in Nigeria [17–21] and other endemic countries such as Senegal, Malawi, Madagascar, Tanzania, and Cameroon [22–25]. However, the intensity and prevalence of infection in the current study is slightly lower than the observation in children from other regions within and outside Nigeria [26]. This variation in the occurrence of infection may be ascribed to difference in epidemiological profile. Besides, a single day urine sample used for this study would likely underestimate the severity of infection in the selected communities.

Generally, high prevalence rate of urogenital schistosomiasis in this study may be attributed to the intense water-contact activities observed in our study areas, particularly in Bacita and Shonga. Children were often found playing, swimming, washing their cloth/kitchen utensils, and doing other

TABLE 4: Univariate analysis of epidemiological factors for urinary schistosomiasis in the study area.

| Factors | Prevalence | Odds ratio (95% CI) | P value |
|--|----------------|---------------------|---------|
| <i>Occupation of the parent</i> | | | |
| Government worker | 195/69 (35.4) | 1 | |
| Trader | 203/85 (41.9) | 1.19 (0.87–2.32) | 0.062 |
| Unemployed | 326/178 (53.1) | 2.12 (1.54–2.39) | 0.003 |
| <i>Frequency of water contact</i> | | | |
| Daily | 380/175 (46.1) | 1.84 (0.54–2.19) | <0.001 |
| Weekly | 134/79 (58.9) | 2.01 (1.88–2.49) | 0.004 |
| Monthly | 210/78 (37.1) | 1 | |
| <i>Source of water</i> | | | |
| Pipe borne | 98/36 (36.7) | 1 | |
| Well | 117/52 (44.4) | 0.98 (0.72–1.53) | 0.061 |
| Stream/river | 509/244 (47.9) | 2.77 (2.80–3.01) | 0.002 |
| <i>Duration of activities in water</i> | | | |
| Long (>5 minutes) | 479/231 (48.2) | 0.58 (0.21–0.83) | 0.319 |
| Short (≤5 minutes) | 245/101 (41.2) | 1 | |
| <i>Awareness of infection</i> | | | |
| Yes | 197/53 (26.9) | 1 | |
| No | 509/279 (52.9) | 2.87 (1.33–3.04) | 0.004 |

TABLE 5: Multivariate analysis of epidemiological factors of urinary schistosomiasis among the infected participants.

| Factors | Adjusted odds ratio | 95% CI | P value |
|--------------------------------|---------------------|-----------|---------|
| Gender (male) | 1.98 | 0.65–2.19 | 0.007 |
| Age (≥6 years) | 1.41 | 1.09–1.75 | 0.421 |
| Unemployment | 2.23 | 1.87–2.94 | 0.036 |
| Frequent water contact | 2.01 | 1.45–2.70 | 0.047 |
| Lack of portable water | 4.76 | 2.64–5.98 | <0.001 |
| Lack of awareness of infection | 2.16 | 0.59–3.83 | 0.001 |

domestic activities in the river in all the three study areas. Also, majority (52.9%) of our study participants had no knowledge about the transmission of *S. haematobium*; let alone any intervention strategy. This poor awareness about schistosomiasis in this part of Nigeria is similar to observations previously reported in Malawi [27], Zimbabwe [28], and Western Kenya [29]. Therefore, the recent call for global effort to eliminate human schistosomiasis by 2025 by World Health Organization [30] should include health education in schistosomiasis endemic communities of the world.

In the current study, the prevalence and intensity of infection varied widely between communities, with the lowest prevalence in Shonga community. This agrees with previous observations in Nigeria and other areas and is most likely due to differences in the force of transmission of the disease [26, 31, 32]. For instance, the inhabitants of Shonga communities are predominantly peasant farmers and fishermen but provided with borehole water as alternative source of water supply. This may have reduced the water-contact activities of the people when compared with the inhabitants of Bacita that depend solely on river and stream waters for their daily domestic activities. Besides, uneven distribution of infrastructural amenities such as health, toilet, and portable water facilities in our study area may also account for variation in the occurrence of infection in the communities.

Our finding on age and sex pattern of infection is identical to what is obtainable in many endemic communities in Africa [6, 14, 33–35]. The highest prevalence (49.4%) and intensity (147.4 eggs/10 ml of urine) were recorded within the 11–15-year age group. These age groups have been tremendously characterized with boisterous water-related activities such as fishing, washing, swimming, and playing that increase the risk of infection in the communities. This probably accounts for high infection rate among the groups. Similarly, the high infection in male children than the female suggests the higher exposure risk activities in males than the females. This observation indicates that the sex and other factors are important transmission foci in our study communities, and it corroborates findings from many other endemic settings [14, 19, 26, 34–39].

Our analysis of risk factors revealed a significant relationship between prevalence of infection and many factors such as lack of knowledge of infection, occupation, and source of water supply. This conforms to several reports in different ecological regions of Nigeria and sub-Saharan Africa [6, 14, 20, 22, 24, 36–38]. Unemployment status of the parent was observed as a significant predictor of schistosomiasis, and it remained an important risk factor in the multivariate logistic regression analysis (aOR = 2.23). This high rate of unemployment in the study area is a direct indicator of low income and

poverty which have been significantly associated with urogenital schistosomiasis.

In our study, only 27% of the study population had a fair knowledge of the cause and prevention of the disease. Many infected male children considered haematuria (blood with urine) as a sign of maturity rather than a symptom of infection. This has serious implication on the control and treatment of infection. Similarly about 63% of the population had no access to pipe-borne water. This possibly influences the high frequency and duration of water contact in the locality.

These findings had demonstrated that urogenital schistosomiasis is endemic and constitute severe morbidity in school children in Kwara State. Therefore, continuous disease evaluation and implementation of a broad-based public health and socioeconomic development that includes provision of clean and safe drinking water and health education are essential to prevent the transmission of infection in the endemic areas.

In conclusion, the recent mass administration of Praziquantel to schoolchildren in the state should be complemented with provision of portable water and strict environmental management in the construction of road, damming and irrigational farming. These will facilitate schistosomiasis elimination in the year 2025 as contained in the global strategic plan.

Conflicts of Interest

The authors declared no conflicts of interest regarding the publication of this manuscript.

References

- [1] "WHO, Schistosomiasis, 2017," <http://www.who.int/mediacentre/factsheets/fs115/en/>.
- [2] D. Engels, L. Chitsulo, A. Montresor, and L. Savioli, "The global epidemiological situation of schistosomiasis and new approaches to control and research," *Acta Tropica*, vol. 82, no. 2, pp. 139–146, 2002.
- [3] P. Steinmann, J. Keiser, R. Bos, M. Tanner, and J. Utzinger, "Schistosomiasis and water resources development: systematic review, meta-analysis, and estimates of people at risk," *The Lancet Infectious Diseases*, vol. 6, no. 7, pp. 411–425, 2006.
- [4] "Global Health Estimates 2015: Disease burden by cause, age, sex, by country and by Region, 2000–2015. World Health Organization, Geneva, 2016," <http://www.who.int/healthinfo/global-burden...>
- [5] P. J. Hotez, M. Alvaldo, and M.-G. Basáñez, "The global burden of disease study 2010: interpretation and implications for the neglected tropical diseases," *PLOS Neglected Tropical Diseases*, vol. 8, no. 7, Article ID e2865, 2014.
- [6] H. D. Mazigo, F. Nuwaha, S. M. Kinung'hi et al., "Epidemiology and control of human schistosomiasis in Tanzania," *Parasites & Vectors*, vol. 5, no. 1, article 274, 2012.
- [7] World Health Organisation, "World health statistics, 2013," http://www.who.int/gho/publications/world_health_statistics/2013/en/.
- [8] P. J. Hotez, L. Savioli, and A. Fenwick, "Neglected tropical diseases of the middle east and north africa: review of their prevalence, distribution, and opportunities for control," *PLOS Neglected Tropical Diseases*, vol. 6, no. 2, Article ID e1475, 2012.
- [9] World Health Organisation, 2016, <http://www.who.int/schistosomiasis/en>.
- [10] O. J. Sunday, O. A. Babamale, and U. S. Ugbomoiko, "Distribution Pattern of Human Urinary Schistosomiasis in Kwara State, Nigeria," *American Journal of Infectious Diseases*.
- [11] A. Abdulkadir, M. Ahmed, B. M. Abubakar et al., "Prevalence of urinary schistosomiasis in Nigeria, 1994–2015: Systematic review and meta-analysis," *African Journal of Urology*, vol. 23, no. 3, pp. 228–239, 2017.
- [12] K. Singh, D. Muddasiru, and J. Singh, "Current status of schistosomiasis in Sokoto, Nigeria," *Parasite Epidemiology and Control*, vol. 1, no. 3, pp. 239–244, 2016.
- [13] P. J. Hotez and A. Kamath, "Neglected tropical diseases in sub-Saharan Africa: review of their prevalence, distribution, and disease burden," *PLOS Neglected Tropical Diseases*, vol. 3, no. 8, article e412, 2009.
- [14] U. S. Ugbomoiko, I. E. Ofoezie, I. C. Okoye, and J. Heukelbach, "Factors associated with urinary schistosomiasis in two peri-urban communities in south-western Nigeria," *Annals of Tropical Medicine & Parasitology*, vol. 104, no. 5, pp. 409–419, 2010.
- [15] D. O. Akinboye, J. U. Ajisebutu, O. Fawole et al., "Prevalence and intensity of schistosoma haematobium infections: a community based survey among school children and adults in wamakko town, sokoto state Nigeria," *International Journal of Tropical Medicine and Public Health*, vol. 2, no. 1, p. 2, 2013.
- [16] I. E. Ofoezie, "Human health and sustainable water resources development in Nigeria: Schistosomiasis in artificial lakes," *Natural Resources Forum*, vol. 26, no. 2, pp. 150–160, 2002.
- [17] M. A. Mafe, T. Von Stamm, J. Utzinger, and E. K. N'Goran, "Control of urinary schistosomiasis: An investigation into the effective use of questionnaires to identify high-risk communities and individuals in Niger State, Nigeria," *Tropical Medicine & International Health*, vol. 5, no. 1, pp. 53–63, 2000.
- [18] H. O. Okpala, E. Agwu, M. I. Agba, O. R. Chimezie, G. O. Nwobu, and A. A. Ohihoin, "A survey of the prevalence of Schistosomiasis among pupils in Apata and Laranto areas in Jos, Plateau State," *The Online Journal of Health and Allied Sciences*, vol. 3, no. 1, pp. 1–4, 2004.
- [19] M. Kabiru, E. I. Ikeh, I. Aziah et al., "Urinary Schistosomiasis: Water contact frequency and infectivity among secondary school students in Ibadan, Nigeria," *Nigerian Journal of Parasitology*, vol. 32, no. 1, pp. 129–134, 2011.
- [20] E. U. Amuta and R. S. Houmsou, "Prevalence, intensity of infection and risk factors of urinary schistosomiasis in pre-school and school aged children in Guma Local Government Area, Nigeria," *Asian Pacific Journal of Tropical Medicine*, vol. 7, no. 1, pp. 34–39, 2014.
- [21] T. A. Babatunde, S. O. Asaolu, and O. A. Sowemimo, "Urinary schistosomiasis among pre-school and school aged children in two peri-urban communities in Southwest Nigeria," *Journal of Parasitology and Vector Biology*, vol. 5, no. 7, pp. 96–101, 2013.
- [22] B. Senghor, A. Diallo, S. N. Sylla et al., "Prevalence and intensity of urinary schistosomiasis among school children in the district of Niakhar, region of Fatick, Senegal," *Parasites & Vectors*, vol. 7, no. 1, article 5, 2014.
- [23] A. H. N. Mtethiwa, J. Bakuza, and G. Nkwengulila, "Prevalence and Intensity of Schistosomiasis in Communities around Water Reservoirs in Malawi," *Journal of Tropical Diseases*, vol. 04, no. 01, 2015.

- [24] C. F. Rasoamananjah, A. M. Rahetilahy, B. Ranjatoarivony et al., "Baseline prevalence and intensity of schistosomiasis at sentinel sites in Madagascar: Informing a national control strategy," *Parasites & Vectors*, vol. 9, no. 1, article no. 1337, 2016.
- [25] R. Ndyomugenyi and J. N. Minjas, "Urinary schistosomiasis in schoolchildren in Dar-es-Salaam, Tanzania, and the factors influencing its transmission," *Annals of Tropical Medicine and Parasitology*, vol. 95, no. 7, pp. 697–706, 2001.
- [26] M. U. Ladan, U. Abubakar, K. Abdullah, M. D. A. Bunza, and M. J. Ladan, "Adamu Urinary schistosomiasis in selected villages around Gusau Dam Site, Zamfara State, Nigeria," *Nigerian Journal of Basic and Applied Sciences*, vol. 20, pp. 189–194, 2012.
- [27] H. Poole, D. J. Terlouw, A. Naunje et al., "Schistosomiasis in pre-school-age children and their mothers in Chikhwawa district, Malawi with notes on characterization of schistosomes and snails," *Parasites & Vectors*, vol. 7, no. 1, article no. 153, 2014.
- [28] N. Midzi, S. Mtapuri-Zinyowera, M. P. Mapingure et al., "Knowledge attitudes and practices of grade three primary schoolchildren in relation to schistosomiasis, soil transmitted helminthiasis and malaria in Zimbabwe," *BMC Infectious Diseases*, vol. 11, article no. 169, 2011.
- [29] G. O. Odhiambo, R. M. Musuva, V. O. Atuncha et al., "Low Levels of Awareness Despite High Prevalence of Schistosomiasis among Communities in Nyalenda Informal Settlement, Kisumu City, Western Kenya," *PLOS Neglected Tropical Diseases*, vol. 8, no. 4, Article ID e2784, 2014.
- [30] World Health Organization, *Accelerating work to overcome the global impact of neglected tropical diseases—a roadmap for implementation*, WHO, Geneva, 2012, http://www.who.int/entity/neglected_diseases/NTD_RoadMap_2012_Fullversion.pdf.
- [31] N. Lucia, N. Flobert, and A. Tazoacha, "Two years impact of single praziquantel treatment on infection of urinary schistosomiasis in the Barombi Kotto focus, South West Cameroon," *International Journal of Biosciences (IJB)*, vol. 3, no. 3, pp. 98–107, 2013.
- [32] U. S. Ugbomoiko, "The prevalence, incidence and distribution of human urinary schistosomiasis in Edo State, Nigeria," *Australian and New Zealand Journal of Public Health*, vol. 24, no. 6, pp. 642–643, 2000.
- [33] J. W. Rudge, J. R. Stothard, M.-G. Basáñez et al., "Micro-epidemiology of urinary schistosomiasis in Zanzibar: local risk factors associated with distribution of infections among schoolchildren and relevance for control," *Acta Tropica*, vol. 105, no. 1, pp. 45–54, 2008.
- [34] N. Nanvyat, D. A. Dakul, and G. S. Mwansat, "Schistosomiasis in Ndinjor district of Langtang north local government area of Plateau State, Nigeria," *Nigerian Journal of Parasitology*, vol. 32, no. 2, pp. 209–213, 2011.
- [35] A. Dabo, H. M. Badawi, B. Bary, and O. K. Doumbo, "Urinary schistosomiasis among preschool-aged children in Sahelian rural communities in Mali," *Parasites & Vectors*, vol. 4, no. 1, article 21, 2011.
- [36] U. S. Ugbomoiko, V. Dalumo, Y. K. Danladi, J. Heukelbach, and I. E. Ofoezie, "Concurrent urinary and intestinal schistosomiasis and intestinal helminthic infections in schoolchildren in Ilobu, South-western Nigeria," *Acta Tropica*, vol. 123, no. 1, pp. 16–21, 2012.
- [37] A. Garba, N. Barkiré, A. Djibo et al., "Schistosomiasis in infants and preschool-aged children: infection in a single *Schistosoma haematobium* and a mixed *S. haematobium*-*S. mansoni* foci of Niger," *Acta Tropica*, vol. 115, no. 3, pp. 212–219, 2010.
- [38] K. Deribe, A. Eldaw, S. Hadziabduli et al., "High prevalence of urinary schistosomiasis in two communities in South Darfur: Implication for interventions," *Parasites & Vectors*, vol. 4, no. 1, article no. 14, 2011.
- [39] A. M. Ahmed, H. Abbas, F. A. Mansour, G. I. Gasim, and I. Adam, "Schistosoma haematobium infections among schoolchildren in central Sudan one year after treatment with praziquantel," *Parasites & Vectors*, vol. 5, article 108, 2012.



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