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Original Article

Prevalence and risk factors associated with the transmission of Urinary Schistosomiasis among the school-going children in Kafue district, Zambia

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Summary
Urinary Schistosomiasis is one of the neglected tropical snail-borne diseases of humans in Zambia. It's endemic in most communities, where water bodies and poor sanitation are prominent. This study was conducted to determine the prevalence and identify risk factors associated with Schistosomiasis propagation among pupils. A total of 321 urine samples and questionnaires were collected. The results showed that 10.6% (34/321) were infected including 3.7% of girls and 6.9% of boys. The results also indicated that 64.7% had 30mg/dL, 17.6% had 100mg/dL and 8.8% had 500mg/dL proteinuria while 18% showed 100mg/dL, 34% showed 300mg/dL and 12% showed 1000mg/dL haematuria. Of the 34 infected, 23.5% (8/34) were herdsmen, 26.6% (9/34) were swimming, and fishing, 17.6% (6/34) were washing plates and clothes, while 17.6% (6/34) were gardening. The boys were more at risk than girls (RR=1.6). Our results showed that not only proximity to the river could be a risk, but also water activities were the principal risks for contraction of Schistosomiasis. Our findings suggest that positive pupils were in contact with infective cercariae through various water activities. Therefore, there is a need to enhance educational campaigns on threats and prevention measures to reduce further infection.
Keywords: Pupils, Risk factors, Urinary Schistosomiasis, Public health.

Introduction

Urinary Schistosomiasis is a snail-borne disease caused by *Schistosoma haematobium*. The snail vector (*Bulinus spp*, an intermediate host) always prefers the water, where the causative agent is released to complete the life cycle (Kalinda et al., 2017). Schistosomiasis is one of the neglected tropical diseases associated with significant morbidity and mortality, especially in the tropical and subtropical countries of Asia and Africa (Hajissa et al., 2018). The disease is associated with many risk factors, which promote the wave of transmission in various communities. These risk factors include low socioeconomic status, lack of clean water supply and poor environmental sanitation (Hajissa et al., 2018; Wepnje et al., 2019).

In Zambia, the disease is most common in rural areas surrounding rivers infested with *Bulinus* spp. snails (Agnew-Blais et al., 2009). The water-bodies with the presence of the intermediate host provide a suitable environment for breeding and transmission of Schistosomiasis. Water contact activities promote the transmission processes of the disease (Sacolo-Gwebu et al., 2019; Houmsou et

al., 2011). The disease has an impact on the victim by causing haematuria resulting in anaemia and proteinuria, which may lead to complications such as urinary and liver carcinoma (Houmsou et al., 2011). Proteinuria could be detected using urinalysis, a laboratory technique used to monitor and diagnose a wide range of urinary tract infections (UTI) and kidney disorders (Usaini et al., 2015).

Most children infected with the disease are from the ages of 5-19 years. These are children who are more active in playing with water as they can swim, bathe and sometimes urinates in the water (Moyo et al., 2016; Nyati-Jokomo and Chimbari, 2017). These activities increase the threat of acquiring the disease. Other activities may include crossing water barefooted, and watering the vegetable gardens from infested waters (Kapito-Tembo et al., 2009; Ivoke et al., 2014). Therefore the study aimed to determine the prevalence and identify associated risk factors among school-going children in the Chanyanya area, Kafue district of Zambia.

Materials and Methods

Study site

The study was conducted in the Chanyanya fishing camp and surrounding areas in the Kafue district of Zambia. Four schools were selected at random to participate in the study. The area is located at 28°2'E and 15°9'S and is about 65km South-west of Lusaka's main post office (Figure1). It is waterlogged and becomes a suitable breeding area for the *Bulinus* snails. Most people depend on livestock, fishing and small vegetables and sugarcane gardens for their income.

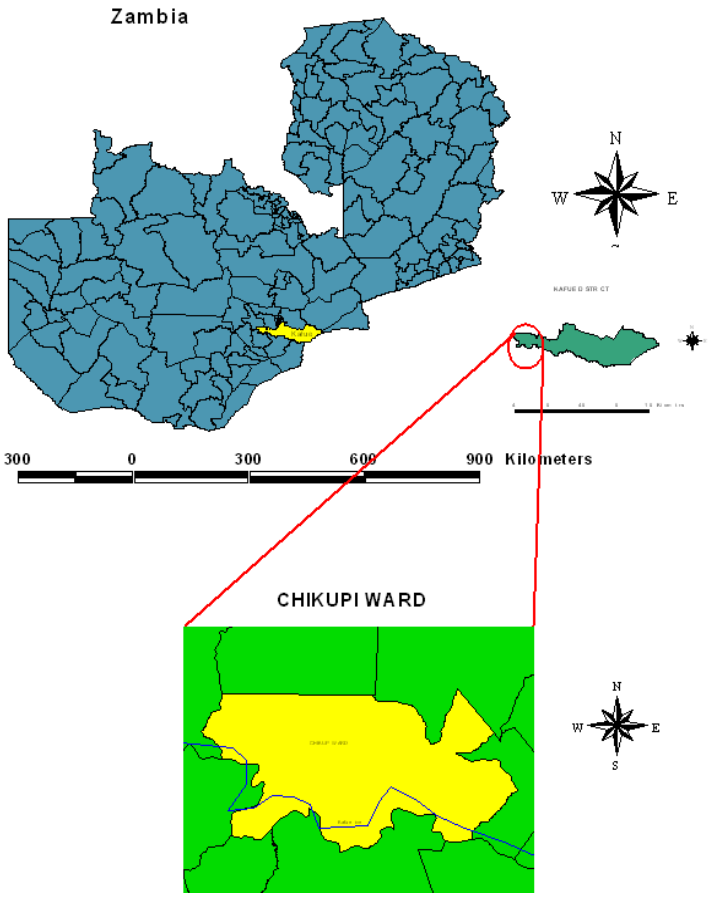

Fig. 1. Chanyanya area in Kafue district.

Study design and sample size

A cross-sectional study design was employed and the sample size was generated from the formula described by (Charan and Biswas, 2013). Using the expected proportion of 30% based on previous studies, the sample size was 322 school-going children.

Sampling technique

Children between the age of 6 and 20 years were randomly and systematically selected in each class. The collection of urine was done between 10:00 and 15:00 hours, which is suitable for egg deposition of the adult worms in the urinary bladder (Houmsou et al., 2011).

The selected children were given sterile specimen bottles to collect urine. About 5-10ml clean catch and midstream urine samples were collected. The sample containers were labeled with the correct identity of the pupil and were immediately transported to Central Veterinary Research Institute laboratories for processing.

Socio-demographic activities

In this study, both qualitative and quantitative approaches were applied using open and closed-ended questionnaires. The consent or assent was obtained from the participants either verbally or written through their parents or their head teachers.

The major questions sought information on personal details (including age, sex, level of education and activities after class and during holidays). The questionnaires were instituted in English and the local language, *Chichewa*, commonly used in the community.

Laboratory analysis

a) Macroscopic

The Urine samples were examined and checked for colour and turbidity and were recorded on the worksheet (Uchendu et al., 2017).

b) Urinalysis

Urine test strips (Combi, Korea) were used to detect the presence of blood, protein and leucocytes which are important markers in Bilharziasis (Usaini et al., 2015).

c) Parasitological examination

Urine was poured into the centrifuge tubes and spun at 3000 rpm for 5 minutes. The supernatant was decanted and a drop of sediment was put on the glass slide. The coverslip was gently placed on the drop to circumvent air bubbles and examined (Moyo et al., 2016). After examination, all pupils who were positive for *S.haematobium*, were treated with a single 40mg/kg oral dose of Praziquantel.

Data analysis

The data obtained from the study was entered into Excel, a statistical package and analysed using Epi Info. Risk Ratio, Chi-square and *p*-value to check the correlation between variables and risk factors were determined.

Results

a) Prevalence of the infection

There were 321 pupils enrolled in the study and were between the ages of 6 and 20 years. The results showed that 34/321 (10.6%) were positive for *S. haematobium* eggs of which 22/321 (6.9%) and 12/321 (3.7%) were boys and girls respectively (Chi-square = 1.88, *p*-value = 0.16). The Risk Ratio (RR) and Odds Ratio (OR) of boys were 1.6 and 1.7, respectively. The age of Children amid 13-14, 15-16, 17-18, and 19-20 exhibited the Risk Ratio of 1.5, 2.2, 1.2, and 1.1, respectively (Table 1).

Table 1. Prevalence of urinary Schistosomiasis in the study area.

Age (yr)	Children sampled	Examined		Total positive	Positivity		Risk Ratio
		Girls	Boys		Girls	Boys	
≤6	0	0	0	n/a	n/a	n/a	n/a
7-8	30	17	13	0 (0%)	0	0	0
9-10	54	28	26	2 (0.6%)	0	2	0.3
11-12	80	31	49	7 (2.2%)	0	7	0.8
13-14	54	31	23	8 (2.5%)	6	2	1.5
15-16	63	29	34	12 (3.7%)	4	8	2.2
17-18	32	11	21	4 (1.2%)	2	2	1.2
19-20	8	2	6	1 (0.3%)	0	1	1.1
≥21	0	0	0	n/a	n/a	n/a	n/a
Total	321	149	172	34 (10.6%) 95% CI= 7.7-14.4	12 (3.7%) 95% CI= 2.2-6.4 RR=0.63 OD=0.60	22 (6.9%) 95% CI= 4.6-10.2 RR=1.59 OD=1.67	

Chi-square=1.88, *p*-value =0.16 between boys and girls. The result is statistically significant at $p < 0.05$.

b) Haematuria

Of the 34 positive pupils, 4/34 (12%) were negative, 8/34 (24%) showed trace, 6/34(18%) showed 100mg/dl (5.5mmol/L), 12/34(34%) showed 300mg/dl (17mmol/L) and 4/34(12%) showed 1000mg/dl (55mmol/L) haematuria.

c) Proteinuria

The results showed that 22/34 had 30mg/dL, 6/34 had 100mg/dL, 3/34 had 500mg/dL, while 3/34 showed that the protein was within normal range. The reference range was 15mg/dl to 20mg/dl.

d) Water-contact activities

Most pupils interviewed reported using streams and rivers water 85%, while 15% used boreholes or dry wells. Swimming and fishing accounted for the highest infection rate of 11/321(3.8%, RR=0.88), while looking after animals barefooted were 9/321 (2.8%, RR=0.45) and the least was others activities 2/321(0.6%, RR=0.13). The results indicated that 6/321(1.9%, RR=0.39) of the positive cases were washing clothes and utensils, and 6/321 (1.9%, RR=0.34) were gardening (Table 2).

Table 2. Activities conducted by pupils after classes especially during weekends and holidays

Activities	Girls	Boys	*Total	No. of positive (%)	X^2, p-value	Risk ratio
Looking after animals in river banks (bare-footed)	12	129	141(44%)	9(2.8)		0.45
Washing clothes and Cleaning utensils in the river	112	2	114(36%)	6(1.9)	X^2=15 p-value= 0.24	0.39
Swimming (bathing) and fishing	8	105	113(35%)	11(3.4)		0.88
Gardening: helping parents	44	79	123(38%)	6(1.9)		0.34
Others Activities	57	47	104(32%)	2(0.6)		0.13
				34(10.6)		

The result is statistically significant at $p < 0.05$. *Note that some children had more than one activity recorded in the study area.

Discussion

The prevalence of 10.6% of urinary Schistosomiasis suggests that school-going children had contracted the parasites in infested waters. Our findings are consistence with those described in Malawi (10.4%) (Kapito-Tembo et al., 2009) and Gambia (10.2%) (Joof et al., 2021), but were slightly lower than those reported in Malawi (13%) (Moyo et al., 2016) and Sudan (12.9%) (Hajissa et al., 2018). Our results were higher than those described in KwaZulu state (1%) (Sacolo-Gwebu et al., 2019) and Kenya (2.3%) (Nagi et al., 2014). The results also showed that boys were more infected than girls, which suggests that male counterparts were frequently in contact with infested waters due to their activities, such as swimming, fishing and gardening. These findings were evidently by a higher risk ratio (RR=1.6) in the boys (Table 1). The report was similar to the findings reported in Nigeria and Zambia (Nagi et al., 2014; Ivoke et al., 2014; Agnew-Blais et al., 2009). Our findings also documented that the most infected age-group was between 11-16 years. This revelation suggests that this age-group is the most active in playing with river water. These findings are consistence with those reported in Nigeria, which suggested that this age-group was the most dynamic among the youths (Atalabi et al., 2016).

Our findings also revealed that swimming, bathing, and fishing were the most contact water activities and showed the highest infection rate of Schistosomiasis 11/34 (32.4%). This report suggests that most children love swimming, bathing and fishing in the rivers, which exposes them to the parasite. Our report was similar to those reported in Nigeria, (Ivoke et al., 2014) Tanzania (Kisiringyo and Kidima, 2020) and Côte d'Ivoire (Angora et al., 2019). This activity was prevalent among children in most tropical countries (Agnew-Blais et al., 2009; Mushi et al., 2022). Our results were constant with those reported in Zimbabwe and Malawi (Nyati-Jokomo and Chimbari, 2017; Moyo et al., 2016). The findings suggest that most Fishermen and gardeners bathe in these waters before going home.

Our study also suggests that children were in contact with infested water as they took their animals to the rivers for grazing and drinking water. As the herdsmen rheostat the animals, they also come in contact with infested waters. This activity is common in the area as there is vast grazing land. Our findings suggest that children do not use personnel protective equipment such as gumboots, which could prevent them from getting infected with *S. haematobium* (Nyati-Jokomo and Chimbari, 2017).

Washing clothes and utensils in the river water allied the urinary Schistosomiasis infection rate of 6/34 (17%) and is common among female counterparts, who often access water through these activities. Our results are similar to those described in Yemen (Sady et al., 2013). Although soap or detergent may be harmful to the cercariae, it can still infect those in contact (Grimes et al., 2015). The washing of utensils in the river waters also showed an associated risk of acquiring the disease. This probably is because they draw water from the infested rivers or streams as it is easier to clean their clothes and utensils. Our study showed that most infected children in this category were girls suggesting that they frequently clean utensils in the rivers. Our findings were similar to those reported elsewhere (Kisiringyo and Kidima, 2020; Steinmann et al., 2006).

These gardening activities suggest that children become in contact with infested water while working in the vegetable gardens.. Vegetable gardens are common in the areas as it's a source of income and nutritional value to the community (Nagi et al., 2014; Oluwadun, 2012). These results were similar to those described in South Africa (Kabuyaya et al., 2017).

Some school-going children indicated no directly contact with river water but were infected which suggests that they may have been in contact with water while barefooted or probably during other water activities (Sady et al., 2013) and similar to those described in Sudan (Hajissa et al., 2018).

The findings of our study showed that haematuria and proteinuria were common cryptograms among

the infected children. The results were similar to those described in Nigeria (Houmsou et al., 2011). Haematuria is the common sign of Urinary Schistosomiasis and our study showed haematuria in most participants, and *S. haematobium* ova were detected. These findings suggest that terminal blood during urination indicates *S. haematobium* infection (Grimes et al., 2015).

Conclusion

In conclusion, our study indicated that most *S. haematobium* infection occurs during water activities. Our results showed that not only proximity to the river could be a risk, but also water activities were the principal risks for contraction of Schistosomiasis. There is a need to educate children about the dangers of being in contact with infested river water without protective wear, such as footwear. In addition, the Schistosomiasis control program in schools and communities, especially those living along the river banks and plains, should be intensified.

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Conflicts of Interest:

The authors declare no conflict of interest.

Ethical approval

Ethical clearance was obtained from the Ministry of Health and Education. School authorities, teachers, parents/guardians, and participants were informed about the objectives, procedures, potential risks, and benefits of the study.

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