Prevalence and factors associated with Schistosomiasis in Ng'ombe Township of Lusaka urban district

***Ng'andwe Kalungwana[1,2], David Mwakazanga[2], James Mwansa[3], Mable Mwale Mutengo[3] and Seter Siziya[1]**

[1]*University of Zambia, School of Medicine, Department of Public Health, P.O. Box 50110, Lusaka, Zambia*
[2]*Tropical Diseases Research Centre, P.O. Box 71769, Ndola, Zambia*
[3]*University Teaching Hospital/ Bilharzia Control Programme, Private Bag R.W. 1X, Lusaka, Zambia*

ABSTRACT

Background: The transmission cycle of schistosomiasis requires contamination of surface water by excreta, specific freshwater snails as intermediate hosts, and human water contact. The disease is a rural problem, but urban foci can be found in many endemic areas. The Zambian Ministry of Health (MOH) reports that schistosomiasis is highly prevalent in rural districts especially those close to the Lakes and rivers. Anecdotal evidence suggests that Ng'ombe Township is the hardest hit by schistosomiasis in Lusaka province of Zambia. Though a number of studies including national surveys have been done on schistosomiasis, no study on the factors associated with the disease in Ng'ombe Township has been documented.

Materials and Methods: A Cross Sectional Exploratory survey was conducted to determine the prevalence and factors associated with schistosomiasis in five schools of Ng'ombe Township in Lusaka district where a total of 260 school-going children aged 8-14 years, attending grade three (3) to grade five (5) participated in the study.

Results: No cases of *S. mansoni* were recorded in the five schools of Ng'ombe Township. However, the overall prevalence of *S. haematobium* infection was 13.1% (34/260). Age was significantly associated with infection. Compared with participants of age less than 10 years, participants aged 10-11 years and those aged 12 years or older were 5.17 (95% CI [1.62, 16.49]) and 14.96 (95% CI [2.52, 88.65]) times more likely to get infected, respectively. Children in grade five were 65% (AOR=0.35, 95% CI [0.02, 0.40]) less likely to have Schistosomiasis than those in grade three. Pupils whose source of water at school was a public water tap were 73% (AOR=0.27, 95% CI [0.09, 0.90]) less likely to have schistosomiasis than those that were using a communal hand pump at school.

Conclusions: The study clearly documents the persistent schistosoma infestation in a peri-urban school age population.

INTRODUCTION

Schistosomiasis is a tropical disease caused by a parasitic worm of the genus Schistosoma. The transmission cycle requires contamination of surface water by excreta, specific freshwater snails as intermediate hosts, and human water contact. The etiological agent of the disease is the schistosoma blood-fluke, and three species account for most of the disease occurring in humans: *S. mansoni*, causing hepatic and intestinal schistosomiasis, is distributed in Africa, the Arabian peninsula and South America; *S. haematobium*, causing the urinary form of the disease, is found in Africa and the Arabian peninsula; and *S. japonicum*, causing intestinal Schistosomiasis, is found in parts of China and Indonesia [1]. Natural streams, ponds and lakes are typical sources of infection, but over the past few decades, man-made reservoirs and irrigation systems have contributed to the transmission of schistosomiasis. The disease is a rural problem, but urban foci can be found in many endemic areas [2] Children are especially vulnerable to acquiring schistosomiasis, and infected school-age children are often physically and intellectually compromised by concurrent anaemia, attention deficits, learning disabilities, school absenteeism and high drop-out rates [3,4]. Unfortunately, few recognize or complain of their symptoms during their childhood years; therefore, failure to treat school-age children not only affects child development, but also leads to a generation of adults disadvantaged by the irreversible sequelae of infection [2].

In Zambia, the Ministry of Health (MOH) reports that schistosomiasis is highly prevalent in rural districts especially those close to the lakes and rivers. Further estimates by MOH indicate that close to 2 million people in Zambia are infected with the disease with prevalence reaching as high as 90% in some communities [5]. Of the two species of human schistosomes (*S. haematobium* and *S. mansoni*) affecting man, *S. haematobium* has a greater distribution than *S. mansoni* in Zambia [6]. Anecdotal evidence suggests that Ng'ombe Township is the hardest hit by schistosomiasis in Lusaka province of Zambia [7]. With this view, a directive from the Ministry of Health Epidemic Preparedness Committee meeting was issued to the Zambia Bilharzia Control Programme to investigate and recommend actions on the complaints from the Public and Health staff concerning apparent high prevalence of urinary schistosomiasis in the Ng'ombe area of Lusaka bordering the Ngwerere stream, a stream associated with high infection rates in the area. Whilst some studies have been done in Ng'ombe Township, mainly prevalence studies[7,8], no study on prevalence of schistosomiasis and factors associated with its transmission has been documented and thus making it difficult for program managers to design effective interventions for the disease in

***Corresponding author**
N. Kalungwana
Email: kalungwanajk@yahoo.com

Keywords: Schistosomiasis, Schools, Ng'ombe, Lusaka, Zambia

Ng'ombe Township. In an attempt to fill this gap, we conducted a cross-sectional survey in Ng'ombe Township where the impact of knowledge, various demographic, behavioural and environmental factors on the prevalence of schistosomiasis was explored.

MATERIALS AND METHODS

Study area and population: The study was on a population of school-going children living in Ng'ombe Township, a peri-urban compound of Lusaka, the capital of Zambia. Data from the Zambia Central Statistics Office [9] indicate that 58% of the population in the peri-urban compounds of the capital is considered poor by national standards, and 39% are considered extremely poor. Lusaka district has a 27% unemployment rate.

Ng'ombe Township, the Township from which the study population was drawn, is one of the 16 peri-urban settlements surrounding Lusaka and contains 27 993 inhabitants within 6044 households [9]. There are 18 community and 10 Government schools within Ng'ombe which serve the Township's school-age children. The study was done in five Government Schools located in Ng'ombe Township. The schools were selected on the basis that they all participated in the Zambia Bilharzia Control Programme in 2007 where the prevalence was found to be 30%. The study was limited to children attending grade three (3) to grade five (5) because of the previous studies which indicated that these grades represent the most affected grades in a primary school relatively well. Kapito-Tembo et al [10] and Siziya & Mushanga [11] describe this population as the most intensely affected in endemic communities. All pupils, both boys and girls, were eligible for the study though random sampling of classes was used.

All assenting children in randomly selected classes, providing urine and stool specimens were included in the study. Children refusing to participate or whose parents/guardians that actively said 'no' to participating, who were absent from school and those unable to produce specimens were excluded from the study. Five schools, namely; Aisha, Chikumbuso, PTA Community, Zambia Open Community and Flying Angels schools were selected for this study. Out of fifteen classes, five classes attending school in the morning were sampled using a computer-aided simple random selection procedure. All boys and girls in selected classes were eligible for the study.

Questionnaire Survey: Information relating to factors associated with schistosomiasis in the five schools of Ng'ombe Township was collected from school going children. Structured interview schedule was used to collect quantitative data. The interview schedule captured demographic variables, knowledge on schistosomiasis and factors associated with the schistosomiasis infection. The schedule had close-ended questions. These close-ended questions helped capture specific and guided responses. The questionnaire was in most cases administered in the local language (Cinyanja) as the target group was not very conversant with the English language.

Laboratory Analysis: The collection of all urine and stool specimens took place between 10:00hrs in the morning and 14:00hrs in the afternoon because the sensitivity for the detection of s*histosoma* eggs is optimal for samples collected during this period of the day [12]. Stool examination – Parasitological diagnosis was carried out using the Kato-Katz quantitative method (Katz et.al [13]. Two slides of each stool sample were examined. The quantitative examination was performed for *S. mansoni*.

Urine examination – Urine samples were tested for micro-haematuria. Each specimen was thoroughly mixed, by drawing it in and out of the syringe ten (10) times, before a 10 ml volume was slowly forced through a 8µmole pore membrane filter. Each filter was moistened with a drop of physiological saline before being checked for eggs under a microscope at X40 magnification. All the eggs detected were counted.

The slides were read by two technicians from the Parasitology Laboratory of the University Teaching Hospital. This was done in makeshift laboratories that were in all cases provided by the schools. A pilot study of this survey was done at a school that is very close to Ng'ombe Township in order to test the tool and determine the duration for each interview. Ten percent of the sample size (26) was interviewed during the pilot study.

Data Analysis and ethical consideration: Raw data from the field was edited for consistency and legibility. The close ended responses were pre-coded before the interview to ensure easy entry and analysis of data using STATA/SE version 11.1 Computer Software.

Parasitological data was entered in the WHO Parasitological Survey form and exported to the STATA/SE computer package for analysis. The Chi-Square test was used to compare proportions and Fisher's exact test was used when expected frequencies were less than five. Logistic regression analysis was used to assess the independent associations between disease outcome and explanatory variables. The confidence interval was set at 95%. A factor yielding a p value of less than 5% was considered statistically significant and was included in the regression model.

This study was performed under a protocol that was reviewed and approved by the Biomedical Research Ethics Committee of The University of Zambia. Written permission was obtained from the Permanent Secretary in the Ministry of Health and the Permanent Secretary in the Ministry of Education. An opt-out situation to parents and guardians was considered in the recruitment of school children.

The purpose of the study was explained to both parents and study participants. Those that declined to participate in the study were not forced, but were assured of their protected privileges. The respondents were interviewed in their classrooms after which stool and urine specimens were collected from them. The names of the respondents did not appear anywhere on the forms thus maintaining confidentiality and privacy. However, a confidential file linking identities to the names of the pupils was kept by the Principal Investigator. All children found positive with Schistosomiasis were referred to Ng'ombe clinic for treatment.

RESULTS

A total of 260 pupils aged 8-14 years participated in the study out of which 160 (61.5%) were boys. The mean age for all the pupils was 10.3 with a standard deviation of 1.31 years. No cases of *S. mansoni* were recorded in the five schools of

Ng'ombe Township. However, the prevalence of *S. haematobium* infection was 13.1%.

Table 1 details the prevalence of *S. haematobium* infection, stratified by age and gender. The 10-11 years age group showed the highest prevalence of schistosomiasis as compared to the other age groups. There was no difference in prevalence of schistosomiasis between males (13.1%) and females (13.0%).

Table 1: Prevalence of Schistosomiasis infection among school children of the five schools of Ng'ombe Township in Lusaka district, categorized by age and gender

	No. examined	No. infected	Prevalence (%)	P-Value
Age - group (Years)				
<10	80	4	5.0	**0.016**
10 -11	128	24	18.8	
=12	52	6	11.5	
Gender				
Males	160	21	13.1	**0.977**
Females	100	13	13.0	

Table 2 reports the results of multivariate regression analysis revealing independent risk factors for schistosomiasis. In an unadjusted model, pupils that did not come into contact with water were 64% (OR=0.36; 95% CI [0.15, 0.86]) less likely to get infected compared to those that came into contact with water. There was no difference after adjusting for other factors, giving an AOR of 0.42 (95% CI 0.17-1.06).

Table 2: Multivariate regression results: likelihood of Schistosomiasis infestation among school-going children based on selected associated characteristics

Factor	OR	95% C.I	AOR	95% C.I
Come into contact with water				
Yes	1		1	
No	0.36	0.15 -0.86	0.42	0.17 -1.06
Age (Years)				
<10	1		1	
10 -11	4.38	1.46 -13.16	5.17	1.62 - 16.49
12+	2.48	0.66 -9.25	14.96	2.52 - 88.65
Grade				
Three	1		1	
Four	1.41	0.63 -3.16	0.64	0.25 -1.65
Five	0.35	0.12 -1.01	0.09	0.02 - 0.40
Source of water at School				
A communal hand pump®	1		1	
A public water tap	0.27	0.10 -0.73	0.30	0.09 - 0.90

Age was significantly associated with infection. Compared with participants of age less than 10 years, participants aged 10-11 years and those aged 12 years or older were 5.17 (95% CI [1.62, 16.49]) and 14.96 (95% CI [2.52, 88.65]) times more likely to get infected respectively. Children in grade five were 65% (95% CI [0.02, 0.40]) less likely to have Schistosomiasis than those in grade three. Pupils whose source of water at school was a public water tap were 73% (95% CI [0.09, 0.90]) less likely to have schistosomiasis than those that were using a communal hand pump at school.

DISCUSSION

The overall prevalence of schistosomiasis was 13.1% in children between the ages of 8 and 14 years. This finding accords that of Simoonga et al [8] who found a prevalence of 9.6%. Age was significantly associated with the disease in the current study. Satayathum et al [14] also observed the same association between age and urinary schistosomiasis. Older age groups were more likely to be infected in spite of the wider confidence interval. Nevertheless, the result conforms to the findings by Firmo et al [15] who in their study found age to be predictive of infection. Studies by Siziya et al [6] and Boatin et al [16] reveal that the most heavily infected persons with *S. haematobium* where children in the age group 10 to 14 years. These are mainly found in Grades Three, Four or Five. This similar observation has been reported by Kapito-Tembo et al [10] who found an increasing trend in infection among children from 6 years to 13 years with a decline from 14 years. This is not surprising as this age group is most adventurous and the decline after age 14 could be attributed to the change in behaviour as children reach puberty.

There was no significant association between gender and infection which conforms with findings by Satayathum et al [14] and Opara et al [17]. This, however, contrasts the finding by Agnew-Blais et al [7], Ogbeide et al [18], and Kapito-Tembo et al [10] who found that gender was associated with infection depending on sex-specific water use behaviour. Differences in the finding between the present study and that by Agnew-Blais et al [7] that was done in the same study population could be attributed to sampling error.

Study participants demonstrated a high level of knowledge (76.2%) on schistosomiasis in terms of what the disease is. A total of 188 (72.3%) pupils gave the correct mode of transmission and a remarkable 238 (91.5%) gave the correct treatment for the disease. This is in line with Ndyomugyenyi [19] who in his paper paid tribute to those who made information about the disease available to the school-going children, particularly their teachers and the general academic syllabus. However, a significant proportion of children had no knowledge, 44 (23.1%) on the transmission and treatment of the disease. These were mostly children from lower grades which could explain the need to introduce such important information to pupils as they begin school. Nevertheless, no significant associations were observed between knowledge and infection.

Schistosomiasis is essentially tied to local water-use behaviours. Some studies have revealed a strong association of human water contact and infection. King [20], Ndyomugyenyi [19],

Kapito-Tembo et al [10] and Satayathum et al [14] all mention this association. Edunga [21] also reported the relationship between water utilization and schistosomiasis. According to Cairncross et al [22] and Watts et al [23], an important characteristic for schistosomiasis transmission is a set of household activities related with water use. Watts et al [23] evaluated the frequency of water contact activities, regarding the most common activities in their communities, such as washing clothes, fetching water, taking baths, swimming, fishing, crossing the river, watering vegetable cultivation and working in agricultural areas and sand extraction. In contrast to these previous studies, water was not a significant predictor of infection in the current study. The difference in the findings observed in the current study and those reported elsewhere could be attributed to different roles boys and girls play at household level in relation to water contact such as fetching water for domestic and agricultural use, crossing the stream when going or coming back from school and recreational activities such as bathing. The significant relationship between water contact and infection in bivariate analysis might have been compounded by water source such that in multivariate analysis, water source remained significantly associated with infection while water contact was no longer significant.

Use of a public water tap as regards the source of drinking water at school was a protective factor. The plausible explanation for this could be that public water is treated water from the local water authority.

The findings of this study cannot be generalized as by gathering data among participants of an in-school health programme, children not in schools at the time of screening were excluded from the study. The other limitation is that only one urine and stool specimen was collected and children were not encouraged to conduct exercises prior to specimen collection probably because of the debate on the type of exercise that achieves maximum yield of eggs. Studies by Doehring et al [24] and Warren et al [25] reveal that repeated examination of urine specimen over consecutive days and exercises prior to urine or stool collection improves egg detection. Hence, we might have underestimated the prevalence of urinary schistosomiasis in our population.

REFERENCES

1. Steinmann P, Keiser J, Bos R, Tanner M, Utzinger J. *Schistosomiasis and water resources development: Systematic review, meta-analysis and estimates of people at risk.* Lancet 2006; **6**(7): 411-425.
2. Gryseels B, Polman K, Clerinx J, Kestens L. *Human Schistosomiasis.* Lancet 2006; **368**(9541): 1106-1118.
3. Mwanakasale V, Siziya S, Mwansa J, Koukounari A, Fenwick A. *Impact of iron supplementation on schistosomiasis control in Zambian school children in a highly endemic area.* Malawi Medical Journal 2009; **21**: 12-18.
4. World Health Organisation. *Action Against Worms-Praziquantel dose pole.* Available from URL: http://www.who.int/wormcontrol, 2004.
5. Zambia Bilharzia Control Programme 2005-2007. *Prevalence baseline status for Schistosomiasis and other soil transmitted helminthes in Zambia.* Ministry Of Health, 2008.
6. Siziya S, Mushanga M, Sichilima W, Sukwa TY, Lengeler C, Sala-diakanda DM. *The distribution of Schistosoma Haematobium in the Isoka district, Zambia; and a possible strategy for its control.* Cenral African Journal of Medicine 1993; **39**(2): 32-37.
7. Agnew-Blais J, Gropper A, Shilika E, Bail R, Ngoma M. *Schistosomiasis haematobium prevalence and risk factors in a school-age population of peri-urban Lusaka, Zambia.* Journal of Tropical Pediatrics 2010; **56**: 247-253.
8. Simoonga C, Kazembe LN, Kristensen TK, Olsen A, Appleton CC, Mubita P, Mubila L. *The epidemiology and small-scale spatial heterogeneity of Urinary Schistosomiasis in Lusaka province, Zambia.* Geospatial Health 2008; **3**(1): 57-67.
9. Central Statistics Office. *Census of population and housing country report. CSO, Lusaka,* 2000.
10. Kapito-Tembo AP, Mwapasa V, Meshnick SR, Samanyika Y, Banda D, Bowie C, Radke S. *Prevalence distribution and risk factors for Schistosoma haematobium infection among school children in Blantyre, Malawi.* PLoS Neglected Tropical Diseases 2009; **3**(1): e361.
11. Siziya S, Mushanga M. *Importance of Schistosomiasis in the Isoka district of Zambia: A pre-requisite for its control using community participation.* Social Science of Medicine 1996; **42**(3): 431-435.
12. Samie A, Nchachi DJ, Obi CL, Igumbor EO. *Prevalence and temporal distribution of schistosoma haematobium infections in the vhembe district, Limpopo province, South Africa.* African Journal of Biotechnology 2010; **9**(42): 7157-7164.
13. Katz N, Chaves A, Pellegrino JP. *A simple device for quantitative stool thick-smear technique in schistosomiasis mansoni.* . Revista do Instituto de Medicina Tropical de São Paulo 1972; **14**: 397-400.
14. Satayathum SA, Muchiri EM, Ouma JH, Whalem CC, King CH. *Factors affecting infection or re-infection with Schistosoma haematobium in coastal Kenya: Survival analysis during a nine-year school-based treatment program.* American Journal of Tropical Medicine and Hygiene 2006; **75**(1): 83-92.
15. Firmo JOA, Lima e Costa MF, Guerra HL, Rocha RS. *Urban Schistosomiasis: Morbidity, Sociodemographic characteristics and water contact patterns predictive of infection.* International Journal of Epidemiology 1996; **25**(6): 1292-1300.
16. Boatin BA, Dukes P, Wurapa FK. *Parasitic infection in the Kasyasya cluster of villages in north-eastern Zambia.* Medical Journal of Zambia 1984; **18**: 2-7.
17. Opara KN, Udoidung NI, Ukpong IG. *Genitourinary Schistosomiasis among pre-primary school children in a rural community within the cross river basin, Nigeria.* Journal of Helminthology 2007; **81**(4): 393-397.
18. Ogbeide O, Okojie O, Wagbatsoma V, Isah E. *Schistosoma haematobium in rural school children in Nigeria.* West African Journal of Medicine 1994; **13**(1): 31-33.
19. Ndyomugyeni R, Minjas JN. *Urinary Schistosomiasis in schoolchildren in Dar-es-Salaam, Tanzania, and factors influencing its transmission.* Annals of Tropical Medicine and Parasitology 2001; **95**: 697-706.

20. King CH. *Epidemiology of schistosomiasis: determinants of transmission of infection.* In Mahmoud AAF, ed. Schistosomiasis. London: Imperial College Press, 2001: 115-132.
21. Edunga LD. *Water utilization and its health implication in llorin, Kwara state Nigeria.* Acta Tropica 1980; **37**: 79-81.
22. Cairncross S, Blumenthal U, Kolsky P, Maores L, Tayeh A. *The public and domestic domains in the transmission of the disease.* Tropical Medicine and International Health 1996; **1**: 27-34.
23. Watts S, Khallaayoune K, Bensefia R, Laamrani H, Gryseels B. *The study of human behaviour and schistosomiasis transmission in an irrigated area in Morocco.* Social Science and Medicine 1998; **46**: 755-765.
24. Doehring E, Feldmeier H, Daffalla AA. *Day-to-day variation and circadian rhythm of egg excretion in urinary schistosomiasis in the Sudan.* Annals of Tropical Medicine and Parasitology 1983; **77**: 587-594.
25. Warren KS, Siongok TK, Houser HB, Ouma JH, Peters PA. *Quantification of infection with schistosoma haematobium in relation to epidemiology and selective population chemotherapy. I. minimal number of daily egg counts in urine necessary to establish intensity of infection.* Journal of Infectious Diseases 1978; **138**: 849-855.