ORIGINAL PAPERS

Urinary Schistosomiasis Scourge among Rural School Children in Chitongo area, Southern Zambia

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ABSTRACT

Objectives: The study was carried out to assess the prevalence of schistosomiasis infection among school children in Chitongo area.

Methods: A survey was carried out at three primary schools in different locations in Chitongo area, Southern Zambia. Urine samples were collected from 303 pupils (149 males and 154 females) aged 4 – 17 years old to determine the prevalence of schistosomiasis among school children in the area. The samples were examined microscopically.

Results: Schistosoma haematobium prevalence ranged from 4.4% - 49.6% across the schools. The study showed a higher prevalence among the males (40.3%) than females (19.5%). Males were 3.4X more likely to be infected than females (95% CI = 1.9 – 6.0, P < 0.001). There was marked school absenteeism in both infected and uninfected children before treatment. School attendance did not improve for most children after treatment with praziquantel (negatives: χ^2 = -0.96, P>0.34 and positives: χ^2 = -0.35, P>0.73).

Conclusion: Urinary schistosomiasis has a focal prevalence among the school-going children in Chitongo. Chemotherapy, public health education, and molluscicide are recommended to improve the long-term health of at-risk children.

INTRODUCTION

There are approximately 200 million people throughout the world infected with schistosomiasis (bilharzia), while 779 million others remain at risk, of which 106 million live in irrigation schemes or close to large dam reservoirs[1,2]. The spatial distribution of schistosomiasis is heterogeneous on a fine scale with increased prevalence and infection intensity occurring in focal clusters around water bodies harbouring susceptible species of snails[3,4].

Schistosoma haematobium is one of a series of related trematode parasites that are reportedly endemic to at least 53 countries in the Middle East and most of the African continent[5]. Trematode or flukes are parasitic flatworms with a complex life cycle involving sexual reproduction by adult worms in mammals (definitive hosts) and asexual reproduction in specific aquatic snails' (intermediate hosts). *Schistosoma haematobium* flukes live in the veins surrounding the urinary bladder (vesical plexus). This group infects humans by direct penetration through the skin. Flukes do not multiply in definitive host, so the intensity of infection is related to the degree of exposure to the infective larvae. In most endemic areas, the majority of infected individuals have light or moderate worm burden[6].

Estimates for morbidity in affected populations are high, with school-aged children usually presenting with the highest prevalence and intensity of infection[7,8]. In Africa alone it has been concluded that the mortality rates attributed to urinary schistosomiasis could be as high as 150,000 per year[9]. Contributing to schistosomiasis morbidity and mortality are long-term consequences of haematuria, dysuria, nutritional deficiencies, and lesions of the bladder, kidney failure, anaemia, and elevated risk of bladder neoplasm[10]. In untreated children, growth deficits and delayed mental development can occur[11]. Helminth infections in general, are known to contribute to the immune suppression of HIV infected persons[12].

The present study was carried out to assess the prevalence of schistosomiasis infection among school children in Chitongo area.

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METHODS

Study area and population

The Chitongo study area is located in the Southern Province of Zambia, and is centered at Latitudes 468591 to 512803 and longitudes 8247934 to 8214130.

The landscape is flat with sparse tree shrubs. The elevation ranges between 1012 and 1090 metres above sea level. The area experiences flooding during the rainy season and the soil has a high percentage of sand which is deposited as sediment from the runoffs making the area prone to developing stagnant water pools, in addition to other water sources such as dams and small streams. This contributes to extensive snail habitats[13].

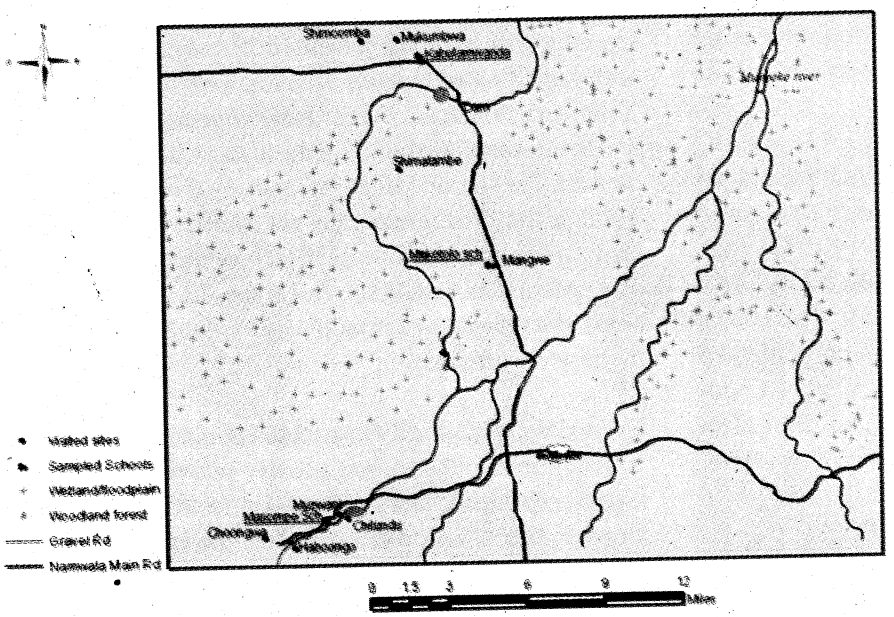

Figure 1: Schools, villages and water sources located in the Chitongo catchment area of study

The study population was drawn from three primary schools in different locations in Chitongo area, rural Zambia and was limited to grade three classes as it encompasses the at risk-group[14]. However, another group of children was included from Masompe after the parents and teachers requested to have all the children tested as a number of them complained of urinating blood. Testing was then made optional to the children in other grades due to limited resources. The pupils who volunteered to be examined were then included in this study. A total of 303 pupils were examined across the schools. The study was carried out during the month of September 2007 in the dry season.

Ethics

The ethical clearance was obtained from the University of Zambia Research Ethics Committee (UNZA-REC). The parents, guardians, chief and the school administrations gave an accepted and informed consent for the participation of the school children.

Absenteeism

School registers for the participating school children were obtained from the school authorities at the various schools. The records were used to determine the relationship between absenteeism before treatment in the second term and absenteeism after treatment in the third term in both positives and the negatives.

Specimen collection, processing and treatment

The pupils were asked to provide urine samples in 500ml specimen containers well labelled for identification of each participant. Their body weights were also recorded during the urine sample collection using a bathroom scale. The urine samples were collected between 10:00 and 13:00 hours[15]. Samples were transported to the laboratory in tightly closed containers placed in a cool and dry box to prevent hatching of the eggs. In the laboratory the urine was examined by sedimentation technique. Ten mL of well-mixed urine was transferred into labelled 15 mL centrifuge tubes for each participant. The samples were then centrifuged for 5 minutes at medium speed of 1500rpm. The supernatant was discarded and the pellet (deposit) was transferred to labelled glass slides, which were then covered with cover slips. The slides were viewed under the microscope using X10 magnification a presence of eggs was recorded. Due to differences in the ages the egg count was not done. Pupils found infected were later treated with a single dose of Praziquantel administered according to their body weights.

Statistical analysis

Logistic regression analysis for presence-absence of *S. haematobium* infection was done to test the statistical relationship with age, sex, age-by-sex interaction, school

attendance and weight (Kilograms). The odds ratio for the dependent variables was calculated. Wilcoxon Signed Rank test for paired samples was used to compare absenteeism in both infected and uninfected children before and after infected children were treated. Statistical analysis was conducted using SPSS, version 11.5.0 software (SPSS Inc., Chicago, IL).

RESULTS

Microscopic examination of urine from 303 pupils aged between 4 and 17 from three rural schools was completed. A total of 149 males and 154 females were examined to determine the prevalence of bilharzia. Of the 303 children screened, 90 (29.7%) tested positive for bilharzia, 60 (40.3%) of these positives were male and 30 (19.6 %) females. The boys were 3.4X more likely to be infected than girls (95% CI = 1.9-6.0, P < 0.001). The highest prevalence in both sexes was observed at Masompe School with 49.6% followed by Kabulamwanda at 19.6% and Makotoolo with the lowest 4.4%. With reference to the schools that the children attended, Kabulamwanda was 5.8X more likely to have infected children compared to Makotoolo (95% CI = 1.6-20.6, P<0.001) while Masompe was 25.1X more likely to have infected children than Makotoolo (95% CI = 7.4-85.3, P< 0.001). The prevalence of *S. haematobium* infection at the three schools in rural Chitongo is presented in table 1. The Hosmer and Lemeshow goodness of fit test showed that the ages and weight were non-significant (χ^2 = 1.12, P> 0.89). See table 2 for stratified ages for all the schools. The nonparametric paired Wilcoxon Signed Rank tests for absenteeism in the schools showed no statistically significant difference amongst those positive and negative in the two terms analysed (negatives: χ^2 = -0.96, P>0.34 and positives: χ^2 = -0.35, P>0.73). At the conclusion of the study, all except one bilharzia positive pupil (who had moved to another area) were treated with praziquantel.

Table 1: **Prevalence of schistosomiasis in children by school**

	Males		Females		All Children		
School	**Positive**	**Total**	**Positive**	**Total**	**Positive**	**Total**	**Prevalence (%)**
Kabulamwanda	12 (26.1%)	46	7 (13.7%)	51	19	97	19.6%
Makotoolo	2 (5.9%)	34	1 (2.9%)	35	3	69	4.4%
Masompe	46 (66.7%)	69	22 (32.4%)	68	68	137	49.6%
Total	60 (40.3)	149	30 (19.5%)	154	90	303	**29.7%**

Table 2: Stratified ages for all schools

Age Group	All Children		
	Positive		Total tested
	Males	Females	
4 - 8	8	4	25
9 -13	49	22	258
14 - 17	3	4	20
Total	**90**		**303**

DISCUSSION

In this area-specific prevalence study of *S. haematobium* (bilharzia) 29.7% children were infected. The results clearly indicate that there is a high prevalence of bilharzia in Chitongo area. This high rate of infection is a public health concern, as schistosomiasis has been found to be associated with bladder cancer [10, 11]. Also, chronic infection affects all aspects of children's health, nutrition, cognitive development, learning, and educational access and achievement [16].

In this study we were interested to see if school attendance was affected by schistosome infection. However, we were unable to demonstrate any such association. There were no statistically significant differences in absenteeism from school among infected or uninfected children during the two terms before and after treatment in this study. The absenteeism observed in the infected and uninfected children could only be attributed to the distances between the villages and the schools, which the children had to walk, illnesses other than schistosomiasis such as malaria and migratory cattle rearing activities. Also lack of consistency in record keeping of the school registers may have affected the results. However this study does not rule out a link between attendance and infection and suggests a more rigorous investigation.

All three schools were located in the shallow wetlands of the country referred to as dambos [17] in the Kafue flats which also included some dams. Some of the children needed to wade in the water in order to get to their schools due to lack of footbridges. This increased the risk of infection. The schools, which the children attended, were found to be statistically significant predictors of infection. Masompe and Kabulamwanda schools had the highest prevalence, while

Makotoolo had the lowest prevalence of about 4.4%. It can be seen from the map (Fig 1) that of the three schools investigated, Makatoolo was further from a stream (snail habitat) and potential source of infection. Additionally the low prevalence was due to the fact that all the children in the school were treated earlier in the year (March 2007) with Praziquantel by the schistosomiasis control programme, which had found the prevalence of bilharzia to be 42% [18]. One of the three children found with bilharzia had been absent from school during treatment at the time, whilst the other two were transfers into the school prior to our visit. These results show that treatment with praziquantel has long lasting effects particularly if there are no snail habitats nearby and should be encouraged in the schools with at-risk children.

In Zambia, urinary schistosomiasis is transmitted by the snail *Bulinus globosus* [19]. A snail survey was done in Masompe stream and dam by Dr. Mwansa from the University of Zambia in June 2007, and the *Bulinus* snail species which are the intermediate host for *S. haematobium* were identified, and portion shown to be infected (personal communication). These results are consistent with earlier studies indicating that landscape alteration could enhance survival of the schistosomes, snails, and humans as definitive hosts [20]. Water impoundment for conservation and irrigation frequently is blamed, along with population growth, for the rising numbers of persons infected with schistosomiasis. Changes in the distribution and characteristics of water may have a profound effect on actual potential snails' habitats and the transmission of schistosomiasis [21].

The finding that bilharzia prevalence rates were higher in the boys than in the girls may be due to the fact that these boys come into contact with the snail-infected fresh water bodies frequently spending much of their leisure time swimming, fishing, hunting and taking cattle to drink water in the flood plains and the streams. A few girls went fishing and swimming, while none took cattle to the plains. Both groups took part in gardening along the streams. If so, variations in schistosomiasis prevalence due to differences in water contact behaviour found in this study would confirm the disease patterns found in other bilharzia-endemic areas and reflect the greater opportunity of males to disease exposure [22]. It was also found that there was no association between the ages and weight of the children with the disease in this case study.

Chemotherapy programmes have shown to reduce morbidity in infected individuals and interrupt the schistosomal life cycle by lessening the output of viable eggs [21]. Praziquantel is currently the drug of choice to treat urinary schistosomiasis. It has been postulated that schistosomiasis treatment with praziquantel leads to increased protection against re-infection, and increased immunoregulatory mechanisms that control morbidity upon subsequent re-infections [23].

Other methods to control bilharzia are also available. Molluscicides are the most effective but costly means of reducing or eliminating snail intermediate-host population. Although this stage is considered the best target in the disease cycle, the fact that snails reproduce rapidly makes it almost impossible to eliminate them entirely [21]. It may be best to combine the use of molluscicides along side chemotherapy. Public health education should be provided to the children, the village leaders and their communities in order to reduce on the disease burden. Desirable results have been obtained using such methods of control in endemic areas [24, 25].

CONCLUSION

In conclusion, the study shows a high prevalence of *S. haematobium* infections in the Chitongo area among the school children. The disease may be brought under control by providing free chemotherapy for the infected school children using praziquantel. It is hoped that morbidity in those infected will be reduced and that an interruption in schistosomal life cycle will follow lessening the output of viable eggs. Chemotherapy, public health education to the children and health workers, and molluscicides to keep the snails under control should be combined to improve the long-term health of at-risk children.

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