International Journal of Tropical Medicine 1 (4): 173-177, 2006
Medwell Journals, 2006

Reinfection Pattern and Predictors of Urinary Schistosomiasis among School Pupils from a Southwestern Village in Nigeria

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Abstract: A total of three hundred and fifty pupils from two primary schools and one secondary school from Ipogun village, Ondo state, Nigeria were screened for urinary schistosomiasis. Urine samples were collected at intervals of four months between October 2002 and October 2003 to determine the pattern of reinfection of the disease. At baseline, 205 (59%) of the pupils were positive for *Schistosoma haematobium* with haematuria in 115(55%). All infected pupils were treated with praziquantel (40 mg kg^{-1} body weight) and rescreened again every 4 months during the year. At each screening exercise, infected pupils were treated with the standard dose of praziquantel (40 mg kg^{-1} body weight). Results showed that two successive doses of praziquantel were needed to achieve a 73% cure rate. Despite this, the rate of reinfection was still high thereby making the village endemic. Prevalence was consistently highest in pupils that fell into the 10-14 age group category throughout the period of survey though not significantly ($p>0.05$), while there was a significant difference ($p<0.05$) in reinfection rates among the male pupils than in the females. Laudable intervention programmes from the foregoing should be multi-pronged and on a long-term basis.

Key words: Reinfection pattern, predictors, urinary schistosomiasis, school pupils

INTRODUCTION

The schistosomes or blood flukes are parasites of the blood stream of warm-blooded vertebrates and they are the only digenetic trematodes to occupy such habitat[1]. These parasites are responsible for the disease, schistosomiasis, which is water borne and accounts for an annual death of about 20,000 patients[2]. Globally, about 200 million people are infected, with more than 600 million people in 74 countries at risk[3] in the tropical and subtropical areas of the world. Despite scientific studies which began about 150 years ago[4], the disease continues to rank second, following malaria, in terms of endemicity and the number of infected people[5]. In Nigeria, schistosomiasis endemicity has been reported[6-8]. However of the four common human schistosomes, two- *Schistosoma mansoni* and *Schistosoma haematobium* have been reported in the country, with the latter more widely spread[7]. Various factors affect the epidemiology of the disease and perhaps none so important as the risk of reinfection following chemotherapy. Reinfection following chemotherapy with the current drug of choice-praziquantel has been reported[9-12], prompting investigations into the dynamics of reinfection following chemotherapy. Kahama *et al.*[13] reported that age, sex and locality were factors associated with reinfection in school children from two villages in the coast province of Kenya, while Etard *et al.*[14] reported that age and sex might be good predictors in Mauritania, although there isn't any interaction between the two. The present study was conducted with the aim of identifying factors that may be associated with schistosomiasis reinfection following chemotherapy. Such knowledge may be helpful in designing laudable intervention programmes to halt disease transmission.

MATERIALS AND METHODS

Study area and subjects: The study was carried out at Ipogun (7°19'N;5°05'E), a southwestern village in Ifedore Local Government Area of Ondo state Nigeria. The village has an estimated population of about 6,000 with 5 schools; 4 primaries and 1 secondary. The major occupation of the villagers was farming with cocoa, *Theobroma cacao* being the chief crop produce. Despite the provision of boreholes, though inadequate, the villagers were observed to prefer the only stream ('Aponmu') in the village for their domestic, occupational and recreational activities like bathing, washing, processing of farm produce, swimming etc. Before commencement, approval and assistance was sought from the Ondo state ministry of health, the king of the

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village and the heads of the three schools used for the survey. In all 350 school pupils were recruited for the study with the assistance of health workers from the ministry. 162 (male-69; female-93) from St. Judes' pry school; 98 (male-54; female-44) from Muslim pry school and 90 (male-58; female-32) from Ayo grammar school (the only secondary school in the village). The pupils were recruited randomly f rom the assembly ground using the class register to eliminate bias. Their names, ages, classes and sex were written down to facilitate easy follow up.

Study design: The 350 pupils recruited were initially screened for urinary schistosomiasis and thereafter those who returned positive were monitored for a year to determine the rate of reinfection following parasitological cure. The study started in October 2002 through October 2003. Screening was done 4 times during this period (every 4 months) and on each round, every infected pupil was treated with praziquantel (40 mg kg^{-1} body weight) by health workers from the state ministry of health. The schistosomiasis control unit, Ondo state ministry of health, Akure, Nigeria, procured the drugs used throughout this study

Urinalysis: Each pupil was given a transparent 20 mL plastic bottle to urinate in. The bottles were corked tight, labelled and taken to the laboratory for analysis. Samples were collected between 09:00 and 13:00 h. Laboratory analysis was done using the centrifugation method. 10 mL of urine was centrifuged at 1,500 rpm for 3 min and the residue examined under the X10 objective of the microscope for the presence of terminal spined ova of *S. haematobium*. Eggs of *S. haematobium* were counted under a light microscope at low magnification. Results were expressed as the number of *S. haematobium* eggs/10 mL urine. Cases of haematuria observed were also reported and monitored throughout the year.

RESULTS

350 pupils were screened for urinary schistosomiasis of which, 205 from the three schools returned positive for *S. haematobium* in October, 2002 (Table 1). All the infected pupils were treated with praziquantel (40 mg kg^{-1} body weight) and rescreened again after 4 months. In the subsequent month of February 2003, 118(58%) remained positive i.e a reduction of 42% by prevalence (Table 2) with a very low level of haematuria (24%). Geometric mean egg count also reduced from 23.12 at baseline to 8.77. In the subsequent month of June 2003, prevalence of infection stood at 54(27%) with 13% haematuria prevalence. Egg intensity had also reduced samples were collected. In October 2003, prevalence of

Table 1: Prevalence of *S. haematobium* infection among school pupils in Ipogun at Baseline (October, 2002)

School	Number examined	Number infected (%)	No. (%) with Haematuria	G.M egg/ 10 mL Urine
St. jude pry. sch.	162	66(41%)	33(50%)	28.23
Muslim pry. Sch.	98	80(82%)	50(63%)	26.51
Ayo grammar sch.	90	59(66%)	32(54%)	16.51
Total	350	205(59%)	115(55%)	23.12

Table 2: Prevalence of *S. haematobium* infection among school pupils in Ipogun between February 2003 and October 2003

School	No. examined	No (%) infected	No (%) haematuria	G.M egg/ 10 mL urine
February 2003				
St. jude pry. sch	66	51(77%)	10(20%)	8.90
Muslim pry sch.	80	40(50%)	11(28)	8.61
Ayo grammar sch.	59	27(46%)	7(26%)	8.80
Total	205	118(58%)	28(24%)	8.77
June 2003				
St. jude pry. sch	66	20(30%)	2(10%)	3.92
Muslim pry sch.	80	18(23%)	3(17%)	5.12
Ayo grammar sch.	59	16(30%)	2(13%)	3.85
Total	205	54(27%)	7(13%)	4.26
October 2003				
St. jude pry. sch	66	41(67%)	5(12%)	9.92
Muslim pry sch.	80	36(47%)	3(8%)	9.91
Ayo grammar sch.	59	25(43%)	2(8%)	6.55
Total	205	102(52%)	10(10%)	8.64

Five students were absent in Ayo grammar school when sampling was done in June 2003, Five students were absent in St Jude Pry. School when sampling was done in October 2003, Four students were absent in Muslim Pry. School when sampling was done in October 2003, One student was absent in Ayo Grammar School when sampling was done in October 2003.

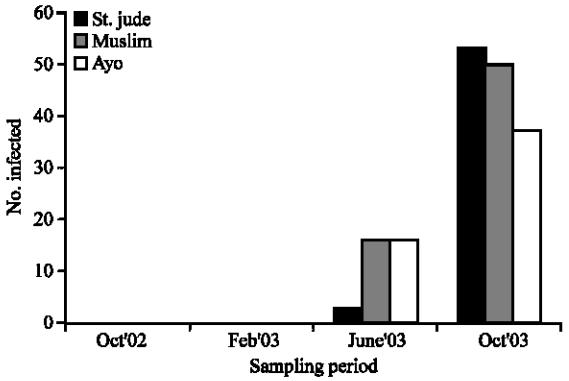

Fig. 1: Trend of reinfection between 2002 and 2003 among school pupils in Ipogun

infection stood at 102 (52%) bringing about resurgence, almost doubling the status observed in June 2003. Cases of haematuria also increased slightly from 7 in June to 10 in October. No visible haematuria was discovered during this period though. All positive cases were discovered on centrifugation. Egg intensities were slightly increased too from 4.26 in June to 8.64 in October 2003. Reinfection trend (Fig.1) in all schools following chemotherapy was similar reaching a peak in

Table 3: Frequency of reinfection with *S. Haematobium* following chemotherapy among school pupils in ipogun within the study period

Schools	No.–ve in Feb.'03 following chemoth-erapy (A)	No. +ve of A in June '03	No. +ve of A in Oct.'03	No. –ve in June'03 following chemoth-erapy (B)	No.+ve of B in Oct. '03.
St. jude pry. sch.	15	3	12	46	41
Muslim pry. sch	40	16	15	60	35
Ayo grammar sch.	32	16	15	38	22
Total	87	35(40%)	42(48%)	144	98(68%)

Nine pupils remained negative throughout following baseline treatment in Muslim pry. Sch., One student was absent in Ayo grammar school.

Table 4: Prevalence of urinary schistosomiasis by sex among the school pupils in Ipogun between October 2002 and October 2003

	October 2002		February 2003		June 2003		October 2003	
Schools	♂	♀	♂	♀	♂	♀	♂	♀
St.jude	35	31	28	23	07	18	33	38
Muslim	45	35	20	20	09	10	23	18
Ayo	36	23	16	11	15	04	21	16
Total	116	89	64	54	31	32	77	72

♂ Male, ♀ Female

Table 5: Frequency of Pupils in the Respective Age Group Distributions among the Sampled Schools in Ipogun.

	Age groups			
Schools	5-9	10-14	>15	total
St. jude	57	99	06	162
Muslim	54	44	00	98
Ayo	00	72	18	90
Total	111(31.7%)	215(61.4%)	24(6.9%)	350

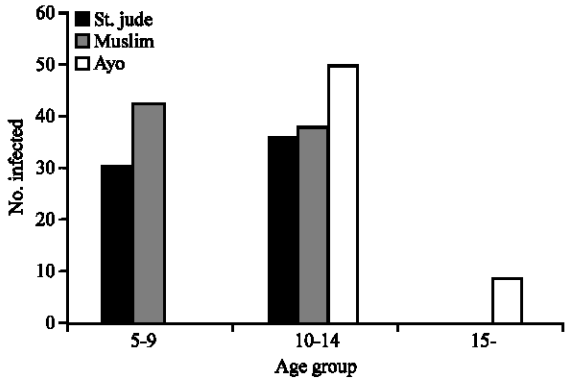

Fig. 2: Prevalence of *S. haematobium* infection by age among the school pupils in October 2002

October 2003. Obvious cases of reinfection were determined in June and October 2003. These represented pupils who returned negative in February 2003 following initial treatment at baseline, but later became reinfected either in June or October 2003 (Table 3). Similarly the other group of reinfected pupils were those who returned negative in June following chemotherapy but became reinfected in October 2003.

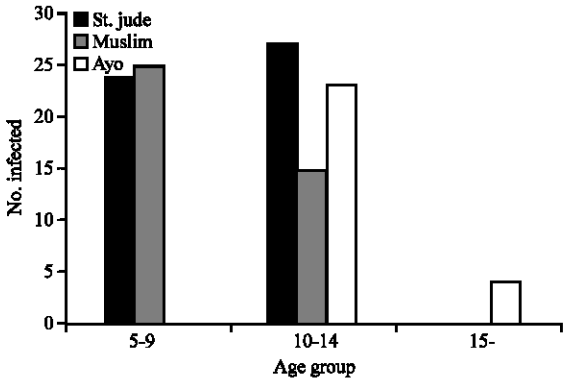

Fig. 3: Prevalence of *S. haematobium* infection by age among the school pupils in February 2003

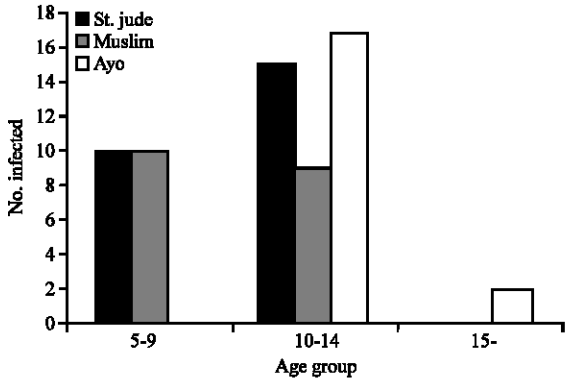

Fig. 4: Prevalence of *S. haematobium* infection by age among the school pupils in June 2003

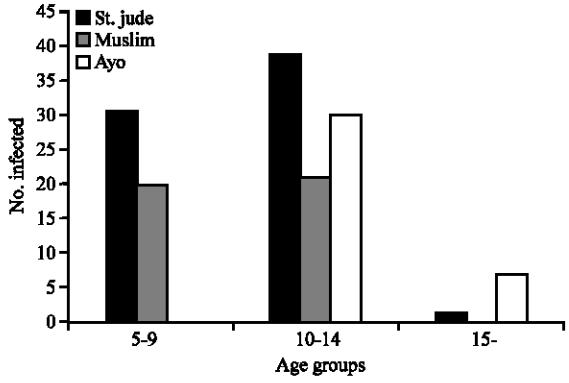

Fig. 5: Prevalence of *S. haematobium* infection by age among the school pupils in October 2003

Prevalence by sex: The findings here showed that male prevalence were consistently higher ($p<0.05$) through-out the period of survey (Table 4). Statistical analysis using Pearson's Chi Square showed that this was significant and thus an epidemiological pointer to disease

transmission in the village. From this, it is safe to assume that the males play a more important role in disease transmission in the village than the females.

Prevalence by age: For ease of data analysis, the pupils were divided into the following age groups: 5-9; 10-14; 15 and above. (Table 5) . Prevalence was consistently highest in the 10-14 age group (Fig. 2-5) throughout the period of survey though not significantly ($p>0.05$). Fairly high frequencies were obtained in the 5-9 category with the least in the over 14 years age group category.

DISCUSSION

Result indicates that Ipogun is an endemic village for schistosomiasis because of the high rate of reinfection. Infection/reinfection rates were higher among males and among the 10-14 year old age group. Screening was done every four months and cases of infection/reinfection were always found. This declined through February 2003 to June 2003, with resurgence in October 2003, but not up to baseline statistics. The trend was similar in all three schools despite praziquantel treatment and factors that promoted the October resurgence may be linked to higher water contact activities, reinforced by the long holidays between July and September, which meant more time for recreational activities as schools were closed. The period between June and October also coincided with the peak and exit of the rainy season, which meant an increased water volume promoting swimming, fishing etc in the midst of the pupils.

There was no clear cut style or pattern of reinfection within age, apart from the resurgence in October 2003, cutting across the predictor. Age acted as a good predictor of reinfection in the village. Majority of the infected pupils fell into the 10-14 age group while the least infected fell into the 15 and above category. Clearly, it could be inferred that this age group (10-14) would play a vital role in the transmission of the disease, but it does not rule out the other age categories since there was no statistical significance ($p>0.05$) between the age groups. While this agrees with Etard *et al.*[15] findings that children under 15 were more prone to reinfection, it does not rule out the role played by other age groups in the epidemiology of the disease in the village. Likewise, the study showed that sex was a good predictor of reinfection among the pupils as more males ($p<0.05$) got infected than the females. Similar results were shown by Etard *et al* .[14]. Though reinfection may largely be predicted by the degree of water contact over sex or age, the latter are equally good predictors and very useful in epidemiological studies.

Results from the present study showed that praziquantel tolerance/resistance may not be completely ruled out as a factor for the high infection/reinfection rates. Data generated so far point out that about two successive doses of praziquantel was needed to achieve a 73% cure rate between October 2002 and June 2003. This successive treatment brought prevalence to its lowest in June 2003, however the resurgence in October (though not up to pre-treatment level and a marked reduction in geometric egg mean count, but not egg positivity) showed that 3 successive doses given within a one year period was not enough to achieve 100% cure rate. Not ruling out other epidemiological factors viz degree of water contact, snail host ecology, refugia and transmission seasons, the probability of drug tolerance among the subjects should equally not be ruled out since praziquantel does not kill every worm in every patient[4] and thus calls for further monitoring. King *et al.*[16] analysed that attempts to increase community treatment coverage to 100% would accelerate the emergence of clinically significant resistance and thus emphasized that targeted treatment has the potential advantage to prolong the useful lifespan of praziquantel. This analysis points out a probable drug tolerance/resistance resulting from long and consistent use of the drug. In an earlier mathematical model by the latter[17], praziquantel resistance by *S. haematobium* was predicted to emerge in about 10 or more years, a date we are gradually but steadily approaching. The development of other therapeutic agents may not be unlikely in the following years and a consideration of herbal alternatives should not be overlooked.

Since juvenile stages of the parasite are largely insensitive to praziquantel[18], whose action is mostly on the adult worms, targeted chemotherapy every 3 months should also be effective in reducing morbidity and transmission. Laurent *et al.*[19], suggested that morbidity due to *S. haematobium* infection can be reduced by annual treatment over several years in a highly endemic area without other associated interventions. Similarly, results from Ipogun suggests that repeated doses over several years will be effective; however chemotherapy should be integrated into other control measures and not as a sole tool. Other measures to be integrated may include molluscicide and regular community based enlightenment programmes. However, this requires a political commitment by the government. While countries where significant progresses have been made on schistosomiasis control had a committed government policy[3], it might not be said for Nigeria. Hitherto, chemotherapy is the only religious control option

mounted by the state government. This alone cannot solve the problem[4]. Although isolated cases of molluscicide have been carried out but not as recurrent as the chemotherapeutic approach, which still needs to be improved upon.

ACKNOWLEGEMENT

The authors are grateful to the staff and students of the schools used for the survey and also wish to acknowledge the contribution of the Ondo state government on provision of the drugs and personnel. Mrs Adetula, Head, Schistosomiasis control unit, Ondo state ministry of health, coordinated the latter.

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