

Treatment of Schistosomiasis Haematobium with Praziquantel in Children: Its Effect on Educational Performance in Rural Nigeria

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Abstract: *Schistosoma haematobium* infection is highly endemic in Adim, a rural rice-farming community located within the rain forest of South-eastern Nigeria. With support from Rockefeller Foundation we initiated a treatment programme among the pupils of the only primary school in the community. All children in the school were screened yearly for infection using reagent strips and light microscopy. Infected children were treated with praziquantel (40 mg/kg body weight). To determine the effect of repeated treatment on the educational performance we followed up children (aged 8.0 - 8.9 years) who were in the same school grade through a three-year period. The prevalence of infection in the cohort measured at 12-monthly intervals with a session of treatment in between the screening were 69.1% at the beginning of the programme then 45.2% and 21.6% at the second and third yearly evaluation respectively. The school attendance rate in the cohort decreased from 86.7% at onset of treatment programme to 81.1% by the third yearly evaluation ($p=0.24$). Standardized, teacher-made educational tests were given to the pupils in between the treatment exercises. The pass rate among the cohort improved following the first treatment session from 81.4% to 90.7%, latter declined to 84.2% following the second treatment session but the net improvement in performance was statistically significant ($\chi^2=7.20$; $p=0.027$). The possibility of enhancement of educational performance as observed in this study should make regular, periodic treatment of children in communities with endemic schistosomiasis a more cost-effective and beneficial public health intervention strategy than was previously assumed.

Key words: *Schistosoma haematobium*, treatment, primary school performance

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INTRODUCTION

Urinary schistosomiasis is highly endemic in Adim, a rural rice-farming community. The prevalence of infection is highest among school-age children. Intensity of infection (assessed by egg-count/10 ml of freshly voided urine) is also quite high in this age group (Ejezie *et al.*, 1991). It is generally held that the school-age group should be the principal target of control activities against *S. haematobium* infection (Chen & Mott, 1989). In 1993 we initiated a school-based control programme with chemotherapy aimed at reducing prevalence and transmission of *S. haematobium* infection in Adim. As a secondary objective we evaluated the impact of treatment of infected children on overall attendance and educational performance.

It has been observed that helminthic infections may be associated with poor academic performance, although these infections are also co-variables of factors known to affect academic performance, such as poor growth (Halloran, Bundy & Pollitt, 1989). Several studies have demonstrated association between intestinal helminthiasis and poor educational performance (Nokes *et al.*, 1991, Bundy, 1991, Bundy, 1994) but views on the educational impact of *S. haematobium* have been inconclusive. For instance Ejezie and Ade-Seranno (1981), and Ekanem *et al.* (1994) have in cross-sectional studies of Nigerian children, detected no association between *S. haematobium* infection and educational performance of school children. On the other hand, Kvalsvig (1986) and Ndamba (1986) have in separate studies shown that treatment of *S. haematobium* infection led to an improvement in physical performance and energetic activities in school-aged children.

Kimura *et al.* (1992) have reported improvement in mental test scores of infected Kenyan children following treatment. The present study sought to evaluate the possible impact of treatment and re-treatment of urinary schistosomiasis on the educational performance of the school children in a rural community where the infection is endemic.

We hypothesized that an improvement in the morbidity parameters (prevalence and intensity) in a cohort of children should be followed by a significant improvement in the overall educational performance of the cohort. It was not our objective to assess the individual pupil but the overall effect on the cohort.

MATERIALS AND METHODS

Study Area and Population

The study area was Adim, a rural, farming community located 110 kilometres to the North of Calabar, the capital of Cross River State in South-Eastern Nigeria.

The principal crops grown by the farmers are rice (*Oryza Sativa*), yam (*Discorea prae-hincilis*) and cassava (*Manihot utilissima*). The only sources of water supply are the local streams and rain water. The area is situated in the tropical rain forest belt with an average annual rainfall of 150-200 centimeters. The study was undertaken between July 1993 and August, 1995. The pupils of the only primary school in the village were the subjects. Consent

and ethical approval were obtained from the guardians, school authorities and the ethical committee of the College of Medical Sciences, University of Calabar.

Screening and Treatment of Subject

A cohort of children all in class three and aged 8.0-8.9 years in 1993 when the project started were selected for this study. Each child was given a clean specimen bottle with which he/she provided urine between 10:00 and 14:00 hours. Semiquantitative estimation of protein and haematuria was performed on the freshly voided urine specimen using Combi-9 reagent strips (Macherev Nagel 10.52348 Damen: Batch No: 32412). Small quantity (5ml) of 1% Carbol fushin was added to 10ml of urine to stain and preserve the schistosoma ova. Egg-count was performed on the preserved urine, after filtration with nytrel filters. Children infected with *S. haematobium* were treated on the same day with 40mg/kg body weight of praziquantel as a single dose. Parents were advised to report drug reactions to the study physician through the teachers and field assistants. The screening and treatment exercise were repeated at 12 monthly intervals in July/August, 1994 and July/August, 1995.

Educational Achievement Tests

Standardized teacher-made test approved by the State Educational Authority for pupil assessment and promotion were administered on the pupils before treatment as part of the usual school assessment exercise. The tests were comparable in structure, as well as degree of easiness and were based on the pupils' current curriculum. The principal test forms were comprehension, simple arithmetic and aptitude tests. The maximum test score was '100'. Pupil who scored 50 or more were classified as having passed while those that scored less than 50 were classified as having failed. To determine the effect of the treatment programme on the selected cohort of children, the pass rate preceding each treatment exercise was compared with pass rate in the tests preceding the next screening treatment exercise.

Attendance register was kept on each school day through the study period for each pupil. To determine the attendance rate, we divided the total actual attendance by the number of days during which school was open for the periods under study and multiplied by 100. The cumulative attendance (Pupil-days) was determined by multiplying the sum total of all the attendace by the number of pupils on the roll. Calculation of geometric mean of schistosoma ova was performed after log-transformation of the individual pupils' count; zero egg-counts were excluded. Statistical analysis was with the aid of a micro-computer using EPI-Info, an epidemiological software package (CDC/WHO). Comparative analysis was done by Mantel-Haenszel test with the level of statistical significance set at p-value less than 0.05. Due to drop-outs and re-entrants the number of the cohort declined and later increased. Calculation of χ^2 was first performed by intention to treat analysis using the original number of the cohort as "n"; and later calculated with "n" value that excluded the drop-outs. Since the p-value of χ^2 in the two calculations were both statistically significant, the p-value of the intention to treat analysis was presented on the table while both calcultions are reported in the text of results. It was not ethically feasible to leave a control group of infected children

untreated.

RESULTS

There were 210 pupils in the cohort at the onset but the number available for assessment fell to 183 (87.1%) and 203 (96.7%) in 1994 and 1995 respectively. Twenty of the cohort who were absent during the 1994 assessment were present at the 1995 assessment hence the apparent increase in the cohort size. Table 1 shows the prevalence and intensity of *S. haematobium* infection in the cohort during the three years covered by the study. Both the prevalence and intensity of infection showed a steady decline among this cohort of children following treatment and re-treatment (Table 1).

Table 2 shows a comparison of the attendance and pass rates over the period (1993-1995) with χ^2 and p-values. The attendance rate declined during the period but the net

TABLE 1: Morbidity characteristics of a cohort of pupils followed yearly (1993-1995) with treatment of *S. haematobium* infection.

| CHARACTERISTICS | PRE-TREATMENT | POST TX (1) | POST TX (2) |
|---|-----------------|----------------|----------------|
| Age (Yr) | 8.0-8.9 | 9.0-9.9 | 10.0-10.9 |
| Class at Assessment | Two | THREE | FOUR |
| Number Examined | 210 | 183 | 203 |
| Prevalence of <i>S. haematobium</i> (%)* | 145/210 (69.1%) | 83/183 (45.2%) | 44/203 (21.6%) |
| Geometric Mean Egg Count** (per 10mL of urine) | 598 | 408 | 65 |
| Mean Erythrocyte/mL of Urine | 237 | 193 | 81 |

*Values taken before treatment each year

**Zero count excluded

TX= Treatment

TABLE 2: Effect of treatment on attendance and pass rate in a cohort of school children over three years.

| Educational Performance | Pre-Tx n=210 | Post-tx (I) n=183 | Post-Tx (II) n=203 | χ^2 | p* |
|-----------------------------|-----------------|----------------------|-----------------------|----------|--------|
| Total attendance Pupil-days | 46,902 | 40,269 | 40,402 | | |
| Attendance rat (%) | 86.7 | 81.5 | 81.1 | 2.99 | 0.22 |
| Days school opens | 257 | 270 | 245 | | |
| Number passed | 171 | 166 | 171 | | |
| Pass rate (%) | 81.4 | 90.7 | 84.2 | 7.20 | 0.027* |

*Statistically significant

change was not statistically significant ($\chi^2=2.99$; $p=0.22$). The improvement in test pass rate was statistically significant by intention to treat analysis ($\chi^2=7.2$; $p=0.27$) and by excluding drop-outs in the analysis ($\chi^2=6.04$; $p=0.048$).

DISCUSSION

This study showed high prevalence of *S. haematobium* infection among this group of pupils indicating that control activities should include this age-group in endemic communities, which declined as they were followed over two years treatment and re-treatments (from 69.0% in 1993 to 21.6% in 1995). Although the prevalence and intensity of *S. haematobium* infection is known to increase with age among school-age children (Chen & Mott, 1989), the drop in prevalence in this cohort from 69.0% in 1993 to 21.6% at an older age (1995) could be attributed to the effect of the repeated treatments. Since the post-treatment prevalence rates were recorded twelve months after treatment (in keeping with the original project design), the recorded decline in infection rate could have been an under-estimate since re-infections could have occurred during the intervening 12-month period.

This study showed no improvement in school attendance following repeated treatment which resulted in decrease in the prevalence and intensity of *S. haematobium* infection. Another study of Nigerian children which involved no treatments also showed no difference in school attendance between infected and non-infected school children (Ekanem *et al.*, 1994). Treatment of other helminthic infections did not influence school attendance in studies of children in Guatemala (Watkins *et al.*, 1996) and Malaysia (Raj *et al.*, 1997). The explanation for the apparent lack of association between helminthic infection and school attendance in the other studies and the present one may not be obvious. Some factors which are known to adversely influence school attendance are malaria (WHO, 1992) and truancy (Billinson, 1978). None of these was assessed in this study, and therefore, their likely influence on the findings of this study could not be evaluated.

There was an initial improvement in the academic achievement following the first treatment (P -value=0.013) but this was not sustained in the following year. The net effect was an improvement in pass rate from 81.4 at base-line to 84.2% after two treatment sessions in the cohort, which was statistically significant ($p=0.027$). The ethical constraint which forbade non-treatment of infected children has made it impossible to compare these observations with those of non-treatment controls. The association of under-achievement in school, or low scores in specific tests of cognitive ability with helminthic infections have been demonstrated by several studies (The Partnership for Child Development 1997; Hollaran *et al.*, 1989). Kvalsvig (1986) and Ndamba (1986) have in separate studies in endemic communities shown that *S. haematobium* infections may adversely affect the physical activities of school children, a factor that is known to influence the learning process (Graves, 1978).

Kimura *et al.* (1992) have in a study of Kenyan school children also reported an improvement in mental tests scores following treatment of *S. haematobium* infections. There have also been reports showing improvement in educational achievement and cognitive func-

tion following treatment of intestinal worms (Kvalsvig *et al.*, 1991; Nokes *et al.*, 1991). On the other hand, Watkins *et al.* (1996) detected no improvement in educational performance following deworming.

Our study has demonstrated a marginal but significant improvement in pass rate among this cohort of children following repeated treatments. Intestinal worms and malaria infections may affect the measurable effects of treatment of schistosomiasis. There is therefore a possibility that several other confounding factors may have influenced the observed effects of treatment among this cohort. Larger, randomised and controlled trials would help to further clarify the effects of this intervention on learning and development.

Although an overview of the available literature on the deleterious effects of *S. haematobium* on school achievement shows that the findings were inconclusive in a number of situations (Nokes and Bundy, 1994), there is a consensus that repeated treatment of school children in endemic communities is beneficial, and should be given attention in school health intervention programme (The Partnership on Child Development, 1997). Again, the observed decline in the overall morbidity of *S. haematobium* following regular treatment in our cohort indicates that the health benefits may be substantial and further justifies this intervention strategy.

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