Efficacy of Single Dose Anthelminthic Treatment against Soil Transmitted Helminth Infections and Schistosomiasis Among School Children in Selected Rural Communities in South East Nigeria

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ABSTRACT

Background

Soil-transmitted helminth infections and schistosomiasis constitute a major public health problem in developing countries. The objective of this study was to evaluate the efficacy of single dose anthelminthic treatment against soil-transmitted helminthic infections and schistosomiasis among school children in Ebonyi State.

Subjects and Methods

A school-based chemotherapeutic intervention study was conducted from September 2007 to January 2008 among five hundred and seventy-six primary school children selected by multistage sampling technique. The study was carried out in three distinct stages: pre-chemotherapeutic, chemotherapeutic and post-chemotherapeutic intervention stages. Selected children diagnosed as infected with the helminths investigated were treated. The efficacy of anthelminthic treatment was determined by helminth egg count at four, eight and sixteen weeks post-treatment.

Results

Up to 38.5% of the children had at least one helminth infection. *Ascaris lumbricoides* was the commonest STH encountered. The cure rate 4 weeks after the treatment of STH infection was lowest in *Trichuris trichiura* cases. At week 8 and week 16 there was a 100% cure rate for all the cases with STH infection. The egg reduction rate at weeks 8 and 16 was 100% for all the STH infection but ranged from 90.6% to 94.4% at week 16 for the *S. haematobium* infected cases. At week 16 following treatment, the cure rates for *S. haematobium* infection ranged from 70.8% to 74.0%.

Conclusion

This study has shown the efficacy of single dose anthelminthic treatment against soil-transmitted helminth infections and schistosomiasis among school-age children.

INTRODUCTION

Helminth infections caused by soil-transmitted helminths and schistosomes constitute major public health and developmental challenges in the vast majority of developing tropical and subtropical regions of the world.[1] They are classified among the neglected tropical diseases, a group of tropical infections which are especially endemic in low-income populations in developing regions of Africa, Asia and the America.[2] Infections caused by soil-transmitted helminths including hookworm (*Necator americanus, Ancylostoma duodenale*), roundworm (*Ascaris lumbricoides*), whipworm (*Trichuris trichiura*) and schistosomes (*Schistosoma haematobium, Schistosoma mansoni*) have been associated with poverty and underdevelopment and are most prevalent in the poorest communities of the developing world.[1,2] Reports have indicated that school-aged children typically exhibit the greatest prevalence of infection, the highest infection intensity, as well as the highest disease burden of soil-transmitted helminth infections due to high level of exposure resulting from poor sanitation and hygiene, and schistosomiasis due to bathing in infected freshwater streams and lakes.[1]

Nigeria is one of the countries known to be highly endemic for urinary schistosomiasis with estimated 101.28 million persons at risk and 25.83 million people infected.[3] Parasitological survey of urinary schistosomiasis among school children revealed prevalence rates ranging from 43.0 % to 52.3 % in rural communities in Osun State[4] and prevalence rate of 53.3% in parts of Ebonyi State.[5] The prevalence of soil-transmitted helminth infections is also high with prevalence rates of 16.9%[6] and 64.0%.[7] recorded among school children in south east and south west Nigeria respectively. Similar parasitological survey of soil-transmitted helminth infections among school children in other parts of Nigeria revealed prevalence rates greater than 68%.[8] The World Health Assembly in 2001 noted that morbidity due to these infections can be controlled at a reasonable cost by means of periodic chemotherapy using effective drugs and deworming campaigns targeted at high risk groups, such as school-age children.[9,10]

Several efficacy trials of anthelminthic therapies in school children have produced promising results, especially in areas where helminth infections are prevalent and intense.[10-12] Chemotherapy with single dose, broad spectrum safe and low cost anthelminthic drug is the main stay of programmes aimed at the control of morbidity due to soil-transmitted helminth infections and schistosomiasis.[2] There is a dearth of information on the efficacy and impact of school based deworming programmes in many rural areas of Nigeria where the prevalence and burden of soil-transmitted helminth infections and schistosomiasis are very high. The objective of this study was to evaluate the efficacy of single dose albendazole and praziquantel in the treatment of soil-transmitted helminth infections and schistosomiasis among school-aged children in Ebonyi State, south east Nigeria.

SUBJECTS AND METHODS

This is a school based chemotherapeutic intervention study conducted from September 2007 to January 2008 among primary school children in two major swamp rice producing rural communities (Idembia-Enyibichiri and Ndiagu-Echara) with grossly inadequate basic amenities in Ikwo East Local Government Area (LGA) of Ebonyi State, south east Nigeria. The climate is tropical and the vegetation characteristics of the rain forest with an average annual rainfall of about 1,600mm and average atmospheric temperature of 30^0C. The area is traversed by a number of streams and

Cross-river tributaries which constitute the major source of water supply to all the communities in the area. Water contact activities like bathing, washing, swimming and fishing are generally the norm. Farming and trading are the major economic activities. Educational status of most of the inhabitants is generally very low and systematic deworming exercise among school children has never been conducted in the area.

A minimum sample size of 478 was obtained using the Fischer's formula for population above ten thousand[13] and an attrition rate of 20 %.[14]

$$n = Z^2 \frac{P(1-P)}{d^2}$$

Where n = minimum sample size required

Z = 1.96 (corresponds to 95% confidence level)

P = 53.3 % (prevalence of helminthic infections)[15]

(1-P) = q = 46.7 % (proportion uninfected)

d = level of precision = 0.05

$$n = \frac{(1.96)^2 (0.533)(0.467)}{(0.05)^2} = 382$$

To compensate for 20% non-response [14], an adjustment was made to the calculated sample size using the following formula.[13]

$$n_s = \frac{n}{1-0.2} = \frac{382}{0.8} = 478$$

A multi-stage sampling technique was used to select a total of 576 participants (25 % of the population of children in the selected primary schools at the time of the study) for the study as follows: from a sampling frame of thirty-four (34) primary school in Ikwo East Local Government Area, two primary schools were selected by simple random sampling using the table of random numbers. The number of participants was proportionately allotted to each stratum of classes in each of the schools. One arm in each stratum of classes was randomly selected and systematic random sampling method (1 in 4) was used to select the final participants using the class registers of the children in both primary schools.

The research instrument was a parasitological checklist. The parasitological checklist inquired about the socio-demographic data of the participants, the type of helminth ova present upon parasitological analysis of stool and urine specimen, treatment record, egg reduction rate and cure rate. The study was carried out in three distinct stages: pre-chemotherapeutic intervention stage, chemotherapeutic intervention stage and post-chemotherapeutic intervention stage. In the pre-chemotherapeutic intervention stage, each child selected was provided a specimen collection container and asked to provide an early morning stool on the following day. The amount of stool needed and how it should be introduced into the container using a wood stick was demonstrated to the children. Approximately 30 ml of urine sample was collected in a 50ml capacity specimen container from each child

who provided stool sample the following day. The urine specimens were collected between the hours of 10:00 AM and 2:00 PM on the day of the visit.[11] The urine and stool samples from each child were appropriately labelled and were carried in a cold box filled with ice packs and transported to the public health laboratory of Department of Community Medicine Ebonyi State University Abakaliki for analysis. They were processed within 3hours of collection. Stool analysis was performed using the Kato-Katz technique.[16,17] The urine sedimentation technique was used to detect the presence of *S. haematobium* ova in the urine samples.[16,17] A child was parasitologically diagnosed infected on identification of ova of helminths in his/her stool or urine sample. In the chemotherapeutic intervention stage, all the children diagnosed as infected following the parasitological analysis were treated. The treatment consisted of a single dose

Table 1: Baseline prevalence of soil transmitted helminth infections and schistosomiasis in relation to the sex and age of the participants.

	CCS Enyibichiri		CSS Ndiagu-Echara		Total No. Ex	Total No. Infected (%)
Sex	No. Examined	No. Infected (%)	No. Examined	No. Infected (%)		
Male	146	78 (60.5)	151	63 (67.7)	297	141(47.5)
Female	142	51(39.5)	137	30 (32.3)	279	81 (29.0)
Total	288	129 (44.8)	288	93 (32.3)	576	222 (38.5)
Chi-square	(χ^2 = 8.92; df = 1; P = 0.003)		(χ^2 = 12.13; df = 1; P = 0.001)			
Age group (years)						
6-9	119 (37.2)	54 (45.4)	120	35 (29.2)	239	89
10-13	117 (40.3)	53 (45.3)	126	45 (35.7)	243	98
14-17	52 (37.2)	22 (42.3)	42	13 (31.0)	94	35
Total (38.5)	288	129 (44.8)	288	93 (32.3)	576	222
Chi-square	(χ^2 = 0.16; df = 2; P = 0.92)		(χ^2 = 0.96; df = 2; P = 0.62)			

Table 2: Prevalence and mean egg count of the various soil transmitted helminth and Schistosoma haematobium infections investigated among the participants.

Type of Helminth	CSS Enyibichiri			CSS Ndiagu-Echara			Total Screened	Total No. (%) Infected	Mean egg count
	No. Ex	No. (%) Infected	Mean egg count	No. Ex	No. (%) Infected	Mean egg count			
Ascaris lumbricoides	288	45(15.6)	[illegible]	288	18 (6.3)	16.8 ± 1.7	576	63(10.9)	17.1 ± 2.1
Hookworm	288	26 (9.0)	15.3 ± 2.3	288	17 (5.9)	16.4 ± 2.5	576	43(7.5)	15.7 ± 2.3
Trichuris trichiura	288	13(4.5)	14.3 ± 1.3	288	11 (3.8)	15.4 ± 16	576	24(4.2)	14.8 ± 1.4
Schistosoma haematobium	288	96(33.3)	31.0 ± 5.4	288	73(25.3)	28.3 ± 4.3	576	169(29.3)	29.7 ± 4.7

Table 3: Baseline prevalence and intensity of *Schistosoma haematobium* infection in relation to sex and age of the participants.

Sex	CSS Enyibichiri				CSS Ndiagu-Echara			
	No Ex.	No. Infected (%)	Intensity of infection		No. Ex.	No. Infected (%)	Intensity of infection	
			Heavy intensity (%)	Low intensity (%)			Heavy intensity (%)	Low intensity (%)
Males	146	56(38.4)	16(11.0)	40(27.4)	151	48(31.8)	13(8.6)	35(23.2)
Females	142	40(28.2)	8(5.6)	32(22.5)	137	25(18.2)	7(5.1)	18(13.1)
Total	288	96 (33.3)	24 (25.0)	72 (75.0)	288	73 (25.3)	20 (27.4)	53 (72.6)
Age group (Years)								
6-9	119	31(26.1)	6(5.0)	25(21.0)	120	23(19.2)	2(1.7)	21(17.5)
10-13	117	47(40.2)	11(9.4)	36(30.8)	126	38(30.2)	13(10.3)	25(19.8)
14-17	52	18(34.6)	7(13.5)	11(21.2)	42	12(28.6)	5(11.9)	7 (16.7)
Total	288	96(33.3)	24(25.0)	72(75.0)	288	73(25.3)	20(27.4)	53(72.6)

Note: Heavy intensity infection (= 50 eggs per 10 mls of urine); Low intensity infection (< 50 eggs per 10 mls of urine).

Table 4: Cure rate (CR) and Egg reduction rate (ERR) in infected children following anthelminthic treatment

Type Helminth	CSS Enyibichiri			CSS Ndiagu-Echara		
	CR/ERR (%) 4th week after treatment	CR/ERR (%) 8th week after treatment	CR/ERR (%) 16th week after treatment	CR/ERR (%) 4th week after treatment	CR/ERR (%) 8th week after treatment	CR/ERR (%) 16th week after treatment
Ascaris lumbricoides	93.6/99.0	100/100	100/100	83.3/99.0	100/100	100/100
Hookworm	88.5/95.4	100/100	100/100	52.9/97.5	100/100	100/100
Trichuris trichiura	61.5/93.0	100/100	100/100	45.5/97.6	100/100	100/100
Schistosoma haematobium	46.9/54.9	63.5/79.4	70.8/90.6	56.2/59.9	71.2/87.5	74.0/94.4

DISCUSSION

The year 2015 which is targeted for the achievement of the millennium development goals (MDGs) is fast approaching, yet helminthic infections remains a significant public health problem among school children. This study had revealed a high prevalence of helminthic infections (38.5 %) among school children in Ikwo east local government area of Ebonyi. This finding supports reports from studies conducted in other parts of Nigeria which also revealed unacceptably high prevalence of helminthic infections among school children.[8,15,19-21]

In this study, more male children were infected by helminths when compared with female children and the difference was statistically significant. This finding is however in contrast with the observations from other studies which did not report a statistically significant difference in the prevalence of helminthic infections between male and female children.[35-37] It is not apparently clear if the prevalence of soil-transmitted helminth infection among children is sex dependent.[19] However, the higher prevalence of *S. haematobium* infection among the selected male children compared to their female counterpart is presumably due to their higher water contact activities particularly in swamp-rice farming and fishing in the study area. In addition, other regular water contact activities such as swimming and bathing in cercariae infested streams and rivers have been reported to be male dominated.[22-24]

Ascaris lumbricoides was the commonest soil-transmitted helminth encountered in this study. This observation supports other studies which also revealed a high prevalence of Ascaris *lumbricoides* among school children compared to other soil-transmitted helminths.[35,38] Recent estimates indicate that *Ascaris lumbricoides* is the most frequently encountered soil-transmitted helminth in the tropics.[25] This can be attributed to the fact that the infective stages of *A. lumbricoides,* the embryonated eggs have enormous capacity for withstanding the environmental extremes of urban environments.[26] Furthermore, *Ascaris* eggs are coated with a mucopolysaccharide that renders them adhesive to a wide variety of environmental surfaces; this feature accounts for their adhesiveness to everything from door handles, dust, fruits and vegetables, paper

money and coins.[27,28]

The findings of this study clearly demonstrate that treatment with single dose albendazole possesses a high efficacy against soil-transmitted helminth infection since at eight weeks post-treatment the cure rate and egg reduction rates were 100%. Although the egg reduction rate of 94.4% was observed following single treatment with praziquantel for *S. haematobium* infection after sixteen weeks, the highest cure rate was 70.4%. The high efficacy of albendazole in the treatment of soil-transmitted helminth infection among school children has also been demonstrated in a number of other studies.[29-31] On the other hand many reports from schistosomiasis endemic regions have indicated that a single oral dose of praziquantel was safe, showed no or only a few but transient side effects, but resulted in high parasitological cure and egg reduction rates against *S. haematobium* infection.[32,33] The relatively lower cure rates and egg reduction rates in children infected with *S. haematobium* compared to children infected with soil-transmitted helminth infection could be linked to the relatively heavier intensity of *S. haematobium* infection compared to soil-transmitted helminth infection among the children rather than a possible emergence of praziquantel resistant schistosomiasis. While all the selected pupils infected with soil-transmitted helminth had low intensity infection, a significant proportion of the pupils infected with *S. haematobium* had heavy intensity infection. Although the possibility of praziquantel resistant schistosomiasis may seem far fetched among the study population, there is however considerable concern that repeated use of anthelminthics over long period of time might result in the development and spread of drug resistant helminths. [34] The World Health Assembly in 2001 urged the countries where soil-transmitted helminth infections and schistosomiasis are endemic to promote access to safe water, sanitation, adequate housing and health education through intersectoral collaboration. These laudable public health strategies would help reduce drug dependence, prevent the emergence of drug resistant helminths and improve the health status of school children.

CONCLUSION

This study brings to the fore, the efficacy of single dose anthelminthic chemotherapy against soil-transmitted helminth infections and schistosomiasis among school children.
In view of the epidemiological importance of and effects of helminthic infections on the well being of school children, a pragmatic public health policy on the control of soil-transmitted helminth infections and schistosomiasis through the implementation of regular school deworming programme in Ebonyi State is recommended.

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