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A MODEL FOR SCHOOL-BASED CONTROL OF COMMON INTESTINAL HELMINTHS USING MASS TREATMENT: PARASITOLOGIC ASSESSMENT

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ABSTRACT

A model for school-based control of common intestinal helminths was developed and tested in San Vicente Elementary School in Biñan, Laguna, Philippines integrating health care with education programmes, monitoring parasitologic parameters, and comparing the efficacy of once versus twice yearly mass treatment. Mebendazole (Antiox) 500 mg choco-flavored tablets were administered to schoolchildren with parental consent following a treatment schedule determined by randomization. Parasitologic assessment and monitoring were conducted among third grade pupils considered the indicator group. Stool specimens were collected and processed using Kato Katz method which allowed qualitative and quantitative diagnosis in terms of parasite species and egg counts, respectively. Parasitologic parameters were monitored at Days 0, 7 to 14, 180, 187 to 194, 360 and 367 to 374. There were significant reductions of infection rates and intensities of infection post-treatment. Twice yearly deworming was shown to be superior to once yearly treatment. Continuation of periodic mass treatment with mebendazole initially twice yearly with monitoring of parasitologic and nutritional progress as well as school performance parameters are strongly recommended for the school. Larger scale application of the results of this and other similar studies are recommended.

Key Words : mass treatment, common intestinal helminths, Ascaris, Trichuris, school-based control, deworming, parasitologic assessment, monitoring

INTRODUCTION

There is overwhelming evidence that roundworms, whipworms and hookworms are leading causes of morbidity in pre-school and school age children especially in developing countries like the Philippines. Intestinal parasitism causes adverse effects on health, growth and school performance further causing underdevelopment. It is believed that the proportion of the world's population infected with these worms have remained virtually unchanged over the past 50 years.

Among a few anthelminthics, mebendazole (Antiox) has been shown to be effective in the treatment of common intestinal helminthiases and is included in the World Health Organization (WHO) Model List of Essential Drugs. Since safe, effective, and easy to administer drugs are available, a strategy of periodic mass treatment through schools could target school age children, as advocated by the Health Promoting Schools initiative of WHO. This same strategy emphasizes the role of schoolteachers as potential partners in making possible a healthy school populace.

Mass treatment has been recommended in areas or target groups with prevalence of more than 50% according to the WHO Panel of Experts. They have suggested that monitoring may be done utilizing third grade students who may provide a good cross-sectional picture of the overall extent of the worm problem in the school. Chemotherapy targeted at population groups like schoolchildren will have benefits to other non-treated populations by clearing the source of infection, thereby reducing fecal contamination of the environment and eventually diminishing transmission. There may be a need therefore to develop and test an affordable school-based model for control of common intestinal helminths using mass treatment.

The main objectives of this study were:

1) To develop a model for school-based control of common intestinal helminths which integrates health care with education programmes;
2) To test the model for school-based worm control using the following parameters:

    a) cure rates
    b) egg reduction rates

3) To compare the efficacy of once yearly versus twice yearly mass treatment.

MATERIALS AND METHODS

Study Design Overview

This was a comparative study in children belonging to an indicator group, the third grade pupils. All pupils meeting the study entry criteria received a single oral dose of mebendazole 500 mg choco-flavored tablet once-yearly or twice-yearly after randomization. Infection rates, mean arithmetic and geometric egg counts, cure and egg reduction rates were derived. All the other pupils from the other grades were treated at the beginning of the project period and a year later. The study was conducted according to Good Clinical Practice Guidelines and the Declaration of Helsinki.

Study Site and Population

San Vicente Elementary School (SVES) is located in Barangay San Vicente, Biñan, Laguna, which is 33 kilometers south of Manila. As part of the Biñan School District, the school has provided public elementary education since it opened in 1958. For academic year 1999-2000, the school had an enrollment of 2,904 with 1,552 boys and 1,352 girls, with ages ranging from 5 to 15 years.

All pupils with parental consent from the third grade comprised the indicator group (Guidelines for the evaluation of soil-transmitted helminthiasis and schistosomiasis at community level, WHO, 1998) in which parasitologic parameters were measured, while all pupils in all grade levels were targeted to be included in the mass treatment strategy.

Inclusion and Exclusion Criteria

Inclusion criteria for mass treatment were the following: 1) male or female, of elementary school age; and 2) written informed consent of the parent or guardian. Exclusion criteria were: 1) demonstration of previous hypersensitivity reaction to a benzimidazole or any related compound; 2) intake of any anthelminthic in the 2 weeks prior to enrolment into the study; and 3) concomitant infection or any other underlying disease which would compromise the evaluation of the response to the study medication.

Mass Treatment

A training of teachers was undertaken in September 1999 by way of a seminar-workshop that aimed to achieve the following:

1) To describe the problem of common intestinal helminthiases;
2) To discuss mass treatment as a control strategy for common worms;
3) To discuss the role of the school, its students and teachers in worm control;
4) To describe possible problems which may be encountered in the implementation of school-based mass treatment for control of common intestinal helminthiases;
5) To propose solutions to these possible problems; and
6) To finalize an action plan for implementation of school-based mass treatment for control of common intestinal helminthiases.

Strategies used to achieve the above mentioned goals included video showing, short lecture-discussions, and a workshop to discuss possible problems and solutions as well as to draw up an action plan for implementation. Based on outputs of the seminar-workshop, the Guidelines for Mass Treatment for SVES Teachers were formulated.

Health education was also conducted among schoolchildren using posters and wall news-type material, known as the *Kontra Bulate Bulletin*. Two meetings with the Parent-Teacher Association (PTA) were conducted aiming to raise awareness of parents regarding common worms and the need for mass treatment. A billboard on the worm control project and the importance of SVES in worm control efforts in the future was also erected in a strategic place in the school grounds. A poster-making contest among schoolchildren was also conducted along with the teachers' bulletin board and jingle presentation contest per grade level with the winners announced in the Treatment Day program.

Mass Treatment Day was held on 5 October 1999 participated in not only by the school community and the project team but also by local officials, the parish priest, the PTA officers, and a representative from Janssen Pharmaceutica. Mebendazole (Antiox) 500 mg chocolate flavored tablets were distributed to classroom teachers by the project team, and teachers administered treatment to pupils with parents' consent overseen by the project team. Teachers recorded and reported who among their pupils were treated, and summary sheets indicating coverage were submitted. Treatment coverage rates were determined, while drug use and inventories were taken note of.

A second Mass Treatment Day was held in February 2000, six months after the first, but only for children who were randomly selected to receive two doses of mebendazole in a year in the indicator grade. Children who were to receive only one dose of the drug were given placebo tablet, a type of candy that simulated a tablet in appearance. A third Mass Treatment Day was held in August 2000 for all consenting pupils in all grade levels.

Adverse experiences were monitored during each Treatment Day and recorded across the name of each pupil who experienced such on the teacher's class list. Teachers referred each pupil experiencing an adverse event to the medical team/ project staff for further assessment and appropriate management. An Adverse Experiences Recording Sheet was accomplished per pupil referred. A guide was devised to help the project staff in assessing the severity and causality of the adverse experience.

Parasitologic Assessment

Stool specimens were collected from all consenting third grade pupils at Day 0 (baseline or pre-treatment 1), Day 7 to 14 (post-treatment 1), Day 180 (+/- 14 days, pre-treatment 2), Day 187 to 194 (post-treatment 2), Day 360 (+/- 14 days, pre-treatment 3), Day 367 to 374 (post-treatment 3). Specimens were processed using Kato Katz method that allowed qualitative assessment of infection according to species that allowed derivation of infection rates and quantitative assessment that allowed estimation of burden of infection through the number of eggs per gram (epg) of feces. Intensity of helminth infection per pupil was assessed as light, moderate or heavy, according to the Classes of Intensity proposed for use by the WHO Expert Committee in 1987 (Prevention and Control of Intestinal Parasitic Infections: Report of a WHO Expert Committee, WHO, 1987).

Post-treatment stool examinations allowed assessment of response at the end of therapy as one of the following:

1) Clinical cure defined as the absence of helminth eggs in stool examinations at Day 7 to 14;
2) Clinical improvement defined as a reduction, compared to baseline, in stool egg counts in patients not cured in stool examinations on Day 7 to 14;
3) Clinical failure defined as no change compared with baseline in the number of helminth eggs in stool examinations on Day 7 to 14; and
4) Clinical outcome indeterminate when a valid assessment of clinical efficacy cannot be made due to poor patient cooperation or extenuating circumstances.

Efficacy measures consisted of cure rates and egg reduction rates (arithmetic and geometric). Reinfection data were also collected from pupils who were infected at baseline and were cured at Day 7 to 14 by doing parasitologic assessments at Days 180 and 360 (+/-14 days).

Data Handling and Analysis

Pre-treatment infection rates (Days 0 and 180) were compared using McNemar Chi-square. The trend of infection rates (having at least one parasite), *Ascaris* and *Trichuris* infection rates of pupils in the two treatment schedules were compared using the Generalized Estimating Equations. The two treatment schedules being compared were once per year (mebendazole at Day 0, placebo at Day 180 and mebendazole at Day 360) and twice per year (mebendazole given at Days 0, 180 and 360).

Efficacy analysis included only those who satisfied the following criteria in all the follow-up periods: 1) pupils with parental consent; 2) pupils who were treated; and 3) pupils who were able to submit stool specimens for examination.

Cure rates at Day 7 to 14 and reinfection rates at Day 180 were described using proportions. At Day 187 to 194, cure rates were compared for pupils given once versus twice per year using chi-square test. The cure rates at Day 7 to 14 among the different intensity of infections were compared using Chi-square test of homogeneity. Reinfection rates at Day 360 were compared similarly. Fishers exact test was used when necessary.

Egg counts were described using arithmetic and geometric means. The egg counts were increased by 1 and transformed using log transformation. Mean log transformed egg counts of the once versus twice per year treatment were compared using the repeated measures analysis of variance. The effect of time and its interaction with treatment regimen on egg counts were also assessed. If the time and treatment interaction was significant, tests of contrasts were performed to determine the follow-up periods by which a significant difference between the two treatment schedules was observed.

RESULTS

Mass Treatment - Consent Rates and Treatment Coverage

Consent rates (for mass treatment) were from 79.1% to 92.4% with an overall consent rate of 84.5%. Among 2454 pupils with consent, 2279 or 92.9% were treated. Treatment rates per grade level ranged from 89.9% to 96.5% among those with consent. The total number of consenting pupils who were treated represented 78.5% of the school population.

For the second round of mass treatment, only Grade III pupils were targeted for treatment and were randomly selected to receive once or twice yearly mebendazole. A total of 460 Grade III pupils still had consent from parents or guardians for inclusion in the second round of mass treatment. This represented 92.2% of the total Grade III population. This was not markedly different from the 92.4% consent rate achieved for the first round of mass treatment. In both instances, consent rates may be considered excellent. For the third round of mass treatment, overall consent rate was 90.9% which was an improvement of the 84.5% consent rate achieved almost a year earlier. Overall treatment coverage was 88.5%, which was likewise an improvement of the 79.1% treatment coverage achieved almost a year earlier.

Baseline Parasitologic Assessment (Pre-treatment 1)

Of the 499 pupils in the indicator group, 418 pupils or 83.8% submitted stool specimens for baseline parasitologic assessment. Of these, 329 pupils or 78.7% were positive for at least one intestinal helminth infection. Positivity rate per section ranged from 57.9% to 90.4%, with increasing positivity rate the lower the section. Of the 418 pupils who were examined, *Trichuris* was the most common intestinal parasite seen with 292 Grade III pupils infected (69.8%). The next most common intestinal parasite was Ascaris with 181 pupils or 43.3% in the same grade infected. Only 3 pupils or 0.7% were found to have hookworm, while only 4 pupils or 1.0% were found to have *Enterobius*.

Overall, majority of pupils infected with *Ascaris* (51.4%) were classified as having light intensity of infection with most pupils (84.0%) having light to moderate intensity. In the same manner, majority of pupils infected with *Trichuris* (51.7%) were classified as having light intensity of infection with most pupils (92.1%) having light to moderate intensity. Only 16.0% and 7.9% of pupils examined had heavy intensity *Ascaris* and *Trichuris* infections, respectively (Tables 1 and 2).

Table 1 Distribution of infected Grade III pupils with ascariasis according to intensity of infection* at baseline (Day 0) SVES, Biñan, Laguna, July 1999

Section	No. of pupils examined	No. of pupils infected (%)	Light		Moderate		Heavy	
			No.	%	No.	%	No.	%
1	57	19 (33.3)	18	94.7	1	5.3	0	0.0
2	62	20 (32.3)	10	50.0	7	35.0	3	15.0
3	65	25 (38.5)	12	48.0	11	44.0	2	8.0
4	63	35 (55.6)	17	48.6	10	28.6	8	22.9
5	68	32 (47.1)	14	43.7	11	34.4	7	21.9
6	51	22 (43.1)	13	59.1	6	27.3	3	13.6
7	52	28 (53.8)	9	32.1	13	46.4	6	21.4
Total	418	181 (43.3)	93	51.4	59	32.6	29	16.0

*Intensity of *Ascaris* infection:
Light: 1 - 4,999 epg
Moderate: 5,000 - 49,999 epg
Heavy: > 50,000 epg
Source: WHO Guidelines for the evaluation of soil transmitted helminthiasis and schistosomiasis at the community level, 1998

Table 2 - Distribution of infected Grade III pupils with trichuriasis according to intensity of infection* at baseline (Day 0) SVES, Biñan, Laguna, July 1999

Section	No. of pupils examined	No. of pupils infected (%)	Light		Moderate		Heavy	
			No.	%	No.	%	No.	%
1	57	20 (35.1)	17	85.0	3	15.0	0	0.0
2	62	43 (69.4)	26	60.5	16	37.2	1	2.3
3	65	47 (72.3)	27	57.4	18	38.3	2	4.3
4	63	43 (68.3)	20	46.5	19	44.2	4	9.3
5	68	51 (75.0)	23	45.1	23	45.1	5	9.8
6	51	42 (82.4)	23	54.8	14	33.3	5	11.9
7	52	46 (88.5)	15	32.6	25	54.3	7	14.8
Total	418	292 (69.9)	151	51.7	118	40.4	23	7.9

*Intensity of *Trichuris* infection:
Light: 1 - 999 epg
Moderate: 1,000 - 9,999 epg
Heavy: > 10,000 epg

Source: WHO Guidelines for the evaluation of soil transmitted helminthiasis and schistosomiasis at the community level, 1998

Arithmetic means of *Ascaris* and *Trichuris* eggs fell within the category of moderate intensity of infection. There was a tendency for arithmetic mean egg counts to be higher as the section became lower for both ascariasis and trichuriasis. Geometric mean egg counts for trichuriasis also had the tendency to be higher as the section became lower.

Follow-up Parasitologic Assessments
Day 7 to 14 (Post-treatment 1)

A total of 426 third grade pupils submitted stool specimens on the first follow-up (post-treatment 1, Day 7-14). This represented 85.4% of all Grade III pupils. Clinical cure was noted in 58.2% of those pupils treated with ascariasis, while clinical improvement was noted in 31.5%. Clinical failure was evident in 3.0% of pupils with ascariasis, while 7.3% of pupils did not follow up. Clinical cure was noted in only 37.2% of pupils with trichuriasis, while clinical improvement was noted in 45.2%. Clinical failure was seen in 7.7% of pupils with trichuriasis, while 9.9% of pupils did not follow up.

For pupils with ascariasis, overall cure rate was 62.7%. Cure rate was highest at 79.8% among those with light intensity of infection on baseline, while it was lowest at 21.7% among those with heavy intensity of infection on baseline. As intensity of infection at baseline increased, cure rate decreased. There was a significant difference in the cure rates for ascariasis with different levels of intensity of infection ($p=0.000$). For pupils with trichuriasis, overall cure rate was 41.3%. Cure rate was highest at 55.9% among those with light intensity of infection on baseline, while it was lowest at 6.3% among those with heavy intensity of infection on baseline. Similar to the findings in ascariasis, intensity of infection at baseline increased, cure rate decreased. There was a significant difference in the cure rates for trichuriasis with different levels of intensity of infection ($p=0.001$).

Overall, egg reduction rate (ERR) in pupils with ascariasis at baseline using arithmetic mean egg counts was 85.6%, while it was 70.7% among those with trichuriasis at baseline using arithmetic mean egg counts. With geometric mean egg counts, ERR was 90.8% for those with ascariasis and 90.1% for those with trichuriasis.

Day 180 (Pre-treatment 2) and Day 187 to 194 (Post-treatment 2)

The stool submission rate increased from 90.7% (pre-treatment 1) to 93.9% (pre-treatment 2). The infection rates for all sections in pre-treatment 2 were lower than the levels in pre-treatment 1. Positivity rates ranged from 57.9% to 90.4% (overall infection rate=78.7%) at pre-treatment 1, while at pre-treatment 2, it ranged from 16.1% to 77.0% (overall infection rate=55.8%). Overall infection rate 180 days after treatment was 29.1% lower than the baseline overall infection rate. Of 432 pupils who underwent parasitologic assessment prior to the next round of mass treatment (pre-treatment 2), 241 or 55.8% were found to be positive for at least one infection. Of these, 226 (52.3%) had *Trichuris* and 63 (14.6%) had *Ascaris*. The proportion of Ascaris infections was 66.3% lower than that observed at baseline or pre-treatment 1, while the proportion of *Trichuris* infections was 25.1% lower than in pre-treatment 1. Three pupils (only 0.7%) had *Enterobius*, and there was no hookworm infection reported.

Majority of Grade III pupils with *Ascaris* infection per section, except section 3, had light intensity infections. Overall, 93.7% of these children were classified as having light to moderate intensity of *Ascaris* infection. Heavy intensity roundworm infection was seen in 6.3% of infected pupils. This was 60.6% lower than the proportion of heavy intensity infections at baseline. No pupil in section 1 was reported to harbor *Ascaris* infection. *Trichuris* infection was seen in 52.3% of those examined. A majority of infected pupils (66.0%) were classified as having light intensity infections with only 1.3% classified as heavy intensity infection. This represented an 83.5% reduction of the proportion of heavy intensity *Trichuris* infections at baseline.

Arithmetic and geometric mean *Ascaris* egg counts 180 days after treatment were 94.6% and 92.7% lower, respectively, compared to baseline levels. Arithmetic and geometric mean *Trichuris* egg counts 180 days after treatment were 24.3% and 79.0% lower, respectively, compared to baseline levels. Arithmetic mean egg counts for both helminth infections were classified as light intensity infections. Arithmetic mean egg count of *Ascaris* per section showed no distinct trend but the geometric mean egg count showed a tendency to be higher as the section became lower as seen also at baseline. For *Trichuris*, this tendency was observed both for the arithmetic and geometric mean egg counts but more clearly in the former. Reinfection rates at pre-treatment 2 for Ascaris per section were from 0.0% to 36.4% while for *Trichuris*, it ranged from 26.7% to 53.8%. There was no distinct trend in terms of reinfection rate and section. The overall reinfection rates 180 days after treatment were 14.4% and 38.1% for *Ascaris* and *Trichuris*, respectively.

Out of the 63 pupils infected with Ascaris at pre-treatment 2, 30 (47.6%) received a second round of mebendazole, 23 (36.5%) received placebo and the remaining 10 (15.9%) did not receive either because they were not present during the treatment day. On the other hand, of the 226 pupils with *Trichuris*, 105 (46.5%) received mebendazole, 88 (38.9%) received placebo and 33 (14.6%) did not receive either because they were not present during the treatment day. Among those who were given mebendazole, clinical cure was observed in 22 or 73.3% of those with ascariasis while 6 (20.0%) were found to show clinical improvement. One pupil was noted to have clinical failure and another one classified as clinical outcome indeterminate. Clinical cure was found in 45.7% of those pupils with Trichuris at pre-treatment 2 who received a second round of mebendazole. Forty-two pupils or 40.0% were observed to have had clinical improvement while 11.4% and 2.9% of pupils were classified as having clinical failure and clinical outcome indeterminate, respectively.

The ERRs for those pupils with ascariasis at pre-treatment 2 who received a second round of mebendazole were 78.8% using arithmetic mean egg counts and 99.9% using geometric mean egg counts. For those with trichuriasis, ERR was 83.7% using arithmetic mean egg counts and 96.9% using geometric mean egg counts.

Overall, the infection rates (positive for at least one parasite) in both treatment groups were much lower in post-treatment 1, pre-treatment 2 and post-treatment 2 as compared to their original levels in pre-treatment 1. It can also be noted that levels of infection in post-treatment 1 and pre-treatment 2 for both treatment groups were not much different. Levels of infection at post-treatment 2 showed that there was a big drop in the infection rates for those who received twice yearly treatment and practically not much change for those who received once-yearly treatment, as expected (p=0.000, for both ascariasis and trichuriasis).

Day 360 (Pre-treatment 3) and Day 367 to 374 (Post-treatment 3)

Overall, stool submission rate was 97.9%. Positivity rates ranged from 0.0% to 100.0%. The overall infection rate was 56.7%. Of the 423 pupils who were found to be infected at pre-treatment 3 follow-up, 210 (49.6%) were positive for *Trichuris* and 113 (26.7%) had *Ascaris*. These rates were 28.9% and 38.3% lower than those observed at pre-treatment 1. The infection rate for *Ascaris* at pre-treatment 3 was 82.3% lower than those observed at pre-treatment 2. On the other hand, the infection rate for Trichuris at pre-treatment 3 was 5.2% lower compared to pre-treatment 2. Two pupils (0.5%) had *Enterobius*. The other two pupils (0.5%) had hookworm. One (0.2%) was seen to have heterophyid egg.

Majority of pupils with *Ascaris* infection per section had light intensity infections. Overall, 47.8% of these children were classified as having moderate to heavy intensity *Ascaris* infection and 74.8% of pupils with *Trichuris* infection were classified as light intensity with only 0.9% classified as heavy intensity. Only sections 3 and 6 had pupils with heavy intensity infections at pre-treatment 2.

Arithmetic mean egg counts were classified as moderate intensity of infection. The arithmetic and geometric mean egg counts of *Ascaris* and *Trichuris* among pupils who were assigned in the once-a-year treatment group were classified as moderate and light intensity infections, respectively. On the other hand, the arithmetic and geometric mean egg counts of *Ascaris* and *Trichuris* among pupils who were assigned in the twice-a-year treatment group were classified as light intensity infections. Arithmetic and geometric mean egg counts of *Ascaris* per section showed no distinct trend. For *Trichuris* however, geometric mean egg count showed a tendency to be higher as the section became lower.

Pupils who belonged to the once-a-year group had higher infection rate having 58.4% of the pupils infected compared to those pupils who belonged to the twice-a-year group having only 51.2% of the pupils infected. Pupils who had a twice-a-year treatment schedule had 21.4% and 43.8% of the pupils infected with *Ascaris* and *Trichuris*, respectively. These were relatively lower than those pupils who belonged to the once-a-year group that had 30.7% and 50.6% of the pupils infected with *Ascaris* and *Trichuris*, respectively.

Reinfection rates were not found to be significantly different between pupils belonging to once versus twice yearly treatment schedules for both ascariasis (p=1.000) and trichuriasis (p=0.687). Reinfection rates for *Ascaris* among pupils who were assigned in once-a-year and twice-a-year treatment schedules were 33.3% and 45.0%, respectively. Reinfection rates for *Trichuris* were seen among 55.6% of the pupils assigned in the once-a-year treatment group and 63.4% of the pupils assigned in a twice-a-year treatment group. At pre-treatment, among pupils with a once-a-year treatment schedule, 1 out of 3 pupils were reinfected with Ascaris, while 5 out of 9 pupils were reinfected with *Trichuris*. Among pupils in the twice-a-year treatment schedule, 9 out of 20 pupils (45.0%) were reinfected with, while 26 out of 47 pupils (63.4%) were reinfected with *Trichuris*.

Overall, among those who received treatment in August 2000, clinical cure was observed in 73.9% of pupils with *Ascaris* while 18.9% showed clinical improvement. Two pupils with clinical failure and 6 others with clinical outcome indeterminate were noted. For those pupils with *Trichuris*, clinical cure was observed in 57.1% of pupils while 29.8% showed clinical improvement. Fourteen pupils with clinical failure and 13 others with clinical outcome indeterminate were noted.

Among those who received once-a-year treatment, clinical cure was observed in 70.6% of those with ascariasis, while 19.6% showed clinical improvement. One pupil with clinical failure and 4 others with clinical outcome indeterminate were noted. For those pupils who received twice-a-year treatment, clinical cure was observed in 76.8% of those pupils having the same infection, while 16.3% showed clinical improvement. One pupil with clinical failure and 2 others with clinical outcome indeterminate were noted. Cure rates between the pupils in the two treatment schedules were not significantly different from each other (p=0.178). Among those who received once-a-year treatment, clinical cure was observed in 58.3% of those with trichuriasis, while 28.6% showed clinical improvement. Five pupils manifested with clinical failure, while 6 others with clinical outcome indeterminate were noted. For those pupils who received twice-a-year treatment, clinical cure was observed in 55.2% of those pupils having the same infection while 29.9% had improved conditions. Eight pupils with clinical failure and 5 others with clinical outcome indeterminate were noted. Cure rates between the two treatment schedules were not significantly different from each other (p=0.667).

The ERR for those pupils with ascariasis at pre-treatment 3 were 93.1% using arithmetic mean egg counts and 97.6% using geometric mean egg counts. For those with trichuriasis, ERR was 88.1% using arithmetic mean egg counts and 98.5% using geometric mean egg counts.

The ERR for those pupils with ascariasis who received once-a-year treatment were 84.3% and 99.9% using arithmetic and geometric egg counts, respectively. For those pupils who received twice-a-year treatment and had the same infection, who belonged to the once-a-year group that had 30.7% and 50.6% of the pupils infected with *Ascaris* and *Trichuris*, respectively.

Reinfection rates were not found to be significantly different between pupils belonging to once versus twice yearly treatment schedules for both ascariasis (p=1.000) and trichuriasis (p=0.687). Reinfection rates for *Ascaris* among pupils who were assigned in once-a-year and twice-a-year treatment schedules were 33.3% and 45.0%, respectively. Reinfection rates for *Trichuris* were seen among 55.6% of the pupils assigned in the once-a-year treatment group and 63.4% of the pupils assigned in a twice-a-year treatment group. At pre-treatment, among pupils with a once-a-year treatment schedule, 1 out of 3 pupils were reinfected with Ascaris, while 5 out of 9 pupils were reinfected with *Trichuris*. Among pupils in the twice-a-year treatment schedule, 9 out of 20 pupils (45.0%) were reinfected with, while 26 out of 47 pupils (63.4%) were reinfected with *Trichuris*.

Overall, among those who received treatment in August 2000, clinical cure was observed in 73.9% of pupils with *Ascaris* while 18.9% showed clinical improvement. Two pupils with clinical failure and 6 others with clinical outcome indeterminate were noted. For those pupils with *Trichuris*, clinical cure was observed in 57.1% of pupils while 29.8% showed clinical improvement. Fourteen pupils with clinical failure and 13 others with clinical outcome indeterminate were noted.

Among those who received once-a-year treatment, clinical cure was observed in 70.6% of those with ascariasis, while 19.6% showed clinical improvement. One pupil with clinical failure and 4 others with clinical outcome indeterminate were noted. For those pupils who received twice-a-year treatment, clinical cure was observed in 76.8% of those pupils having the same infection, while 16.3% showed clinical improvement. One pupil with clinical failure and 2 others with clinical outcome indeterminate were noted. Cure rates between the pupils in the two treatment schedules were not significantly different from each other (p=0.178). Among those who received once-a-year treatment, clinical cure was observed in 58.3% of those with trichuriasis, while 28.6% showed clinical improvement. Five pupils manifested with clinical failure, while 6 others with clinical outcome indeterminate were noted. For those pupils who received twice-a-year treatment, clinical cure was observed in 55.2% of those pupils having the same infection while 29.9% had improved conditions. Eight pupils with clinical failure and 5 others with clinical outcome indeterminate were noted. Cure rates between the two treatment schedules were not significantly different from each other (p=0.667).

The ERR for those pupils with ascariasis at pre-treatment 3 were 93.1% using arithmetic mean egg counts and 97.6% using geometric mean egg counts. For those with trichuriasis, ERR was 88.1% using arithmetic mean egg counts and 98.5% using geometric mean egg counts.

The ERR for those pupils with ascariasis who received once-a-year treatment were 84.3% and 99.9% using arithmetic and geometric egg counts, respectively. For those pupils who received twice-a-year treatment and had the same infection, ERR were noted to be 97.2% and 99.9% with arithmetic and geometric egg counts, respectively. For those pupils with trichuriasis, ERR among pupils who received once-a-year treatment were 89.8% and 98.7% using arithmetic and geometric mean egg counts, respectively. For those pupils who received twice-a-year treatment and had the same infection, ERR were noted to be 80.2% and 98.0% with arithmetic and geometric egg counts, respectively.

Efficacy Analysis

The number of pupils satisfying the criteria for efficacy analysis was 244 with 123 pupils randomized to the once-a-year treatment schedule and 121 pupils to the twice-a-year treatment schedule. With comparison of pre-treatment infection rates (Days 0 and 180), of 244 pupils considered, 194 (79.5%) were positive for at least one infection at Day 0. At Day 180, the positivity rate was 52.9% (129/244) which was significantly lower than the baseline positivity. (McNemar Chi-square = 50.9, $p<0.01$). The overall trend in terms of infection rates in the two treatment schedules was found to have slight significant difference ($p=0.055$), with a marked difference observed at Day 187-194 (Table 3).

The overall trend in terms of Ascaris infection in the two treatment schedules was found to have significant difference ($p=0.048$) where infection rates in pupils in the twice yearly treatment schedule was significantly lower than those in the once yearly treatment schedule beginning at Day 194 onwards. The overall trend in terms of *Trichuris* infection in the two treatment schedules was not significantly different ($p=0.097$) (Table 4).

As for the overall trend of *Ascaris* egg counts, repeated measures analysis of variance of transformed data showed that there was significant interaction between time effect and treatment schedule effect on log egg counts ($p=0.04$). Test of contrasts showed the time periods when a significant difference between the two treatment schedules was seen. The test of contrasts showed that the change in the mean log egg counts from Day 0 to Day 194 in the twice yearly group is significantly higher compared to that of the once yearly group. There was an increase in mean log egg counts from Day 180 to Day 194 in the once yearly group while a decrease was observed in the twice yearly group. In both treatment schedules, there was an observed increase in the mean log egg count from Day 194 to Day 360, but the increase was not statistically significant. The mean log egg counts at Day 360 were lower than at baseline in both treatment schedules, but the decrease in the twice yearly group was significantly greater compared to the once yearly group (Tables 5 and 6).

As for the overall trend of *Trichuris* egg counts, repeated measures analysis of variance of transformed data showed that there was significant interaction between time effect and treatment schedule effect on log egg counts ($p=0.01$). Test of contrasts showed the time periods when a significant difference in the two treatment schedules. The test of contrasts showed that the difference in the mean log egg counts at Day 194 and mean log egg counts in other follow-up periods in

Table 3. Overall trend of infection rates SVES, Biñan, Laguna
Days 0 to 374

Treatment group	Day 0	Day 7	Day 180	Day 194	Day 360	Day 374
Once-a-year (n=123)	95 (77.2%)	70 (56.9%)	68 (55.3%)	68 (55.3%)	69 (56.1%)	32 (26.0%)
Twice-a-year (n=121)	99 (81.8%)	59 (48.8%)	61 (50.4%)	33 (27.3%)	57 (47.1%)	27 (22.3%)

Table 4. Overall trend of *Ascaris* and *Trichuris* infection rates SVES, Biñan, Laguna
Days 0 to 374

Treatment group	Parasite	Day 0	Day 7	Day 180	Day 194	Day 360	Day 374
Once-a-year	*Ascaris*	48 (39.0%)	37 (30.1%)	15 (12.2%)	19 (15.4%)	36 (29.3%)	11 (8.9%)
(n=123)	*Trichuris*	87 (70.7%)	55 (44.7%)	63 (51.2%)	61 (50.0%)	58 (47.2%)	25 (20.3%)
Twice-a-year	*Ascaris*	52 (43.0%)	25 (20.7%)	12 (9.9%)	6 (5.0%)	22 (18.2%)	5 (4.1%)
(n=121)	*Trichuris*	85 (70.2%)	47 (38.8%)	56 (46.3%)	30 (24.8%)	49 (40.5%)	23 (19.0%)

Table 5. Arithmetic and Geometric mean* *Ascaris* and Trichuris egg counts over time SVES, Biñan, Laguna Days 0 to 374

Treatment group	Parasite	Day 0	Day 7	Day 180	Day 194	Day 360	Day 374
Once-a-year (n=123)	*Ascaris*	13000.9 (21.51)	2037.1 (5.50)	1307.7 (1.66)	2290.9 (2.77)	5512.6 (11.81)	1110.9 (0.92)
	Trichuris	1763.6 (116.2)	199.8 (7.3)	413.5 (20.0)	393.6 (18.8)	329.4 (14.6)	50.0 (1.6)
Twice-a-year (n=121)	*Ascaris*	10634.4 (27.22)	904.3 (2.21)	604.0 (1.10)	114.8 (0.36)	2836.4 (3.14)	54.9 (0.34)
	Trichuris	1975.7 (112.4)	176.3 (5.8)	446.7 (15.5)	85.9 (2.6)	273.1 (9.9)	44.4 (1.4)

*Arithmetic mean (Geometric mean)

Table 6. Overall trend of mean log *Ascaris* and *Trichuris* egg counts SVES, Biñan, Laguna Days 0 to 374

Treatment group	Parasite	Day 0	Day 7	Day 180	Day 194	Day 360	Day 374
Once-a-year (n=123)	*Ascaris*	3.11	1.87	0.98	1.33	2.55	0.65
	Trichuris	4.76	2.11	3.04	2.99	2.75	0.96
Twice-a-year (n=121)	*Ascaris*	3.34	1.16	0.74	0.31	1.42	0.29
	Trichuris	4.73	1.92	2.80	1.28	2.39	0.88

the once yearly group is significantly different from that in the twice yearly group. The change in the mean log egg counts from Day 0 to Day 194 in the twice yearly group is significantly higher compared to that in the once yearly group. The mean log egg count increased from Day 7 to Day 194 while the mean log egg count decreased in the twice yearly group. The mean log egg counts from Day 194 to Day 374 dropped in both treatment schedules, but the decrease was greater in the once yearly group (Tables 5 and 6).

DISCUSSION

This study has illustrated the development and testing of a model for school-based control of intestinal helminths utilizing existing school infrastructure in the delivery of mass treatment and health education. Crucial to the success of such an undertaking was the partnership that was forged between the project team and the schoolteachers under the guidance of school officials, among them, the District Supervisor, the School Prinicipal, and the Department of Education (DepEd) Medical Officer. The project team initiated the building of ties with the local government officials. Although the municipal and barangay officials were represented in major events, the fruits of the relationship among such officials remained to be seen up to the time of closing of the project.

Acceptability of the mass treatment concept was shown by this study to be excellent which gives promise that teachers, parents and children may subscribe to and actually participate in mass deworming programs in the school. The necessary ingredients were proven to be adequate information dissemination and health education that aimed to correct misconceptions which led to unwise decisions in the past. Regular feedback of results and progress of the mass deworming campaign to the teachers and parents also may have contributed to sustaining interest in the program.

Possible areas of focus in terms of health education and promotion may have to be considered when initiating mass deworming programs in the school. For schoolteachers, their important role in the mass treatment process and health education must be emphasized. For parents, attempts to correct misinformation should be made in order to make possible an enlightened decision to allow their children to participate. For pupils, the ease of taking deworming drugs, their pleasant taste and the wonders of eliminating worms from their system are important issues to consider. In all, basic information on intestinal helminths, their modes of transmission, clinical manifestations, complications, treatment and control will be prerequisites of a good understanding of the problem and a wise decision making.

Morbidity is directly related to worm burden. The greater the number of worms in an infected person, the greater will be the morbidity caused by the worm. Helminth infection and disease adversely affect child growth and development, nutritional status and cognitive capacity. These effects have also been shown to be proportionally associated with worm burden.

The first objective of a control program is to reduce morbidity. This is done by reducing the proportion of heavily infected individuals in the target population. Heavily infected individuals suffer most of the clinical consequences of the infections and are the major sources of infection for the rest of the community, although their proportion in the community may be small. Lightly infected individuals have minimal health consequences.

Although a majority of schoolchildren monitored in this study had light to moderate intensities of infection, infection rates were nonetheless high which meant that the proportion of infected individuals or reservoirs was high. This could probably be explained by long-standing high transmission due to high prevalence of infections in a background of poor environmental sanitation. There was a need therefore to aim for reductions of worm prevalence through mass treatment which was the subject of this research and intervention initiative.

Chemotherapy, health education and improvements in sanitation are the major components of an intestinal helminth control program. Chemotherapy is aimed at reducing worm burden and decreasing transmission. Health education is aimed at encouraging healthy behavior. Lastly, improvements in sanitation are aimed at reducing soil or water contamination.

Mass chemotherapy was the primary component of this project. Mass treatment is recommended in areas where more than 50% of the population are infected with soil-transmitted helminths. Mebendazole is one of only a few drugs that are recommended by WHO for treatment. These safe and effective drugs have been used widely in the past several years. Mebendazole was given as mass or targeted treatment aiming to cover the highest percentage of target individuals like school children, one of the main high-risk groups in the community. Targeted treatment is the strategy which is recommended in areas where prevalence is high and where intensity is noted to be light. Such an area is typified by San Vicente Elementary School.

Crucial to mass or targeted treatment will be issues of coverage and frequency. The higher the coverage, the higher is the likelihood of being able to eliminate more worms, thereby reducing as much morbidity as possible. Although the efficacy of the measure is higher if the whole target population is treated simultaneously, there may be a need to determine the ideal or minimum coverage that will result in a significant reduction of worm burden. Frequency is another important issue related to chemotherapy. Mass treatment given two to three times per year may be necessary in areas where high intensities of infections exist. In this study, the benefits of targeted mass treatment given two times a year has been shown to be superior over once-a-year treatment. In the future, attention may be given to operational research that will help to determine ideal treatment intervals, frequency and end point of treatment as well to explore age-targeting and other related issues.

Health education may have proven to be an important component of this study. In areas where targeted or mass treatment will be implemented, submission to treatment and monitoring will be necessary to ensure the success of the control program. The community preparation through meetings with school and local officials as well as with parents and guardians may have proven to be beneficial in attaining high consent rates and treatment coverage. The schoolteachers proved to be essential partners in this undertaking. From securing consent from parents and guardians, sharing important information that would correct misconceptions, helping with administration and inventory of drugs as well as recording treatment accomplishments per class, the schoolteachers surely provided invaluable services that helped to ensure desirable outcomes. Their innate creativity in the teaching-learning process should be maximized to help in the delivery of important messages that in turn will lead to right decision making and submission to treatment.

Among the components of an intestinal helminth control program, improvements in sanitation may be the most difficult to accomplish since poor socioeconomic conditions may be a limiting factor in achieving such improvements. Families, however, can be important resources that may help improve sanitation and reinforce school education activities. Improved sanitation, including proper disposal of human waste, provision of safe water supplies, and personal and food hygiene greatly contributes to reduction of diseases spread through human feces.

Control programs are designed to reduce worm burdens. Children will become reinfected, but they will have much less worms for longer periods throughout the year if periodic mass treatment will be continued. In the short-term and long-term, periodic mass treatment will have a positive effect on their health.

School-based intestinal helminth control programs show enough promise for reducing morbidity and transmission. To date, a number of countries have initiated such programs that have offered opportunities for improvement of the quality of life of school children. Results of a number of operational researches have shown advancement in knowledge in terms of the type of interventions to be administered, the frequency of application of intervention, the logistic and financial support required, and the collaborations and partnerships that lead to successful implementation and sustainability of the intestinal helminth control program.

The school system in developing countries may provide an efficient means of reducing health problems that are caused by helminth infections. Schools may be able to help in the delivery of interventions with potentially sustainable results. In most communities, there are more schools than health centers and more teachers than nurses. Teachers may play an important role as health educators and as facilitator of community actions to improve sanitary conditions.

Helminth control interventions in schools may benefit the entire community. Children with heavy worm infections are more likely to contaminate the environment, thus increasing the risk of transmission to others. Effective worm control efforts in the schools can help reduce the spread of helminth infections within the community. Indeed, repeated treatments involving the most heavily infected like the pre-school and school-age children have helped to lower the prevalence of soil-transmitted helminth infections in the whole community. In addition, health education provided to the children on intestinal helminths may also serve as a means to inform families and other community members about ways to reduce helminth infections and prevent reinfections.

This study, probably the first well-monitored school-based intestinal helminth control program in the Philippines, has attempted to document the impact of this program in terms of standard indicators. The results of this undertaking will certainly help in guiding current and future practice as well as future applications and research. It is most beneficial to document milestones and lessons learned including problems encountered and possible approaches to these.

In a study area with an epidemiologic situation like SVES, twice yearly deworming has been shown to be superior to once yearly deworming. The questions that remained to be answered are: in the future, how frequent and up to when? Monitoring may help to answer these two important issues that need to be settled. The project team recommends limited monitoring as recommended by the WHO that will consider selection of from 40 to 50 pupils in the third grade to be monitored during pre-treatment periods over a few years. The parasitologic status of this indicator group of pupils will provide a "window" through which policy- and decision-makers will be able to appreciate progress of the mass deworming program. Significantly lowered infection rates and intensities of infection may signal the need to decrease the frequency of mass deworming to once a year, and later to shift to selective treatment.

The WHO sees monitoring as an integral part of control programs themselves. This will be essential in ensuring that programs are run effectively and efficiently by health and school authorities and that maximal benefit is attained by infected individuals, their families and their communities (WHO, 1999).

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