SCHOOL-BASED CONTROL OF SOIL-TRANSMITTED HELMINTHIASIS IN WESTERN VISAYAS, PHILIPPINES

VY Belizario, FIG Totañes, WU de Leon and KMH Matias

National Institutes of Health, University of the Philippines Manila, Manila, Philippines

Abstract. We evaluated the effect of a local government unit-led, school-based, teacher-assisted mass drug administration (MDA) treatment of soil-transmitted helminthiasis (STH) on the morbidity of school children in selected provinces of western Visayas, the Philippines. Parasitological assessment was done on stool samples using the Kato-Katz technique. Nutritional status and school performance were also evaluated using secondary data from the Department of Education. The overall prevalence of STH decreased from 71.1% to 44.3% (p<0.0001) and the prevalence of heavy infection with STH decreased from 40.5% to 14.5% (p<0.0001), after two years of biannual MDA. The prevalence of underweight children decreased from 26.2% to 17.8% (p<0.0001) and the prevalence of stunted children decreased from 20.9% to 16.6% (p<0.0001) after two years of biannual MDA. School performance improved on standardized testing from a mean percentage of 53.8% to 64.6%. Advocacy, social mobilization, strong local government support and intersectoral collaboration with other agencies probably contributed to the success of the program.

Keywords: integrated helminth control program, mass drug administration, neglected tropical disease, preventive chemotherapy, school-based deworming, soil-transmitted helminthiasis

INTRODUCTION

Soil-transmitted helminthes (STH) infections caused by *Ascaris lumbricoides* (roundworm), *Trichuris trichiura* (whipworm) and hookworm are among the most prevalent infections in developing countries where there is poverty, inadequate sanitation facilities, unsafe water supply and indiscriminate defecation (Ulukanligil and Seyrek, 2003; DOH, 2006; Ostan *et al,* 2007). Approximately 2 billion people are affected by STH worldwide (WHO, 2006). Children are at high risk for STH infections which can cause poor appetite, growth stunting, decreased physical activity, anemia, and poor mental development affecting school performance (Easton, 1999; Crompton and Nesheim, 2002; The Henry J Kaiser Family Foundation, 2009).

A nationwide survey conducted in 2003 in the Philippines revealed 66% of preschool children had STH infections, with more than 70% being infected in the western Visayas (de Leon W Lumampao V. Final report submitted to UNICEF, 2005). In another study involving elementary school children at selected sites in Luzon, the Visayas, and Mindanao, the cumulative

Correspondence: Vicente Y Belizario, National Institutes of Health, University of the Philippines Manila, 623 Pedro Gil Street, Ermita, Manila, 1000 Philippines.
Tel/Fax: (632) 525 0395
E-mail: vbelizar@yahoo.com

prevalence for at least one type of STH infection was 67% (Belizario *et al*, 2005). In response to this public health problem, the Department of Health (DOH) developed the Integrated Helminth Control Program (IHCP), providing implementation guidelines for the control of STH and other helminth infections in the Philippines. The IHCP has recommended biannual mass drug administration (MDA) of school children with albendazole or mebendazole in communities with a STH prevalence >50% (DOH, 2006). The WHO recommends MDA as a main strategy for STH and its morbidity control (WHO, 2006). MDA has been shown to improve a child's nutritional status and motor and language development (Stoltzfus *et al*, 2004; Disease Control Project Priorities, 2008). School-based MDA is commonly performed but the low ratio of school nurses to students makes this a challenge. There is a need to improve drug distribution to improve outcomes.

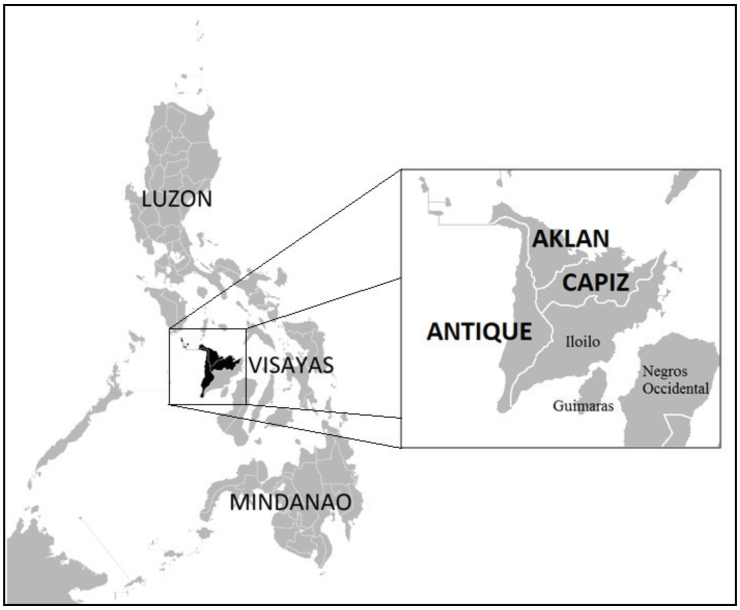

Fig 1–Map of the Philippines showing study sites.

Johnson & Johnson Pharmaceuticals Philippines, Inc, and Janssen Pharmaceuticals Philippines, Inc initiated the Mebendazole Donation Program in the Philippines, providing free anthelminthics to treat all public elementary school children in selected provinces in the western Visayas. Advocacy and social mobilization were initiated to ensure local government support and collaboration with health and educational agencies. School-based, teacher-assisted biannual MDA was employed. We evaluated the parasitological, nutritional, and school performance of public elementary school children treated with this program in three provinces in the western Visayas to determine the efficacy of this program.

MATERIALS AND METHODS

Study area and population

Aklan, Antique, and Capiz Provinces in the western Visayas region of the Philippines (Fig 1) were treated with MDA program because: a) not all the provinces were covered by the National Filariasis Elimination Program (NFEP); b) the above provinces had a cumulative prevalence of STH of ≥50%; c) the prevalence of underweight and stunted children in these provinces was ≥35%; d) the provinces were priority provinces for the Food-for-School Program (FSP) of the Department of Education (DepEd); e) these provinces had a history of an inadequate supply of drugs for MDA; f) the population of elementary school children in these provinces was ≤300,000.

The FSP is a hunger-mitigation initiative launched in 2005 through the Health and Nutrition Center (HNC) of the DepEd where school children are given one kilogram of rice per day for the 95 school days per year (Manasan and Cuenca, 2007; DepEd, 2010).

Two school districts from each province were randomly selected for the study. Four or five public elementary schools were selected from each district. Approximately 50 grade three students were chosen from each selected school for parasitological monitoring. A sample size of 200-250 children per district was chosen based on WHO guidelines for monitoring helminth control programs (Montresor *et al*, 1998).

Parasitological assessment

Stool samples were collected and examined at a field laboratory the same day using the Kato-Katz method (WHO, 1994). Ten percent of the slides were re-examined by a blinded reference microscopist from the University of the Philippines Manila-National Institutes of Health (UPM-NIH) for quality control.

The prevalence and intensity of STH infections were determined. STH, reduction rates were calculated as follows:

$$\text{Percent reduction in STH infections} = \frac{p_2 - p_1}{p_1} \times 100\%$$

Where: p_2 was the follow-up prevalence and p_1 was the baseline prevalence.

The intensity of infection was determined in eggs per gram (epg) of stool and classified as light, moderate, or heavy following WHO classifications (Montresor *et al*, 1998). The geometric mean egg count (GMEC) was calculated with Microsoft Excel 2007 (Montresor *et al*, 1998) as follows:

$$GMEC = \exp\left[\frac{\sum\log(c+1)}{n}\right] - 1$$

Where: c was the individual egg count and n was the total number of samples.

Moderate and heavy infections were both classified as a heavy infection (Montresor *et al*, 1998). The results were double entered into Microsoft Excel. The chi-square test was used to determine differences among the survey periods. Significance was set at $p<0.05$.

MDA in the study area is conducted every January and July. A baseline parasitological survey was conducted in October 2007, three months after MDA in July 2007. The first and second follow-up parasitological surveys were conducted in November 2008 and November 2009, respectively. Mebendazole 500 mg chewable tablets were given to each of the elementary public school children (with parental consent) in the three provinces by trained teachers, supervised by school and local health unit staff.

Nutritional status assessment

Nutritional data were obtained from the DepEd Western Visayas Regional Office. The height and weight of the school children were measured by the school nurses at the beginning of the academic year and used to calculate nutritional status based on weight-for-age (WFA) and height-for-age (HFA). The values were classified as below normal, normal, and above normal by the DepEd using an international reference standard (IRS). Values from the 2007-2008 school year (SY) were used as baseline data, to compare with SY 2008-2009 and SY 2009-2010.

School performance assessment

School performance was determined with the National Achievement Test (NAT) administered annually by the National Educational Testing and Research Center (NETRC). The mean percentage score (MPS) (items answered correctly) (Department of Education, 2008) was

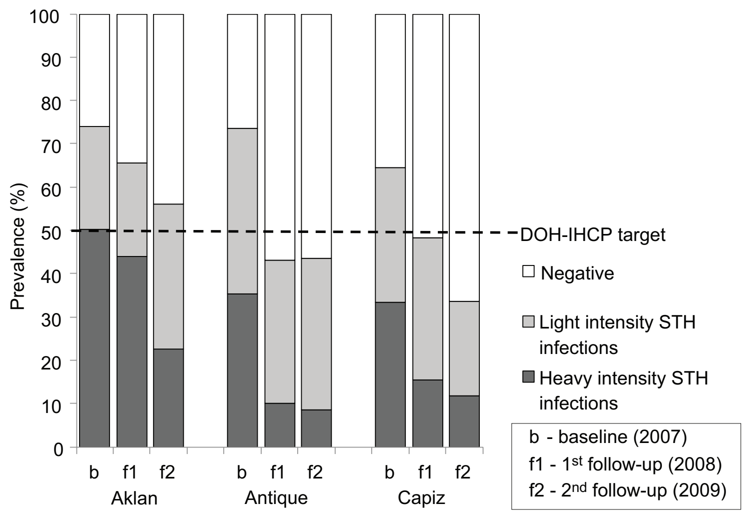

Fig 2–Total STH prevalence and prevalence of heavy intensity infections in selected provinces in western Visayas, the Philippines during the three survey periods (2007-2009). DoH-1 HCPD, Department of Health-Intergrated Helminth Control Program; STH, soil transmitted helminthes.

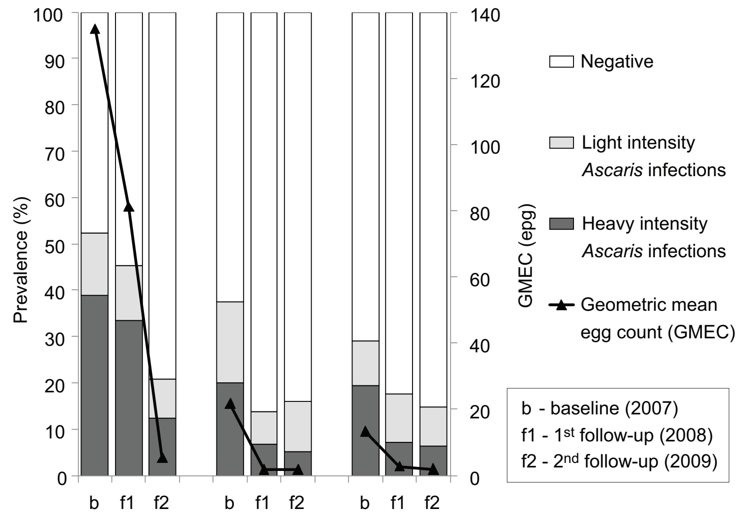

Fig 3–*Ascaris* prevalence and proportion of heavy intensity infections in selected provinces in western Visayas, the Philippines during the three survey periods (2007-2009).

compared with the national target of at least 75% (Benito, 2011).

Ethical considerations

The study followed established ethical guidelines for the protection of human subjects. Confidentiality was maintained through replacement of participant identifiers with codes. Only authorized personnel from the research team were allowed access to the results. With regard to treatment of identified cases, all school-age children, whether examined or not, received mebendazole in line with the MDA mandated by the IHCP. This study was funded by Johnson & Johnson/Janssen Pharmaceuticals.

RESULTS

Baseline and follow-up parasitological assessments

A total of 1,230, 1,349 and 1,211 subjects submitted stool specimens at baseline and at the first and second follow-up assessments, respectively. The prevalences of STH at baseline and at the first and second follow-up assessments were 71.1%, 52.3% and 44.3%, respectively. The prevalence of STH infections decreased by 26.4% (p<0.0001) after two rounds of treatment and 37.7% after four rounds of treatment (p<0.0001). The prevalence of heavy infections was 40.5% at baseline, 22.5% (p<0.0001)

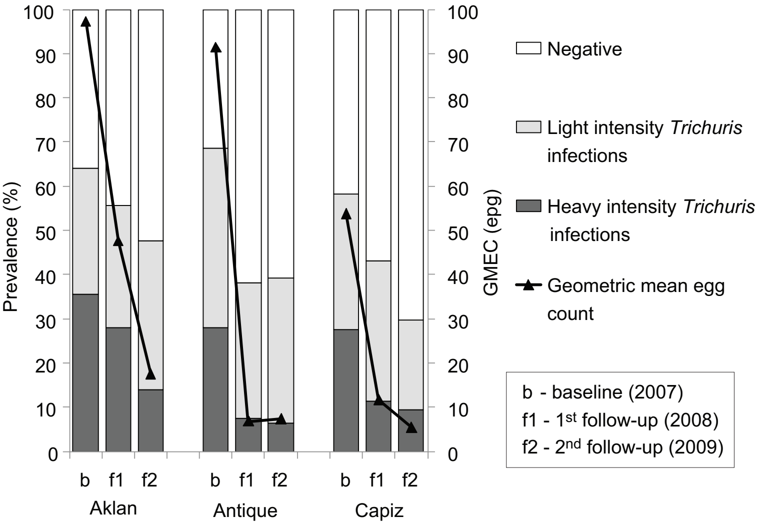

Fig 4–*Trichuris* prevalence and proportion of heavy intensity infections in selected provinces in western Visayas, the Philippines during the three survey periods (2007-2009).

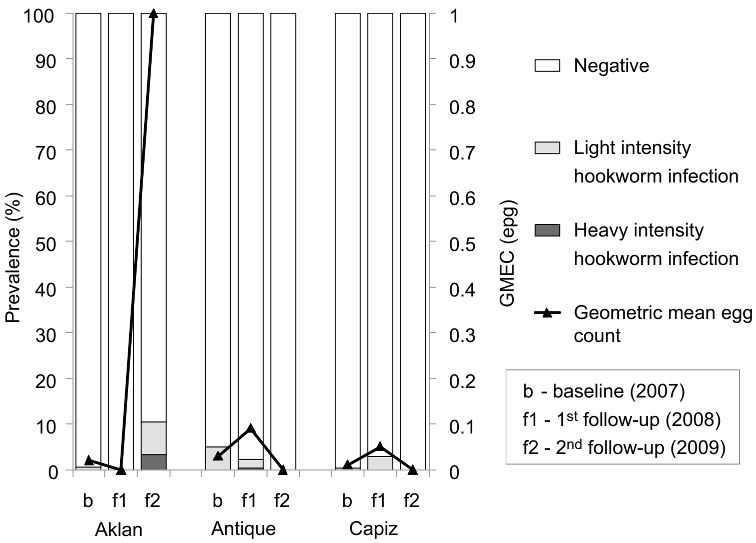

Fig 5–Hookworm prevalence and proportion of heavy intensity infections in selected provinces in western Visayas, the Philippines during the three survey periods (2007-2009).

at the first assessment, and 14.5% at the second assessment giving an overall heavy infection reduction rate of 64.2% (Table 1; Fig 2).

The prevalences of *Ascaris* and *Trichuris* decreased significantly (p<0.001) from baseline to the second assessment. The prevalences of heavy infections with *Ascaris* and *Trichuris* also decreased significantly (p<0.0001) during the study period. However, the prevalence of hookworm did not decrease; in fact it increased between the first and second follow-up assessments (Tables 2-4; Figs 3-5).

The quality control assessment revealed the sensitivity and specificity ranges for detecting STH were 70.4-89.1% and 82.4-93.5%, respectively.

Nutritional assessment

The overall prevalences of underweight school children at baseline, the first and second assessments were 26.2%, 26.2% and 17.8%, respectively (Table 5) and the overall prevalences of stunted school children were 20.9%, 25.1%, and 16.6%, respectively. The mean WFA and HFA levels significantly improved (p<0.0001) between baseline and the second assessment in Akland and Capiz Provinces but in Antique the mean levels worsened (Table 6).

Table 1
Overall STH prevalence and prevalence of heavy intensity STH infections in the study area during 2007-2009.

Parasitological parameters	Aklan			Antique			Capiz			Overall		
	B[a]	F_1[b]	F_2[c]	B	F_1	F_2	B	F_1	F_2	B	F_1	F_2
Total no. of stool specimens examined	476	430	418	397	390	372	357	529	421	1,230	1,349	1,211
Total no. of STH infections (%)	352 (73.9)	282 (65.6)	234 (56.0)	292 (73.6)	168 (43.1)	162 (43.5)	230 (64.4)	255 (48.2)	141 (33.5)	874 (71.1)	705 (52.3)	537 (44.3)
Total no. of heavy intensity STH infections (%)	239 (50.2)	189 (44.0)	94 (22.5)	140 (35.3)	39 (10.0)	32 (8.6)	119 (33.3)	82 (15.5)	50 (11.9)	498 (40.5)	303 (22.5)	176 (14.5)

[a]Baseline; [b]First follow-up; [c]Second follow-up; STH, soil transmitted helminthes.

Table 2
Prevalence of *Ascaris* infections and heavy intensity infections in the study area during 2007-2009.

Parasitological parameters	Aklan			Antique			Capiz			Overall		
	B	F_1	F_2	B	F_1	F_2	B	F_1	F_2	B	F_1	F_2
Total no. of stool specimens examined	476	430	418	397	390	372	357	529	421	1,230	1,349	1,211
Total no. of *Ascaris* infections (%)	249 (52.3)	195 (45.3)	87 (20.8)	149 (37.5)	54 (13.8)	59 (15.9)	104 (29.1)	93 (17.6)	62 (14.7)	502 (40.8)	342 (25.4)	208 (17.2)
Total no. of heavy intensity *Ascaris* infections (%)	185 (38.9)	144 (33.5)	52 (12.4)	79 (20.0)	26 (6.7)	19 (5.1)	69 (19.3)	38 (7.1)	27 (6.4)	333 (27.1)	208 (15.4)	98 (8.1)
GMEC (in EPG)	135.0	81.3	5.4	21.9	2.0	1.9	13.3	2.8	2.1	17.4	8.5	2.9

GMEC, geometric mean egg count; EPG, eggs per gram.

Table 3
Prevalence of *Trichuris* infections and heavy intensity infections in the study area during 2007-2009.

Parasitological parameters	Aklan			Antique			Capiz			Overall		
	B	F_1	F_2	B	F_1	F_2	B	F_1	F_2	B	F_1	F_2
Total no. of stool specimens examined	476	430	418	397	390	372	357	529	421	1,230	1,349	1,211
Total no. of *Trichuris* infections (%)	305 (64.1)	239 (55.6)	199 (47.6)	272 (68.5)	149 (38.2)	146 (39.2)	208 (58.3)	228 (43.1)	125 (29.7)	785 (63.8)	616 (45.7)	470 (38.8)
Total no. of heavy intensity *Trichuris* infections (%)	169 (35.5)	121 (28.1)	58 (13.9)	111 (28.0)	29 (7.4)	24 (6.5)	98 (27.5)	60 (11.3)	40 (9.5)	378 (30.7)	210 (15.6)	122 (10.1)
GMEC (in EPG)	97.3	47.6	17.5	91.4	6.8	7.3	53.7	11.6	5.5	24.4	15.9	9.1

GMEC, geometric mean egg count; EPG, eggs per gram.

Table 4
Prevalence of hookworm infections and heavy intensity infections in the study area during 2007-2009.

Parasitological parameters	Aklan			Antique			Capiz			Overall		
	B	F_1	F_2	B	F_1	F_2	B	F_1	F_2	B	F_1	F_2
Total no. of stool specimens examined	476	430	418	397	390	372	357	529	421	1,230	1,349	1,211
Total no. of hookworm infections examined by Kato Katz	3 (0.6)	0 (0.0)	44 (10.5)	20 (5.0)	9 (2.3)	0 (0.0)	1 (0.3)	16 (3.0)	0 (0.0)	24 (2.0)	25 (1.9)	44 (3.6)
Total no. of heavy intensity hookworm infections (%)	0 (0.0)	0 (0.0)	14(3.3)	0 (0.0)	2 (0.5)	n/a	0 (0.0)	0 (0.0)	n/a	0 (0.0)	2 (0.1)	14 (1.6)
GMEC (in EPG)	0.02	0.00	1.0	0.03	0.09	0.0	0.01	0.05	0.0	0.1	0.04	0.3

GMEC, geometric mean egg count; EPG, eggs per gram.

Table 5
Prevalence of underweight school children in selected provinces in western Visayas, the Philippines (SY 2007-2008 to SY 2009-2010)[a].

Province	Below normal WFA/BMI								
	SY 2007-2008			SY 2008-2009			SY 2009-2010		
	Total measured	No.	%	Total measured	No.	%	Total measured	No.	%
Aklan	83,032	17,105	20.6	82,976	15,871	19.1	76,003	12,856	16.9
Antique	78,943	21,250	26.9	81,451	26,595	32.7	75,995	23,687	31.2
Capiz	81,248	25,293	31.1	88,670	23,846	26.9	81,965	5,052	6.2
Overall	243,223	63,648	26.2	253,097	66,312	26.2	233,963	41,595	17.8

[a]Adapted from reports entitled "Consolidated regional nutritional status record per grade level" for SY 2007-2008, SY 2008-2009 and SY 2009-2010 by Department of Education Western Visayas Regional Office. SY, school year.

Table 6
Prevalence of stunted school children in selected provinces in western Visayas, the Philippines (SY 2007-2008 to SY 2009-2010)[a].

Province	Below normal HFA								
	SY 2007-2008			SY 2008-2009			SY 2009-2010		
	Total measured	No.	%	Total measured	No.	%	Total measured	No.	%
Aklan	60,382	13,385	22.2	60,213	13,075	21.7	55,172	10,048	18.2
Antique	62,503	8,936	14.3	48,158	13,892	28.8	46,653	14,033	30.1
Capiz	53,313	14,508	27.2	57,338	14,651	25.6	57,886	2,411	4.2
Overall	176,198	36,829	20.9	165,709	41,618	25.1	159,711	26,492	16.6

[a]Adapted from reports entitled "Consolidated regional nutritional status record per grade level" by Department of Education Western Visayas Regional Office (2008-2010). SY, school year.

Table 7
National Achievement Test Mean Percentage Scores of school children in the selected provinces in western Visayas, the Philippines (SY 2006-2007 to SY 2008-2009)[a].

Province	SY 2006-2007	SY 2007-2008	SY 2008-2009
Aklan	59.5	60.0	62.1
Antique	55.7	61.0	62.9
Capiz	61.1	64.3	69.3

[a] Adapted from results of National Achievement Test results by National Educational Testing and Research Center (2007-2009). SY, school year.

School performance

The mean MPS on the NAT increased between baseline and the second assessment by 8.2%, 7.2% and 2.6% in Capiz, Antique and Aklan, respectively, but non of the provinces reached the target score of 75% (Table 7).

DISCUSSION

Poor environmental sanitation and hygiene practices and low drug coverage, probably explain the high prevalence and intensity of infection at baseline in our study. The prevalence rates are comparable to another study among elementary school children on Luzon, the Visayas, and Mindanao (Belizario *et al*, 2005). School-based deworming, has not been fully rolled out since the program started in 2006 (DOH, 2006). We found a significant overall reduction in the prevalence of STH infections and prevalence of heavy infections during the study period. The overall prevalence of STH infections in our study was lower than that reported for the Negros Occidental Province (60.9%) (Belizario VY *et al*, Report submitted to UNESCO, 2010). After MDA, the prevalence of heavy intensity STH infections in our study (19.7%) was lower than that in Negros Occidental (35.0%); and only minimal reductions in the overall prevalence and prevalence of heavy intensity infections were observed in Negros Occidental and two other provinces (Belizario VY *et al*, Report submitted to UNESCO, 2010), in marked contrast to our results.

The overall MDA coverage rates in the three study sites in our study were greater than 75% during 2008 and 2009 (DepEd, 2008), meeting the WHO recommended coverage rate of at least 75 (Belizario *et al*, 2005). MDA is recommended for STH control among populations at risk (WHO, 2002). In areas where the prevalence of heavy intensity STH infection is still high, it is important to evaluate the coverage rate and factors that affect that rate. A recent study showed increased knowledge of the benefits of deworming can improve acceptability of MDA, influencing participation (Amarillo *et al*, 2008). Program monitoring and evaluation can confirm drug coverage and identify factors influencing that coverage, such as challenges in drug distribution, administration, recording, reporting and inventory. These factors are especially important in developing countries such as the Philippines.

The participation of local government units (LGUs) may also be an important factor for MDA coverage rates. In a country with a decentralized healthcare system, such as the Philippines, LGUs can encourage community participation and ensure sustainability of the program (Lumampao and David, 2003; Holveck *et al*, 2007). Partnerships were formed among the DepEd, DOH, and LGUs for the pharmaceutical company Mebendazole Donation Program. Defining the objectives of the program and responsibilities of stakeholders strengthened the local health care systems in the three studied provinces. The donation program has ended in those three provinces but the anthelminthic drugs are still needed if the MDA for STH is to continue. The funding parties need to be indentified. Antique and Capiz Provinces have approved resolutions to support the MDA for STH program. Local legislation can ensure budgetary support. LGU support for improvements in sanitation and provision of safe water are needed as part of the helminth control program.

The WHO recommends schools be the venue for MDA to insure efficient, cost-effective delivery of service (WHO, 2002). Schools have an existing infrastructure in close contact with the community, and a workforce that can assist in program delivery (Satoto *et al*, 2003). Teachers can be trained to deliver anthelminthic drugs to their students (Albonico *et al*, 2008). The cooperation of the DepEd was needed to use schools as a venue for MDA and parasitological monitoring in this study. Teachers participated in the distribution of anthelminthic medication to pupils under supervision of the school nurse. Challenges reported by teachers included not having parental consent to give the drug to their children. Household surveys, key informant interviews and focused group discussions, may identify reasons for lack of parental consent for MDA.

Although several factors affect nutritional status, helminthiasis is a cause of undernutrition (Zulkifi *et al*, 1999; Wambangco and Solon, 2004; Pullan and Brooker, 2008). Anorexia, chronic blood loss, and malabsorption, found even in light STH infections, may cause stunting (Easton, 1999). Nutritional status improved at the second follow-up in our study. The nutritional status parameters at all three periods in our study were better than those reported by the Food and Nutrition Research Institute in its National Nutrition Survey in 2008, where 25.6% of children aged 6-10 years were underweight and 33.1% were stunted (FNRI, 2009). The weight and height measurements were collected by several school nurses in various areas, which could be subject to inter-observer and instrument-to-instrument variability (Quizon A, 2010, personal communication).

Several studies have found an association between STH infections and poor cognitive performance (Nokes *et al*, 1992; Ezeamama *et al*, 2005). Treatment of STH has been shown to improve nutritional status and cognitive performance (O'Lorcain and Holland, 2000; Stoltzfus *et al*, 2004; DCPD, 2008). In our study, treatment of STH was associated with improved school performance. Since multiple factors influence cognitive performance, further studies need to explore this finding further.

The improvement in STH prevalence was aided by cooperation between the health and education sectors. This type of cooperation was not seen in a recent and sentinel survey (Belizario VY *et al*, Report submitted to UNICEF, 2010). The participation of teachers in MDA contributed to the success of the project. The high MDA coverage rate also contributed to the marked decrease in prevalence and intensity of STH infections in the study. The cooperative approach and favorable outcomes of this project have been noted by provincial authorities, leading to recognition in two of the three studied provinces of the efficacy of the STH control program. This recognition can lead to continuing support for STH control program (Belizario *et al*, 2006). Local legislation can help ensure continued local support for the control program. Efforts to improve environmental sanitation, clean water and health education can build on the benefits of MDA (Engels and Chitsulo, 2003). Program monitoring can identify effective practices and challenges to program implementation to improve success.

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