Acta Tropica 127 (2013) 112–117

Contents lists available at SciVerse ScienceDirect

Acta Tropica

journal homepage: www.elsevier.com/locate/actatropica

Monitoring the impact of a mebendazole mass drug administration initiative for soil-transmitted helminthiasis (STH) control in the Western Visayas Region of the Philippines from 2007 through 2011

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ARTICLE INFO

Article history:
Received 8 January 2013
Received in revised form 22 March 2013
Accepted 31 March 2013
Available online 8 April 2013

Keywords:
Helminthiasis
Soil transmitted helminth infection
Mass drug administration
Neglected tropical disease
Parasitemia

ABSTRACT

School-aged children in tropical developing countries carry the highest burden of soil-transmitted helminth (STH) infections in the world. The Western Visayas region of the Philippines continues to struggle with this as a major public health issue in both private and public schools. The War on Worms-Western Visayas approach was launched in 2007 with school-based mass drug administration (MDA) as one of the strategies to control morbidity from STH in support of the Department of Health – Integrated Helminth Control Program. This study aimed to determine trends in prevalence and intensity of STH infections as well as to assess related morbidity and program sustainability through 2011. A cross-sectional parasitologic survey was conducted on three independent samples of Grade 3 students in 2007, 2009, and 2011. Supporting aggregate data were obtained for MDA coverage, National Achievement Test mean percentage scores, and nutritional status. Tests for trend were utilized to detect changes in prevalence over time, with a particular emphasis on trends seen between 2009 and 2011. The initial impact of the program was robust as cumulative prevalence, infection intensities, and parasite densities were all reduced four years following the launch. However, subsequent and significant increases in each were found from 2009 until 2011. These results implicate issues with program sustainability, despite consistent MDA, and existing frameworks for environmental sanitation, hygiene, and education.

1. Introduction

1.1. Background

The World Health Organization (WHO) estimates 1–2 billion people suffer from soil-transmitted helminth (STH) infections worldwide (Silva et al., 2003; WHO, 2012). School-aged children 5–14 years bear the largest burden of disease (Bundy, 1995). Children are also far more susceptible to infection than adults with increased outdoor exposures (Belizario et al., 2007). Helminths causing STH infections are found in tropical and sub-tropical regions where climatic conditions are optimal for survival and transmission, particularly in rural areas (Montresor et al., 2008) *Ascaris lumbricoides*, *Trichuris trichiura*, and hookworms are responsible for the vast majority of infections globally; they commonly cause intestinal obstruction, abdominal pain and distension, anemia, and increased susceptibility to other infections (Bethony et al., 2006; Montresor et al., 1999). Eggs from each of these species can remain infectious and viable in the soil for years, illustrating the importance of sanitation and hygiene to interrupt transmission (Hotez et al., 2006).

Cognitive impairments among infected children may manifest, increasing school absences and decreasing school performance (Ezeamama et al., 2005; Miguel and Kremer, 2004). STH infections can also negatively impact nutrition as high worm burdens correlate with poor nutrition status (Belizario et al., 2009). Furthermore, the World Bank has deemed STH infection the leading disease with respect to loss of disability adjusted life years (DALYs) (World Bank, 1993). Methods for controlling STH vary somewhat based on the prevalence and endemicity of each helminth, but research has shown large-scale, school-based mass drug administration (MDA or deworming) programs to be effective. Regular deworming could

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http://dx.doi.org/10.1016/j.actatropica.2013.03.017

increase individual productivity and thus incomes by the time adulthood is reached as much as 40–45% according to previous studies (WHO, 2010, 2003).

In 2007, a school-based program in the Philippines with MDA as a primary strategy, referred to as "The War on Worms – Western Visayas (WOW–V)", was initiated in three Western Visayas provinces (Aklan, Antique, Capiz) and 6 corresponding municipalities (Banga, Kalibo, Pandan, San Jose, Panay, Roxas City) to reduce STH through bi-annual treatments of donated mebendazole. Follow-up monitoring evaluations occurred in 2009 and 2011; parasitologic monitoring survey details are presented in Table 1. The program was integrated directly within the school systems and operated by a largely collaborative partnership among the Department of Health (DOH), the Department of Education (DepEd), local government units (LGUs), and the University of the Philippines Manila – National Institutes of Health (UPM–NIH), Johnson and Johnson, Inc.

1.2. Program and study objectives

The overarching goal of WOW–V as part of DOH's Integrated Helminth Control Program (IHCP) was morbidity control, to be achieved by reducing cumulative prevalence to less than 50%, but with no established target for heavy intensity infections. On the other hand, the WHO recommends that in order to mitigate morbidity, an area must attain cumulative prevalence less than 20% as well as eliminate moderate/heavy infection intensities entirely through 0% prevalence. The WOW–V initiative also aimed for an increase in MDA that was sufficient to stimulate morbidity control, and improve National Achievement Test mean percentage score (NAT-MPS), and nutritional status results. The program additionally incorporated a component called WASHED (Water, Sanitation, Hygiene, Education, Deworming), to provide necessary access to clean water and improve sanitation through a zero open defecation policy, while promoting good hygiene, educational awareness, and deworming.

Study objectives included the evaluation of changes in STH prevalence and occurrence of moderate/heavy intensity infections across years during which the program was active. We hypothesized that prevalence declines following program initiation would co-occur with improvements in MDA coverage, mean test scores, and nutritional status.

2. Methods

2.1. Study design and population

This analysis summarizes data collected from 2007 through 2011 as part of the WOW–V initiative. Two general types of data were involved: individual-level parasitologic data collected by province and municipality as part of program evaluation, and aggregate data collected by administrative division as reported through the DepEd. Divisions corresponded to the provinces of Aklan, Antique, and Capiz, but also included separate results for Roxas City. Alternately, with respect to the parasitological data, Roxas City was considered a municipality within the Capiz province and contributed to overall Capiz totals.

Parasitologic monitoring via stool sample collection was conducted by the UPM–NIH team on approximately 3500 students enrolled in Grade 3 from 4 to 5 schools per district. Three independent samples were taken at baseline in October 2007 and just prior to the July drug administration time points in 2009 and 2011. Parasitologic assessment using Kato Katz method for stool examination, as described in the World Health Organization Bench Aids for the Diagnosis of Intestinal Parasites, was performed to determine the presence and intensity of STH infections (WHO, 1994). Kato Thick method, a qualitative technique for stool examination, was used when the quantity of the stool sample submitted was insufficient. Cumulative prevalence was collected dichotomously and defined by the presence or absence of any eggs using Kato Thick or Kato Katz results. Infection intensities were defined according to WHO thresholds for each helminth species based on eggs per gram (EPG); stool samples were categorized as having no infection or light, moderate, heavy infections (Montresor et al., 1998). For the purposes of the study, moderate and heavy intensity infections were referred to as heavy intensity infections. Hookworm presence was considered in detection of positive parasitemia, but not analyzed separately due to limited ability of Kato Katz tests to accurately detect hookworm counts (Tarafder et al., 2010). All infection intensity and parasite density analyses were limited to Kato Katz results for greater precision with respect to egg counts.

Aggregate-level or secondary data on MDA coverage, NAT-MPS, and nutritional status were collected periodically throughout WOW–V as reported by DepEd and collated by the UPM study team; only Grade 3 students were included in analysis for population comparability with parasitologic data. Drug administration was completed bi-annually (January and July) from the start of WOW–V in 2007 through 2011; at each time point, student participants were given a single dose of mebendazole 500 mg as a chewable flavored tablet (initially donated by Johnson and Johnson). MDA coverage rates were proportional as calculated by the number of children dewormed out of the number enrolled at each school, and compiled by school nurses following the teacher-assisted drug administration. DepEd administered the NATs, and the tests were scored to obtain overall means with standard deviations for each division. Nutritional status was also reported proportionally using data from the number of children weighed out of those enrolled. After 2009, nutritional status categories were revised and expanded as DepEd adopted the standard categories defined by WHO. To conduct across year comparisons in this study, data values collected in 2011 which were classified into the five new categories per WHO, were collapsed down to fit within the three broader categories initially utilized in 2007 and 2009 (e.g. below normal, normal, and above normal nutritional status).

2.2. Statistical analysis

Chi-square and the Cochran–Armitage test for trend were used to detect differences in categorical measures of prevalence

Table 1
Parasitologic monitoring sample sizes ($N = 3510$)[a].

Province Municipality	Aklan			Antique			Capiz		
	Banga	Kalibo	Total	Pandan	San Jose	Total	Panay	Roxas City	Total
2007 ($N = 1230$)	233	243	476	197	200	397	208	149	357
2009 ($N = 1243$)	216	214	430	234	138	372	217	224	441
2011 ($N = 1037$)	310	228	530	0[b]	0[b]	0[b]	225	274	499
			1444			769			1297

[a] Table includes both Kato Katz and Kato Thick tested samples; Kato Katz only, $N = 3432$.
[b] Children were dewormed prior to parasitologic monitoring, so 2011 results not reported.