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The Effectiveness of School-based and Community-based Deworming Methods in Primary School Children with Soil-transmitted Helminth Infection

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Abstract

OBJECTIVE: Soil-transmitted helminth (STH) infection remains a public health problem, especially children. Preventive chemotherapy for school-aged children with STH infection in 2012 had only reached half of the World Health Organization target. Therefore, mass drug administration by community-based deworming (CBD) could be a solution to achieve the target.

METHODS: A quasi-experimental study was the sample test in STH-infected primary school children at Suka Village, Indonesia. It was conducted from December 2016 to April 2017. A single dose 400 mg albendazole was given in both study groups. Effectiveness was assessed by Kato-Katz stool examination at the 1st and 3rd months after treatment.

RESULTS: We enrolled 257 children and divided into school-based deworming (SBD) and CBD group. SBD consisted of 123 children while CBD was 134 children group which divided based on a school cluster system. The prevalence of STH infection is 55.6% with the most common infection that is ascariasis in both groups. The uninfected children are 72.5% of SBD and 59.5% of CBD group. Reinfection was found in 31.8% of SBD and 54.1% of CBD group. There are no significant differences of worm eggs intensity before and after deworming in both groups ($P > 0.05$).

CONCLUSION: SBD found to be more effective compared to CBD in primary school children with STH infection in Suka village, Indonesia.

Introduction

Soil-transmitted helminth (STH) infection remains a public health problem. Chronic STH infection can lead to malnutrition, anemia, physical, and cognitive impairments in children especially for those who are living in developing countries with low levels of education, densely populated, poverty, inadequate water, and sanitation supplies and lack of access to health centers [1], [2]. STH infection is one of the neglected tropical diseases (NTD) that infects more than 1.45 billion people worldwide. More than 610 million children are at risk of STH infection, where school-aged children are as a high-risk group for this infection. Therefore, this is the target of deworming programs (school-based deworming [SBD]) [3], [4].

STH infection can be controlled by anthelmintic drugs on a mass scale, regardless of individual infection level (preventive chemotherapy). Preventive chemotherapy can be divided into three methods, which are mass drug administration (MDA), targeted prevention chemotherapy, and selective preventive chemotherapy [2]. In 2001, the World Health Assembly passed a resolution and warned states member to control the morbidity of STH infections through large-scale usage of anthelmintic drugs for school-aged children/SBD in underdeveloped countries [5].

The World Health Organization has agreed on a declaration in London about NTD in 2012 to scale up drug administration for STH infection, so 75% of school-aged children would be treated regularly by 2020. In fact, the achievement was only 37% in 2012. Therefore, MDA-based strategies with community-based deworming (CBD) methods are encouraged to achieve these targets [3], [6], [7].

The prevalence of STH infection in Indonesia's children is generally high, 60.7% in 2008 [8]. The efforts to eradicate the worms have been started since 1975 with SBD method. It succeeded in reducing the prevalence of helminth years ago, but now it is not [9]. A recent study of the impact of child deworming methods on STH transmission at the large community has been done in the past 5 years, which the study compared the effect of SBD methods with CBD [7], [10], [11]. The purpose of this study was to compare the effectiveness of SBD and CBD methods in school-aged children with STH infection.

Materials and Methods

Study design

This quasi-experimental study was conducted among school-aged children at four primary schools in Suka Village, Tiga Panah District, Karo Regency, North Sumatera Province, Indonesia, from December 2016 until April 2017.

Ethical approval

Ethical clearance was obtained from the Health Research Ethical Committee of Medical Faculty, Universitas Sumatera Utara, Indonesia. Prior the study starting, written informed consent was obtained from the parents or legal guardians and assent from the participating children above 7 years old.

Study sample and procedures

Primary school children with single or mixed-infection from *Ascaris lumbricoides*, *Trichuris trichiura*, or Hookworm from Kato-Katz examination were included as the study subjects. Exclusion criteria for this study were unable to follow the study procedure, taking anthelmintic less than a month before and during the study, and children with family members or newcomers living in the same house <6 months for CBD group. Primary school children who fulfilled inclusion and exclusion criteria were divided into two groups, SBD and CBD groups. The minimum sample size was using a hypothesis test of two unpaired groups, with a 95% significance level and 90% strength. A structure questionnaire was collected the sociodemographic characteristics such as age, sex, level of education of the parents, and socioeconomic status.

Single-dose 400 mg albendazole was administered in SBD as well as CBD group. In CBD group, three household members who are not enrolled in school will receive a single dose of 400 mg albendazole indirectly. Effectiveness of the cure rate was assessed by comparing the result of stool examination with Kato-Katz technique after a month of treatment and reinfection after 3 months in both groups.

Statistical analysis

Data were processed with computerized Statistical Package for Social Sciences for Windows (SPSS) version 15, with a 95% confidence interval and significance level $P < 0.05$. Chi-square test was used to assess the effectiveness and reinfection of deworming method. A dependent *t*-test was used to assess the differences in the intensity of infection before and after intervention in both groups. Independent *t*-test was used to assess the mean difference of decreasing intensity of worm eggs in both groups.

Results

Stool examination was conducted in 511 primary school children. A total of 257 children (55.6%) infected with STH and fulfilled the inclusion and exclusion criteria were conducted in this study. The samples were divided into two groups, 123 children in SBD group and 134 children in the CBD group. Sample characteristics data show that girls and boys students have a comparable number, with the same average age in both groups. In general, the nutritional status of the study subjects is normal. This research was conducted in an agricultural area and generally the parent's occupations' are farming with most of education levels are a senior high school and the average number of family member in a household almost same in both groups (see Table 1).

Table 1: Subject characteristics

Subject characteristics	SBD	CBD
Sex, n (%)		
Boy	59 (48.0)	72 (53.3)
Girl	64 (52.0)	63 (46.7)
Age (year), mean (SD)	9.3 (1.8)	9.3 (5.3)
Weight (kg) (SD)	25.9 (7.7)	24.8 (6.3)
Nutritional status, n (%)		
Underweight	21 (17.1)	15 (11.2)
Normal	88 (71.5)	99 (74.1)
Overweight	11 (8.9)	14 (10.4)
Obesity	3 (2.4)	6 (4.4)
Number of household members, n (SD)	4.9 (1.1)	5 (1.4)
Parent occupation, n (%)		
Father		
Farming	114 (94.2)	118 (88.1)
Government employee	0 (0.0)	1 (0.7)
Private employee	6 (5.0)	11 (8.2)
Labor	1 (0.8)	2 (1.5)
Others	0 (0.0)	2 (1.5)
Mother		
Farming	115 (94.3)	122 (91.0)
Government employee	2 (1.6)	4 (3.0)
Private employee	4 (3.3)	6 (4.5)
Labor	1 (0.8)	2 (1.5)
Parent education, n (%)		
Father		
Illiterate	2 (1.6)	8 (6.0)
Primary high school	23(18.7)	25 (18.6)
Junior high school	45 (36.6)	51 (38.1)
Senior high school	50 (40.7)	47 (35.1)
Diploma/university	3 (2.5)	3 (2.2)
Mother		
Illiterate	2 (1.6)	3 (2.2)
Primary high school	16 (13.0)	16 (11.9)
Junior high school	28 (22.8)	39 (29.1)
Senior high school	75 (61.0)	65 (48.5)
Diploma/university	2 (1.6)	11 (8.2)
STH infection, n (%)		
Ascaris lumbricoides	44 (35.8)	62 (46.3)
Trichuris trichiura	37 (30.1)	29 (21.6)
Hookworm	3 (2.4)	2 (1.5)
Mixed-infections	39 (31.7)	41 (30.6)
Intensity of STH infection, n (%)		
Ascaris lumbricoides		
Mild	60 (76.9)	102 (54.2)
Moderate	18 (23.1)	86 (45.8)
Trichuris trichiura		
Mild	75 (100.0)	67 (98.5)
Moderate	0 (0.0)	1 (1.5)
Hookworm		
Mild	9 (100.0)	7 (100.0)
Moderate	0 (0.0)	0 (0.0)

CBD: Community-based deworming, SBD: School-based deworming, SD: Standard deviation.

After a month of intervention, 6 children were excluded (3 children in SBD group and 3 children in CBD group) because of not collected their stools and infected by *Hymenolepis nana*. At 3 months follow-up, 6 children were excluded (2 children in SBD group and 4 children in CBD group) because they did not collect stools (Figure 1).

Distribution of STH infection

STH infection was mostly caused by a single *A. lumbricoides* infection in both groups, 35.8% (44/123 children) in SBD group and 46.3% (62/134 children) in CBD group (Table 1). The lowest infection was caused by hookworm in both groups (Table 1).

Intensity of STH infection before and after intervention

Before intervention, mild, and moderate intensity were observed from *A. lumbricoides* infection in both groups (60 children and 18 children in SBD group and 102 children and 86 children in CBD group). In *T. trichiura* infection, only mild intensity was found in SBD group (75 children), but both mild and moderate intensity were available in CBD group (67 children and 1 child). Whereas in hookworm infection, only mild intensity was found in both groups (9 children in SBD group and 7 children in CBD group). After 1 month intervention, there was a decrease in the intensity of worm eggs in both groups in *A. lumbricoides* (2 children with mild infection in SBD group and 2 children with mild

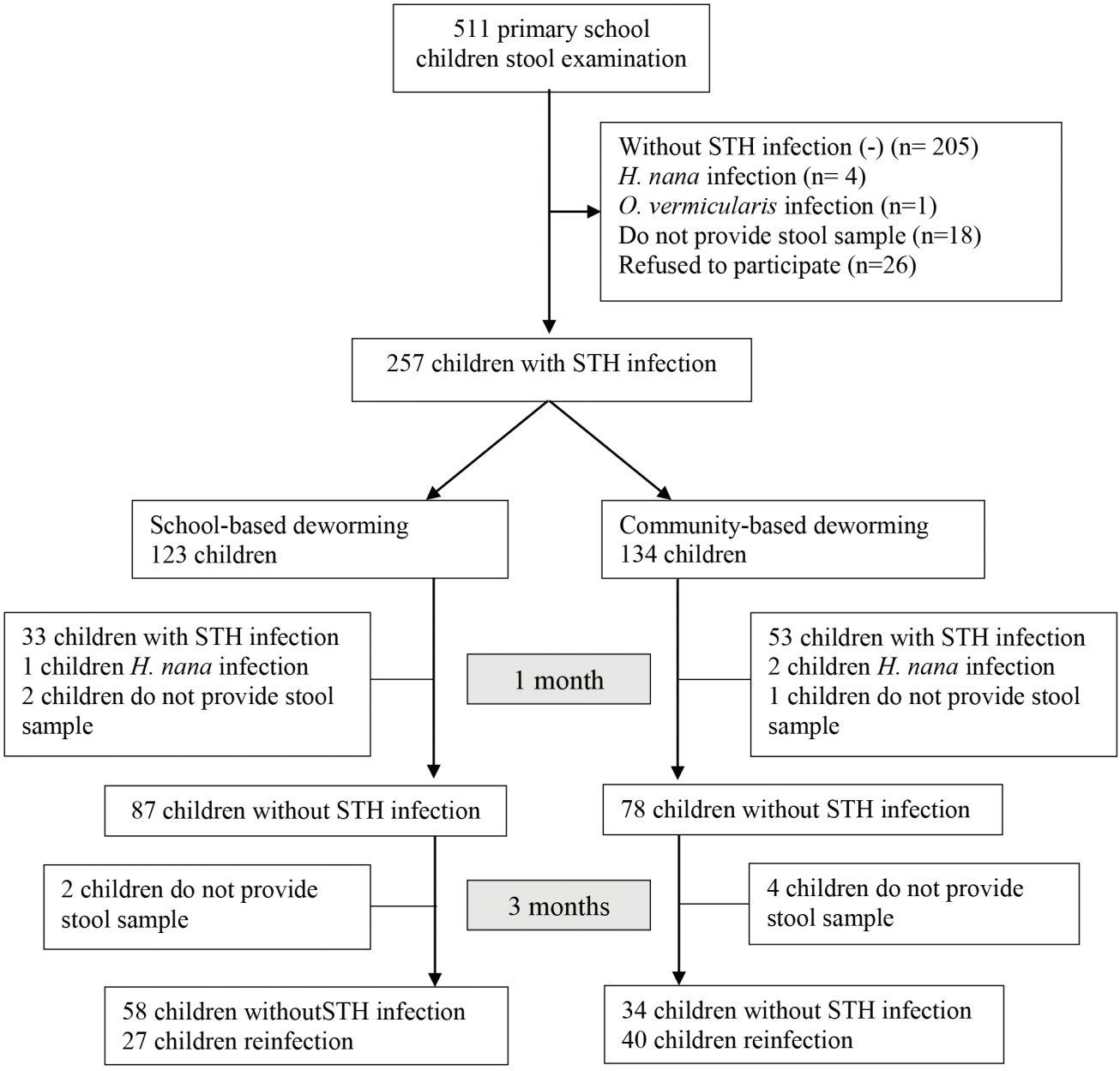

Figure 1: Consort diagram. STH: Soil-transmitted helminth, H. nana: Hymenolepis nana, O. vermicularis: Oxyuris vermicularis

infection in CBD group) and hookworm was infections (1 child with mild infection in SBD group and 5 children with mild infection in CBD group). Furthermore, in *T. trichiura* infection, infection was decrease in SBD group (31 children), and in CBD group, there was a decrease in the number of infections with mild intensity (49 children) and an increase in the number of infections with moderate intensity (2 children)

There was a significant egg intensity decrease after intervention in *A. lumbricoides* infections in both group and *T. trichiura* was infections in SBD group. However, the mean reduction difference of egg intensity between the two groups was found not significant for all STH worm types (Table 2).

Table 2: Comparison of mean reduction difference of eggs intensity

Comparison	Worm type (n)	Mean intensity reduction (EPG)	p
The mean egg intensity reduction before and after intervention based on the type of worm in each group[a]	*Ascaris lumbricoides*		
	SBD (123)	1,880.1	0.001
	CBD (134)	2,131.8	0.001
	Trichuris trichiura		
	SBD (123)	51.6	0.001
	CBD (134)	32.4	0.443
	Hookworm		
	SBD (123)	10.5	0.052
	CBD (134)	9.7	0.078
The mean reduction difference of egg intensity between the two groups[b]	*Ascaris lumbricoides*		
	SBD (123)	10.1	0.394
	CBD (134)	79.9	
	Trichuris trichiura		
	SBD (123)	20.1	0.059
	CBD (134)	105.2	
	Hookworm		
	SBD (123)	0.2	0.066
	CBD (134)	2.3	

[a]Dependent t-test. [b]Independent t-test. EPG: Egg per gram, CBD: Community-based deworming, SBD: School-based deworming.

Cure rate and reinfection

Cure rate in a month after intervention was 72.5% (87 children) for SBD group and 59.5% (78 children) for group CBD. Reinfection after 3 months, intervention was 31.8% (27 children) in SBD group and 54.1% (40 children) in CBD group (Table 3). The cure rate (P = 0.043) and reinfection (P = 0.007) have significantly better in SBD group compared CBD group.

Table 3: Cure rate after 1-month intervention and reinfection after 3 months intervention

Time	Deworming group		p[a]
	SBD n (%)	CBD n (%)	
Baseline	123	134	
After 1 month (cure rate)			
Positive	33 (27.5)	53 (40.5)	0.043
Negative	87 (72.5)	78 (59.5)	
After 3 months (reinfection)			
Positive	27 (31.8)	40 (54.1)	0.007
Negative	58 (68.2)	34 (45.9)	

[a]Chi-square test. CBD: Community-based deworming, SBD: School-based deworming.

Discussion

The study reveals a high prevalence of STH infection in Suka Village, Tiga Panah District, Karo Regency, North Sumatera Province, Indonesia. About 55.6% of primary school children were infected with one or more STH. The main infection was caused by *A. lumbricoides* and the lowest infection caused by hookworm. The result shows better than previous studies which performed at the same place in 2004 (91.3%) [12]. A cross-sectional study in 2015 on school-aged children in two elementary schools in Belawan, North Sumatra, reported that the prevalence of STH infection was 65.4%, with the most infections was mixed infections of *A. lumbricoides* and *T. trichiura* [13]. In addition, a longitudinal study conducted in the same area resulted that STH infection prevalence was 34.4% in preschool children [14]. However, this study was consistent with other studies showing the high prevalence of STH infection [15].

In this study, the most common infection was a single infection with *A. lumbricoides* followed by mixed infection. This is different from the previous study, where most infections are mixed infections [12]. This previous study explains that the high intensity of *A. lumbricoides* infection was significantly related to the high intensity of *T. trichiura* infection.

In general, the nutritional status of study subjects is normal, this is different from the previous study, which is the highest nutritional status underweight. Nutritional disorder can be caused by many things, such as lacking of caloric and protein intake, impaired food absorption, and infectious diseases such as helminthiasis. In this study, we were only able to determine the various causes of malnutrition (underweight) which is helminthiasis, although other factors cannot be ruled out [12], [14].

This study was conducted in an agricultural area and parents occupations' are generally farmers. The results of previous studies found that soil pollution by *A. lumbricoides* was high at 45.8%. The bigger the yard space or agricultural fields are around the house, the greater the spread of helminthiasis infection is there. The data show that most of the parent education is senior high school. Various studies explain that education and knowledge of mothers affect STH infections, where STH infections are more common in children with low-educated mothers. The large number of household members has a role in the spread of infection. The more family members are in a household, the more frequent STH infections occur. In this study, the average family members were 4–5 people in both groups [12].

The number of primary school children with STH infection after deworming was reduced in both intervention groups. The results of this study showed that the reduction of *A. lumbricoides* infection was greater than the other STH infection in both groups. This study result contradicted with other meta-analysis studies that CBD has a greater effect on the prevalence reduction of *A. lumbricoides* and hookworm than SBD method [3]. It can be caused by low number hookworm infections in our study and peak infection

in adulthood, so the deworming effect in reducing community transmission is not obvious [16]. No effect of SBD versus CBD deworming method on prevalence reduction was seen for *T. trichiura*. Albendazole is known to have poor efficacy against *T trichiura* and reinfection would occur rapidly after any successful treatment [3], [17].

There was a difference of worm eggs intensity reduction before and after deworming in both groups. The effectiveness of cure rate with SBD method is better than CBD method ($P = 0.04$). In the case to reinfection, there were significant differences in reinfection between the SBD and CBD groups, which mean that the risk of reinfection was higher in the CBD method than in the SBD method. The other study in the different countries showed that the CBD is at least as effective as the SBD in reducing the prevalence and intensity of STH among school children [18]. It contradicted to a systematic review that assessing the effect of a community-based intervention to prevent and control NTD, which reported a significant decrease in the prevalence and intensity of STH with community-based prevention and control strategies [19].

There are some limitations found in this study, such as anthelmintic administration in CBD method only given to three family members who live in the house, and were given indirectly so that it may lead to low medication adherence and possibility of community transmission. This study only interferes one of the four controlling sectors of STH that is deworming alone with a short monitoring time. These finding highlights were the necessity of new drugs and drug combination strategies in areas with high *T. trichiura* prevalence because environmental reservoirs of infective stages would remain high and reinfection would occur rapidly after any successful treatment. Further research is needed to compare the effectiveness of SBD and CDB methods that are integrated with the WASH (water, sanitation, and hygiene education) program with longer monitoring. As a conclusion of this study, SBD method was more effective than CBD method in primary school children with STH infection in Suka Village, North Sumatera, Indonesia.

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