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Risk Factors Associated with Intestinal Parasitic Infections among School Children

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Authors' contributions

This work was carried out in collaboration between all authors. All authors read and approved the final manuscript.

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ABSTRACT

Background: Soil-transmitted helminthiasis (STH) is a major public health problem in tropical areas such as the Philippines. A significant portion of the population in the Philippines consists of people located in the provinces as well as hard to reach localities that often cater to fishing and rural communities.

Objectives: This study determined the prevalence of intestinal helminth infections, helminth densities, and relevant risk factors associated with helminth infections among grade school children.

Materials and Methods: In July 2015, the prevalence of soil-transmitted helminths among Kindergarten to Grade 10 pupils in Jaime Hilario Integrated School-La Salle (JHIS-LS) in Bagac,

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Bataan, Philippines was determined using Kato-Katz technique. Moreover, socio-demographic profile including sex, age, and hygiene and sanitation practices of the pupils were obtained.

Results: Of the 110 pupils, a prevalence rate of 6.36% with at least one STH infection was identified. The predominant parasites were *Trichuris trichiura* (56%), *Ascaris lumbricoides* (22%), and *Enterobius vermicularis* (22%). *T. trichiura* was identified in single infection while *A. lumbricoides* and *E. vermicularis* were found in mixed infections. Of the socio-demographic characteristics of the pupils, the use of soap in washing hands is a protective factor against helminth infections (OR=0.15, 95% CI: 0.02-0.97).

Conclusion: Further studies using different STH diagnostic procedures must be done and other risk factors associated with STH must be identified.

Keywords: Soil-transmitted helminths; Kato-Katz; prevalence; risk factor; school children; hand washing.

1. INTRODUCTION

Intestinal parasites, namely the soil-transmitted helminths (STHs) are of worldwide importance [1], are the most common parasites that cause parasitic diseases in the world [2]. *Ascaris lumbricoides*, *Trichuris trichiura*, and *Ancylostoma duodenale* (hookworms) are among the commonly found STHs in the human body [3]. These STHs thrive in areas with poor sanitation, in tropical, subtropical [4], and developing countries [5] with adults, children, and even animals identified as potential hosts. However, children 4-14 years old or below are at a greater risk compared to adults [6]. Several children are affected yearly causing physical, intellectual, and cognitive problems and even growth retardation among these affected children [4].

One of the countries where poor communities are evident is the Philippines, where there is a high prevalence of STHs even though various health-promotion programs have been implemented [7]. Studies conducted among elementary schools in the Philippines showed a 67% prevalence rate for at least one type of STH infection [8]. In 2000, a baseline study showed a cumulative prevalence rates of infection among public school children in different areas: 51.6% in Quezon City, 77% in Nueva Ecija while heavy intensity infections documented had rates of 22% in Cavite and 11.3 % in Nueva Ecija, with both *Ascaris* and *Trichuris* reported as causes of these heavy intensity infections [9].

The Department of Health (DOH) has implemented a mass deworming program to prevent the increasing rate of STH infections: the *Oplan Goodbye Bulate* campaign. In coordination with the Department of Education (DepEd), the program aimed to deworm children from Kindergarten to Grade 6 in all public

schools in the Philippines once every six months. However, this does not cater private schools such as the Jaime Hilario Integrated School-La Salle (JHIS-LS) located in Bataan, Philippines. Although mass deworming of children reduces the overall worm transmission in the community, high reinfection rates negate the benefits gained by deworming. As early as 3 months post-deworming, the prevalence rates of *A. lumbricoides*, *T. Trichiura*, and hookworms reached 26%, 36%, and 30% of the pre-treatment levels, respectively; and a year post-treatment, the prevalence rates increased to 94%, 82%, and 57%, respectively [10]. Hence, suggesting the importance of monitoring the prevalence rates of post-dewormed pupils and identifying reinfection rates or recognizing new cases of infection after deworming.

Moreover, there is still no available literature whether a one-time stool sample collection is sufficient enough to infer the results needed for a baseline study. However, a one-time stool sample collection proves to be an adequate measure in providing information which may help in assessing health statuses, specifically for parasitic infections among pupils in the community. The present study will provide data on the current prevalence rate of helminth infection of pupils from Kindergarten to Grade 10 in JHIS-LS. With the information obtained, control measures may be implemented such as deworming of children and improving sanitation, which may contribute to control the infections and prevent transmission among other members of the community.

2. MATERIALS AND METHODS

2.1 Study Location and Population

Jaime Hilario Integrated School – La Salle (JHIS-LS) is in Sitio Looc in Bagac, Bataan, Philippines

is a co-educational primary and secondary school which caters to the less fortunate in the local area. It was established in 2006 as the 17th Lasallian school in the Philippines. It integrates agriculture and fishery in its curricula, which are the primary source of employment of the nearby communities. Community involvement and environmental awareness are also introduced in the school's educational program [11].

The study protocol was reviewed and approved in compliance with the existing institutional ethical guidelines. The researchers sought permission from the school administrators through a written consent to conduct a study on the prevalence of soil-transmitted helminths among Kindergarten to Grade 10 pupils of JHIS-LS. Permission was also obtained from the parents of the pupils through a written informed consent. The purpose of the fecal collection was explained, which was to know the results of the deworming done during the medical mission organized by the Biology Department, De La Salle University.

2.2 Data Collection

Prior to the collection of samples, the researchers conducted a room-to-room information campaign and health education on soil-transmitted helminths. Each participant was given a collection kit which includes a plastic stool cup with a one-inch marker to hold the sample, a short bond paper to hold the fecal matter, and the instructions for fecal sample collection. A day after the distribution of the collection kit, only 110 pupils completed the survey form and submitted their fecal samples, which were subsequently fixed in 10% formalin and immediately transported to the Zoology and Parasitology Laboratory, Science and Technology Research Center, De La Salle University, Manila, Philippines for examination.

2.3 Survey Questionnaire

Information regarding socio-demographic characteristics of the pupils such as their way of living, hygiene practices, and deworming history were obtained using a questionnaire administered in Filipino. Questionnaires were either accomplished by the pupils or their parents and were subsequently collected together with the fecal samples. All information obtained from the participants were treated with strict confidentiality. A questionnaire was assigned with a specific number and the

submitted fecal sample was correspondingly labelled. The information obtained were encoded in a password-protected file made accessible and available only to the authors.

2.4 Kato-Katz Method

Approximately 41.7 mg of fecal sample was utilized in this procedure with the unwanted debris sieved using a wire mesh screen. A cardboard template with a hole measuring 6 mm in diameter was used to obtain the 41.7 mg of stool sample for analysis. Cellophane, pre-soaked on glycerol-malachite green solution, was used as the coverslip to examine the samples clearly, incubated for 30 min at room temperature, and subsequently examined under a light microscope to check for the presence of eggs and to estimate the number of eggs per gram (EPG) of feces to assess the intensity of infection.

3. RESULTS AND DISCUSSION

Prevalence of soil-transmitted helminths using the Kato-Katz method was determined among 110 pupils, enrolled in JHIS-LS during School Year 2015-2016, who participated in the study. There were 58 females and 52 males, with 101 pupils dewormed two weeks prior to the collection of stool samples. The age of the participants ranged from 5 to 17 years, with 68% of the pupils in the 7-12 years age group (Table 1). An STH infection prevalence rate of 6.36% was found among these pupils of JHIS-LS, with *Trichuris trichiura* as the most prevalent species. Furthermore, 4.54% of the respondents were detected to have single infection predominantly of *T. trichiura*, while 1.82% had mixed infections with *Ascaris lumbricoides* and *Enterobius vermicularis*. *E. vermicularis* had the highest EPG (50.29), followed by *A. lumbricoides* (44.57) and *T. trichiura* (32.00).

Table 1. Distribution of pupils by age and sex

Age group (years)	Male	Female	Total
5-6	3	4	7
7-8	8	14	22
9-10	14	10	24
11-12	17	12	29
13-14	5	7	12
15-17	11	5	16
Total	58	52	110

In the Philippines, health programs such as *Oplan Goodbye Bulate* which aimed to conduct

deworming in public schools nationwide twice a year or every six months had been implemented by the Department of Health (DoH). Despite of the implementation of these various health programs to control the prevalence of intestinal helminths, STH infections remain highly prevalent in the country [7]. In addition, since JHIS-LS is a private school in the province, the program of DoH does not cover this school. Thus, JHIS-LS pupils were surveyed because they were at risk due to their living conditions. Children aged 4-14 are commonly infected with STH [4], and those living in areas with poor sanitation are at a greater risk of infection [4,5].

In the present study, *Enterobius vermicularis* was the STH identified with the highest EPG. This parasite is easily transmitted from one person to another and the eggs from the infected person may contaminate linen sheets, clothes, and other furniture which may subsequently infect other people [12]. Moreover, a single dose of antihelminthic drug is not enough to eradicate this parasite because of reinfection from previously infected people not totally cured [13]. However, even though *E. vermicularis* had the highest EPG, it was not the most prevalent STH.

Out of the 110 pupils surveyed, 5.94% of the pupils who underwent deworming were still observed to be infected with STHs. Normally, a single dose is effective for treating STH infections, but a second dose may be needed after two weeks if the infection recurs or persists. This is the primary reason why it is important to break the cycle of reinfection which can be

solved by administering antihelminthic drugs along with proper hygiene and sanitation. Another possible reason could be that the individual is severely infected with mixed STH infections that a single dose of an antihelminthic drug is insufficient. For instance, Albendazole was effective in treating Ascariasis and hookworm infection, but not Trichuriasis [6]. Albendazole is mainly used to treat tapeworm infection but it can also be used to treat STH infections [14]. Mebendazole can be used to treat single and mixed infections of *A. lumbricoides*, *T. trichiura*, *E. vermicularis*, and hookworms [15]. Hence, a single dose of an antihelminthic drug may not be enough to eliminate all these helminths [6].

Assessment on the possible risk factors associated with STH infection showed that the use of soap when washing hands has a significant protective effect (OR = 0.15; 95% CI 0.02-0.97). However, sex, deworming, washing of hands, access to clean drinking water, use of neighbor's toilet, allowing neighbor to use toilet, and trimming of nails were found to be not statistically significant (Table 2). Regarding washing of hands with and without the use of soap, 92.7% of the pupils used soap when washing their hands. However, five of them had STH infections. Additionally, 7.3% of the pupils did not use soap when washing their hands, and two of them were infected. The odds ratio for those who did not use soap when washing their hands compared to those who used soap is 6.47, which indicates increased odds of infection among pupils who did not use soap. Thus, using

Table 2. Risk factors associated with prevalence of soil-transmitted helminths

Risk factors		Infected	Uninfected	Total	OR	95% CI
Sex	Female	4	48	52	1.53	0.33-7.17
	Male	3	55	58		
Deworming	No	1	8	9	1.98	0.21-18.54
	Yes	6	95	101		
Washing of hands	No	1	10	11	1.55	0.17-14.20
	Yes	6	93	99		
Use of soap	Yes	5	97	102	0.15	0.02-0.97
	No	2	6	8		
Access to clean drinking water	No	3	21	24	2.93	0.61-14.11
	Yes	4	82	86		
Use of neighbor's toilet	No	4	88	92	0.23	0.05-1.13
	Yes	3	15	18		
Allow neighbor to use their toilet	No	4	81	85	0.36	0.08-1.73
	Yes	3	22	25		
Trimming of nails	No	2	10	12	3.72	0.64-21.73
	Yes	5	93	98		

OR: odds ratio; CI: confidence interval

soap significantly reduces the odds of acquiring the infection. There is a statistically significant difference between washing hands with and without the use of soap. This finding is similar in a tribal population in Tamil Nadu, India, wherein people who did not wash their hands with soap and water were more likely to acquire the infection [3] since the use of soap was associated with decreased risk of any STH infection [5]. Among school-aged Ethiopian children, using soap exclusively for hand washing reduced intestinal helminth reinfection rates by 68% [13]. Moreover, only 14% of the pupils who used soap regularly were reinfected compared to the 29% who did not use soap when washing their hands [16], and frequent washing of hands with the use of soap contributed to reduced infection of STHs in the household [17].

Considering that Jaime Hilario Integrated School was not included in the list of the participating schools for deworming by the DOH's *Oplan Goodbye Bulate*, it is still a school which caters to the less fortunate in the area so preventive measures such as periodic deworming should be done. Medical missions organized by De La Salle University should be continued, to reduce the STH infection which will improve health and education outcome. Also, the medical missions conducted in this area aimed to deworm all children attending JHIS-LS, to minimize possible transmission of STHs from one pupil to another. Deworming during the medical mission was an additional initiative to reduce the prevalence of soil-transmitted helminth infections in a private school where national school-based deworming program was not implemented. The medical mission held two weeks prior to the conduct of the study, which included administration of antihelminthic drugs, significantly reduced the prevalence of STH infection. Given such positive results, this suggests that medical mission should be routinely conducted. The effect of the administration of the drugs was seen in the results of this study with only 6.36% of the participants positive for infection using Kato-Katz method. However, this method has a low specificity particularly in low intensity infections. The present study found a significantly lower prevalence of soil-transmitted helminth infections when compared to the 73.7% in the previous study [18], which were attributed to poor hygiene and sanitation, unspecific antihelminthic drug, and proximity to animals which served as hosts to parasites, and non-consumption of antihelminthic drugs.

4. CONCLUSION

The overall prevalence of soil-transmitted helminths among Kindergarten to Grade 10 pupils of JHIS-LS in Bagac, Bataan is 6.36%. Using Kato-Katz technique, the helminths were identified based on egg morphology and quantified to determine the intensity of infection. Single infections were observed in 4.54% of pupils predominantly of *T. Trichiura*, while only 1.82% had mixed infections of *A. lumbricoides* and *E. vermicularis*. In this study, *T. trichiura* appeared to be the most prevalent, and *E. vermicularis* had the highest density (EPG). Most of the participants had taken one dose of antihelminthic drugs before the conduct of the study, but some of the pupils still had infections suggesting that a single dose of the drug is insufficient to completely eradicate the parasites. However, the use of soap when washing hands appeared to have a protective effect against STH infections.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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