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Recurrent soil-transmitted helminthiasis in pre-school-aged children consistently treated with anthelminthics in Bacolod City

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ABSTRACT:

- ***Objective:*** Soil-transmitted helminthiasis (STH) is among the neglected tropical diseases that commonly affect children in tropical and subtropical regions, especially in countries with finite resources like the Philippines. Although mass drug administration of anthelminthics is done annually, little is still known about the effectiveness of deworming, the prevalence and intensity of STH infection among preschoolers.
- ***Materials and Methods:*** This is a descriptive, cross-sectional study conducted with 101 preschoolers in five daycare centers.
- ***Results:*** Overall, STH infections observed were about 45.54%, with *A. lumbricoides* predominating and most cases were classified as light infection. Other parasites observed were *T. trichiura* and hookworm, of which the majority were co-infections with *A. lumbricoides*.
- ***Conclusions:*** The data gathered from this study indicate a high possibility of reinfection, despite the study participants being dewormed consistently twice a year. Thus, other interventions, such as proper hygiene and sanitation, together with consistent deworming, should be implemented to prevent reinfection with STH.

- ***Keywords:*** Soil-transmitted helminthiasis, Preschoolers, Bacolod City.

INTRODUCTION

Soil-transmitted helminthiasis (STH), or geohelminthiasis, is a condition where parasitic worms live in the human intestine and is considered one of the most common infections worldwide, affecting the poorest communities[1]. Considered to be the most prevalent neglected tropical disease, these intestinal worms spread through soil, water, or vegetation that was contaminated by human feces containing the parasite eggs or larvae. The burden of infection is higher in underdeveloped nations where sanitation is sparse, and hygiene practices are poor[2]. STH includes *Ascaris lumbricoides*, *Trichuris trichiura,* and hookworms.

STH infection can result in nutritional deficiency, caloric malnutrition, stunting, impairing growth, and cognitive development, especially in children. It can also produce a wide range of symptoms, including diarrhea, abdominal pain, general malaise and weakness, and even chronic anemia. Infections of very high intensity can lead to intestinal obstruction and need to be treated surgically[3]. Accompanied by various clinical complications and sequelae, it can result in significant morbidity and economic loss[3].

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For epidemiology, approximately 1.5 billion people are infected with STH with one or several species, mostly occurring in tropical and subtropical regions[3]. In the Philippines, Sorsogon has the highest number of STH infections in the country, followed by Capiz and La Union in 2019[4]. To answer this problem, a nationwide STH mass drug administration program that started in 2006 is being implemented or administered among daycare centers and public schools. This is made to control or interrupt transmission of STH among the most vulnerable group, which is preschool children. However, even with these programs, STH infection is still persistent nationwide and considered a perennial public health problem[5].

Most regions in the country have received multiple rounds of mass drug administration, and STH infection is expected to decrease in prevalence. However, measurement of the efficacy of the program remains scarce or limited, so a call for enhanced community-based monitoring and evaluation is needed. It is therefore the objective of this study to determine the prevalence of STH among pre-school-aged children consistently treated with anthelminthics in daycare centers in Bacolod City, Negros Occidental, Region VI, Philippines.

MATERIALS AND METHODS

Study Design

We conducted a daycare center-based cross-sectional study to assess the parasitological status of pre-school-aged children in five participating barangays (the smallest unit of a community) in Bacolod City, Philippines. These barangays include Barangay Villamonte, Mandalagan, Banago, Barangay 3, and Barangay 7.

Study Area

Bacolod City is the capital city of Negros Occidental and is located at 10.6713° N, 122.9511° E, with a land area of 160.71 sq km. It has an estimated population of 661,465 (61 barangays); its economy is primarily driven by business process outsourcing. Bacolod City has a tropical monsoon climate. The rainy season spans from March to December, and the dry season usually starts from January to April. According to the daycare center in charge and their barangay captain, the center only administers deworming medication provided by the barangay health workers. No stool examinations or health education were conducted beyond the deworming.

Ethics Consideration

The study protocol was submitted and approved by the Research Ethics Committee of Colegio San Agustin-Bacolod with the assigned protocol 2023-01-STU-Pineda-RPA3: Parasitic Load Determination in Intestinal Nematodal Infection on April 12, 2024. Permission was also sought from the City Health of Bacolod and the Barangay Captain of each Barangay Daycare Center prior to the conduct of the study. Orientation was provided to parents, legal guardians, and teachers of the preschoolers regarding the purpose and procedures of the study. Consent from the participants' guardians was obtained prior to specimen collection. After the completion of the analyses, the results were communicated to the teachers of daycare centers. Only those who gave consent and were willing to participate were admitted to the study.

Specimen Collection

A one-time sampling of feces was taken from the daycare center preschoolers, as discussed and requested by the guardians and the daycare center's teachers, to avoid further inconvenience and class disturbance. Specimen cups, popsicle sticks, and clear plastic were provided and distributed to the parents and daycare teachers on the day of collection. They were also instructed to collect at least a thumb-sized sample and submit the collected samples as soon as possible. Specimens were stored in an ice box and transported to the Colegio San Agustin-Bacolod laboratory for examination within 2 hours. Specimens that were not formed (loose, mucoid, or watery) in consistency were automatically rejected. This is because the calculation of the parasite eggs per gram is based on the assumption that the density of a stool sample is equal to 1.0, as a template determines a defined volume, not weight. Thus, any changes in consistency will moderately influence results. The Kato-Katz technique uses a template with a standard measurement and the use of formed consistencies of stool ensures ease of preparation of samples to be analyzed. Parasitic eggs or ova are also more concentrated in formed stool samples; thus, recovery of parasitic eggs can be easily done in formed stools than in non-formed samples.

Parasitological Assessment

Fecal analysis was made using direct fecal wet mount microscopy and the three-slide Kato-Katz technique. Methods for the Kato-Katz technique are described in the paper of Menezes et al[6]. Microscopic readings were made within 2 hours after collection. Fecal analysis was further validated by three professional and experienced Medical Technologists at Colegio San Agustin-Bacolod. The intensity of infections was reported as eggs per gram and classified according to the WHO classification of intensity of STH infections[7], as seen in Table 1.

Data Analysis

The obtained data were subjected to descriptive statistics analysis that included means, frequencies, and cross-tabulations.

RESULTS

Table 2 shows the prevalence of STH among preschool children in selected daycare centers in Ba-

Table 1. Classes of intensity of infections for STH and *S. japonicum.*

	Ascaris spp	*Trichuris spp*	Hookworm	*S. japonicum*
Light	1 - 4,999	1 - 999	1 - 1,999	1 - 99
Moderate	5,000 - 49,999	1,000 - 9,999	2,000 - 3,999	100 - 399
Heavy	>50,000	>10,000	>4,000	>400

colod City. Only 101 pre-school children participated, with an overall prevalence of STH of 46; 45.54%. Among the selected barangays, Barangay Banago reported the highest prevalence of 62% (18/29), followed by Barangay 3 with 53% (10/19). On the other hand, Barangay Mandalagan had the lowest prevalence, with 22% (2/9). A summary of the results is shown in Table 2.

Only Barangay Banago and Barangay 3 did not meet the national target of reducing STH prevalence to less than 50%. Other barangays studied were somewhat successful, as their prevalence rate was less than 50%. Among the identified STHs, *A. lumbricoides* was noted to be the most common or most prevalent helminth (43.56% prevalence rate). Mixed infections were also observed, as shown in Table 3, with *Ascaris-Trichuris* coinfection being the most common.

Light to moderate intensity was found among people infected with *A. lumbricoides* and *T. trichiura*. The intensity of infections was reported as eggs per gram and was classified as light, moderate, or heavy (Table 4).

DISCUSSION

The Philippines reports a high prevalence of STH infections despite the continuous implementation of nationwide mass deworming among pre-school and school-aged children since 2006[1]. The persistence of these infections is usually caused by a persistent lack of access to clean water, proper environmental sanitation, and poor personal hygiene. Also, low socioeconomic status, poverty, low levels of education, a lack of nail trimming, and crowded living conditions contribute to recurrent helminthiasis. Among all age groups, children carry the highest risk[3], being in constant and closed contact with soil.

The prevalence in this study is higher compared to the nationwide prevalence study presented by Tangcalagan et al[8] in 2022, but lower than the study of Belizario et al[9]. Reasons for the discrepancy among studies might be due to the differences in sample size, location and culture of participants, sanitary practices among areas, level of awareness and others. Species of helminths were also similar in other countries like Indonesia[10], Ethiopia[11], India[12], and Nigeria[13]. However, in Thailand, hookworm predominates among the species of intestinal parasites[14,15].

As the prevalence of STH is linked to poverty, poor environmental hygiene, and poor sanitation, periodical deworming should eliminate the infecting worms. On the other hand, health education helps prevent reinfection, and improved sanitation will reduce soil contamination with infected eggs. The Department of Health (DOH) of the Philippines established the STH Control Program in 1999 through the issuance of Administrative Order No. 30-F s. 1999. Then, there is DOH Administrative Order No. 2010-0023, released July 13, 2010 – "Guidelines on Deworming Drug Administration and the Management of Adverse Events Following Deworming". This was intended to deworm children aged 1–12 and was conducted every April and October of the year for preschoolers, and every January and July for schoolchildren. Albendazole (400 mg) or Mebendazole (500 mg) are the anthelminthics of choice for mass treatment of intestinal infections[16].

Although resistance of STH to anthelmintic drugs was already noted in animals, it was observed to be slow to develop under normal conditions[2]. On the other hand, in humans, no conclusive evidence of anthelminthic resistance was observed among STH species[2]. However, reduced efficacy of albendazole was noted in the study of Gebreyesus et al[17] and Krucken et al[18], there is still no concrete proof of resistance or the presence of heritably resistant parasite populations. The paper of Gomez et al[19] also indicates that a single dose of albendazole, although highly effective

Table 2. Prevalence of soil-transmitted helminthiasis among the studied participants.

Sites	No. of examined subjects	No. of individuals infected with STH	Prevalence
Barangay Villamonte	27	10	37%
Barangay Banago	29	18	62%
Barangay 7	17	6	35.29%
Barangay Mandalagan	9	2	22%
Barangay 3	19	10	53%
Total	101	46	45.54%

Table 3. Prevalence of specific soil-transmitted helminths per barangay.

Sites	Barangay Villamonte	Barangay Banago	Barangay 7	Barangay Mandalagan	Barangay 3	Total
Single infection						
Ascaris spp	10	6	4	1	5	26
Trichuris spp	0	1	1	0	0	2
Hookworms	0	0	0	0	0	0
Mixed infection						
Ascaris + *Trichuris*	1	10	1	1	5	18
Ascaris + hookworm	0	0	0	0	0	0
Trichuris + hookworm	0	0	0	0	0	0
Ascaris + *Trichuris* + Hookworm	0	1	0	0	0	1

against *A. lumbricoides* and hookworms, does not kill all worms, specifically *T. trichiura*. As it has only a cure rate of 23%. Thus, surviving worms may augment reinfection following treatment.

The study sites are continuously supplemented with regular anthelminthic treatments. This represents the main approach to controlling STH in areas with high prevalence. However, resources for STH control still remain limited, and funding for sanitation is still insufficient. A high prevalence of STH combined with poor hygiene and sanitation often indicates future health problems in the country. Thus, the eradication of STH, especially in growing children, also remains a priority. Although the study sites are continually treated, the prevalence of STH remains high at 45.54% or perhaps higher because of the study's limitation in specimen collection. This means giving out anthelminthic drugs is not enough to control STH, as reinfection is common. Thus, other means to help control STH should be implemented to control reinfection among these children. This includes long-term strategies like regular health education, such as handwashing and the promotion of proper sanitation for all ages in the community.

Commonly, reinfection may appear 6-8 weeks post deworming for *A. lumbricoides*, and 12 weeks post deworming for *T. trichiura*, especially for individuals with poor sanitation practices and poor hygiene. There are also other factors that lead to reinfection. Aside from poor hygiene and sanitation, a predisposition to reinfection also exists in human communities[19]. The predisposition to reinfection, although unclear at present, was also suggested as a result of a combination of programmatic, behavioral, environmental, and genetic factors. Therefore, comprehensive prevention and control measures of drug deworming and environmental improvement are required to reduce STH prevalence[3].

As emerging issues of drug resistance among STH against commonly used anthelmintics and subsequent reinfection arise, enhanced community-based monitoring of prevalence is necessary. This is crucial for accurately assessing the impact of STH control programs and, concomitantly, ensuring the progress made over the years.

Strengths and Limitations

The cross-sectional design used in this study was not able to generate evidence for a causal relationship nor account for seasonal variations of STH transmission that may lead to under- or over-estimation of prevalence. The sensitivity of the technique and one-time sampling might also affect the intensity of infection and its prevalence. The method used is not effective for the detection of other parasites like *Strongyloides stercoralis*, *Enterobius vermicularis,* and other helminths which do not shed eggs. Lastly, the relatively small sample size may have resulted in the poor statistical analysis.

CONCLUSIONS

The findings in this paper indicate that the studied community is still somewhat far from eliminating STH, as the prevalence rate is at 45.54%, given that

Table 4. Intensity of infections of STH among the studied participants.

	Ascaris spp	*Trichuris spp*	Hookworm
Uninfected	57	80	100
Light	27	19	1
Moderate	17	2	0
Heavy	0	0	0
Total	101	101	101

only consenting participants were included. *A. lumbricoides* or mixed infection with *T. trichiura* of light intensity predominates among the infected individuals. Reinfection is a great possibility, as participants are dewormed consistently twice a year. With the current data, there is a strong need to incorporate other measures to control STH other than deworming.

Authors' Contributions:
Conceptualization and planning were made by ACJ, DGM, and JASP. The specimen collection was made by KVA, JFBJ, JJSJ, V, and LVL. Experimentations that included direct fecal smear and the Kato-Katz technique were performed by JFBJ, JJSJ, VLVL, EMM, and RSM. ACJ and DGM supervised the execution of experiments. Data analysis was accomplished by DGM, JASP, KVA, JFBJ, and ACJ. JASP, KVA, JFBJ, and JJSJ took care of the preparation of documents for Ethics and Biosafety Clearance. The first draft was prepared by ACJ and DGM. All authors read and agreed to the published version of the manuscript.

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The authors declare no conflict of interest.

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Data Availability:
Data sharing does not apply to this paper as no data sets were generated or analyzed during this study.

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Ethics Approval and Informed Consent:
The study protocol was submitted and approved by the Research Ethics Committee of Colegio San Agustin-Bacolod with the assigned protocol 2023-01-STU-Pineda-RPA3: Parasitic Load Determination in Intestinal Nematodal Infection on April 12, 2024. Informed consent was provided by the legal guardians of the participants. Only those who gave consent and were willing to participate were admitted to the study.

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