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Monitoring of soil transmitted helminth (STH) Helminthiasis on school-age children in final garbage dump, Bantar Gebang, East Bekasi

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ABSTRACT. The prevalence of helminthiasis in West Java is 13.9%, but there is no data on STH helminthiasis on school-age children in the final garbage dump (FGD), Bantar Gebang, East Bekasi, Indonesia. Therefore, it is necessary to monitor STH helminthiasis on school-age children living around FGD. This study aims to determine the description of helminthiasis on school-age children who live in the FGD Bantar Gebang, Indonesia. This type of research is descriptive quantitative with a cross-sectional design. The sample in this study consisted of 79 stool children aged 5-9 years, 5 g of fly vectors from wet, dry, and soil were taken from 36 locations around the FGD. STH examination on stool, flies, and soil samples was carried out using the native, Harada Mori, flotation, and sedimentation methods. All data were analyzed using a descriptive approach to determine the percentage of the incidence of STH. The results of this study, among others, from 79 children there were six (7.60%) children infected with STH with the genus or species *Ascaris lumbricoides*, hookworm, and *Trichuris trichiura*. As for the 18 points of soil extraction, there were 12 (66.7%) positive points containing hookworm larvae, while the flies found were more dominant in *Musca domestica* than *Chrysomya* sp. with worm parasites attached to the fly's body are *Ascaris lumbricoides*, *Diphyllobothrium latum*. *Enterobius vermicularis*, hookworm, *Hymenolepis* sp., *Schistosoma* sp., *Trichuris trichiura*. The conclusion of this study is percentage incidence of STH helminthiasis on school-age children living in FGD Bantar Gebang is 7.60% which is in the low category.

Keywords: Fly vectors; helminthiasis; morphological characteristics; school children age; soil transmitted helminth

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INTRODUCTION

Helminthiasis are an infectious disease that is still a public health problem in Indonesia. This disease predominantly infects the community with school-age children. According to Zahara (2021) who compiles research data on the incidence of helminthiasis in several provinces of Indonesia during the period 2011-2021 reports that as many as 29.7% of Indonesian people experience Helminthiasis infections with the most dominant age category being 5-12 years. This is because children aged 6-12 years have a high curiosity to play intensely with the soil. In addition, at that age children still depend on their parents for maintain personal hygiene, such as washing hands before eat and defecate.

According to data from the Dinkes Jawa Barat (2020), the national Helminthiasis prevalence rate is 28.12% with a medium category spread across 34 provinces in Indonesia. One of the provinces that need to be monitored regarding the incidence of Helminthiasis is West Java, considering that it is still difficult to obtain Helminthiasis data in Bantar Gebang area, East Bekasi. One of the most recent studies on worms in West Java was conducted by Elba (2021) who reported that the prevalence of children under five in West Java who suffered from Helminthiasis was 1.1%. Nasution (2021) reported that the prevalence of helminthiasis in children aged 5-14 years in villages on Subang district, West Java was 13.9% with more males infected than females. The results of Dinkes Jawa Barat (2020) found that cases of Helminthiasis in West Java were caused by a lack of understanding of children about Helminthiasis, especially the effects of unclean food and drink on body health.

The survey results are related to several factors that cause Helminthiasis, including poverty, lack of sanitation, and hygiene such as walking barefoot, and not washing hands with soap before eating and after defecating. The incidence of Helminthiasis can occur in a person through contact with contaminated soil (hookworms) or consumption of food contaminated with worm eggs (Sihura *et al*., 2022). If there are no prevention efforts, intestinal worms can have an impact on decreasing the absorption of nutrients such as carbohydrates, proteins, and causing blood loss (Naing *et al*., 2013; Cattadori *et al*., 2016). While nutrients are considered important as one of the factors needed by school-age children to support brain growth or intelligence and optimal growth development. Based on the Khurana *et al*. (2021), school-age children are more at risk of being affected by intestinal worms, including anemia, physical weakness, impaired growth, and cognitive development, as well as malnutrition caused by the absorption of blood and essential nutrients by worms. Another impact of worms is the loss of productive time or global disability adjusted life years lost (Global DALY's Lost) which has the potential to reduce the long-term productivity of human resources. Referring to the problem and impact of intestinal worms, it is necessary to monitor the incidence of STH Helminthiasis in school-age children in the West Java area, especially at final garbage dump (FGD) Bantar Gebang. The selection of subjects and objects of research was due to the highest prevalence of STH Helminthiasis found in school-age children, while the FGD is the largest final waste disposal site in Indonesia which has the potential to become an endemic area for incidence of STH in West Java, Indonesia.

Various studies on the status Helminthiasis of STH in various developing countries have been carried out and have resulted in varying prevalence rates. Research by Aung *et al*. (2022) showed that the prevalence Helminthiasis of STH in school-age children in Myanmar was 78.8% after 10 years of the national deworming program. Eltantawy *et al*. (2021) informed that the prevalence rate of STH Helminthiasis in Tanzania was 34%. Idowu *et al*. (2022) stated the prevalence of STH in children under 2 years in Nigeria was 69.9%. Kache *et al*. (2020) stated that the prevalence of STH Helminthiasis in Thailand was 15.7%. Molla & Mamo (2018) and Leta *et al*. (2020) revealed that the prevalence of STH Helminthiasis in Ethiopia started from 43.5% in the 2003-2006 period and then rose to 54% in the 2007-2010 period and decreased by 21.7% in the 2013-2015 period after the Mass Drug administration (MDA) program was implemented. Rahimi *et al*. (2022) described the overall prevalence of STH in children as 39.8% with the dominant number of STH infections being male.

Based on the results of previous studies, there has never been any data regarding the incidence of STH Helminthiasis in school-age children who live around the FGD. The novelty of this research is the examination of STH eggs and worms in various samples such as feces, soil, and flies which are mechanical vectors of STH eggs. As for the method in this study, apart from using the native method, flotation also Harada Mori. These three methods are an updated aspect of how to identify worms in this study. In addition, sampling around the FGD location is characteristic for determining the category of helminthiasis in elementary school children living in the area. The purpose of this study was to determine the description of STH helminthiasis in school-age children living on the FGD Bantar Gebang. This study is expected to be used as a reference for the Indonesian Ministry of Health to develop an STH helminthiasis prevention program in FGD Bantar Gebang area, East Bekasi, Indonesia.

MATERIALS AND METHODS

This research is quantitative with a cross-sectional design. The sample in this study consists of 79 stools when children were 5-9 years old, 5 grams of fly vectors from wet, dry, and soil were taken from 36 locations around the FGD Bantar Gebang, West Java, Indonesia. Sampling was carried out in July 2022 (Fig. 1). All samples were examined at the parasitology laboratory of STIKes Mitra Keluarga.

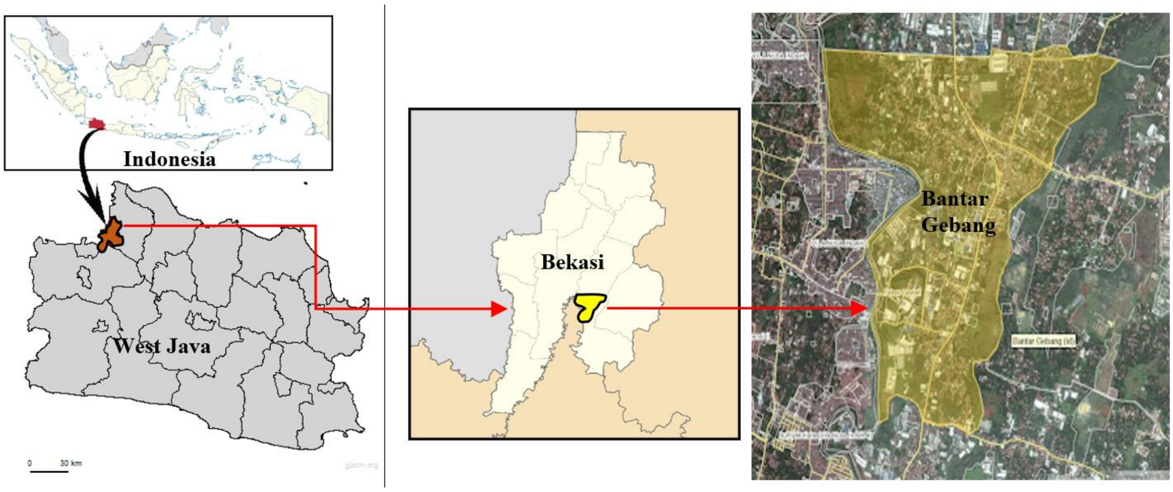

Fig. 1. Mapping Area of the FGD Bantar Gebang, East Bekasi, West Java, Indonesia

Pre-analytic stage consists of sampling stool, soil, and flies. Sampling stool is conducted from a dry place, and must not be contaminated with urine, water, or disinfectants. Children can defecate on the top surface of the toilet. The stool is taken as much as half a tube using a spoon that is already available in the stool tube. The stool tube is tightly closed, write the full name on the tube label paper, then put it in a plastic bag and store it. As for soil sampling were taken as much as 5-10 grams. One location point was taken with 3 replications at different places at each point of the soil location. Samples were collected in a closed container and then observed at the Parasitology Laboratory of STIKes Mitra Keluarga. Whereas for fly sampling were taken using insect nets at random from 3 zones, each zone was taken at three location points. The three zones include piles of wet garbage, piles of dry garbage, and piles of garbage overgrown with plants. Sample collection was carried out from 08.00-11.00 WIB. The flies were collected on plastic and then killed by placing them in the refrigerator and identified using the identification key Sanchez-Arroyo & Capinera (2020) and Irish *et al*. (2014). Identification of flies based on the morphological characteristics of the fly's body. The flies obtained were counted according to the genus and capture zone.

Analytical stage consists of examination of stool, soil, and flies. Stool examination use native, flotation, and Harada methods. The native method is carried out by dripping 1-2 drops of 0.9% physiological NaCl or 2% eosin solution separately on each end of a clean object glass. The stool is taken a little using a stick and placed in each solution then stirred until homogeneous, and covered with a cover glass. The preparations were examined under a microscope using a magnification of 40×. The flotation method was carried out by weighing 1 gram of stool and adding 10-12 ml of 33% NaCl solution and homogenizing it. The mixture is filtered with gauze or filter paper. The results of the filtration were collected in a 15 ml falcon tube and centrifuged for 4 minutes at a speed of 4000 rpm. The supernatant was taken using a dropper and placed on a glass object, then covered with a cover glass and observed using a microscope with a magnification of 40 times. The Harada Mori method carried out by smearing a stool sample in the center of the filter paper. The filter paper is put in a plastic clip and then drops of distilled water until the volume touches the end of the filter paper. The culture medium is placed at room temperature in a suspended position for 4-7 days. The culture media that had reached 4-7 days were homogenized, and the distilled water was taken using a dropper, then 2-3 drops were dripped on a sterile object glass and then covered with a sterile coverslip, and observed using a microscope with a magnification of 40×. Soil samples in this study were carried out using native and sedimentation methods. The sedimentation method was carried out by inserting 5 g of soil sample into a glass beaker, then adding 20 ml of 33% NaCl solution, then stirring until homogeneous. The sample was filtered using gauze. The results of the filtration were transferred into an 8 ml falcon tube and then centrifuged for 10-15 minutes at 1500 rpm. The precipitate was taken and then dripped onto a glass object, covered with a cover glass, and then observed with a microscope with 10×, 40×, and 100× magnifications. The fly examination was carried out using the sedimentation method, which was done by inserting the sample into a plastic bottle and adding 1 ml of physiological NaCl solution for 0.1 g of flies. Plastic bottles containing flies of the same genus are shaken to remove parasites from the fly's body surface. The shaking liquid was then transferred into a falcon tube and centrifuged at 3000 rpm for 5 min. The sediment was taken, placed on a glass object, covered with a cover glass, and observed with a light microscope with a magnification of 40×. The post-analytic stage carried out with a confirmation test by identifying worm eggs found in stool, soil, and fly samples. Identification of microscopic morphological characteristics of worm eggs using the ATLAS book on parasitological identification (Ash & Orihel, 2007).

Data analysis. The results of this study were processed in the form of tables and graphs. The data in the form of tables and graphs are then interpreted using descriptive analysis to clarify information regarding the description of STH in the FGD. The classification of helminthiasis prevalence in this study refers to the Vegvari (2019) which groups 3 categories, namely low (<20%), medium (25–30%), and high (60–70%).

RESULTS AND DISCUSSION

The examination stool samples taken from 79 children aged 5-9 years in the around FGD Bantar Gebang obtained six positive stools containing STH. The results of the percentage of STH in stool samples is provided in Table 1.

Table 1. Percentage of STH in stool samples

Result	Total (n)	Percentage (%)
Positive	6	7.60 %
Negative	73	92.40%
Total	79	100%

Table 1 shows that the percentage of stool samples containing STH 7.59%. The STH found in the stool samples included *A. lumbricoides*, hookworm, and *T. trichiura* eggs as shown in Fig. 2.

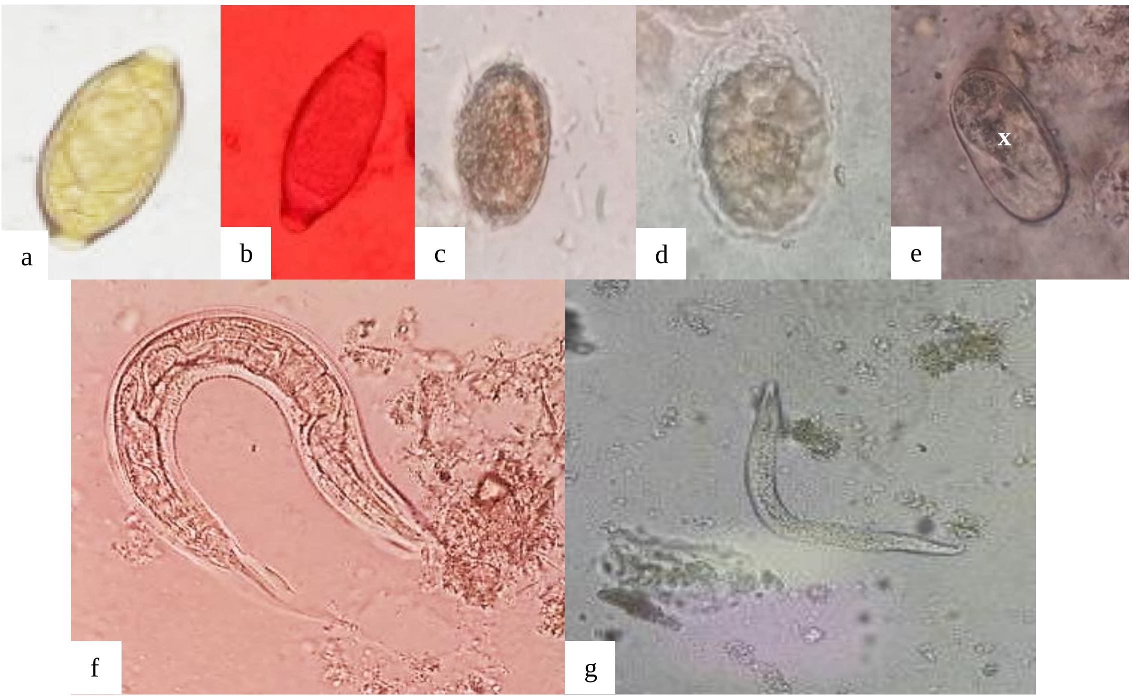

Fig. 2. Microscopic structure of STH eggs: a. *T. trichiura* (0.9% NaCl); b. *T. trichiura* (Eosin 2%); c. *A. lumbricoides* (fertile); d. *A. lumbricoides* (non-fertile); e. hookworm (x: contains larvae); f. microscopic structure of hookworm larvae: *Strongyloides stercoralis* (Harada Mori); g. hookworm. Native method (40× magnification)

The results of the examination of soil samples taken from 18 points in the around of FGD Bantar Gebang obtained 12 positive soils containing STH while six soils were negative STH. The results of the percentage of STH in the soil sample can be seen in table 2.

Table 2. Percentage of STH in soil samples

Result	Total (n)	Percentage (%)
Positive	12	66.7 %
Negative	6	33.3 %
Total	18	100%

Table 2 shows that the percentage of soil samples containing STH 66.7%. The STH found in the soil sample is hookworm which is shown in Fig. 3.

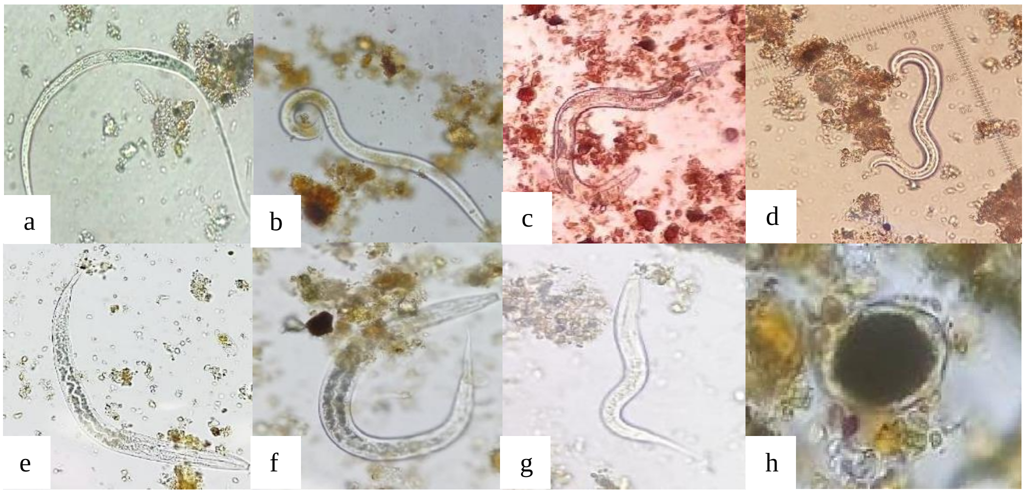

Fig. 3. Microscopic structure of hookworm larvae (a-g) and eggs (h) in soil samples. Examination of native and sedimentation methods (40× magnification)

The results of the examination of fly samples found the number of *Musca* sp. 538 (87%) and *Chrysomya* sp. 77 (13%). *Musca domestica* percentage which was found to be higher than *Chrysomya* sp. The results of this study also show that wet waste is the location point where flies are most commonly found. Overall, the number and percentage of fly genera found in the FGD Bantar Gebang can be seen in Table 3.

Table 3. Number and percentage of fly genera found in Bantar Gebang landfill

No	Genera	Location point			Total	Per. (%)
		Wet garbage	Dry garbage	Garbage overgrown plant		
1	*Musca domestica*	331	168	39	538	87
2	*Chrysomya* sp.	51	26	0	77	13

Fig. 4 visualized the phenotype of *Musca domestica*. and *Chrysomya* sp.

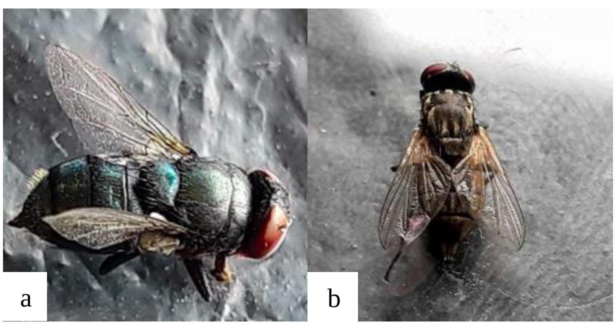

Fig. 4. Morphological structure: a. *Musca domestica*; b. *Chrysomya* sp.

In this study, the identification of parasites contained in the body of the fly *Chrysomya* sp. and *Musca* sp. The results of the identification of worm parasites found in the body of flies can be seen in Table 4.

Table 4. Number and percentage of parasitic worms found in *Musca domestica* and *Chrysomya* sp.

No	Species	*Musca domestica*	*Chrysomya* sp.	Number	Per. (%)
1	*A. lumbricoides.*	13	7	20	58.82
2	*Diphyllobothrium latum*	3	0	3	8.8
3	Hookworm	6	10	16	47.0
4	*Enterobius vermicularis*	2	0	2	5.88
5	*Hymenolepis* sp.	4	1	5	14.70
6	*Schistosoma* sp.	0	1	1	2.94
7	*Clonorchis sinensis*	2	0	2	5.88

Table 4 shows genus and species of parasitic worms found in the bodies of *Musca domestica* and *Chrysomya* sp. including *A. lumbricoides*, *Diphyllobothrium latum*, *Enterobius vermicularis*, hookworm, *Hymenolepis* sp., *Schistosoma* sp., and *Clonorchis sinensis*. The highest number of parasitic worms is *A. lumbricoides* as much as 20 (58.82 %). The results of the examination of parasitic worm eggs found in the fly's body presented in Fig. 5.

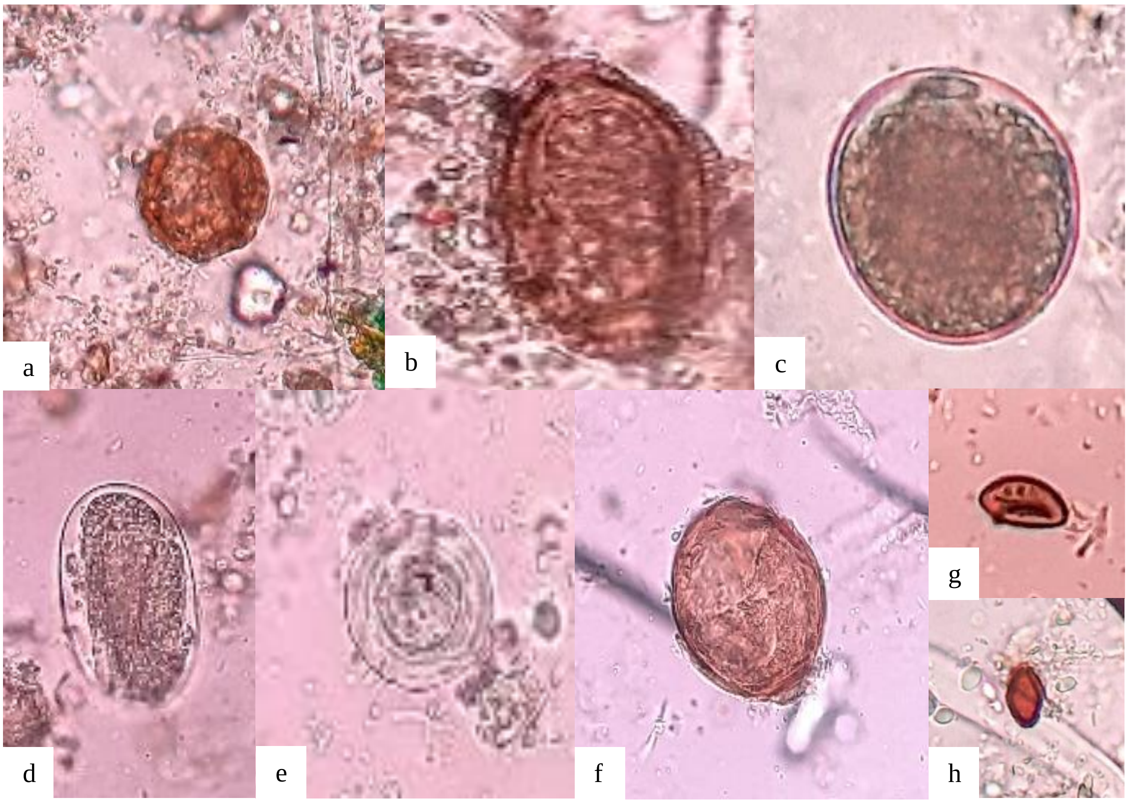

Fig. 5. Microscopic structure of worm parasite eggs found in the body of a fly: a. *A. lumbricoides* fertile; b. *A. lumbricoides* non fertile; c. *Diphyllobothrium latum*; d. hookworms; e. *Hymenolepis* sp.; f. *Schistosoma* sp.; g. *Enterobius vermicularis*; h. *Clonorchis sinensis* (40× magnification)

The results of examination of fecal stool on 79 children aged 5-9 years in the around of the FGD Bantar Gebang showed that 7.60% of children were positive for STH infection, while 92.41% showed STH negative. In general, the results of the percentage of positive STH children in this study were in a low category or below 10%. The low percentage of children who are positive for STH is because the environmental sanitation conditions of the FGD Bantar Gebang are quite good, including elementary schools in the area that already have closed toilets equipped with toilets and there are no piles of garbage in the school environment. As for personal hygiene, most the children already understand about washing their hands with soap before and after eating. According to Bartlett *et al*. (2022), the dominant factors that cause STH infection are determined by poor sanitation and socioeconomic demographics. Aung *et al*. (2022) reported that the WHO recommendation program in the form of mass administration of deworming drugs to school-age children could control STH infection, but was not effective in preventing the emergence of reinfection from STH. Reinfection can be effectively prevented by improving infrastructure in helminthiasis endemic areas, such as the provision of clean toilets and access to clean water. This increase is reinforced by health education in the form of socializing the application of clean and healthy living behavior by washing hands with soap, maintaining food and environmental hygiene.

Eltantawy *et al*. (2021) explained that STH is a group of worms that require soil for maturation of eggs or infective larvae. Transmission of infective eggs or larvae from the soil into the body of the host occurs through food and fingers contaminated with STH infective eggs or larvae that penetrate the skin. Therefore, the condition of poor people is more susceptible to infection with STH considering that poor people have bad hygiene and sanitation, low education levels and poor living habits. Meanwhile, 7.60% of children who were positively infected with STH were still found because there were still children who worked to help their parents to collect garbage around the landfill. Children who help their parents make a living are less likely to use gloves, masks, and footwear so that they are exposed to contamination by eggs or STH larvae. The results of this study are different from the study of Omotola & Ofoezie (2019) which reported that the prevalence of STH among school children in Ifetedo, Osun State, Nigeria was 44.2% with the risk factor for causing STH being the presence of open toilets around homes and schools. Gupta *et al*. (2020) reported that the high prevalence of STH in school children aged 6–14 years in East Delhi was 54.8% with a majority of 85.3% of *Ascaris* and *Trichuris* caused children having poor handwashing behavior at school, irregular handwashing before eating, and lack of de-worming The same finding by Workineh *et al*. (2020) who reported that 340 children aged 5-18 years in Rural Debre Tabor, North West Ethiopia only 24 (7%) children were positive for STH. The very low percentage of STH in the area is due to the availability of well-functioning toilets and all children being directed to use closed toilets when urinating and defecating, the development of a rural water system to provide clean drinking water, ventilated toilets in every house, and policies which recommends administering albendazole or mebendazole twice a year for preschool and school age children.

Idowu *et al*. (2022) added that the practice of non-hygiene behavior in places with poor sanitation in landfills, especially in school-age children is at risk of increasing the prevalence of STH infection. The same thing was also reported by Chelkeba *et al*. (2022), Muluneh *et al*. (2020), Kache *et al*. (2020), and Rahimi *et al*. (2022) who concluded that personal hygiene needs to be socialized as a deworming program for people living in areas with poor sanitation to prevent the spread of STH infection. The infection will increase if the water consumed is not cooked first, defecate on the ground, and the habit of children sucking their fingers.

The genus or species of STH in the stool samples in this study included *A. lumbricoides* eggs, *T. trichiura*, hookworm eggs, and larvae. This study also examined soil samples around the research site which found hookworm eggs and larvae. The results of this study complement the systematic review study conducted by Riaz *et al*. (2020) who reported that three main species of STH predominantly infect school-age children in areas with poor sanitation, hygiene, and water sources in various countries, including *A. lumbricoides*, *T. trichiura*, hookworm (*Ancylostoma duodenale, Necator americanus*), and *Strongyloides stercoralis.*

The results of the examination of soil samples in this study showed that 66.7% contained hookworm eggs and larvae, but no *A. lumbricoides* and *T. trichiura* eggs were found. This is because hookworm eggs and larvae have high viability to survive at the research site with the characteristics of the soil texture being a mixture of sand and clay with temperatures between 28ºC-32ºC and 80%-90% humidity. According to Hassan & Oyebamiji (2018) and Haziqah *et al*. (2021) a combination of sandy (75% sand) and silty (15% silt) soil can provide optimal oxygen and moisture for the development of hookworm eggs or larvae. This worm also has a wide pH tolerance range between 4.6-9.4 with a survival rate of 3 weeks. The eggs of *A. lumbricoides* and *T. trichiura* were not found because the two worm eggs could not survive long at that temperature. This is explained in the study of Bosch *et al*. (2021) which reported that the eggs of *T. trichiura* and *A. lumbricoides* could survive well at an optimal environmental temperature of 20.25 ºC-27.75 ºC and an optimal soil temperature of 31.54 ºC. Khurana *et al*. (2021) added that the detection of STH in soil samples was also influenced by the ability to stick STH eggs to the soil texture. STH eggs stick better to clay and loam soils than sandy soils.

The research results of Nisha *et al*. (2019) explained that hookworms are more dominant and survive in soils with sand and clay textures because hookworm larvae move more easily to the surface and in sandy soils, besides that sandy soils have larger pores than clay and clay soils which facilitate the movement of oxygen and water. The presence of clay mixed in sandy soil further increases the water content and organic matter needed for hookworm survival. Oh *et al*. (2021) added that the eggs of *A. lumbricoides* and *T. trichiura* require more water and organic matter so that the eggs are more resistant to clay soils which tend to store more water and organic matter.

Other samples that were examined were flies as mechanical vectors of parasitic worm eggs into the human body through food and drink. The genus of flies found in this study was *Musca domestica* and *Chrysomya* sp. According to Sanchez-Arroyo & Capinera (2020), *Musca* sp. and *Chrysomya* sp. is a genus of flies that are easily found in the environment around humans and can act as mechanical vectors of various parasites, including parasitic worms. Parasites generally attach to the legs, wings, and body of the fly. The fly's feet are equipped with fine hairs that contain adhesive liquid so that parasites can easily attach to the fly's feet. One of the parasites attached to the fly's body is worm eggs. The flies that are attached to the worm eggs then land and cause the worm eggs to move on to food and drink. If these foods and beverages are consumed, they have the potential to cause health problems for humans (Benelli *et al*., 2021; Muthmainnah *et al.*, 2021).

As for this study, the highest number of flies was found in the zone of wet waste piles compared to the dry waste and overgrown with plants. This is because wet waste contains more organic matter as a source of food and a place for reproduction and laying eggs for flies. The dominant type of fly found in this study was *Musca domestica* compared to *Chrysomya* sp. This is because *M. domestica* prefers habitats with a variety of organic matter from the remains of household waste which are more commonly found in the FGD Bantar Gebang, while *Chrysomya* sp. is found less because the adult and larval phases have a habit of living on decaying carcasses of fish and mammals (Badenhorst & Villet, 2018) and are found in small numbers in the Bantar Gebang landfill.

The results of the examination of parasitic worms on samples of *M. domestica* and *Chrysomya* sp. flies found the presence of eggs of *A. lumbricoides*, *T. trichiura*. *D. latum*. *E. vermicularis*, *C. sinensis*, hookworms, *Hymenolepis* sp. and *Schistosoma* sp. The results of this study following the research of Muthmainnah *et al.* (2021) and the results of a literature review study from Issa (2019) which reported that flies are mechanical vectors that carry the spread of various parasites such as *E. vermicularis*, *S. stercoralis*, *T. trichiura*, and *T. caracanis*, *Trichomonas*, *Diphyllobothrium* sp., *Hymenolepis* sp., *Taenia* sp., and *Dipylidium* sp.

The limitations of this study are that the design used is still simple in the form of a cross-sectional, complete data collection on sanitation, hygiene, and habits of school children as research subjects has not been carried out, and data analysis still uses quantitative descriptive, no analysis has been carried out on the relationship of factors which influence and correlate with the incidence of helminthiasis. The advantages of this study are the use of three examination samples in the form of stool, soil, and flies, the use of various methods of examining samples of stool, soil, and flies, as well as objects and subjects that are on target.

CONCLUSION

Monitoring the incidence of STH helminthiasis in school-age children living in the final landfill area of Bantar Gebang, East Bekasi, Indonesia, still found that there were children who were positively infected with STH worms with a percentage of 7.60% or low category. Therefore, it is necessary to carry out a clean and healthy life education program to reduce the incidence of helminthiasis so that it does not fall into the high category.

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