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RESEARCH ARTICLE

Soil-Transmitted Helminths Contamination on the Yard's Soil of the Public Elementary Schools in Bandung City

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Abstract

Soil contamination by soil-transmitted helminths (STH) on the schoolyard can act as reservoir STH infection for students. The STH contamination on soil due to contamination of human and animal waste which was disposed of inappropriately. This study aimed to determine the presence of STH eggs in the yard's soil of public elementary schools in Bandung city. This research was an analytic observational study with a cross-sectional approach during September 2019. This study's samples were 97 surface soil of the public elementary schoolyard in Bandung city, selected randomly. Microscopic identification is made for identifying the STH contamination on soil samples. STH contaminates about 66% yard's soil of public elementary schools in Bandung city. We identified larva nematode, *Ascaris* eggs, *Trichuris* eggs, *Toxocara* eggs, and *Capillaria* eggs. The most common STH we had found was larvae nematode (53%). There is a correlation between flood and human STH contamination on soil (p=0.015). We concluded that STH contaminates the yard's soil of the public elementary schools in Bandung city. The source of STH contamination is from human and animal waste. Flood has a role in spreading human waste on the soil.

Keywords: Contamination, soil, soil-transmitted helminths

Kontaminasi *Soil-Transmitted Helminth* pada Tanah Pekarangan Sekolah Dasar Negeri Kota Bandung

Abstrak

Pencemaran tanah oleh *soil-transmitted helminth* (STH) di halaman sekolah dapat menjadi reservoir penularan STH bagi siswa. Pencemaran ini dapat terjadi akibat pengelolaan kotoran manusia dan hewan yang tidak tepat. Penelitian ini bertujuan mengetahui keberadaan telur STH di tanah pekarangan sekolah dasar negeri di Kota Bandung. Penelitian ini merupakan penelitian observasional analitik dengan pendekatan *cross-sectional* yang dilaksanakan pada bulan September 2019. Sampel penelitian berjumlah 97 tanah permukaan halaman sekolah dasar negeri di Kota Bandung yang dipilih secara acak. Identifikasi mikroskopis dilakukan untuk mengidentifikasi kontaminasi STH pada sampel tanah. Data banjir didapatkan dari wawancara dengan penduduk sekitar. Pencemaran STH terjadi pada 66% sampel. Kami mengidentifikasi larva nematoda, telur *Ascaris*, telur *Trichuris*, telur *Toxocara*, dan telur *Capillaria*. Jenis STH yang paling banyak ditemukan adalah larva nematoda (53%). Terdapat korelasi antara banjir dan pencemaran STH manusia di tanah (p=0,015). Kami menyimpulkan bahwa tanah pekarangan sekolah dasar negeri di Kota Bandung tercemar STH. Sumber pencemaran STH berasal dari kotoran manusia dan hewan. Banjir berperan dalam menyebarkan kotoran manusia di tanah.

Kata kunci: Kontaminasi, *soil-transmitted helminth*, tanah

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Introduction

Contaminated soil can be the source of diseases, one of which is a disease caused by soil-transmitted helminths (STH).[1,2] Soil contamination by human waste can occur if human waste management is inappropriate. Factors that contribute to it are the absence of a standard septic tank. The wastewater can overflow and spread to the environment during floods or the human waste disposal straight into rivers, polluting the soil during floods.[3] Then the soil-transmitted helminths eggs or larva in human waste contaminate soil and develop into infective stage.[1,2]

Ascaris lumbricoides, *Trichuris trichiura*, *Ancylostoma duodenale*, *Necator americanus*, and *Strongyloides stercoralis* are STH that infect humans. Soil-transmitted helminths infect about 24% of the world's population.[1,2,4] The incidence rate of STH infection in Indonesia is 2.5–76.67%. Infection by *Ascaris lumbricoides* and *Trichuris trichiura* mainly occurs in pre-school and elementary school children. The incidence rate of STH infection in primary school age in Indonesia is 60–80%.[5] Otherwise, the incidence of *Ancylostoma duodenale* and *Necator americanus* infections mainly occurs in young adults.[1,2,4]

Besides contamination by human waste, STH contamination on soil can also occur by animal waste contamination.[6] The incidence of STH in dogs and cats is relatively high.[7–16] About 37.8% of cat litter in Surabaya contains STH eggs, and about 34.21% of stray dogs in Bali are infected with STH.[15,16] *Ancylostoma* sp. and *Toxocara* sp. was the most common species that infect dogs and cats. Helminths that infect animals can also infect humans, and vice versa (helminthic zoonosis). This zoonotic disease is one of the neglected diseases, which is a world problem.[7–16] Research in Thailand states that *Strongyloides stercoralis* in cats can cause zoonotic diseases in humans.[17] *Ancylostoma ceylanicum*, a cat and dog hookworm, is the second most common human hookworm in Asia.[18] Seroprevalence *Toxocara* sp. in humans also reached 19% in Europe.[19]

The schoolyard is one of the places which is contaminated by animal waste. The schoolyard is also a place to play for children of primary school age, which allows for contact between children and the soil.[12,15]

This study aims to determine the presence of STH eggs in the yard's soil of public elementary Schools in Bandung city.

Methods

This research was an analytic observational study with a cross-sectional approach and was conducted in September 2019. This study's sample was the surface soil of the public elementary schoolyard in Bandung city, which was selected randomly. The formula obtains the minimum number of samples for the number of descriptive samples, and the minimum sample size was 97 samples. Flood status was carried out by asking questions to the people who lived around at the sampling site. The dried soil sample was sifted to remove solid objects. Then 3 g sample was put into a 15 mL centrifugation tube. Twelve milliliters of 5% sodium hydroxide (NaOH) was poured into the sample, shake, and then left for one h to separate eggs from the soil. The sample was then centrifuged for 2 minutes with 2.000 rotations per minute (rpm) to settle the eggs on the bottom. The supernatant was discarded, and the sediment was washed three times with distilled water. After washing, the sediment was resuspended in saturated sodium chloride (NaCl). We placed the tube into the stand add saturated NaCl in a pipette until the fluid was raised to the tube's brim. Left it for 15 minutes, then placed a coverslip on the fluid's surface for 5 minutes for sticking parasitic eggs to the glass. Placed the coverslip on the slide and observed the sample under the microscope at 100 and 400 magnification.

The study protocol had approved by the Health Research Ethics Committee of the Faculty of Medicine, Universitas Islam Bandung.

Results

The soil samples we got from 97 public elementary schoolyards in Bandung city were selected by random sampling. The public elementary school distribution in which the soil sample was taken describes in Figure 1.

The result of soil examination for STH contamination in Duplo examination is described in Table 1. Soil-transmitted helminths (STH) contaminate about 66% yard's soil of public elementary schools in Bandung city.

We identified the eggs and larva STH from soil samples. The larvae of the nematode showed the highest contamination. We found it in 53% yard's

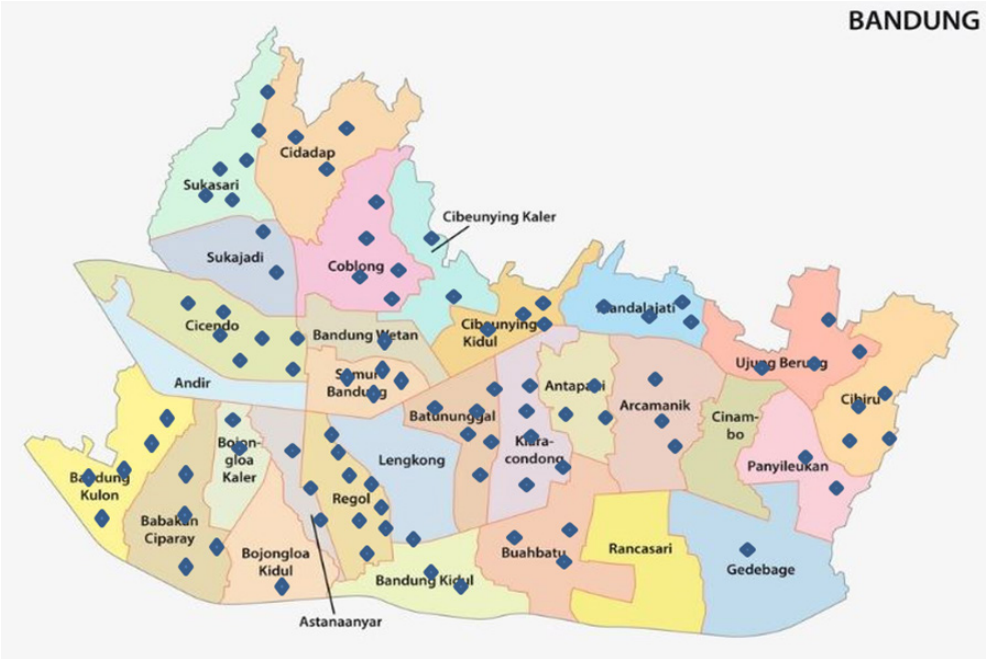

Figure 1 Area of Public Elementary Schools which Selected for Soil Examination

soil sample (Table 2). We could not differentiate the larva of hookworm or *Strongyloides*, so we grouped both of them as nematode larva (Figure 2a). We also found the *Trichuriasis* eggs (Figure 2b), which is similar to *Capillaria* (Figure 2c). Both eggs have a barrel shape with a polar plug, but the polar plug of *Capillaria* is asymmetry. *Ascaris's* eggs, which are spherical and thick walls, are identified (Figure 2d). We found the eggs of *Toxocara*, the morphology similar to *Ascaris's* eggs with a larger size (Figure 2e).

Ascaris and *Trichuris* are STH that infected humans. *Toxocara* and *Capillaria* are STH which infected animals. Nematode larva that we found

Table 1 STH Contamination on Soil of Public Elementary Schoolyard in Bandung City

STH Contamination	Number of Sample (n=97)	Percentage (%)
Positive	64	66
Negative	33	34

Table 2 Soil-Transmitted Helmints Identification

STH Eggs	Number of Sample (n=97)	Percentage (%)
Ascaris	7	7
Trichuris	11	11
Toxocara	5	5
Capillaria	2	2
Nematode larvae	51	53
Negative	21	22

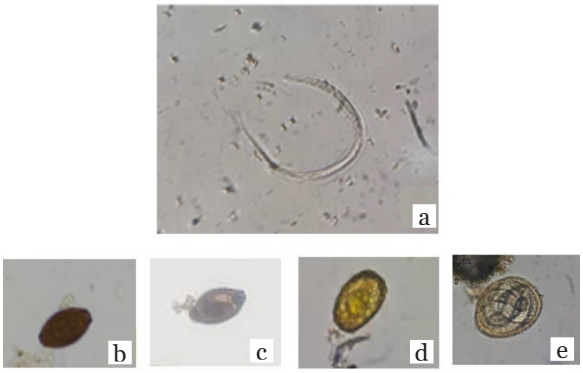

Figure 2 Nematode Larvae (a), *Trichuris's* Egg (b), *Capillaria's* Egg (c), *Ascaris's* Egg (d), and *Toxocara's* Egg (e) in 400 Magnification

Table 3 Correlation between Flood and Contamination of Human STH

Flood	Human STH		p Value
	Positive	Negative	
Yes	7	15	0.015
No	8	67	

Table 4 Correlation between Flood and Contamination of Nematode Larva

Flood	Nematode Larva		p Value
	Positive	Negative	
Yes	11	11	0.78
No	40	35	

could be *Strongyloides* larva with a free-living life cycle on soil or hookworm that infected animals or hookworms that infected humans.

The source of human STH contamination on soil can be from a flood that can spread the human waste which was not managed properly, such as dumped in the river. Because of it, we analyzed the correlation between flood and contamination of *Ascaris* and *Trichuris* eggs on the soil (Table 3).

There was a correlation between flood and contamination of human STH on soil (p=0.015) after analyzing data with chi-square. The source of contamination larva nematode found on soil samples could be from humans or animals or could be just a free-living nematode on the soil. We analyzed the correlation between flood and nematode larva contamination on the soil to predict the source of nematode larva contamination (Table 4).

There is no correlation between flood and contamination of nematode larva on soil (p=0.78).

Discussion

In this research, we identified contamination of STH, which infected humans on the soil. They are *Ascaris* and *Trichuris*. We found 7% *Ascaris* eggs and 11% *Trichuris* eggs from 97 soil samples. This result indicated human waste contamination on soil, which corresponding to the low endemicity of helminthiasis in Bandung city.[20] Although the prevalence of *Ascaris* and *Trichuriasis* was not too high. It could still be a potential source for *Ascariasis* and *Trichuriasis* to elementary students. *Ascaris* and *Trichuris* lives in the human intestine and causes diarrhea, anemia, and poor cognitive develompment.[1,21,22]

The statistical analysis showed a correlation between and contamination of human STH on soil (p=0.015). It indicated that flood has a role in spreading STH contamination on the soil. A flood can cause overflow and spread human wastewater on the ground when human waste had improper management, such as not dumped to the standard septic tank or dumped it to the river.[11]

In this study, nematode larvae were found in 53% of the soil sample. Because there was no correlation between flood and contamination of nematode larva on soil (p=0.78), we conclude that the source of nematode larva contamination was not from human waste. The source of animal STH contamination on soil can be from animals that dispose of their waste at the schoolyard due to the lack of animal supervision.[6,8,10,23–25] This soil contamination by animal waste can cause zoonotic diseases to public elementary school students in Bandung city.

We found the nematode larva could be *Strongyloides*, a free-living life cycle on soil, or larva animal hookworm. *Strongyloides* have a free-living life cycle nematode in soil, but *Strongyloides stercoralis* is also a parasite in humans, cats, and dogs. In this case, cats and dogs are reservoirs for humans. In human, *Strongyloides stercoralis* can cause diarrhea in human and even death in immunocompromised patients.[1,27]

The hookworm that infected dogs and cats are *Ancylostoma ceylanicum* and *Ancylostoma braziliensis*.[6–10,12–18] Both dog's and cat's hookworms can cause zoonotic diseases in humans. *Ancylostoma ceylanicum* can develop into an adult in the human intestine and lead to anemia, cognitive impairment, and enteritis in humans.[1,14,18] *Ancylostoma braziliensis* larvae that enter human skin can cause cutaneous larvae of migrants in humans. The *Ancylostoma braziliensis's* larvae can penetrate human skin but cannot penetrate the basal layer of the human's epidermis due to a lack of enzymes. Therefore, the larvae migrate and cause inflammation in the human epidermis resulting in itchy serpiginous

lesions.[1,26]

In this study, we also identified eggs of STH that belong to dogs and cats. They were *Toxocara* and *Capillaria*. *Toxocara* is a nematode that infects cats and dogs.[11,19,23,24] These nematodes live in the intestines of cats and dogs. *Toxocara* cannot develop into adults in the human body, but *Toxocara's* larvae can cause visceral larvae migrant if humans accidentally eat the eggs. The swallowed eggs will hatch in the human stomach. The larvae will penetrate the intestines and enter the bloodstream until they reach the organs and then cause inflammation.[9,23,24,28]

Capillaria eggs found in the schoolyard can also cause disease in humans who accidentally eat them. Although the disease is rare, *Capillaria hepatica* can cause hepatitis in humans. *Capillaria hepatica* is a helminth that lives in rat liver tissue. Its eggs can contaminate the soil through the waste of cats or dogs when cats or dogs eat rats suffering from capillariasis.[28,29]

Conclusions

Soil-transmitted helminths (STH) contaminates around 66% of public elementary schoolyards in Bandung city. The sources of STH contamination are from human and animal waste. Flood has a role in spreading human waste on the soil.

Conflict of Interest

The authors state that there is no conflict of interest.

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