

Correlation Between Soil-Transmitted Helminth (STH) Infection and Eosinophil Score on Residents Around Landfill of Mojosongo Village, Jebres Sub-District, Surakarta City

Rochmadina Suci Bestari¹, Supargiyono², Sumarni³, Suyoko⁴

¹Master Program in Basic Medical & Biomedical Science, Universitas Gadjah Mada, Yogyakarta, Indonesia;

^{2,3,4}Department of Parasitology Faculty of Medicine, Universitas Gadjah Mada, Yogyakarta, Indonesia.

Corresponding author: supargiyono@gmail.com

ABSTRACT

Introduction: Soil-Transmitted Helminth (STH) infected more than one million people all over the world. In Indonesia, the prevalence of STH infection is still high in a few places, some of them are 40-60 % of all ages, with different species of helminth and intensity. Citizens around landfills usually has unhealthy sanitary and life style. Some data indicated that they often suffer allergic symptoms, like itchy on the skin and chronic coughing which could be due to STH infection.

Objectives: This study was held to know the relationship between STH infection and eosinophil score at citizens around landfills of Kelurahan Mojosongo Kecamatan Jebres Kota Surakarta, Central Java, Indonesia.

Methods: Stool and blood sample from 96 citizens of study site who agreed to participate (by *informed consent*) were collected. Kato-Katz method was used to determine the helminths infection intensity. Eosinophil count was done on thin blood smear stained with Giemsa to identify the percentage of eosinophil among other cells on the blood smear subjects. .

Results: Prevalence of STH infection was 7,29% (7/96) with egg density of 61 Eggs Per Gram Feses (EPGF). Single type of helminth infection occurred among the participants and there was no co-infection. *Hookworm* infection was 6,25% (6/96) and *Trichuris trichiura* infection was 1,04% (1/96). There was no *Ascaris lumbricoides* infection. All of them were fall into category of light infection. The prevalence of eosinophilia was 27,8% (26/96) with 2,63% mean eosinophil percentage. There was a very weak association between STH infection intensity and eosinophil score ($r=0,190$; $p=0,032$).

Conclusion: The prevalence of STH infection of the population around landfills of Mojosongo, Surakarta was 7,29% and predominated by Hookworm. There was a very weak association between STH infection intensity and eosinophil score ($r=0,190$; $p=0,032$).

Keywords: STH infection, STH infection intensity, eosinophil score, Kato-Katz, eosinophilia

INTISARI

Pendahuluan: *Soil-Transmitted Helminth* (STH) menginfeksi lebih dari satu milyar orang di seluruh dunia. Di Indonesia, prevalensi STH di beberapa tempat juga masih tinggi, ada diantaranya dengan prevalensi 40-60 % pada semua umur, dengan jenis cacing dan intensitas yang berbeda-beda. Masyarakat yang tinggal di sekitar Tempat Pembuangan sampah Akhir (TPA) biasanya sanitasi lingkungan dan kebiasaan hidupnya tidak sehat. Beberapa data menunjukkan bahwa mereka biasanya mengeluhkan adanya gejala alergi seperti gatal-gatal pada kulit dan batuk kronis yang sangat mungkin disebabkan oleh infeksi STH.

Tujuan: Penelitian ini dilaksanakan untuk mengetahui hubungan infeksi STH dengan angka eosinofil pada masyarakat di sekitar TPA Kelurahan Mojosongo Kecamatan Jebres Kota Surakarta, Jawa Tengah, Indonesia.

Metode : Sampel tinja dan darah dikoleksi dari 96 warga yang bersedia berpartisipasi (dengan *informed consent*). Metode Kato-Katz digunakan untuk mengetahui adanya infeksi STH dan mengetahui intensitas infeksinya. Hitung eosinofil dilakukan pada sediaan apus darah tipis yang dipulas dengan Giemsa untuk mengetahui persentase eosinofil pada penderita.

Hasil: Prevalensi infeksi STH secara keseluruhan sebesar 7,29% (7/96) dengan rata-rata jumlah telur 61 telur per gram feses. Semua menderita infeksi tunggal dan tidak ada yang infeksi campuran. Infeksi *hookworm* sebesar 6,25% (6/96) dan infeksi *Trichuris trichiura* sebesar 1,04% (1/96). Tidak ditemukan infeksi *Ascaris lumbricoides*. Semuanya menderita infeksi ringan. Prevalensi eosinofilia adalah 27,8% (26/96) dengan rata-rata persentase eosinofil 2,63%. Terdapat hubungan yang signifikan antara intensitas infeksi STH dengan angka eosinofil, dengan kekuatan sangat lemah ($r=0,190$; $p=0,032$).

Simpulan: Terdapat hubungan yang signifikan antara intensitas infeksi STH dengan angka eosinofil, dengan kekuatan sangat lemah ($r=0,190$; $p=0,032$).

Kata kunci : infeksi STH, intensitas infeksi STH, angka eosinofil, Kato-Katz, eosinofilia

INTRODUCTION

Soil-Transmitted Helminth (STH) infected more than one million people all over the world¹. In Indonesia, the prevalence of STH infection is also still high, in many places such as in rural areas where the educational level is still low and have poor socio-economic status which resulted in unhealthy environment and life style, may reached up to 40-60 % of all ages, with variety of species and intensity².

There are three most common STH in Indonesia. They are *Ascaris lumbricoides*, *hookworm* dan *Trichuris trichiura*³. These nematodes are parasites of human which commonly inhabited in the small intestine. The male and female worms gain their nutrient from digested food in surrounding environment. Several days after mating the gravid female worms will secreted thousands of eggs into the lumen of the intestine which concomitantly will be secreted out together with the feces. In the area where people still have unhealthy habit such as defecate in lavatory landfill around

the house or in the garden, the worm eggs will pollute all the surrounding soil and become a high-risk area of the spreading of STH infection.

Garbage disposal is another problem in many developing countries especially countries with huge population density such as Indonesia. In this situation people still have unhealthy habit to dispose garbage anywhere, in the irrigation canals and river which may causing flooding during rainy season. Garbage dump around housing estate usually also have a negative impact such as attract people (garbage collector) to come into the garbage dump to find recycled materials and therefore may affect their health status such as higher risk to get STH infection.

To have a view on the effect of garbage dump around housing estate on the prevalence of STH infection can be carried-out by examining the stool sample from the population. The diagnosis of the STH infection can be confirmed by the specific microscopic morphology of helminth egg in stool preparation. The standard method for the quantitative stool examination is by Kato-

Katz². This method can also be used to classify the intensity of STH infection, by which can be classified into mild, intermediate and heavy infection. The classification is different for each type of helminth².

During the life cycle of the intestinal nematodes the worm larvae migrate from blood circulation into the alveolae producing a chronic coughing and allergic symptom of urticaria on the skin named as “Loefer Syndrome” accompanied by the increased of Ig E and Eosinophilic cells. This condition can be determined by routine blood analysis test which are characterized by eosinophilia⁴. Eosinophilia, represents a marker of Th2 cell responses, which are very common occur during helminth infection⁵. However, eosinophilia also occurs on some condition, like wheezing, rhinitis allergica, exzema and antibiotic medication^{6,7}. This study was aimed to know the correlation between STH infection and eosinophil score on residents around landfill of Mojosoongo Village Jebres Sub-district Surakarta City, Central Java, Indonesia.

MATERIALS AND METHODS

This study is observasional analitic, by cross sectional design and was stool sample were collected from the population in RW 30 Kelurahan Mojosoongo which is situated around landfills (Garbage dump) Putri Cempa, Mojosoongo, Surakarta. Stool and blood smears were collected from 96 residents of randomly selected subject. This site was chosen since the preliminary study on four residents, all of them had STH infection, two of them had mixed infection and another two had single infection. Sample size was determined by using Lwanga and Lemeshow (1991) formula⁸ :

$$N = \frac{1,96^2 \times 0,5 \times 0,5}{0,1^2}$$

Data Collection

Ethical clearance of the study was granted by the Ethical Committee of the Faculty of Medicine, Gadjah Mada University. Selected population were invited to the local Health Center for peripheral blood sample collection. A total of 96 blood sample were processed for thin blood smear preparation. After air drying, blood smears were stained with 5% Giemsa for 20 minutes. The percentage of the Eosinophils among other white blood cell were determined microscopically.

After blood sample preparation was completed, the citizens were given stool pot containing 4% of formalin and were explained how to collect the stool sample into the pot and how to write sample identification. They were also asked to collect the stool pot at “Pak RT” house. Stool samples were then taken by researcher to be examined at Parasitology Laboratory, Medical Faculty GMU Yogyakarta.

Stool sample were processed for quantitative stool examination using Kato-Katz Method to determine the STH infection and to know the intensity of the infection. Stool was stirred homogenously then put 5 grams on oil paper. Metallic wire was then placed on the stool and pressed so the stool was filtered through it. A specific perforated cardboard was placed on an object glass, the filtered stool was printed in the intire hole so that the amount of stool was approximately 30 mg. The was then covered by celophan tape which previously have been soaked in a solution of glycerol-malachite green within 24 hours. The stool preparation was spreaded and flattened so that the stool spreaded to filled all space under the celophan tape. The preparation were then be left at room temperature for at least 30 minutes to be transparent, and then examined under

microscope with the magnification of 400 times. The number of eggs founded in 30 mg feces was counted for each species of STH.

Data analysis

The data of the characteristic of individual sample such as age, gender, occupation and level of education were collected by filling the questionair and were calculated accordingly. The percentage of Eosinophil and the number of eggs / gram of feces from quantitative Kato-Katz examination of each individual sample were

recorded in ratio scale, and then their correlation were analyzed using Spearman correlation test.

RESULTS AND DISCUSSIONS

The study was conducted in the population who lives around garbage dump of the sub-village (“Kelurahan”) of Mojosongo , “Kecamatan” Jebres Surakarta City. The number of subjects to be studied were 96 residents of RW 30 Mojosongo Village Jebres Sub-district Surakarta City who collected blood and stool samples.

Tabel 1. The distribution of subjects of residents around garbage dump (landfill) of Mojosongo Village Jebres Sub-district Surakarta City according to age, gender, level of education and occupation

Characteristic	Amount	Percentage (%)
Age (years)		
• 6-10	8	8.3
• 11-20	8	8.3
• 21-30	14	14.6
• 31-40	27	28.2
• 41-50	24	25
• 51-60	7	7.3
• 61-70	5	5.2
• >70	3	3.1
Gender		
• Male	40	41.7
• Female	56	58.3
Level of education		
• Not schooling	11	11.5
• TK (pre-school)	3	3.1
• SD (Elementary)	35	36.5
• SMP (Secondary)	25	26
• SMA (High-school)	20	20.8
• D3/S1 (Undergraduate)	2	2.1
Occupation		
• job-less	14	14.5
• housewife	3	3.1
• private sector	34	35.4
• employee/worker/civil servant	11	11.5
• teacher	2	2.1
• Pupil (school-age)	11	11.5
• trader/self-employed	5	5.2
• Recycled material collector	16	16.6

From Table 1 it can be shown that the age of subjects ranged from 6 years to 80 years old. Mean of the age was 37.83 years (6-80 years). According to gender, the ratio of male : female = 2 : 3 (40/56). From table 1 it can be known that majority of the subjects have level of education of primary school, which is 36.5%. Whereas the subjects that have level of education of undergraduate is just 2.1%. From the occupation, the majority of the subjects are from private sector and the other second largest have job that related to garbage who their main activities are collecting recycled material from garbage dump to be sold to a kind of company of producing utensil from recycled materials. These type of people will always in contact with household garbage which might be contaminated with infectious materials including intestinal nemathod eggs.

Table 2. The prevalence of STH infection among residents around garbage dump (landfills) of Mojosongo Village Jebres Sub-district Surakarta City

Type of helminth	No. of positive	Percentage (%)
<i>Ascaris lumbricoides</i>	0	0
Hookworm	6	6,25
<i>Trichuris trichiura</i>	1	1,04
Negative	89	92,71
Total	96	100

From Table 2, it can be known that the prevalence of STH infection in RW 30 is 7.29% (7/96). It consists of hookworm infection 6.25% (6/96) and *T. trichiura* infection 1.04% (1/96) and *A. lumbricoides* and mixed infection was not found . In this study, the prevalence of hookworm infection is higher than *T. trichiura* infection. *Trichuris trichiura* infection was very rare, just one subject.

Table 3. Distribution of STH infection on residents around landfills of Mojosongo Village Jebres Sub-district Surakarta City based on gender, job and age

Characteristic	Type of STH	
	Hookworm	<i>Trichuris trichiura</i>
Gender		
• Male	3 (50%)	0 (0%)
• Female	3 (50%)	1 (100%)
Occupation		
• Scavenger	5 (83,3%)	0 (0%)
• Jobless	1 (16,7%)	1 (100%)
Age		
• 6-10	0	0
• 11-20	0	0
• 21-30	2	0
• 31-40	0	1
• 41-50	1	0
• 51-60	1	0
• 61-70	0	0
• >70	2	0

From Table 3, it can be concluded that female subjects infected by STH are more than male subjects (4:3). Majority of the subjects which infected by STH have job as scavengers, 71.42% (5/7). The age of the subjects who infected with hookworm, 50% (3/6) of it is 30-44 years old whereas 50% (3/6) is >50 years old. The subject infected by *Trichuris trichiura* is 40 years old.

Table 4. The intensity of STH infection on the residents around landfills of Mojosongo Village Jebres Sub-district Surakarta City

Type of STH	RTPG	Intensity	Amount
Hookworm	33	mild	3
	66	mild	1
	99	mild	1
	132	mild	1
<i>Trichuris trichiura</i>	33	mild	1

From Table 4, it showed that the intensity of STH infection was mild, not only on hookworm infection but also *T. trichiura* infection. The

average of the number of eggs was 61 egg per gram of stool.

Table 5. The percentage of eosinophils among the residents around garbage dump (landfills) of Mojosongo Village Jebres Sub-district Surakarta City

Level of Eosinophil count	Catagory of eosinophilia	Amount (person)	Percentage
0 % - 3 %	normal	70	72.9
4 % - 6 %	mild	24	25
7 % - 9 %	intermediate	2	2.1
> 9 %	high	0	0
Total		100	

From table 5, it can be seen that the percentage of individu with eosinophilia is 27.1 % and individu with normal level of eosinophils is 72.9%.

During this study eosinophil count was conducted microscopically by the researcher and for quality control the result were compared with the readings of the profesional technition from acredited laboratory and the value of Kappa Coefficient from 10 sample readings was 0.44, or intermediate.

Table 6. Correlation of STH infection and eosinophilia on the residents around garbage dump (landfills) of Mojosongo Village Jebres Sub-district Surakarta City

STH infection	Intensity	Level of eosinophilia			
		0-3% (normal)	4-6% (mild)	7-9% (intermediate)	>9% (high)
Hookworm	mild	3	3	0	0
	intermediate	0	0	0	0
	severe	0	0	0	0
<i>Trichuris trichiura</i>	mild	0	1	0	0
	intermediate	0	0	0	0
	severe	0	0	0	0
uninfected		67	20	2	0
		70	24	2	0
Total		70	26	26	26

From Table 6, it is shown that the percentage of subjects infected STH and showed eosinophilia is 57% (4/7).

Total number of subject with eosinophilia and STH infection is 15.4% (4/26). While the number of subjects with STH infection and showed normal eosinophils is 43% (3/7); and number of subjects with normal eosinophil level but STH-infected is 4.3% (3/70). Number of uninfected subjects but showed eosinophilia is 24.7% (22/89) and number of subjects with eosinophilia and uninfected by STH is 84.6% (22/26).

The correlation between the intensity of STH infection and the degree of eosinophilia was tested by using Spearman test. The result indicated that the two variables are correlated significantly ($p=0.032$). The power is very weak and the direction is positive ($r=0.190$).

From Table 1 it can be concluded that the age of subjects ranged from 6 years to 80 years with varying amounts. Mean of the age was 37.83 years (6-80 years). It shows even distribution at each age. According to gender, the ratio of the subjects is male : female = 2 : 3 (40/56).

From table 1 it can be known that majority of the subjects have level of education as elementary school (SD), which is 36.5%. Whereas the subjects that have level of education of undergraduate is just 2.1%. It showed that the level of education in this area is low. From the occupation, the majority of the subjects are from private sector and the second largest is the people which their daily activities are to find and collect recycled material from garbage dump and sell them to a kind of company for a certain utensil production. These people are mostly lives in area closed to garbage dump of Putri Cempa, Mojosongo, Jebres, Surakarta.

From Table 2, it can be known that the prevalence of STH infection in RW 30 is 7.29% (7/96). The majority of nematodes found is hookworm infection 6.25% (6/96) and *T. trichiura* infection 1.04% (1/96). *A. lumbricoides* infection and mixed infection. In this study, the prevalence of hookworm infection is higher than *T. trichiura* infection. Study in The Philipine showed that the hookworm infection was 14.7% and *T. trichiura* infection was 1.7%⁹. In this study, *T. trichiura* infection was very rare, just one subject. Study in Ambon, the highest prevalence of hookworm infection was 4.25% at Desa Amahusu with land unit kambisol from seven land unit Pulau Ambon¹⁰. So, maybe the soil type of RW 30 is *kambisol*, sandy clay.

From Table 3, it can be concluded that female subjects are infected by STH more than male subjects (4:3). It maybe because the hygiene of the female is less healthy than the male, although the amount of female and male is not different significantly and they have almost same opportunity to get the infection. Majority of the subjects which infected by STH have occupation as recycle material collector or even as garbage collector, 71.42% (5/7). The

main activities of Recycle material collector is to search and find recycled material from from garbage dump, therefore they always in close contact with garbage which might polluted or contaminated with infected materials including worm eggs and ultimately they are in a high-risk to get helminth infection¹¹. The age of the subjects who infected with hookworm is between 30-44 years old whereas 50% (3/6) is >50 years old. Hotez (2009) in Crompton & Peters (2010) found that the peak of hookworm infection is at adult age, 33-44 years old even >50 years old¹. The peak of *T. trichiura* infection is at 5-14 years, meanwhile in this study the subject infected by *Trichuris trichiura* is 40 years old. It may because the therapy to this STH is hard to do quickly¹². The subject may got the infection when he/she was still young with mild infection which are asymptomatics and therefore he/she did not get any therapy.

From Table 4, it showed that the intensity of STH infection was mild, not only on hookworm infection but also *T. trichiura* infection. The average number of eggs was 61 eggs per gram of stool. Study in Ambon island showed that the intensity of single infection *T. trichiura* at five land unit from seven land unit was mild¹⁰. It happened maybe because the prevalence of *T. trichiura* infection is low in Indonesia.

From table 5, it can be shown that the percentage of people with eosinophilia is 27.1 % and people with normal eosinophil count is 72.9%. Eosinophilia can be caused by some conditions, such as infection, allergic condition, cancer, vasculitis. Mild eosinophilia can also occur during convalescent stage of bacterial infection, but significant eosinophilia are usually happened during parasitic infection. All over the world, the most cause of eosinophilia is helminth infection especially nematoda and trematoda.

Meanwhile, the most often cause of eosinophilia at industrial countries is atopic disease^{7,13}.

During this study eosinophil count was conducted microscopically by the researcher and for quality control the result were compared with the readings of the profesional technician from accredited laboratory and the value of Kappa Coefficient from 10 sample readings was 0.44, or intermediate.

From Table 6, it is concluded that the percentage of subjects infected STH and show eosinophilia is 57% (4/7). 41.5% of individu infected by helminth show eosinophilia¹⁴. The eosinophilia in helminth infection s represent innate immunity responses of the host^{15,16}. In hookworm infection, there is increasing eosinophil on blood¹⁷. Study held in Indonesia concluded that there is increasing level eosinophil >5% on students with STH infection at elementary school of Binjai in Nort Sumatra¹⁸.

The defence mechanism against helminth is held by the activation of Th2 cell. It then generate IgE and activation of eosinophil. One of the immune mechanism during nemathods infection is afected by specific antibody which may cover the worm body (opzonization) and then eosinophils which carry Fc-receptor will be stimulated to destroy the worm in the intestinal lument.. When eosinophils are activated by IgE-opsonized worm, eosinophils will release enzyme granules which are toxic to helminth. This process is called Antibody Dependent Cellular Cytotoxicity (ADCC)^{19,20}.

The causes of eosinophilia are not only STH infection. Eosinophilia also occurs at alergic condition, cancer patient, certain medication and inflamatory condition during organ infection such as during vasculitis condition^{7,14}. From anamnesis and physical examination to subjects infected by STH, there is only one person have

dermatitis atopi, one of alergic disease on skin. All of the subjects infected by STH diny to have cancer and medication.

Number of subject with eosinophilia and STH infection is 15.4% (4/26) Other study among traveler to developing country indicated that 18.9% patients eosinophilia were infected by helminth infection and therefore it was concluded that tourists from developing country showed increasing possibility helminth infection¹⁴.

In the curent study the percentage of subjects with STH infection and show normal level of eosinophils is 43% (3/7). This indicated that not every STH infection resulted in eosinophilia. It may because some STHs stimulate eosinophilia just during tissue-invasion stage. Besides, the highest eosinophilia is usually occur during the acute helminth infection¹⁴.

Twenty four point seven persent (24,7%) of uninfected subjects showed to have eosinophilia. The couse of eosinophilia among these people need further investigation.

From 26 subjects with eosinophilia, 22 were uninfected by STH 84,6%. Many factor and condition can be resulted to eosinophyilia. From anamnesis and physical examination, 50% (11/22) maybe suffer Dermatitis Atopi, Rhinitis Alergic or Asthma. Whereas the other 50% is still unknown. All of the subjects deny having cancer and at medication.

Correlation between the intensity of STH infection and the level of eosinophyilia was tested by using Spearman test. The result, indicated that those two variables are significantly correlated ($p=0.032$). However, the power of correlation is very weak and the direction is positive ($r=0.190$). Study in Philipine showed that there is positive correlation between percentage of eosinophil count and the incidence of STH infection ($n=74$;

Pearson's $r=0.328$; $p=0.004$)⁹. The degree of eosinophilia with helminth infection is varies depended on geographycal distribution, maturation migration and burden of infection¹⁴. During helminth infection suppression of host immunity can also happended. This mechanism is usually occur during most helminthic infection and represent the parasite evasion of host immunity in order the worm to be able to survive of the host defence mechanism²².

CONCLUSION

The prevalence of STH infection on the residents around garbage dump (landfill) of Mojosongo Village, Jebres Sub-district, Surakarta City is 7.6%, which are consisted of hookworm infection 6.25% and *T. trichiura* infection 1.04%. There is no *A. lumbricoides* infection.

The intensity of STH infection on the residents around garbage dump (landfill) of Mojosongo Village, Jebres Sub-district, Surakarta City is mild for hookworm and *T. trichiura* infection.

The percentage of eosinophilic cells on the residents around garbage dump (landfill) of Mojosongo Village, Jebres Sub-district, Surakarta City varies beetween 1% until 15%. The residents that have normal eosinophil count is 71.92% whereas 27.1% show eosinophilia

There is positive correlation between the intensity of STH infection and the level of eosinophilia on the residents around garbage dump (landfill) of Mojosongo Village, Jebres Sub-district, Surakarta City with very weak power ($r=0.190$; $p=0.032$).

SUGGESTIONS

To further know the correlation between the intensity of STH infection and eosinophil score, it is suggested to be carried out at the study site which has higher prevalence and more type of

STH infection. For clinical practitioner, if you find eosinophilia case, it is better also to consider helminth infection. Suggestion for citizens, if there is a chronic coughing with skin urticaria, it may be helminth infection.

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