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Research Report

## SOIL-TRANSMITTED HELMINTH INFECTION AND EOSINOPHIL LEVEL AMONG WASTE COLLECTORS IN BANDA ACEH

Teuku Romi Imansyah Putra<sup>1,2a</sup>, Ricke Loesnihari<sup>3</sup>, Merina Panggabean<sup>4</sup>

<sup>1</sup> Tropical Medicine Program, Faculty of Medicine, University of North Sumatera, dr T Mansur St, Padang Bulan, Medan, Sumatera Utara, Indonesia.

<sup>2</sup> Department of Parasitology Faculty of Medicine, Syiah Kuala University, Tgk Tanoh Abee St, Darussalam, Banda Aceh, Indonesia.

<sup>3</sup> Department of Clinical Pathology Haji Adam Malik General Hospital, Bunga Lau St, Medan Tuntungan, Medan, North Sumatera, Indonesia.

<sup>4</sup> Department of Parasitology Faculty of Medicine, University of North Sumatera, dr T Mansur St, Padang Bulan, Medan, North Sumatera, Indonesia.

<sup>a</sup> Corresponding author: teukuromiimansyahputra@unsyah.ac.id

### ABSTRACT

*Soil-Transmitted Helminth (STH) has infected more than one billion people worldwide. In Indonesia, the prevalence of worms is still relatively high in 2006, which amounted to 32.6% and in 2007 reached 65% mainly on the economically disadvantaged group. Primary infections are usually occurred in children and can persist into adulthood through exposure to recurrent infections to stool-contaminated environments and may be chronic to residents living in endemic areas. Waste collectors are one of the groups associated with land at risk for STH infection. The work environment of waste collectors which has many seeds of disease, causing pollution and other negative effects. Waste collectors are also often contact with the ground directly. The research was conducted to find out the association of STH infection with eosinophil level in waste collectors from Sanitation Department in Banda Aceh City. The design of this research is an observational study using cross sectional method. Statistical analysis using chi square test with significance  $p < 0.05$ . Stool and blood samples were collected from 60 workers who were willing to participate (with informed consent). The Kato-Katz method was used to determine STH infection and absolute eosinophil count was performed on blood preparations seeing in the count chamber to find out the number of eosinophils in the waste collectors. The prevalence of STH infection is 23.3% (14/60) consisted of *T.trichiura* infection (21.7%) and a mixed infection of 1.6% (both of *A. Lumbricoides* and *T.trichiura*) There was no single infection of *A. lumbricoides* and Hookworm infection. The prevalence of eosinophilia is 21.7% (13/60). There was no significant association between STH infection and blood eosinophil level ( $p$  value = 1.00). This study does not recommend the use of eosinophilia as a marker for STH infection.*

**Keywords:** Eosinophilia, Kato Katz, STH infection, Waste Collectors, Banda Aceh

### ABSTRAK

*Soil-Transmitted Helminth (STH) menginfeksi lebih dari satu milyar orang di seluruh dunia. Di Indonesia, prevalensi kecacingan masih relatif tinggi pada tahun 2006, yaitu sebesar 32,6% dan pada tahun 2007 mencapai 65% terutama pada golongan penduduk kurang mampu dari sisi ekonomi. Infeksi primer biasanya terjadi pada anak-anak dan bisa menetap sampai dewasa melalui paparan infeksi berulang terhadap lingkungan yang terkontaminasi tinja dan dapat bersifat kronis pada penduduk yang tinggal di daerah endemis. Petugas sampah merupakan salah satu kelompok yang berhubungan dengan tanah yang beresiko terinfeksi STH. Lingkungan kerja petugas sampah banyak mengandung bibit penyakit, menimbulkan polusi dan berbagai efek negatif lainnya. Petugas pengangkut sampah juga sering bersentuhan langsung dengan tanah. Penelitian ini dilaksanakan untuk mengetahui hubungan infeksi STH dengan kadar eosinofil pada petugas pengangkut sampah Dinas Kebersihan dan Keindahan Kota Banda Aceh. Desain studi observasional menggunakan metode cross sectional. Analisis statistik menggunakan uji chi square dengan kemaknaan  $p < 0,05$ . Sampel tinja dan darah dikoleksi dari 60 petugas yang bersedia berpartisipasi (dengan informed consent). Metode Kato-Katz digunakan untuk mengetahui adanya infeksi STH dan hitung eosinofil absolut dilakukan pada sediaan darah yang dilihat pada kamar hitung untuk mengetahui jumlah eosinofil pada petugas pengangkut sampah. Prevalensi infeksi STH sebesar 23,3% (14/60) terdiri dari infeksi *T.trichiura* 21,7% dan infeksi campuran 1,6% (*A. lumbricoides* dan *T. trichiura*). Tidak ditemukan infeksi tunggal *A.lumbricoides* dan infeksi Hookworm.*

Prevalensi eosinofilia adalah 21,7% (13/60). Tidak terdapat hubungan yang signifikan antara intensitas infeksi STH dengan kadar eosinofil darah ( $p$  value = 1.00). Penelitian ini tidak menganjurkan eosinofilia sebagai marker adanya infeksi STH.

**Kata kunci:** eosinofilia, Kato-Katz, infeksi STH, petugas sampah, Banda Aceh

## INTRODUCTION

Soil-Transmitted Helminth is a parasitic disease caused by a nematode worm transmitted to humans through faecally contaminated soil.<sup>1</sup> More than one billion people have been infected by at least one species of Soil-Transmitted Helminth (STH) group. Nematodes, also called geohelminth, includes the roundworm (*Ascaris lumbricoides*), whipworm (*Trichuris trichiura*), hookworm (*Necator americanus* and *Ancylostoma duodenale*) and *Strongyloides stercoralis*.<sup>2,3</sup>

Waste collectors are at risk of being infected by STH due to the frequent contact with soil and waste.<sup>1,4</sup> A study conducted in Pekanbaru showed that 77.78% of park workers were positively infected by *Ascaris lumbricoides* and *Trichuris trichiura*.<sup>5</sup> Another study was conducted among waste collectors in Pematang Siantar found that 11.1% of waste collectors were infected by worm.<sup>6</sup> A study in Yogyakarta was revealed that waste collectors have yet to make adequate efforts in protecting themselves against waste-related diseases.<sup>7</sup>

The human immune response to worm infection is associated with increased level of IgE, eosinophils, and mastocytosis that stimulate Th2 production, namely Interleukin 4 (IL-4) and Interleukin 5 (IL-5). One of the main functions of eosinophils is to protect against infections and fully responsible for worm infestation inflammatory pathology.<sup>8</sup> Study in northern Mindanao, The Philippines is showed the association between the increased number of eosinophils (eosinophilia) and STH parasite infections.<sup>9</sup> Eosinophilia, as a Th2 cell response marker, can be used to assess worm infections<sup>10</sup> but the effect of STH infection on eosinophilia may vary depending on the distribution, maturation, and chronicity and type of parasites.<sup>8</sup> The researcher was also observed that the waste collectors did not use or wear the standard Personal Protective Equipment (PPE) such as gloves or shoes while working, thus exposed to garbage-related diseases, including the STH. Data on the STH infection among waste collector is not available and there is no existing research on the association between STH infection and eosinophil level among waste collectors in Banda Aceh. Therefore, it is necessary to conduct such a research to find out the prevalence and the association between STH infection and eosinophil level among waste collectors in the City of Banda Aceh.

## MATERIAL AND METHOD

This cross-sectional study was conducted to determine the prevalence and the association of STH infection and eosinophil level by performing faecal and blood eosinophil examination. The research was also wanted to know the association between the hand-washing habit and STH infection, and the association between the use of standard PPE and STH infection. The research subjects were 60 waste collectors in Banda Aceh. They were selected using the simple random sampling method. They clearly informed about the objective of the study. Waste Collectors are involved in this study were provided a written informed consent for examining their faecal and blood. For their hand-washing habit and standard PPE, authors were interviewed by person and gave questionnaire to be filled.

Medical Research Ethics Commission of Faculty of Medicine University of North Sumatera (USU) approved the study. (No:780/TGL/KEPK FK USU-RSUP HAM/2016).

The study was conducted in March 2017 at the Sanitation department of Banda Aceh. The examination of stool samples using The Kato-Katz technique was performed at the Parasitology Laboratory, Faculty of Medicine, Syiah Kuala University in Banda Aceh. Absoluted Eosinophil Count examination was conducted at The Health Clinic Laboratory of Prodia in Banda Aceh. Chi Square test was used to estimate the association between STH infection and eosinophil level. If it does not meet the test requirements then Fisher's Exact Test were conducted through a computer software with significance value of  $<0.05$ .

### Kato Katz Method

Study participants were instructed how to collect stool samples and provided with labeled clean plastic container, toilet tissue paper and applicator sticks. The team was labeled empty containers with identification (ID) numbers, distributed these to the waste collectors and collected filled containers that had been distributed the day before. Each day, approximatel 5-6 workers were enrolled and lime-sized early morning stool samples were collected.

The Kato-Katz method is a recommended examination with a thick quantitative smelling technique. This method is most recommended and widely used for epidemiologic surveys, as it is both easy and cost-prohibitive.<sup>11,12</sup> The materials used were prepared in accordance with standard

laboratory in-house procedures. Thus, the glycerin-malachite green solution was mixed with 1 ml of 3% malachite green, 100 ml of 6% phenol and 100 ml of pure glycerin. The cellophane strips, each 22x40 mm, were soaked in this solution for at least 24 hours before use.<sup>13</sup> Immediately after the stool sample arrived at Syiah Kuala Parasitology Laboratory (SKPL), Kato-Katz thick smears from each stool sample were prepared by 2 members of SKPL, using 41.7 mg templates. The cellophane is then placed directly on the stool, so that the eggs are more easily visible and stored for long periods in slide. After a clearing time of 20-40 min, each Kato-Katz thick smear was examined quantitatively for geohelminth eggs by one of two experienced microscopists. In the afternoon, 3-6 hour after slide preparation, the thick smears were re-examined by the other one of two experienced microscopists, who counted eggs of *A. Lumbricoides*, *T. trichiura* and hookworm then recorded them separately. Additionally, in order to eliminate fibers or seed, the technique was modified by pressing a 105-mesh stainless steel grid onto the sample which was then filtered, transferred to slides covered by the cellophane soaked cover slips and allowed to stand for 30 minutes. All preparations were initially screened with a low-power (10x) objective lens. Suspected parasitic objects were subsequently examined under a high-power (40x) objective.<sup>13,14</sup> The stool samples were preserved in 10% formalin for later confirmation, if needed.

#### Absolute Eosinophil Count

The Health Clinic Laboratory of Prodia in Banda Aceh uses The Manual Method. The Equipment consists of Improved Neubauer counting chamber, White Blood Count (WBC) pipette and Diluting Dunger's fluid. The technique are Gently mix the blood in the EDTA vial, so that the cells mix well with plasma. Draw the blood in the WBC pipette up to mark 1. Wipe off the excess blood from sides of the tip of the pipette. Dip the tip of the pipette in the Dunger's fluid and draw the fluid up to mark 11. The dilution is 1 in 10. Holding the pipette horizontally in its long axis, rotate it slowly to ensure thorough mixing of blood and diluent. This is facilitated by the white bead in the bulb. Place the cover slip on the cleaned ruled area of the counting chamber. We were discarded the first 2 to 3 drops (since the fluid has not mixed with blood) of WBC fluid from the pipette and charged the chamber by placing the tip of the pipette just under the cover slip and fluid flows under it by capillary action. Then we were allowed until Allow till the counting chamber is just filled. We were waited for 5 minutes for the eosinophils to settle in the chamber and counted the number of eosinophils in the 4 corner squares under the microscope using a low power objective. Eosinophils are identified because of their bright red granules and count should be done within 30 minutes. Absolute Eosinophil Count (AEC) = Total number of eosinophils in 4 squares  $\times$  25. Eosinophils constitute 1 to 6% of circulating WBCs. The range of absolute eosinophil count is 40-450 cells/ $\mu$ l.<sup>15</sup>

## RESULT AND DISCUSSION

Table 1 was showed the demography and clinical features of the respondents. From the 60 subjects, half of them were aged between 31-40 years (50%) and the majority (83.3%) did not wear Personal Protection Equipment (PPE) while working. The prevalence of STH infection was 23.3%, where 21.7% were infected by *T. trichiura*, and 1.6% by mixed infections. Based on the frequency distribution of absolute eosinophil level, it was found that there was 21.7% of subjects with an increase of absolute eosinophil and 78.3% of them with normal level. The majority of the waste collectors (96.7%) is washed their hands after working and the other 3.3% did not. Meanwhile only 16.7% of them use or wear the PPE while working and the other 83.3% did not maintain that habit.

**Table 1.** Demography and clinical features of study respondents

No	Category	Frequency	%
1	Age (year)		
	20-30	20	33,3
	31-40	30	50
	41-50	8	13,3
	>50	2	3,3
2	Positive Kato-Katz		
	<i>T. trichiura</i>	13	21,7
	<i>A. lumbricoides</i>	0	0
	Hookworm	0	0
	Mixed infection ( <i>A. lumbricoides</i> + <i>T. trichiura</i> )	1	1,6
3	Negative Kato-Katz	46	76,7
4	Absolute eosinophil level		
	Normal	47	78,3
	Elevated	13	21,7
5	Hand-washing habit after work		
	Yes	58	96,7
	No	2	3,3
6	Personal Protective Equipment		
	Yes	10	16,7
	No	50	83,3

The results of this study were showed that of the 60 STH-infected subjects, *T. trichiura* infection was the most prevalent worm infection which was suffered by the subjects (21.7%) and 1.6% of subjects suffered from one mixed infection subject (*T. trichiura* and *A. lumbricoides*) and no one suffered from *A. lumbricoides* single infection as we see in table 2. This is probably because the subject's work environment is located in a humid area which facilitates the growth of *T. trichiura* worm eggs. *T. trichiura* eggs will be able to grow optimally at 30°C. In addition, the fewer number of STH-infected subjects may also be caused by the administration of worm infestation medication Albendazole 400 mg (single dose) in the office.

As many as 600 tablets of medication supply were obtained from Banda Aceh city Health office but there was

**Table 2.** Absolute eosinofil count value and eggs Per gram value from each waste collector (quantitative data)

No.	ID	Absolute Eosinofil Count (x 10 <sup>3</sup> /μl)	Helminth Eggs by Kato Katz Examination	EPG
1	88	0,070	Tt = 2	48
2	313	0,080	N	
3	29	0,462 ↑	N	
4	515	0,110	N	
5	118	0,144	Tt = 1	24
6	392	0,188	N	
7	288	0,270	N	
8	87	0,070	N	
9	301	0,144	N	
10	374	0,490 ↑	Tt = 8	192
11	123	0,165	N	
12	400	0,929 ↑	N	
13	25	0,120	N	
14	207	0,122	N	
15	508	0,160	Tt = 4	96
16	240	0,350	N	
17	226	0,090	Tt = 2	48
18	103	0,070	N	
19	502	0,130	N	
20	227	0,621 ↑	N	
21	375	0,187	N	
22	455	0,270	N	
23	298	0,110	N	
24	214	0,440	Tt = 4	96
25	315	0,150	N	
26	133	0,187	N	
27	94	0,121	N	
28	264	0,133	Tt = 3	72
29	403	0,110	N	
30	348	0,649 ↑	N	
31	31	0,550 ↑	N	
32	95	0,160	N	
33	193	0,210	N	
34	439	0,122	N	
35	449	0,070	Al = 32 Tt = 20	Al=768. tt=480
36	73	0,831 ↑	N	
37	507	2,480 ↑	N	
38	251	0,310	N	
39	46	0,357	Tt = 6	144
40	99	0,132	N	
41	286	0,080	N	
42	121	0,110	N	
43	128	0,324	N	
44	209	0,460 ↑	N	
45	228	0,070	N	
46	506	0,570 ↑	Tt = 2	48
47	349	0,050	N	
48	444	0,180	N	
49	336	0,200	N	
50	407	0,080	Tt = 5	120
51	291	0,120	Tt = 13	312
52	199	0,050	N	
53	248	0,230	N	
54	257	0,570 ↑	Tt = 2	48
55	202	0,198	N	
56	389	0,467 ↑	N	
57	144	1,800 ↑	N	
58	377	0,150	Tt = 3	72
59	371	0,120	N	
60	360	0,060	N	

Note:

Tt = *T. trichiura*  
n = NormalAl = *A. Lumbricoides*  
EPG = eggs per gram

no accurate record of the waste collectors who received it or who directly took it. In populations receiving treatment of worm infection, the natural pattern of infection is altered because single dose Albendazole is effective for the treatment of *Ascaris lumbricoides* infection compared to the other two types of worm.<sup>16</sup> Based on a meta-analysis study, single dose administration of Albendazole was not adequate for the treatment of *T. trichiura*. The cure rate increases after the administration of Albendazole for three consecutive days.<sup>17</sup>

Table 2 was showed the quantitative data of each study subjects obtained from the examination. Subjects infected with STH and also experiencing eosinophilia are given an arrow and highlight marker. There were 13 people who experienced an increase in eosinophil count and among 13 people only 3 people who were detected had STH infection. Table 2 also was showed the intensity of worms based on the value of eggs per gram (EPG) from each subject infected STH as mild intensity category.

Table 3 was shows the association between hand-washing habits and STH infection. From 60 samples, the subjects who did not wash their hands all had STH infection (100%), subjects who washed their hands and got infected with STH were as many as 20.7%, subjects who washed their hands and were not infected with STH were 9.3%. Prevalence Ratio (PR) of 0.2 (95% CI = 0.12-0.34). However, the statistical test revealed p-value of 0.051. Therefore, the study is found that there is no significant association between hand-washing habits and STH infection. Hygiene (in this case hand washing treatment) in waste collector is very necessary because they always contact with garbage which can lead to susceptibility to some garbage diseases such as infection of worms.<sup>18</sup> This study is revealed that from the sample of 60 subjects examined by Kato-Katz method, there were 23.3% of the subjects who were positively infected with STH.

The fact that there were fewer subjects infected with STH may result from their maintaining good personal hygiene (hand-washing habits) although they are still at risk of being infected with STH due to constant exposure to waste and soil. Another possible explanation is that because the subjects routinely take anti-helminthic medication for prevention which are available in their office as part of worm medication program. However, there is no available data regarding the number of waste collectors who have taken such a medication because it is distributed through the team foreman.

The association between hand-washing habit after work and STH infection incidence is showed that of 58 subjects who washed hands, there were 46 STH-uninfected subjects (79.3%) and 12 STH-infected subjects (20.7%) as well as 2 subjects (100%) who did not wash their hands and got infected with STH. The finding that subjects who wash their hands but got infected with STH was probably due to their washing their hand without using soap or antiseptics. This study is found that there is no association between hand-washing habits and STH infection (p-value = 0.051).

**Table 3.** The Association between Hand-washing Habits and STH Infection

Hand-washing	STH Infection Based on Kato-Katz				Total		<i>p-value</i>	PR
	Positive		Negative		N	%		
	N	%	N	%				
Yes	12	20.7	46	79.3	58	100	0.051	0.2
No	2	100	0	0	2	100		
Total	14	23.3	46	76.7	60	100		

**Table 4.** Association between Complete Use of PPE and STH Infection

Complete use of PPE	STH Infection Based on Kato-Katz				Total		<i>p-value</i>	PR
	Positive		Negative		N	%		
	N	%	N	%				
Yes	1	10.0	9	90.0	10	100.0	0.427	0.3
No	13	26.0	37	74.0	50	100.0		
<b>Total</b>	<b>14</b>	<b>23.3</b>	<b>46</b>	<b>76.7</b>	<b>60</b>	<b>100.0</b>		

This finding was similar to a study which was conducted by Butarbutar *et al* who found no association between hygiene and STH infection among collectors in Pematang Siantar city.<sup>6</sup> However, the finding was different to a study in Pekanbaru, where Siregar found a significant association between hand-washing with antiseptic soap and worm infestation incidence (*p*-value 0,024).<sup>5</sup>

A research conducted in Tanzania was shown that STH infection can spread in the case of hand-washing without soap and clean water so the risk of STH infections is lowered when washing hand.<sup>19</sup> The personal hygiene habits among waste collectors include changing clothes after work, washing work clothes, washing hands and feet after work (in contact with waste) and using soap during shower after getting in contact with garbage or waste.<sup>18</sup> The present study is found that hand washing is a common practice among waste collectors in Banda Aceh, where 96.7% washed their hands after work. This indicates that the subjects have made a conscious effort to maintain their personal hygiene, one of which is by washing their hands. However, it was not clear if the subjects washed their hand using soap, because according to the researcher's observation in the waste collectors' workplace, only tap water for hand washing was available, without soaps or antiseptics. The finding of this study was significantly different from a research conducted by Maywati, where she found that waste collectors in Tasikmalaya did not maintain personal hygiene.<sup>20</sup>

Table 4 was showed the association between the complete use of PPE and STH infection. From 60 subjects, there were 74.0% of subjects with incomplete use of PPE and were not infected with STH, 26.0% of subjects with incomplete use of PPE and got infected with STH, 90% of subjects who completely used PPE and were not infected with STH and 10.0% of subjects who completely used PPE and got infected with STH. The Prevalence Ratio of 0.3 (95% CI = 0,5–2,6) indicates that complete use of PPE is not necessarily a factor of protection against STH infection

among waste collectors. Statistical test revealed the *p*-value of 0.427, which suggests there is no significant association between the use of PPE and STH infection. PPE which is a compulsory must be used when working as needed to maintain workers' safety and health such as gloves or shoes.<sup>4</sup> PPE is the completeness that must be worn when working as needed to maintain safety. A small number of waste collectors who used PPE (16.7%) demonstrates their lack of awareness on the safety at work. Irregular availability of PPE in each work unit also contributes to the few workers who wear PPE. The Ministry of Manpower Regulation of 2010 was mentioned that the use of PPE is aimed to protect a person and isolate some or all of the body from potential hazards in the workplace that can cause illness or work accident. The use of PPE at work can include wearing closed shoes, gloves, masks and hats.<sup>18</sup>

The study is also found that the proportion of the subjects who did not completely use PPE and were not infected with STH was higher than the subjects who did not completely use PPE and been infected by STH (74%: 26%), while the subjects who completely used PPE and were not infected with STH were also higher than those subjects with complete use of PPE and infected with STH (46%: 14%). Based on the incidence of the subjects positively suffering from worm infestation, the proportion of STH-infected subjects and incomplete use of PPE was higher than that of STH-infected subjects and complete use of PPE. This suggests that complete use of PPE at the workplace reduces the risk of STH infection. This is similar to a research conducted by Islami *et al* in Wakatobi which was showed that STH infection was higher in subjects who did not completely use PPE (60%), whereas in those subjects with complete use of PPE, there were 28.6% of subjects who got infected with STH.<sup>4</sup> This indicates that STH infection does not originate from the workplace but may come from elsewhere. The results of this study was found no association between the use of PPE and the incidence of STH infection (*p*-value = 0.427). The finding

**Table 5.** The Association between STH Infection and Eosinophil Level

STH Infection	Eosinophil Level				Total		<i>p-value</i>	PR
	Increased		Normal		N	%		
	N	%	N	%				
Positive	3	21.4	11	78.6	14	100.0	1.00	0.98
Negative	10	21.7	36	78.3	46	100.0		
<b>Total</b>	13	21.7	47	78.3	60	100.0		

was similar to a study in Yogyakarta and Pematang Siantar where they found that the association between the use of PPE and worm infection among collectors was poor ( $p$ -value > 0.05).<sup>6,18</sup> This finding however was differed from a study conducted by Islami *et al* which shows a significant association between the use of PPE and the incidence of STH infection ( $p$ -value = 0.04).<sup>4</sup> According Maywati, PPE cannot completely eliminate the work-related hazards or diseases. Workers who wear PPE do not come into direct contact with the source of the disease or danger.<sup>20</sup>

Table 5 was showed the association between STH infection and eosinophil level. In regard to STH-infected subjects, there were 78.6% of STH-infected subjects with normal eosinophil count and 21.4% of STH-infected subjects with eosinophilia.

While among STH-uninfected subjects, there were 78.3% of them with normal eosinophil level and 21.7% of them with elevated eosinophil level. The Prevalence Ratio of 0.98 (95% CI = 0.2 - 4.2) is indicates that STH infection may not be considered a factor of protection against the increase of eosinophil level among waste collectors.

The statistical test is revealed the  $p$ -value of 1.00, which suggests no significant association between STH infection and eosinophil level.

The present study is also showed that of the 60 subjects were examined, there were 21.7% who suffered from eosinophilia. Because eosinophilia not only occurs in STH infection but can occurs due to allergies, malignancy and vasculitis but there was no anamnesis in this study nor any physical examination nor a specific allergy test for atopy. The results of this study are similar to the findings in Surakarta,<sup>21</sup> where they were found that of 96 samples of residents living around a landfill, there was 27.1% of them who suffered from eosinophilia. However, our findings were differed from a study in Puerto Rico in densely populated and low-income areas, where they were found that eosinophilia was present in 15 out of 16 people infected with worms (94%).<sup>22</sup>

This study is also indicates that there is a mild intensity of STH infection among waste collectors. The nature of the worm, which continues to lay eggs, will cause the daily accumulation of worm eggs in the host's body so that the length and severity of the worm infection may affect the intensity of STH infection.

The current study also found that the STH-infected subjects within normal eosinophil level are more prevalent than STH-infected subjects with eosinophilia (78.6%:

21.4%). This is probably due to the mild intensity of worm eggs in the feces of STH infected patients and there is a possibility that the subjects suffered from chronic STH infection. This is consistent with the research that has been conducted by Darmadi *et al* among elementary school students which is revealed that the more number of eggs found in per gram of stool, the higher the eosinophils level, with the elevation of eosinophils level of > 9%.<sup>23</sup> The results of this study were differed from that of Bestari *et al* in Surakarta which suggests that STH-infected subjects with normal eosinophils level were fewer than STH-infected subjects with eosinophilia (43%: 57%).<sup>21</sup> Chronic eosinophilia are associated with chronic inflammation that may contribute to the absence of eosinophils in peripheral blood.<sup>24</sup> In the case of worm infestation, normal eosinophil level can be found because eosinophil maturation and age are heavily dependent on the level of IL-5 which cause eosinophils to be more responsive to granulocyte and macrophage colony-stimulating factor (GM-CSF).<sup>25</sup> *Ascaris lumbricoides* are tends to cause chronic infections that may interfere with Th2 responses. The association between STH infection and allergies can occur due to several factors namely first-time infection, infection intensity, and genetics.<sup>26</sup> Furthermore, symptoms of invisible worm infection in patients indicating eosinophilia are common in rural areas.<sup>9</sup>

The findings of this study is based on the absence of STH infections and the increase in the eosinophils level (eosinophilia) at 21.7%. In addition, 78.3% of the subjects were not infected with STH and had normal eosinophil level. This is likely due to eosinophilia not only occurring in STH infection but can also occur in patients with allergies, cancer, and vasculitis. The results of this study were similar to the research conducted by Bestari *et al* which showed that the STH-uninfected subjects with normal eosinophils level are 75.3% and the STH-uninfected subjects with eosinophilia of 24.7%.<sup>21</sup> The results of a research which was conducted by Heukelbach *et al* in Brazil was showed that there were 14% of samples with eosinophilia without STH infection.<sup>22</sup> The finding of poor statistical association between STH infection and eosinophil level ( $p$ -value = 1.00) may be due to eosinophils level being higher in the early invasive phase than in the chronic phase. The eosinophil level depends on the host factor so it depends not only on previous exposures but also in this study using the stool samples examination showed infected STH results in mild intensity.

Lastly, not every STH infection is followed by eosinophilia. Some STH infection is induced eosinophilia only during the stage of tissue invasion in the development of the worm. In addition, the highest eosinophilia is usually present in acute worms infection.<sup>21</sup> This is common in developing countries where eosinophilia is caused by parasite invasion, one of which is worms. STH infection has a strong association with eosinophilia, especially in the initial stages of infection, when migratory larvae occur.<sup>27</sup> Schulte *et al* was stated that eosinophilia is only one of the diagnostic support tools (biomarker) for people affected by worms.<sup>28</sup> Eosinophilia as a Th2 cell response marker can be used to assess worm infections.<sup>28</sup> However, according to Gabriele *et al* there is no agreement among experts whether eosinophils could be as a biomarker for worm infection or not. Some researchers still consider eosinophilia as a predictor of worm infection that is still used temporarily in people living in tropical and sub-tropical regions.<sup>27</sup> Figures of eosinophils associated with parasitic infection are determined by the development, migration and distribution of the parasite and the host immune response<sup>24,29</sup> which is characterized by product parasite's interaction with effector cells of the immune system in the tissue, especially in the migration phase.<sup>29</sup> The research which was conducted by Cabada *et al* in Peru was showed that eosinophilia was found in 21.2% of subjects. One out of five children with eosinophilia (> 500 eosinophils / mL) increased with the discovery of the parasite in the tissue.<sup>30</sup> Eosinophilia is not seen in intraluminal parasites such as adult tapeworms or cysts (e.g hydatid cysts) unless there is an integrity disruption in the cyst wall which enables it to escape the cyst.<sup>29</sup>

## CONCLUSION

The study among waste collectors in Banda Aceh was found no association between STH infection and eosinophil level ( $p = 1.00$ ), between hand-washing habit and STH infection ( $p = 0.051$ ), nor between the use of PPE and STH infection ( $p = 0.427$ ). Therefore, elevated eosinophil level (eosinophilia) can not be used as STH infection marker.

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## REFERENCES

1. World Health Organization. Soil-Transmitted Helminthiasis: Eliminating Soil-Transmitted Helminthiasis as a Public Health Problem in Children. Prog Rep. 2012;1–90.
2. Mascari-Serra L. Prevention of Soil-transmitted Helminth Infection. J Glob Infect Dis. 2011 Apr;3(2):175–82.
3. Andiarsa D, Hairani B, Meliyani G, Fakhri D. Helminth infection, immunity and allergy. J Buski. 2012;4(1):47–52.
4. Islami LN, Ode W, Asfiah S. Perbedaan Kejadian Infeksi Cacing Antara Petugas Pengangkut Sampah Yang Menggunakan Alat Pelindung Diri Dengan Petugas Pengangkut Sampah Yang Tidak Menggunakan Alat Pelindung Diri. Medula. 2014;2(1):108–11.
5. Anita S, Siregar I, Zulkarnain Z. Hubungan personal hygiene dengan penyakit cacing (soil transmitted helminth) pada pekerja tanaman Kota Pekanbaru. Pus Penelit Lingkungan Hidup Univ Riau 102. 2013;93–102.
6. Butarbutar M, Ashar T, Santi D. Hubungan Hygiene Perorangan Dan Pemakaian Alat Pelindung Diri (Apd) Dengan Keluhan Gangguan Kulit Dan Kecacangan Pada Petugas Pengangkut Sampah Kota Pematang siantar. 2012;3(2):1–7.
7. Adnani H. Perilaku Petugas Pengumpul Sampah Untuk Melindungi Dirinya Dari Penyakit Bawaan Sampah Di Wilayah Patangpuluhan Yogyakarta Tahun 2009. Kesmas. 2010;4(3):144–52.
8. Silalahi RHB, Wistiani, Dharmana E. Jumlah Eosinofil pada Anak dengan Soil Transmitted Helminthiasis yang Berusia 6-10 Tahun. Sari Pediatr. 2014;16(2):79–85.
9. Sumagaysay JB, Emverda FM. Eosinophilia and Incidence of Soil-Transmitted Helminthic Infections of Secondary Students of an Indigenous School. Asian J Heal. 2011 Jan 25;1(1).
10. Janeway C. Immunobiology : the immune system in health and disease. New York. 2005. 29-30, 48-49, 68, 79, 517-517, 542-547 P.
11. Speich B, Knopp S, Mohammed KA, Khamis IS, Rinaldi L, Cringoli G, et al. Comparative cost assessment of the Kato-Katz and FLOTAC techniques for soil-transmitted helminth diagnosis in epidemiological surveys. Parasit Vectors. 2010;3(1):71.
12. Taye S. Comparison of Kato-Katz and Formol-Ether Concentration Methods for the Diagnosis of Intestinal Helminthic Infections among School Children of Wonji Shoa Town, Eastern Ethiopia: A School Based Cross-Sectional Study. Am J Heal Res. 2014;2(5):271.
13. Tungtrongchitr A, Chiworaporn C, Praewanich R, Radomyos P, Boitano JJ. The potential usefulness of the modified Kato thick smear technique in the detection of intestinal sarcocystosis during field surveys. Southeast Asian J Trop Med Public Health. 2007 Mar;38(2):232–8.
14. RI K. 5. Peraturan Menteri Kesehatan Republik Indonesia, No.15 Tahun 2017 Tentang. Penanggulangan Cacingan. 2017;1–78.
15. Nayak R, Rai S, Gupta A. Essentials in Hematology and Clinical Pathology. fiirst edi. new delhi: Jaypee Brothers Medical Publishers; 2012. 368-369 p.
16. Sanchez A, Mahoney D, Gabriele J. Interleukin-10 and soil-transmitted helminth infections in Honduran children. BMC Res Notes. 2015;8(1):55.
17. Keiser J, Utzinger J. Efficacy of Current Drugs Against Soil-Transmitted Helminth Infections. JAMA. 2008 Apr 23;299(16).
18. Mulasari SA, Maani D. Hubungan Antara Kebiasaan Penggunaan Alat Pelindung Diri dan Personal Hygiene Dengan Kejadian Infeksi Kecacangan Pada Petugas Sampah Di Kota Yogyakarta. J Ekol Kesehat. 2013;12(2):161–70.
19. Kumar D, Kumari R, James J, Sekharan B. Soil-Transmitted Helminth Infections and the Associated Risk Factors in Pre-Primary School Children, Kiwangwa Rural Ward, Bagamoyo District, Tanzania. Tanzania Asian J Med Pharm Res. 2016;6(3):24–31.
20. Maywati S. Kontribusi penggunaan alat pelindung diri terhadap kejadian infeksi nematoda usus (studi pada petugas pengangkut sampah di kota Tasikmalaya). J Kesehat komunitas Indones. 2013;9(1):1–10.

21. Bestari RS, Supargiyono, Sumarni, Suyoko. Derajat eosinofilia pada penderita infeksi soil-transmitted helminth (sth). *Biomedika*. 2015;7(2):27–34.
22. Heukelbach J, Poggensee G, Winter B, Wilcke T, Kerr-Pontes LRS, Feldmeier H. Leukocytosis and blood eosinophilia in a polyparasitised population in north-eastern Brazil. *Trans R Soc Trop Med Hyg*. 2006;100(1):32–40.
23. Darmadi D, Irawati N, Nasrul E. Perbandingan Kadar IL-5 dan Jumlah Eosinofil Antara Anak dan Orang Dewasa yang Terinfeksi *Ascaris Lumbricoides*. *J Kesehat Andalas*. 2015;4(3):756–64.
24. Kremyanskaya M, Ackerman S, Butterfield J, Mascarenhas J, Hoffmann R. Eosinophilia, eosinophil-associated diseases, chronic eosinophil leukemia, and the hypereosinophilic syndromes. In: *Hematology: Basic principles and practice*. 6th ed. Philadelphia, PA: Elsevier; 2013. p. 1082–3.
25. Medeiros D, Silva AR, Rizzo JA, Motta ME, Oliveira FHB de, Sarinho ESC. Total IgE level in respiratory allergy: study of patients at high risk for helminthic infection. *J Pediatr (Rio J)*. 2006 Aug 9;82(4):255–9.
26. Sarinho ES, Medeiros D, Silva A, Rizzo JÂ. Specific IgE Anti-*Ascaris* in Brazilian Children and Adolescents. *World Allergy Organ J*. 2010 Mar;3(3):53–6.
27. Gabrie JA, Rueda MM, Rodríguez CA, Canales M, Sanchez AL. Immune Profile of Honduran Schoolchildren with Intestinal Parasites: The Skewed Response against Geohelminths. *J Parasitol Res*. 2016;2016:1–13.
28. Schulte C, Krebs B, Jelinek T, Nothdurft HD, von Sonnenburg F, Loscher T. Diagnostic Significance of Blood Eosinophilia in Returning Travelers. *Clin Infect Dis*. 2002 Feb 1;34(3):407–11.
29. Khanna V, Tilak K, Ghosh A, Mukhopadhyay C. Significance of high Eosinophilic count in Non-Helminthic parasitic infections. *Int J Microbiol Parasitol*. 2015;1(1):1–4.
30. Cabada MM, Goodrich MR, Graham B, Villanueva-Meyer PG, Deichsel EL, Lopez M, et al. Prevalence of intestinal helminths, anemia, and malnutrition in Paucartambo, Peru. *Rev Panam Salud Publica*. 2015;37(2):69–75.