ORIGINAL ARTICLE

The Comparison of Giardia lamblia Infection and Nutritional Status of Elementary School Students in Mandangin Island, Sampang and Mojo Village, Surabaya, Indonesia

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ABSTRACT

Introduction: *Giardia lamblia* infection can cause malabsorption of nutrients and affects to the nutritional status that has not yet fully investigated in Indonesia. This study aimed to compare the prevalence of *G. lamblia* infection and nutritional status of elementary students in rural and urban area in East Java.
Methods: An analytical observational study with cross sectional design was conducted in rural area, Mandangin island, in July 2017 and urban area, Mojo village, in June 2018. Stools of elementary students were collected for *G. lamblia* identification under a light microscope using direct smear method. Nutritional status of students was determined by body mass index (BMI). All data analyzed using chi-square test.
Results: Forty-five stools samples were collected from elementary students in Mandangin island and 55 stools samples in Mojo village. Prevalence of *G. lamblia* infection without symptoms was higher in elementary students in Mandangin island than Mojo village, and it was a significant difference (28,9%, 13/45 vs 1,8%, 1/55; $p<0.0001$). Nutritional status of students in both study sites showed dominant healthy weight (73.3%, 34/55) in Mandangin island and (61.8%, 33/45) in Mojo village. Giardiasis was commonly observed in healthy-weight students and it was higher in Mandangin island (8/33, 24.2%) than Mojo village (1/34, 2.9%).
Conclusion: Asymptomatic giardiasis students was found more in Mandangin island and commonly observed in students with healthy-weight from both regions. It suggested that asymptomatic giardiasis might not affect to the nutritional status of students.

Introduction

Giardia lamblia is an intestinal protozoan that can cause interference in the digestive tract which called giardiasis. Cyst of *G. lamblia* is an infective stage that plays a role in the transmission of giardiasis by entering the human body through food and beverages which are consumed. Cyst and trophozoite are released into the environment together with stools.[1] Giardiasis can cause a malabsorption of nutrients such as fat, vitamin A and vitamin B12 due to damage and atrophy of microvillous. The malabsorption of fat leads to steatorrhea (fatty stools) while malabsorption of vitamin B12 can induce vitamin B12 deficiency anemia.[2] These occurrence in children will inhibit their growth.[3] About 3.5 billion people are infected worldwide and 450 million children are infected intestinal parasites.[4]

The prevalence of *G. lamblia* in Indonesia was showed by several studies that have been carried out, that were 1% in North Jakarta,5 3.1% in Bekasi,6 30% in Seribu island,7 3.9% in Minahasa,8 and 37.88% in Padang.[9] *G. lamblia* related to nutritional status was also reported in

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Bantul, Yogyakarta (2010) that *G. lamblia* played a role in cases of malnutrition and found the prevalence of *G. lamblia* of 21.74% in patients with malnutrition.10 Study from Colombia (2009) showed that 27.6% of children were infected with *G. lamblia*, which 8.1% and 1.9% of children were mild and underweight, respectively, and 14.1% presented stunting.[11]

G. lamblia infection was also found in Mandangin island as much as 33.3% in 2014 (unpublished). Mandangin island is an isolated island with limited access to clean water source, health, and transportation facilities. People education and socio-economic level in Mandangin island are lower than in Mojo village, an urban area is part of Surabaya city where establishes the clean water source, transportation, communication, health and education facilities.

The comparison of the prevalence of G. lamblia infection and nutritional status in elementary students between in Mandangin island and Mojo village have not yet investigated. Thus, this study will be useful for children welfare.

Methods

Subject

This was a cross sectional study performed in Mandangin 2 elementary school, Mandangin island, Sampang district, in July 2017 and Mojo 4 elementary school, Mojo sub-district, Surabaya city in June 2018. Location of study sites were shown in figure 1.

The population of this study was all children on Mandangin island and Mojo village, while the samples in this study were elementary students in grade of 1st to 6th, who were willing and allowed by their parents. Sampling was done by distributing students who meet the inclusion criteria were students who returned the stools pots. The stools samples were collected and age, gender, body weight and height were noted. The sample size in this study was calculated using a cross sectional sample formula and obtained a minimum sample result of 53 children with a 10% drop rate.

Characteristic of stools and G. lamblia identification

Stools pots were distributed to 150 children in Mandangin island and 90 pots to children in Mojo village. Characteristic of stools were determined by color and consistency examination. The color stools were identified into 3 categories: brown, brownish yellow, and greenish. The consistency examination was divided into 3 categories: hard, soft and liquid/slimy.[12]

Students stools samples were collected and preserved by 10% formalin solution. Direct smear of student stools was performed and stained with 1% lugol solution for intestinal protozoan parasite identification under light microscope (Olympus, Tokyo, Japan) with 1000x magnifications.[13] Examination of stools samples was carried out in the Laboratory of Parasitology, Faculty of Medicine, Universitas Airlangga, Surabaya.

Nutritional status determination

The nutritional status of students was assessed by body mass index (BMI), which was measured body weight in kg and height in meter. The assessment of body weight and height were assisted by teachers. Nutritional status was categorized to be severe under-weight, under-weight, healthy-weight, over-weight, and obese.[14]

Data analysis

The data obtained was analyzed using the SPSS version 20.0 program (SPSS Inc., Chicago, USA). The ratio and chi-square test were used when applicable.

Ethical clearance

This study was approved by Ethics Committee of the Faculty of Medicine, Universitas Airlangga (No. 88 / EC / KEPK / FKUA / 2018).

Results

Subject characteristics

There were 45 students who returned the stools pots from Mandangin island and 55 students from Mojo village. A total of female students was nearly equal with male students in Mandangin island (23/43, 51.1% and 22/45, 48.9%, respectively) and it was lower than male students in Mojo village (23/55, 41.8% and 32/55, 58.2%, respectively). Elementary students from Mandangin island and Mojo village participated in this study were highly found on 4th grade (13/45, 28.9% and 28/55, 50.9%, respectively). The distribution of elementary students in the classes from both study sites was significantly different ($p < 0.0001$) (see table 1). From all subjects, only one student had the history of diarrhea.

Characteristics of stools

Characteristic of elementary student stools were determined by color and consistency examination. Two stools samples from elementary students in Mandangin island were difficult to identify because the specimens were covered by tissue, so only 43 samples from Mandangin island and 55 samples from Mojo village were examined (see figure 2). Brown color stools were commonly found in Mandangin island and Mojo village (39/43, 90.7% and 47/55, 85.5%, respectively) and followed by greenish colors (4/43, 9.3% and 1/55, 1.8%, respectively), but brownish yellow is only found in Mojo village 12.7% (7/55) then it had a significant different distribution ($p = 0.017$) (see table 5).

Five stool samples from elementary students in Mandangin island could not be identified for the consistency because of insufficient volume, so only 40 samples from Mandangin island and 55 samples from Mojo village were identified. Samples of elementary students in Mandangin island were commonly found on hard consistency 37.5% (15/40) followed by soft and liquid/slimy consistency (13/40, 32.5% and 12/40, 30%, respectively). In contrast, the soft stools consistency samples were highly found in Mojo village (44/55, 80%) then followed by hard and liquid / slimy consistency (10/55, 18.2% and 1/55, 1.8%, respectively). It also was a significant difference among these two regions ($p < 0.0001$) (see table 5).

The characteristics of student stools infected with G. lamblia from Mandangin island showed brown color (13/13, 100%) with consistency of hard, soft, and liquid / slimy consistency (5/13 (41.7%), 4/13 (33.3%), and 3/13 (25%), respectively). In addition, one student stools infected with G. lamblia in Mojo village was brownish-yellow color and soft consistency.

Giardiasis

Intestinal protozoan parasites were highly detected in elementary students stools in Mandangin island compared with Mojo village (31/45, 68.8% and 13/55, 23.6%, respectively). These intestinal protozoan parasites were Blastocystis spp, *G. lamblia,* and *Entamoeba coli*. *Blastocystis spp* was highly observed in infected stools compared with other protozoan parasites that was 70.9% (22/31) in Mandangin island and 100% (13/13) in Mojo village. The prevalence of *Blastocystis spp* infection was significantly different between Mandangin island and Mojo village (p = 0.008) (see on table 2).

The cyst form of *G. lamblia* was detected in elementary student stools. The prevalence of G. lamblia was significantly higher in Mandangin island than Mojo village (13/45, 28.9% and 1/55, 1.8%, respectively) (p <0,0001). In addition, *E. coli* infection was also found in two elementary students stools in Mandangin island compared with Mojo village, but it was not significantly different (p = 0.114) (see table 2).

Nutritional status

Nutritional status of students in both regions showed dominantly healthy weight 73.3% (34/55) in Mandangin island and 61.8% (33/45) in Mojo village. However, the number of student with severe underweight and underweight was higher in Mandangin island compared with Mojo village (3/45, 6.7% and 4/45, 8.9% vs 1/55, 1.8% and 2/55, 3.6%, respectively). Children nutritional status was significant different distribution in both study sites (p = 0.003) (see table 3).

Nutritional status and giardiasis

Nutritional status of elementary students infected with *G. lamblia* in Mandangin island were divided into underweight, healthy weight, and overweight (1/4 (25%), 8/33 (24.2%), and 4/4 (100%), respectively), but infected one student in Mojo village was in the health-weight category. The elementary students who infected with *G. lamblia* with normal nutritional status in Mandangin island was significantly different with Mojo village (p= 0.021) (see table 4).

Table 1. The Characteristic of Elementary Students

Characteristic	The Number of Students		P value
	Mandangin n=45 (%)	Mojo n=55(%)	
Sex			
Male	23 (51.1)	23 (41.8)	0.354
Female	22 (48.9)	32 (58.2)	
Grade			
2	9 (20)	0	<0.0001*
3	10 (22.2)	0	
4	13 (28.9)	28 (50.9)	
5	10 (22.2)	27 (49.1)	
6	3 (6.7)	0	

* P value is calculated using Chi-square. P ≤0.05 was significant.

Table 2. Intestinal Parasitic Infection in Stools of Elementary Students

Infection Agent	Infection Agent		Total	P value
	Mandangin	Mojo		
Blastocystis spp.	22	13	35	0.008*
Giardia lamblia	13	1	14	<0.0001*
Entamoeba coli	2	0	2	0.114
Tidak terinfeksi	14	42	56	<0.0001*

*P value is calculated using Chi-square. P ≤0.05 was significant.

Table 3. Nutritional Status of Elementary Students

Nutritional Status	The Number of Students		P value
	Mandangin n=45 (%)	Mojo n=55(%)	
Severely Underweight	3 (6.7)	1 (1.8)	0.003*
Underweight	4 (8.9)	2 (3.6)	
Healthy weight	33 (73.3)	34 (61.8)	
Overweight	4 (8.9)	7 (12.7)	
Obese	1 (2.2)	11 (20)	

*P value is calculated using chi-square. P ≤0.05 was significant.

Table 4. Nutritional Status of Giardiasis Elementary Students

Nutritional status of giardiasis student	The Number of Students		P value
	Mandangin n=45 (%)	Mojo n=55(%)	
Underweight	1/4 (25)	0 (0)	*0.011
Healthy weight	8/33 (24.2)	1/34 (2.9)	
Overweight	4/4 (100)	0 (0)	

*P value is calculated using chi-square. P ≤0.05 was significant.

Table 5. The Characteristics of Elementary Students Stools

Characteristics	The Number of Students		Total	P value
	Mandangin	Mojo		
Color	n=43* (%)	n=55 (%)	n=98 (%)	0.017***
Brownish	39 (90.7)	47 (85.5)	86 (87.8)	
Brownish Yellow	0 (0)	7 (12.7)	7 (7.1)	
Greenish	4 (9.3)	1 (1.8)	5 (5.1)	

Consistency	n=40** (%)	n=55 (%)	n=95 (%)	
Hard	15 (37.5)	10 (18.2)	25 (26.3)	<0.0001***
Soft	13 (32.5)	44 (80)	57 (60)	
Liquid/ Slimy	12 (30)	1 (1.8)	13 (13.7)	

*2 samples were not able to identify.
**5 samples were not able to identify.
*** P value is calculated using chi-square. P ≤0.05 was significant.

Discussion

Asymptomatic intestinal protozoan infections were highly found in elementary students, especially in Mandangin island. Transmission of intestinal protozoan parasites are generally through water, also found in previous studies in Lao (2017) that intestinal protozoan infection are closely related to contamination of water sources by human/animal stools.[15] Mandangin island has limited access to clean water sources which is important to control the intestinal protozoan infections.

G. lamblia was observed in students stools from both rergions, however, it was higher in Mandangin island (see on table 1). Giardiasis is an endemic disease found almost all over the world. A previous study showed that stools samples of tourists from the United States were positively infected with *G. lamblia* after visiting the Caribbean, Middle East, Eastern Europe, Central America, South America, North Africa, South Africa and Southeast Asia.[16] Giardiasis is a serious problem in areas that have poor sanitation, especially in developing countries.[17]

The cyst stage was detected but not trophozoite stage in all student stools infected with *G. lamblia.* This cyst form is usually found in patient with asymptomatic or giardiasis carriers, while the trophozoite form is found in patients with diarrhea.[18] The cyst form plays a role in the transmission of giardiasis. Cyst and trophozoite are released into the outer environment in stools, however, trophozoite form cannot survive in long time in environment compared with cyst form. Thus, cyst form, an infective stage able to enter the human body directly through the food and water which contaminated.[1] In addition, the main transmission of *G. lamblia* is through water source contamination.[19] Students should defecate in the toilet in order to prevent the contamination of water source and be aware of the quality of the drinks.

Mandangin island is isolated by beach and has a lower level of health education than Mojo village. It is predicted to affect the high rate incidence of giardiasis in Mandangin island, due to asymptomatic giardiasis students carrying cyst form that create continuously a chain of giardiasis transmission within the island. The habit of defecation in toilet is necessary to break the chain of giardiasis transmission.

The nutritional status of elementary students in Mandangin island showed severe underweight and underweight significantly higher than students in the Mojo village (see on table 3). Elementary students in Mandangin island are used to buy snacks but rarely do hand washing than students in Mojo village (unpublished). Various factors influence to the children nutritional status, such as the low education level of their parent, limited physical environment, and low socio-economic conditions.[20] Those factors seem to appear in Mandangin island.

G. lamblia was detected in stools of elementary students with nutritional status of underweight, healthy-weight, and overweight categories in Mandangin island (see table 3). Only a student with healthy nutritional status had stools infected with *G. lamblia* in Mojo village. In addition, there were no steatorrhea stools from any elementary student in both regions. Studies in South India (2012) reported that 50% of patients with giardiasis were asymptomatic.[21] Patients who are infected with *G. lamblia* over the time might able to build immune response that causes trophozoites in the intestinal lumen not be able to induce any symptom.[22] Symptoms of *G. lamblia* infections such as persistent diarrhea, cognitive deficits, and nutritional deficiencies are able to inhibit children growth. However, they are to be less relevant because *G. lamblia* infections commonly exhibit asymptomatic and subclinical symptoms. It is reinforcing the fact that there is a lack of connection between *G. lamblia* infection and the delayed child growth.[23] It seems that the asymptomatic giardiasis does not affect to reduce the child nutritional status, particularly elementary students in Mandangin island.

In addition, Blastocystis spp. was highly detected than *G. lamblia* in elementary students stools in both studies sites, especially higher in Mandangin island (see on table 2). In many epidemiologic surveys reported that Blastocystis is the most frequently isolated parasite, with a higher prevalence in under developing countries, where poor hygiene, exposure to animals, and consumption of contaminated food or water are observed. It is more common than other protozoan parasites such as G. lamblia and Dientamoeba fragilis.[24, 25] A study conducted in Colombia (2006) reported that Blastocystis spp. was not related to the student poor nutritional status while had less gastrointestinal symptoms.[26] In our study, most students with either *Blastocystis spp.* or *G. lamblia* in their stools did not have the history of diarrhea that might affect their nutritional status.

Conclusion

Giardiasis prevalence was found higher in Mandangin island but the nutritional status of students from both regions were not different. Thus, giardiasis might not affect to the elementary student's nutritional status particularly in Mandangin island.

Conflict of Interest

The author stated there is no conflict of interest

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