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Original Article

Intestinal Parasitic Infection, The Use of Latrine, and Clean Water Source In Elementary School Children At Coastal And Non-Coastal Areas, Sumenep District, Indonesia

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ABSTRACT

Inadequate latrine and water source cause transmission of intestinal parasitic infection, particularly in children. There is a lack information about it and it is needed to be investigated. This study aimed to compare the prevalence of intestinal parasitic infection, the use of latrine and clean water source in elementary school children at coastal and non-coastal areas in Sumenep District, Indonesia. An analytic observational study with cross sectional design was conducted in Dasuk Timur Elementary School located at coastal area, and Kolor II Elementary School at non-coastal area, Sumenep district, in January 2020. Intestinal parasites in students' stools were identified by microscopic examination using wet direct smear stained with lugol. The use of latrine and water sources were analyzed with questionnaire. A total of 68 children stools were collected from both elementary schools. Worm infections were not found. Thirty-one children (31/44, 70.5%) from Dasuk Timur Elementary School and eight children (8/24, 33.3%) from Kolor II Elementary School were infected with intestinal protozoan and significant difference (P=0.003, Chi-square test). Blastocystis hominis was highly found in stools of Dasuk Timur Elementary School's students (31/44, 70.5%) and significantly different from Kolor II Elementary School's students (P<0.0001, Chi-square test). Three children (3/44, 6.8%) from Dasuk Timur Elementary School were still practicing open defecation. Dasuk Timur Elementary School's students suffered from intestinal parasitic infection were mostly using non-piped water source (20/31, 64.5%) and were significantly different between two elementary schools (P=0.015, Fisher's exact test). Prevalence of intestinal parasitic infections in children was found higher in coastal than non-coastal area due to the commonly use of unclean water sources and inadequate latrine.

Keywords: *Intestinal Parasitic Infectio; Clean Water Source; Latrine, Elementary Children; Coastal Area*

ABSTRAK

Jamban dan sumber air yang tidak layak menyebabkan transmisi infeksi parasit usus, terutama pada anak. Sedikit informasi terkait jamban, sumber air dan infeksi parasit usus pada anak, sehingga perlu untuk diteliti. Penelitian ini bertujuan untuk mengidentifikasi perbedaan prevalensi infeksi parasit usus, penggunaan jamban, dan sumber air bersih pada anak sekolah dasar di daerah pesisir dibandingkan dengan bukan pesisir di Kabupaten Sumenep, Indonesia. Penelitian observasional analitik dengan desain cross sectional dilaksanakan di SDN Dasuk Timur berlokasi di daerah pesisir, dan SDN Kolor II berlokasi di daerah bukan pesisir Kabupaten Sumenep pada bulan Januari 2020. Parasit usus dalam tinja anak sekolah dasar diidentifikasi dengan pemeriksaan mikroskopis dari sediaan hapusan tinja basah yang tercat dengan larutan lugol. Penggunaan jamban dan sumber air dianalisis dengan kuesioner. Sebanyak 68 tinja anak dikumpulkan dari kedua sekolah dasar. Kecacingan tidak ditemukan. Sebanyak 31 anak (31/44, 70.5%) SDN Dasuk Timur dan 8 anak (8/24, 33.3%) SDN Kolor II terinfeksi protozoa usus dan berbeda chisquare test). Blastocystis hominis ditemukan banyak dalam tinja anak SDN Dasuk Timur (31/44, 70.5%) dan

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berbeda bermakna dengan anak SDN Kolor II (P<0.0001, Chi-square test). Tiga anak (3/44, 6.8%) dari SDN Dasuk Timur masih melakukan defekasi di tempat terbuka. Anak SDN Dasuk Timur yang terinfeksi parasit usus kebanyakan menggunakan sumber air non-pipa (20/31, 64.5%) dan berbeda bermakna antara kedua sekolah dasar (P=0.015, Fisher's exact test). Prevalensi infeksi protozoa usus pada anak ditemukan lebih tinggi di daerah pesisir dibandingkan di daerah bukan pesisir karena penggunaan sumber air tidak bersih dan jamban yang tidak layak.

Kata kunci: *Infeksi Parasit Usus; Sumber Air Bersih; Jamban; Anak Sekolah Dasar; Daerah Pesisir*

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INTRODUCTION

Parasitic infections are caused by intestinal helminth and protozoa that are very common in developing country, such as Indonesia. Parasitic infections can cause high morbidity and mortality in endemic area[1]. Intestinal parasitic infections are estimated to occur in 3.5 billion people around the world and the majority occur in children[2].

The intestinal helminth infections can cause iron deficiency anemia, impaired mental function and cognitive delevelopment that affect to children growth and development[3]. Intestinal protozoan infections also impact growth and development in children[2]. Children who consume contaminated food and water can lead to intestinal parasitic infections. Moreover, enviromental and economy factors, such as poor sanitation, poverty, and lack of education, also contribute to intestinal parasitic infections. Children have active period of playing and moving, then they forget to wash their hands that affect to the intestinal parasite transmission[4].

Based on Law Number 27 Year 2007 about Management of Coastal Areas and Small Islands, coastal areas are transitional areas between land and marine ecosystems which are affected by changes on land and sea. Indonesia is the largest archipelago in the world that consists of around 18,110 islands with coastline of 108,000 km5. This makes coastal areas in Indonesia a hope for people to fulfill life necessities. However, the environment will be damaged as the development blooms in coastal area. The damaged environment can trigger health problems and makes the disease transmission easier, such as water pollution, littering, and defecate in the open place [6].

The prevalence of parasitic infection in coastal area were reported by a study in Tanawangko, Tombariri Sub-district, Minahasa District found that 4.3% elementary school children were infected with Ascaris lumbricoides [7]. Another study conducted in coastal area of Wori Sub-district, North Minahasa District showed that 4.7% children suffered from intestinal helminth infections and 15.5% children were infected with with intestinal protozoa.[8] In addition, previous research in coastal area of Makassar City reported that the prevalence of intestinal helminth infections was 59.3% in children.[9]

Therefore, the incidence of intestinal parasitic infection is still quite high in Indonesia. Sumenep Regency is located at the eastern part of Madura Island and has a coastline length of 577.76 km. It can increase the risk of intestinal parasitic infections in coastal area.[10] A study conducted in Aeng Merah III Elementary School, Batuputih Sub-district, Sumenep District showed that 55.6% of 14 children who defecated on the ground and 44.4% of 20 children who defecated in latrine were infected with intestinal nematodes in 2014.[11] The prevalence of intestinal parasitic infection in elementary school children at Sumenep District has not yet been

investigated further. Thus, the identification of prevalence of intestinal parasitic infection with the use of latrine and clean water sources in elementary school children at coastal area and non-coastal area of Sumenep District, Indonesia were conducted in this study.

MATERIALS AND METHODS

Study Site and Population

An observational analytic study with cross sectional design was conducted in coastal area, Dasuk Timur (DT) Elementary School, and non-coastal area, Kolor II (KII) Elementary School, of Sumenep District, Indonesia in January 6-13, 2020. Sumenep district lies in the eastern part of Madura Island. The study sites is shown on Figure 1. Dasuk Timur School is 0.07 km from seashore and Kolor II School is 6.32 km. The distance of Dasuk Timur School from Kolor II School is 16 km.

Elementary school children in 1-4 grade, who were willing and allowed by their parents, were included in this study. Their stools and the questionnaires were collected. Sterilized-clean tool pots were distributed to children in both elementary schools. Children, who submitted stools pots and also fulfilled the questionnaire, were analyzed.

Data Collection

The stool samples of elementary school children were collected and preserved by 10%formalin solution. Stool samples were examined with direct smear using 1% lugol solution under light microscope with 200x magnifications for identifying intestinal helminth, and 1000x magnifications with immersion oil for detecting intestinal protozoa. The stool examination was performed in the Laboratory of Medical Parasitology Department, Faculty of Medicine, Universitas Airlangga, Surabaya. The use of latrine and clean water sources were determined by using questionnaires. Questionnaire was guided by researchers and teachers to the children. The latrine types consisted of household toilet, public toilet, and open air defecation in river, sea, or the bush. The clean water sources were composed by piped and non-piped water sources. The non-piped water sources consisted of river, sea, pond, and draw or artesian well water. The collected data were analyzed using 25.0 version SPSS program. The Chi-square test were used when

Ethical Consideration

This study was declared by Ethics Committee of the Faculty of Medicine, Universitas Airlangga (Number of 221/EC/KEPK/FKUA/2020).

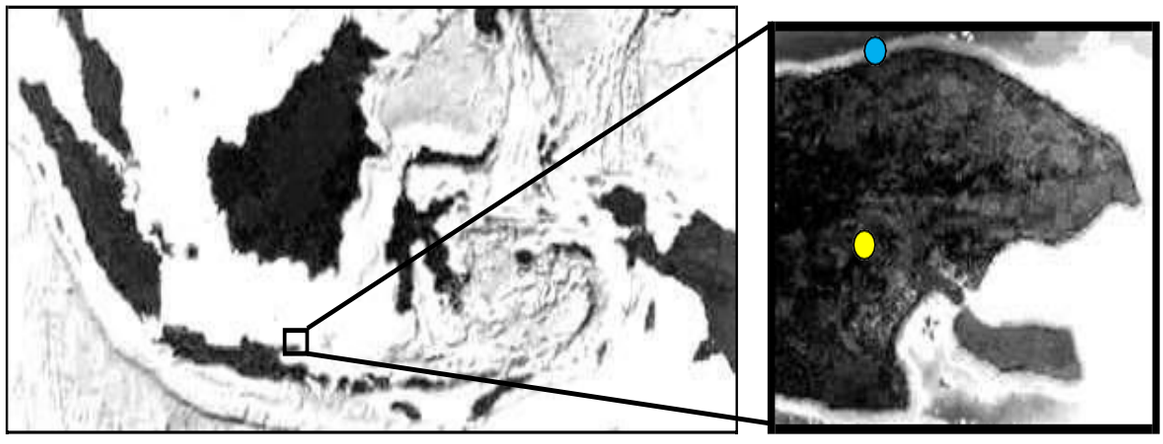

Figure 1. Study sites are located in Sumenep District, Madura Island, Indonesia that are in Dasuk Timur Elementary School (the blue circle) and Kolor II Elementary School (the yellow circle).

RESULTS

Characteristics of Subjects

Elementary school children from grade 1st to 4th were voluntarily to participate this study by filling data using questionnaire and submitting their stools that were totally of 68 children (68/155, 43.9%) from both elementary schools (see on Figure 2).

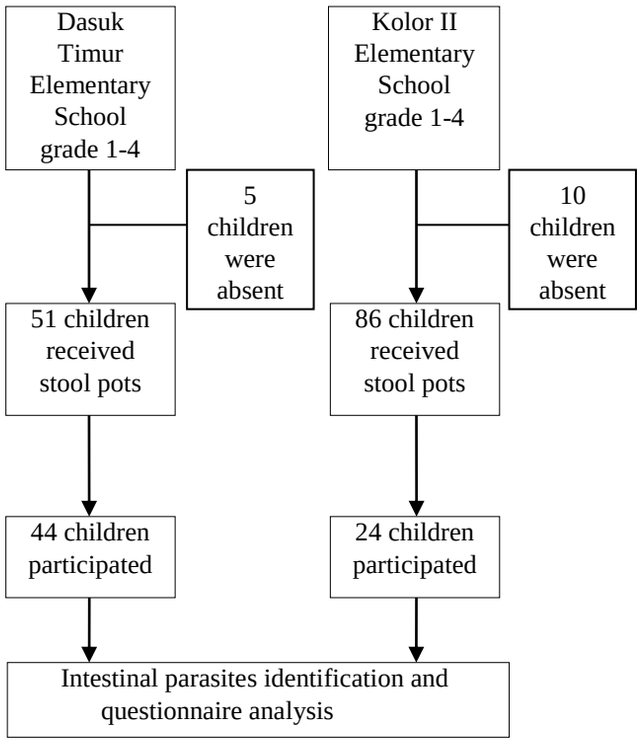

Figure 2. Flow diagram of sample collection

Most samples were obtained from Dasuk Timur Elementary School (44/68, 64.7%). The oldest participants (11-year old) were only found in Dasuk Timur Elementary School. However, there was no significant difference between the distribution of age from both schools. The distribution of children infected with intestinal parasites according to sex and age did not show a significant difference between the two elementary schools (see on Table 1).

Intestinal Parasitic Infections

The collected stool samples were examined with a direct smear or wet mount. Intestinal helminth infection was not found in children from both elementary schools (see on Table 2). Children infected with intestinal protozoan parasites were highly shown in Dasuk Timur Elementary School (31/39, 79.5%).

Table 1. The Characteristic of elementary school children

Characteristic	Study Site: Dasuk Timur Elementary School N (%)	Study Site: Kolor II Elementary School N (%)	*P* value
Sex			
Male	25 (56.8)	10 (41.7)	0.232*
Female	19 (43.2)	14 (58.3)	
Age (y.o)			
6	3 (6.8)	5 (20.8)	
7	8 (18.2)	5 (20.8)	
8	7 (15.9)	5 (20.8)	0.017+
9	10 (22.7)	7 (29.2)	
10	13 (29.5)	2 (8.3)	
11	3 (6.8)	0	
Infected Children Sex			
Male	15 (48.4)	5 (62.5)	0.695*
Female	16 (51.6)	3 (37.5)	*
Age (y.o)			
6	1 (3.2)	2 (25)	
7	7 (22.6)	1 (12.5)	
8	4 (12.9)	0	0.311+
9	8 (25.8)	4 (50)	
10	9 (29)	1 (12.5)	

Latrine

Three children (3/44, 6.8%) from Dasuk Timur Elementary School were still practicing open defecation in places such as a river, sea, or bushes, while all children from Kolor II Elementary School were defecating in the latrine. However it was not statistically significant between both elementary schools (p=0.336, Fisher exact test) (see on Table 4).

A total of 29 infected children from Dasuk Timur Elementary School used household toilet (29/31, 93.5%), while all Kolor II Elementary School children who suffered from intestinal parasitic infections used household toilet (8/8, 100%). It was no a significant difference found between two elementary schools (see on Table 4).

Table 2. Intestinal protozoan in stools of elementary school children

Intestinal Parasitic Infection		Study Site: Dasuk Timur Elementary School n=44 (%)	Study Site: Kolor II Elementary School n=24 (%)	*P* value
Intestinal Helminth				
Positive		0	0	
Negative		44 (100)	24 (100)	
Intestinal Protozoan				
Giardia lamblia	Single	0	0	0,536**
	Mix	2 (4.5)	0	
Entamoeba coli	Single	0	1 (4.2)	0,413**
	Mix	5 (11.4)	0	
Blastocystis hominis	Single	25 (56.8)	5 (20.8)	**<0,0001**
	Mix	6 (13.6)	0	
Cryptosporidium spp.	Single	0	2 (8.3)	0,121**
	Mix	0	0	
Negative		13 (29.5)	16 (66.7)	**0,003***

* P value is calculated using Chi-square test. P≤0.05 was significant.
** P value is calculated using Fisher's exact test. P≤0.05 was significant.

The infected stool samples consisted of 33 samples (33/39, 84.6%) with single infection and 6 samples (6/38, 15,8%) with mixed infection. *B. hominis* infection was found more frequently in Dasuk Timur Elementary School children (31/31, 100%) compared to Kolor II Elementary School children (5/8, 62,5%) and it was significantly different (*P*<0,05, *Chi-square test*) (see Table 2). Seventeen children (17/36, 45.7%) were infected with *B. hominis* by density of 1/20 field (see on Table 3).

Table 3. Blastocystis hominis density

Number of *Blastocystis hominis**	No. Infected Samples n (%)
1/20 fields	17 (47.2)
2/20 fields	4 (11.1)
3/20 fields	4 (11.1)
4/20 fields	1 (2.8)
5/20 fields	2 (5.5)
7/20 fields	5 (13.9)
10/20 fields	1 (2.8)
11/20 fields	1 (2,9)
40/20 fields	1 (2,9)
Total	36 (100)

*Number of B. hominis was counted by the field of 1000x magnifications with immersion oil in total 20 fields.

The intestinal protozoa were identified tha were cysts of *G. lamblia*, cysts of *E. coli* vacuolar type of *B. hominis* and oocyst o *Cryptosporidium spp*. (see on Figure 3).

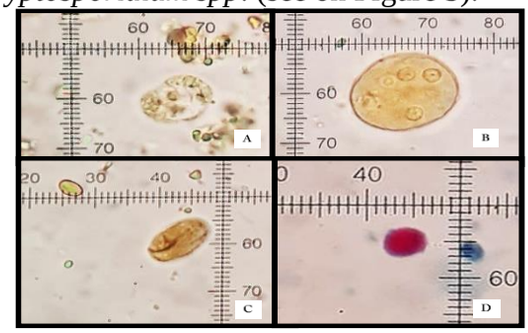

Figure 3. The morphology of intestinal protozoa in children's stool samples were (A) vacuolar type of B. hominis; (B) cyst of E. coli; (C) cyst of G. lamblia; and (D) oocyst of Cryptosporidium spp (modified Ziehl Neelsen stain). Minimal length is 1 micrometer.

Table 4. Latrine usage of elementary school children

Latrine	Study Site: Dasuk Timur Elementary School N (%)	Study Site: Kolor II Elementary School N(%)	*P* valu
Household Toilet	40 (90.9)	22 (91.7)	
Public Toilet	1 (2.3)	2 (8.3)	0.336
Open Defecation	3 (6.8)	0	
Infected Children			
Household Toilet	29 (93.5)	8 (100)	
Public Toilet	1 (3.2)	0	1.000
Open Defecation	1 (3.2)	0	

* P value is calculated using Fisher's exact test. P≤0.05 was significant.

Clean Water Sources

Non-piped water sources were mostly used by children from Dasuk Timur Elementary School compared to children from Kolor II Elementary School (28/44, 63.6% vs 2/24, 8.3%) and there was a significant difference between two elementary schools (P<0,05, Chi-square test) (see Table 5).

Non-piped water sources were mostly used by infected children from Dasuk Timur Elementary School compared to infected children from Kolor II Elementary School (20/31, 64.5% vs 1/8, 12.5%) and it was a significant difference between two elementary schools (P<0,05, Chi-square test) (see on table 5). The non-piped water sources in Dasuk Timur village are open draw well, artesian well, river, a pond and sea water, while in Kolor II

village is artesian well water (see on Figure 4).

Figure 4. The non-piped water types are A) an open draw well, B) an artesian well, and C) a pond with outfall.

Table 5. Clean water sources of elementary school children

Clean Water Source	Study Site: Dasuk Timur Elementary School N (%)	Study Site: Kolor II Elementary School N (%)	*P* value
Piped Water	16 (36.4)	22 (91.7)	**<0,0001***
Non-Piped Water	28 (63.6)	2 (8.3)	
Infected Children			
Piped Water	11 (35.5)	7 (87,5)	**0.015****
Non-Piped Water	20 (64.5)	1 (12,5)	

* P value is calculated using Chi-square test. P≤0.05 was significant.
** P value is calculated using Fisher's exact test. P≤0.05 was significant.

DISCUSSION

The present study determined that sex and age had the same probability to be infected with intestinal parasites. Molina[12] and Saputra[13] stated that there was no statistical difference in intestinal parasitic infections based on age and sex. Another study conducted in Sanandaj City showed that sex and age did not have a significant difference in intestinal parasitic infection[4]. Sex and age did not affect the incidence of intestinal parasitic infections at Dasuk Timur Elementary School and Kolor II Elementary School.

The present findings found no intestinal helminth infections in children from both elementary schools. The zero prevalence of intestinal helminth infection in children might due to the regular consumption of oral anthelmintic medicine. Based on interview to teachers, anthelmintic medicine, albendazole, is regularly consumed by children in their schools twice per year.The albendazole was provided by public health service or local public health center. Albendazole was last taken by children in September 2019 or 4 months before collecting the stools samples. Previous studies also showed the reduction of intestinal helminth infection in elementary school students after providing regularly albendazole and health education such as in Bunduduk elementary school Central Lombok[14], and Pagi Paseban elementary school Central Jakarta[15]. The prevalence of intestinal helminth infections in elementary school children can be eliminated by regular consumption of oral anthelmintic and education of intestinal helminth infections.

Blastocystis hominis was found the most in children's stools both from Dasuk Timur elementary school (31/31, 100%) and Kolor II elementary school (5/8, 62,5%) and significantly different (P<0,05, Chi-square test). It indicates that Dasuk Timur elementary school children are more at risk to be infected with *B. hominis.* In addition, they were without symptoms and did not have a history of diarrhea. Asymptomatic *Blastocystis* infection might due to rare number of *B. hominis* in their stools. It was reported that finding >.5 parasites per high- power field (400 magnifications) is associated with the presence of gastrointestinal disease[16]. Asymptomatic Blastocystis infection occurred in elementary school children in coastal and non-coastal areas. They could be carriers who were able to contaminate *B. hominis* into environment, particularly in the poor personal hygiene and sanitation.

Most of Dasuk Timur elementary school children used non-piped water sources and they were carrying the *B. hominis* in their stools. In addition, people in Dasuk Timur village including elementary children used to the wells water for their drink. Some of them used to without boiling wells water for drink (based on interviews with several children and teachers). *B. hominis* infection belongs to waterborne disease and transmitted by the fecal-oral route,

such as through food and water contaminated with feces containing B. hominis and poor sanitation in the community.[17,18] A study in Sanandaj City reported that a high prevalence of intestinal protozoan infection among school children occurred and the use of drinking water sources from unprotected wells was a risk factor of intestinal parasitic infection[4].

It was also found in Lao PDR that people used the water sources from mountain and wells water were infected with either intestinal helminth or protozoa.[19] This fact confirmed that unboiling non-piped water source for drink is potential to transmit the *B. hominis* into children living in Dasuk Timur village.

Poor sanitation facilities in coastal areas can also contribute to spreading the intestinal parasites infection, such as the inadequate supply of clean water, inadequate latrine, improper waste disposal, and littering.[6,20] Furthermore, a study in Karangasem District, Bali showed that 34% of elementary school children were infected with *B. hominis* and most of the children were still practicing poor sanitation, shared water with animals, and had a lack of household toilets[21]. Our study showed that the most children stools carrying *B. hominis* used the house toilets for defecation. Only two elementary children carrying *B. hominis* in their stools used to either open defecation or public toilet and they are living in Dasuk Timur. Nevertheless, they could contaminate the water source. Ironically, they still used unboiling non-piped water source for drink in Dasuk Timur village, so *B. hominis* transmission occurred more in Dasuk Timur than in Kolor II village. Therefore, the non-piped water source needs to be investigated further, whether contains *B. hominis* or not, in order to cut off the B. hominis transmission. Thus, coastal areas with non-piped water sources, without boiling water for drink, and still doing the open defecation can increase the risk of *B. hominis* infection.

Our findings showed that *G. lamblia* and *E. coli* were found more frequently in Dasuk Timur Elementary School children's stools compared to Kolor II Elementary School children's stools. These protozoan parasites also belong to water borne disease.[22,23,24,25] It showed that Dasuk Timur Elementary School children were more at risk to be suffered from intestinal protozoan infection because most of the children in the coastal area still used non- piped water sources. Gabbad et al revealed that difficulty accessing clean water in Elengaz, Khartoum, Sudan caused children suffering from intestinal parasites.[18] A study in a rural area of Boyer-Ahmad, Iran represented that the prevalence of intestinal protozoan infection was 37.5% with 9 species of protozoa found in stool samples, including G. lamblia, B. hominis, E. coli, and Endolimax nana. This high prevalence of intestinal protozoan infection might due to water shortages during decresed level of rainfall in Iran, which caused poor sanitation.[26] Recent study in Kenya stated that source of water for drinking was a major determinant for the risk of intestinal protozoan infections in children under 5 years with diarrhea.[27] Lack of access to clean water sources is one of the risk factors of intestinal protozoan infection.

CONCLUSION

Prevalence of intestinal parasitic infection was found higher in coastal than non-coastal area due to commonly use unclean water source and inadequate latrine.

CONFLICT OF INTEREST

The authors declare that there is no conflict of interest.

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