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Nutritional Status of School-aged Children with Intestinal Parasite Infection in South Jakarta, Indonesia

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Abstract

BACKGROUND: The prevalence of intestinal parasitic infection still high in Indonesia and lead to nutritional disorder, especially in the school-aged children.

AIM: This research conducted to find the association of intestinal parasitic infection to the nutritional status of the children.

METHODS: This was a cross sectional study, conducted in January 2016 in one primary school in South Jakarta, Jakarta, Indonesia, by collecting the children's stool from 1st to 5th grade. Direct examination of the stool was conducted in the Parasitology Department, Faculty of Medicine, Universitas Indonesia, by Lugol and eosin staining. Nutritional status categorized using BMI chart. Data were analyzed using Chi-square test, Statistical Product, and Service Solutions version 20.

RESULTS: From the total 157 stool examined in the laboratory, there were 60 (38.2%) children positively infected with various kinds of intestinal parasites. Mostly the infection is caused by *Blastocystis hominis*, which infects 44 children (69.4%). The other infection is caused by *Giardia lamblia* (15.3%), *Trichuris trichiura* (1.4%), and hookworm (1.4%), and mixed infection of *B. hominis* and *Escherichia coli* (4.2%) and *B. hominis* with *G. lamblia* (4.2%). From the total of infected children, 17 children (28.3%) have BMI below 5th percentile, and it was considered as malnourished. Moreover, 67 uninfected children have normal nutritional status. Statistically, there is an association between intestinal parasitic infection and nutritional status in school-aged children in South Jakarta ($P < 0.05$).

CONCLUSION: The incidence of intestinal parasitic infection in school-aged children is 38.2%. Moreover, 28.3% of the infected children were malnourished and it is suggested that children with intestinal parasite infection have low nutritional status.

Introduction

Intestinal parasitic infection is defined as an infection in the gastrointestinal tract by an organism that tends to obtain their food from their host, specifically humans. The parasites itself can be classified into two main groups, which are protozoa and helminths. The most frequent helminths infection is caused by *Ascaris lumbricoides*, hookworm (*Necator americanus, Ancylostoma duodenale*), and *Trichuris trichiura,* which they are usually called as soil-transmitted helminths [1], [2]. Moreover, the most frequent protozoan parasites that caused infection in the gastrointestinal tract are *Giardia lamblia* and *Entamoeba histolytica* [3], [4].

Asia is one of the continents that have high number of parasite infections [5]. Furthermore, those infections usually found in children, especially in developing countries that have well-suited conditions that support the life cycle of the parasites. Parasites usually inhabit countries that have high humidity with warm or hot weather in correlation with other factors [1], [2]. One of the countries that have the characteristic for the parasite to spread is Indonesia. Several research regarding these kinds of infections has been conducted before in Indonesia, and the prevalence of several parasites can be found including *A. lumbricoides* for all ages and for children ranging from 5 to 10 years old (40–60% and 60–80%, respectively), *T. trichiura* (30-90%), hookworm (30–40%), [6] *Blastocystis hominis*, *Entamoeba histolytica,* and *Giardia lamblia* [3], [7].

There are several factors that increase the risk of parasite infection in human. Parasites will tend to infect humans that live in a country with high humidity, hot, or warm weather and have tropical climate [1]. In addition, these parasites infections commonly higher among country with poverty, lack of sanitation and clean water, malnourished population, crowded population, substandard behavior of the people and ignorance of educational system [1], [2], [4], lower maternal education level, and those children in the 1st year of the school-life [8]. At present, all of those factors were still found in Indonesia, in that reason intestinal parasitic infection is still high.

Nutrition and intestinal parasitic infections are closely linked. There are still high rates of children mortality and morbidity caused by the effect of intestinal parasitic infection which is malnutrition [9]. Up to now,

intestinal parasitic infection as a cause of malnutrition is still becomes a major public health problem in the world especially in developing countries [10]. Malnutrition is usually caused by inadequate food intake and the infection that damage the body's ability to absorb the food. The infection can lead to several problems such as diarrhea, which may lead to malnutrition of the children [9]. Moreover, malnutrition will delay the growth of the children and their brain/intellectual development [11].

Nutritional status is an important measure of health in individual. Lower nutritional status may be the result of inadequate nutrient intake which can be due to intestinal parasitic infections [11]. The assessment of nutritional status is now established by calculating the body mass index (BMI), it can be assessed by weight-for-height measurement [12], and it will calculate the total body fat in children and determine their nutritional status classifications. Children continue to grow, and their amount of body fat is changing, which leads to changes of the BMI. Based on that circumstance, BMI measurement for children must be interpreted relative to other children with the same age and sex and resulting in percentile number [12]. According to WHO in 2018, more than two thirds of all wasted children under 5 lived in Asia and more than one quarter lived in Africa [13]. Considering all the issues above, this research was conducted to find the association of intestinal parasitic infection to the nutritional status of the children.

Methodology

This study obtained ethical approval from the Ethical Committee on Health Research, of Faculty Medicine Universitas Indonesia (No. 468/UN2.F1/ETIK/2015). This cross-sectional study was conducted in SDN 04 Kalibata, South Jakarta, Jakarta, Indonesia. The data were collected in January 2016 with target population was school-aged children from 1st until 5th grade students. The student and their parents were explained about the purpose of the study and how to collect the stool. We obtained the informed consent from the parents and asked them to fill the questionnaire. The data that are needed for this research are primary data, obtained from the questionnaire, antropometri examination to know the nutritional status, and from microscopic examination of the stool.

Stool examination

The stool was examined microscopically in the Parasitology Laboratory in the Faculty of Medicine, Universitas Indonesia with wet mount methods using Lugol or eosin staining. Intestinal parasitic infection is an infection that is caused by intestinal parasites. It can be worms or protozoa. In this research, the parasites that are going to be observed were ova of *A. lumbricoides,* hookworm, and *T. trichiura* (whipworm), cyst of *Entamoeba* sp., *Blastocystis hominis,* and *Giardia lamblia*. Positive infection can be ruled out if the ova of the worm or protozoan cyst can be found in the stool of the studied subject.

Nutritional status

The nutritional status of school-aged children can be assessed by counting their BMI. BMI can be counted by measuring the child's body weight (kg) by the square of height (m). The students were asked to remove shoes and hat during height and weight measurement. The measurement of weight was done using digital scale. The weight and height of children 2–20 years old are changing during their growth, thus the child's BMI must be interpreted relative to other children of the same sex and age and expressed as a percentile, which can be obtained from a percentile calculator and usually called BMI for-age percentiles. The purpose of comparing the BMI is to know the proportion of the child's weight to other children. However, BMI is enough to represent the nutritional status classification of the children. Nutritional status is one of the important outcomes for intestinal parasitic infection.

Location of school-aged children

In this research, the school-aged children that are going to be observed are the student from one primary schools in South Jakarta. The students live around the school and this area is located in the high-risk flood. The floods have happened once or 2 times every year.

The data were processed using Statistical Product and Service Solutions (SPSS) version 20 to yield tables and graphs. SPSS was done using the Chi-square test at p-value α 0.05.

Results

This study involved 157 primary school children from 1st until 5th grade. Stool and questionnaires were collected from students from grade one till five.

It can be seen from Table 1, there are 79 male students and 78 female students (50,3% and 49.7%, respectively) that come from different age groups in this study. The children's age is classified from 6 to 8 years old group (74 children) and 9–11 years old group (83 children).

From 157 stools that undergo direct examination, there are 60 children who are positively

infected with various intestinal parasites. This accounts for about 38.2% of the total population. On the contrary, there are 97 children (61.8%) with no intestinal parasitic infection. The distribution of nutritional status of the children is examined from BMI percentile. The majority of the children have a normal weight (64.3%). However, there are 19 underweight children, which account for 12.1% of the total population. In addition, there are overweight and obese children found (12.7% and 10.8%, respectively).

Table 1: Characteristics of population

Sociodemographic characteristics	Frequency	Percent
Sex		
Male	79	50.3
Female	78	49.7
Grade		
1	23	14.6
2	29	18.5
3	42	26.8
4	30	19.1
5	33	21.0
Age category (year)		
6 – 8	74	47.1
9 – 11	83	52.9
Infection of intestinal parasite(s)		
Positive	60	38.2
Negative	97	61.8
Nutritional status (BMI)		
Underweight	19	12.1
Normal weight	101	64.3
Overweight	20	12.7
Obese	17	10.8

Table 2 illustrates the nutritional status based on the presence of parasitic infection and the associations between intestinal parasitic infection and the nutritional status of the children assessed by their BMI percentile. Out of 157 children examined, there are 60 children infected with various intestinal parasitic infections. It can be seen from Table 2 that 17 children that are infected from all the target population are underweight that represents poor nutritional status/ malnourished because the BMI percentile shows less than 5th percentile in comparison to children with the same age and sex, it accounts for 28.3% of the infected population. However, two children (2.1% of the non-infected population) who are not infected have low nutritional status. Moreover, there were 34 infected children (56.7% of the infected population) to have healthy weight, means that BMI percentile is ranging from 5th to 85th percentile. In the other hand, mostly non-infected children, which accounts for 69.1% of the non-infected population (67 children), have a healthy weight. It is also found 6 children (10%) infected with parasites were overweight and 3 children (5%) were obese, which means that their BMI percentile is ranging between 85th-95th percentile and above 95th percentile, respectively.

p-value is the probability value of having the data by chance. It is obtained from the Chi-square test in SPSS 20. The data collected has a normal distribution. Therefore, the significance value (p-value) can be assessed using Chi-square test, which results in $p \leq 0.001$ in this research. This shows that the data are significant ($p < 0.05$), and there is an association between the positive status of intestinal parasitic infection and low nutritional status (underweight) of the school-aged children.

Table 3 shows the distribution of various parasites that infect the target population. Out of the children investigated, there was single and mixed infection found. The infections are caused by *B. hominis, G lamblia,* hookworm (*N. americanus* and *A. duodenale),* and *T. trichiura*. It can be seen from both Table 3 and Figure 1 that *B. hominis* is the most frequently encountered parasite found in school-aged children (44 out of 157 or 69.4%). High number of infections is also caused by *G. lamblia,* which accounts for 15.3% of the total samples; however, the number is not as high as infection by *B. hominis*. *T. trichiura,* and hookworm infection has the same number of infections, which is 1.4%. There were two types of mixed infection found which also have the same number of infection (4.2%); however, the number of mixed infections is higher than the infection caused by *T. trichiura* and hookworm.

Table 3: Distribution of intestinal parasitic infection

Intestinal parasitic infection	Frequency	Percent
Blastocystis hominis	44	69.4
Giardia lamblia	8	15.3
Trichuris trichiura	1	1.4
Hookworm	1	1.4
Blastocystis hominis + *Escherichia coli* (mix)	3	4.2
Blastocystis hominis + *Giardia lamblia* (mix)	3	4.2

Figure 1 illustrates the various types of intestinal parasitic infection of 60 children in different nutritional status, which are underweight, healthy weight, overweight, and obese. It can be seen clearly that underweight or malnourished child are frequently infected with protozoa of *B. hominis* and *G. lamblia* and mixed infection of *B. hominis* and *Escherichia coli*.

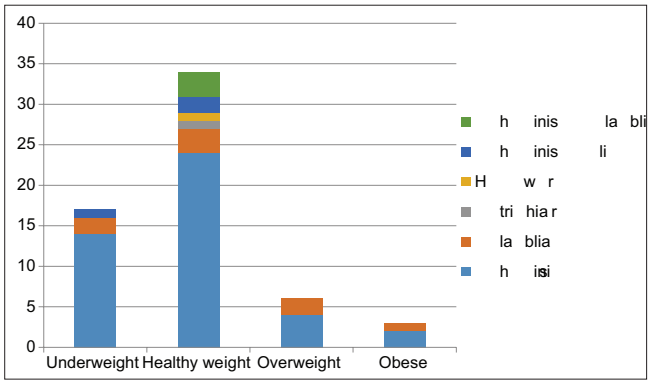

Figure 1: The proportion of etiologic agents among several nutritional status

Table 2: Associations between intestinal parasitic infection and nutritional status

Intestinal parasitic infection	Nutritional status (%)				Total	p-value
	Underweight	Normal weight	Overweight	Obese		
Positive	17 (28.3)	34 (56.7)	6 (10)	3 (5)	60 (100)	≤ 0.001
Negative	2 (2.1)	67 (69.1)	14 (14.4)	14 (14.4)	97 (100)	
Total	19 (12.1)	101 (64.3)	20 (12.7)	17 (10.8)	157 (100)	

(14, 2, and 1 children, respectively). For the healthy weight, there are more various types of intestinal parasitic infection, which are *B. hominis* (24 children), *Giardia lamblia* (3 children), hookworm (1 child), and *T. trichiura* (1 child), and mixed infection of *B. hominis* and *G. lamblia* (3 children), and *B. hominis* and *E. coli* (2 children). For the overweight and obese children, the infection is caused by 2 types of protozoa, which are *B. hominis* and *G. lamblia.*

Discussion

Intestinal parasitic infection is defined as the process when infectious agents enter and growth in the GI tract of the host and that will lead to a disease. Intestinal parasitic infection is still a common public health problem of school-aged children these days, especially in the developing countries [1], [2]. A high number of parasitic infections were found in environments that have well-suited conditions for the parasites to conduct their life cycle. They are usually tropical countries with high humidity [3], [4]. In addition to that other contributing factors that support the life cycle of the parasites include poor hygiene, inaccessibility to clean water, unhygienic behavior, low education level of the society, and low socioeconomic status [8]. Infection can give rise to several outcome to the infected host by various mechanisms, including malnutrition, abdominal pain, anemia, and diarrhea [11].

According to this study, the prevalent of intestinal parasitic infection is 38.2%. The prevalent is higher than Khariri *et al*. [14] study, but the prevalence in this primary school is less than in previous study by Winita *et al*. [15]. This relatively low number of incidences may be due to several factors such as the cleanliness of the schools and the season of research conduct.

Albeit it is high risk of getting flood, the school environment is clean. The school's histories of being frequently flooded might have increased the awareness of the school staff to educate their students to maintain their hygiene (e.g., washing their hands before eating and after doing outdoor activities). Handwashing with soap at five key moments has effective in preventing intestinal parasite infection [16], [17]. This risk factor has been well controlled by the school management.

Under optimal environment conditions (high humidity and warm temperature), parasites can easily grow and infect the host. However, this study was not conducted in the rainy season, which usually has high humidity. Thus, the environment's condition did not favor the life cycle of the parasites, resulting in a smaller number of infections. Due to the low level of humidity, moist soil was not found in the schools area and that is the prerequisite for the transmission of soil-transmitted helminths [1], [2].

Nutritional status is assessed by calculating the BMI. Special case for children 2–20 years old who continue to grow, BMI is in the form of percentile. That means: It is interpreted relative to other children with the same age and sex. It can be seen that there were 28.3% infected intestinal parasites children have BMI below 5th percentile, which indicates they were underweight and representing poor nutritional status. They were mostly infected by *B. hominis* (14 children), and the rest are infected by other protozoa which are G. lamblia, and mixed infection with *E. coli.* In addition, infection of helminthes of *T. trichiura* and hookworm was not found to affect the nutritional status of the children. This might be due to the degree of the infection that is still under the symptomatic stage. For children with mild/acute infection of *T. trichiura*, there will be no significant symptoms, but we can identify the parasite in the stool [1]. However, chronic infection will cause chronic diarrhea, anemia, and decreased body weight. In addition, hookworm infection can cause malnutrition by inducing anemia in their mature stage or severe degree of infection because symptoms depend on the number of helminths infecting the children and also the nutritional status of the children (iron and protein) [18]. Hookworm infection may not affect the nutritional status because of the good composition of iron and protein in the children and a low number of parasitemia [19]. Thus, it explains why two children in this case infected with *T. trichiura* and hookworm have healthy weight.

Intestinal parasitic infection and nutritional status are closely linked [9]. Intestinal parasitic infection as a cause of malnutrition in school-aged children remains a significant public health problem in society especially in Indonesia [6]. Even though the incidence of parasitic infection in primary schools investigated is lower than the prediction, this study found a significant difference in nutritional status between infected and non-infected children. The p-value was obtained from Chi-square test. Therefore, this study proves the presence of an association between intestinal parasitic infection and nutritional status. Moreover, this research demonstrates the importance of decreasing the number of infections in decreasing the number of children malnutrition.

Due to the factors above, this research result is not in accordance with previous findings. It illustrates the types of intestinal parasites that were found to infect the school-aged children in primary schools in South Jakarta. There are no *A. lumbricoides* and hookworm infections, because moist soil was not found in the schools area and also most of houses in Jakarta are almost without yards. The eggs of soil-transmitted helminthes were not found due to the dry soil and eggs cannot develop in dry areas with direct sunlight exposure [1]. These factors were proven by a previous study in Ethiopia, which had the same environmental characteristics [11].

Having said that some of our results were in

line with prediction. In contrast to helminths, intestinal protozoa do not need moist soil to infect the susceptible hosts, and the cyst found in stool is already an infective form [1]. Finally, the highest number of infections was caused by *B. hominis* (69.4%). This is due to their numerous habitats in tropical regions. Its higher prevalence than other protozoa in Jakarta was also proven in the previous study, which accounts for about 52.5% [7], [20]. Contaminated food and water especially drinking water is the primary source of *B. hominis* infection [21]. *Entamoeba coli* infection was also found (coinfection with *B. hominis* infection) in 4.2% of the target population and this parasite is non-pathogenic [1]. The process of how parasites cause malnutrition is different between each parasite. *B. hominis* can cause malnutrition by their clinical symptoms including diarrhea, anorexia, and vomiting. By that symptom, it may indirectly decrease the body weight of the children [22]. Moreover, *B. hominis* infection is an opportunistic infection that usually causes symptoms in immunocompromised patients. The clinical symptoms will appear in association with the degree of infection and virulence strain of *B. hominis* [23]. In this study, there are children infected with *B. hominis* has healthy weight, overweight, and obese. Previous studies said that it may be due to the children's immune system is good enough to counteract the infection, resulting in good nutritional status with no significant clinical symptoms [22].

G. lamblia was also found infecting the children and causing BMI below 5th percentile. Infections that lead to malnutrition may be due to their ability to cause acute or chronic diarrhea, leading to lower body weight of the children [24]. Another clinical symptom in the acute phase is loss of appetite that may contribute to lower BMI. However, significant malnutrition changes happen when the children have chronic infection with chronic diarrhea and malabsorption, leading to a significant decrease of body weight [24]. The children infected with these protozoa may be in their chronic state, resulting in low nutritional status. However, *G. lamblia* infection in their acute state will not lead to malabsorption, because it is usually asymptomatic [25]. Thus, it explains why several infected children still have normal nutritional status.

E. coli is a non-pathogenic protozoan that frequently exists as commensal parasites in the human gastrointestinal tract and is known as harmless parasites. However, if children infected with *E. coli*, other pathogenic parasites may have been entering the gastrointestinal tract at the same time when *E. coli* entered [1]. Therefore, it may be the reason that 1 case of mixed infection of *E. coli* and *B. hominis* causing malnutrition.

There is also malnutrition observed in 2 uninfected children. It may be due to other factors that may lead to BMI below 5th percentile such as poor appetite, metabolic, and clinical disturbances. Poverty may be one of the factors that may cause the children do not have adequate food intake [26].

Conclusion

The incidence of intestinal parasitic infection in primary schools in South Jakarta is 38.2%. The characteristic of nutritional status in infected students is 28.3% underweight. There is an association between intestinal parasitic infection's positivity status and poor nutritional status in school-aged children in South Jakarta. It is suggested to broaden the target population for future research by including more larger age-group population or target area. In addition, finding correlation with other variables such as seasonality and environment condition can provide more information to the health promotion program to decrease the intestinal parasites infection incidence.

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