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ARTICLE

THE CORRELATION BETWEEN NUTRITIONAL STATUS, AGE, AND GENDER ON THE INCIDENCE OF SOIL-TRANSMITTED HELMINTH INFECTIONS

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ABSTRACT

Soil-transmitted helminth (STH) infections most commonly infect preschool and school-age children. The prevalence of STH infection remains high, i.e., 73 million children are infected in Indonesia. The most commonly infecting worms are roundworms (*Ascaris lumbricoides*), whipworms (*Trichuris trichiura*), and hookworms (*Ancylostoma duodenale* and *Necator americanus*). STH infection is transmitted through soil contaminated by STH eggs or larvae. Personal hygiene, availability of clean water, and defecation behavior are factors in the development of STH infection. Prolonged infection can cause malnutrition, anemia, and slow growth. This study aims to examine the association between nutritional status, age, and gender on the incidence of STH infection. This research is a descriptive-analytical study with a cross-sectional approach. Fifteen (42.86%) of 35 preschool and school-age children's stool samples were positive for *Ascaris lumbricoides* eggs. The nutritional status of the children was grouped into underweight, normal, and overweight. The body mass index (BMI) calculation resulted in 65.71% (23/35) underweight, 31.43% (11/35) normal, and 2.86% (1/35) overweight children. The Spearmen test shows that there is no significant correlation between nutritional status (p=0.517), age (p=0.614), and gender (p=0.637) on STH infection.

Keywords: Age, Gender, Infection, Nutritional status, Soil-transmitted helminth

АБСТРАКТ

Инфекции гельминтов, передающихся через почву (ГПП), чаще всего поражают детей дошкольного и школьного возраста. Распространенность ЗППП остается высокой: в Индонезии инфицировано 73 миллиона детей. Чаще всего заражение происходит круглыми червями (Ascaris lumbricoides), глистами (Trichuris trichiura) и анкилостомами (Ancylostoma duodenale и Necator americanus). Инфекция STH передается через почву, загрязненную яйцами или личинками STH. Личная гигиена, наличие чистой воды и поведение при дефекации являются факторами развития инфекции STH. Длительная инфекция может вызвать недоедание, анемию и замедление роста. Цель данного исследования - изучить связь между статусом питания, возрастом и полом на заболеваемость STH-инфекцией. Данное исследование является описательно-аналитическим с перекрестным подходом. Пятнадцать (42,86 %) из 35 образцов стула детей дошкольного и школьного возраста были положительными на яйца Ascaris lumbricoides. По уровню питания дети были разделены на детей с недостаточным весом, нормальным и избыточным весом. Расчет индекса массы тела (ИМТ) показал, что 65,71% (23/35) детей имеют недостаточный вес, 31,43% (11/35) - нормальный и 2,86% (1/35) - избыточный вес. Тест Спирмена показал отсутствие значимой корреляции между статусом питания (p=0,517), возрастом (p=0,614) и полом (p=0,637) на инфицирование STH.

Ключевые слова: Возраст, пол, инфицирование, статус питания, гельминт, передающийся через почву

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INTRODUCTION

Soil-transmitted helminth (STH) infection is an infection caused by intestinal nematodes. It is estimated that around 1.5 billion people globally have been infected. This infection is mainly suffered by poor people with poor sanitation and difficult access to clean water. The highest prevalence is in sub-Saharan Africa, South America, China, and Asia.[1] STH often infects preschool and school-age children with the highest prevalence of STH infection in preschool and school-age children in Southeast Asia, i.e., 496 million. Most Southeast Asian countries have a tropical climate with high humidity.[2] Indonesia is one of the countries in the Southeast Asia region. The prevalence of STH infection in preschool and school-age children in Indonesia is relatively high, i.e., 73 million.[2]

STH infections in Indonesia are caused mainly by roundworms (*Ascaris lumbricoides*), whipworms (*Trichuris trichiura*), and hookworms (*Ancylostoma duodenale* and *Necator americanus*).[4] Several studies show that most infections in Indonesia are caused by *Ascaris lumbricoides* rather than *Trichuris trichiura* and hookworm. The prevalence of *Ascaris lumbricoides* infection in each region is different. Areas with high prevalence include West Nusa Tenggara (92%), West Java 90%, Sulawesi (88%), Kalimantan (79%), and Sumatra (78%). The prevalence of *Trichuris trichiura* is relatively high in several areas, i.e., West Java (91%), West Nusa Tenggara (84%), Sumatra (83%), Kalimantan (83%), and Sulawesi (83%). Meanwhile, the prevalence of hookworm infection ranges from 30 to 50% in various regions, with a higher prevalence found in plantation areas.[3]

STH infections are transmitted through soil. STH eggs or larvae develop in warm and moist soil.[3] This infection is caused by several factors, including lack of clean water, soil contaminated with STH eggs or larvae, and poor personal hygiene, such as not keeping nails clean, not washing hands before eating and after defecating, and not defecating in the toilet.[4,5]

Chronic STH infection can cause delayed in the physical growth and cognition, anemia, and decreased stamina. Patients with mild infections show no symptoms, while severe infections cause various symptoms, including stomach pain, diarrhea, loss of appetite, intestinal bleeding, and malnutrition.[6]

MATERIAL AND METHODS

This study is a descriptive-analytical research with a cross-sectional approach. The study was conducted in July 2021. The sample population was children under 15 years old who lived in RT 014 RW 013, Warakas Village, Tanjung Priok District, North Jakarta. The inclusion criteria include children under 15 years old who have not taken any anthelmintics in the previous month.

The data used was primary data obtained from children's stools. The stools were examined at the Parasitology Laboratory of the Faculty of Pharmacy and Science, Prof DR HAMKA Muhammadiyah University, using the centrifugation flotation method with $ZnSO_4$ solution. The obtained data was processed using SPSS.

Tools And Materials For Identifying Sth Eggs

The tools used in this study include stirring rods, beakers, centrifuge, cover glasses, funnels, measuring cups, hot plates, stool sample pots, LAF, gauze, microscope, object glasses, centrifuge tubes, tube racks, test tubes, pipettes, stopwatch, ice cream sticks, refractometer, and amber bottles.

The materials used in this study include distilled water, 10% formalin solution, $ZnSO_4$ powder, filter paper, and stool samples.

Work Procedure for Identifying STH Eggs

1. Preparation of 33% $ZnSO_4$ Solution The solution was prepared by weighing 33 grams of $ZnSO_4$ powder, placing it into a beaker glass, and adding 100 ml of distilled water.
2. Identification of STH eggs using the centrifugation flotation method with 33% $ZnSO_4$ solution

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3. The stool sample was diluted by adding one milliliter of distilled water
4. The diluted stool sample was filtered using filter paper
5. The obtained supernatant was centrifuged at 3000 rpm for five minutes
6. The supernatant was discarded quickly
7. Ten milliliters of 33% ZnSO4 solution was added into the sample tube, and then the pellet was homogenized
8. The sample was centrifuged at 3000 rpm for four minutes
9. A cover glass was placed over the sample tube and then left for ten minutes
10. The cover glass was removed from the sample tube and then placed on the object glass
11. The specimen was observed under a microscope at 10- and 40-times field of views
12. The sample is positive if STH eggs are observed.[7]

RESULT

The samples in this study were 35 children. All children fulfilled the inclusion criteria.

Table 1. Sample distribution based on age and gender

Characteristics of Subject	N	%
Age		
Preschool-age	14	40
School-age	21	60
Gender		
Male	18	51.42
Female	17	48.58

Table 1 shows that the school-age children are more dominant, as many as 21 (60%). Moreover, boys are also dominant, as many as 18 (51.42%).

Table 2. Nutritional Status

Nutritional Status	N	%
Underweight	23	65.71
Normal	11	31.43
Overweight	1	2.86

Table 2 shows that 23 students (65.71%) are underweight, 11 students (31.43%) are normal, and one student (2.86%) is overweight.

Table 3. STH Infection Status

Infection Status	N	%
Negative	20	57.14
Positive	15	42.86

Table 3 shows that the number of students infected with STH is lower than those not infected. There are 15 students (42.86%) infected with STH and 20 students (57.14%) not infected.

Table 4. STH infection distribution based on age and gender

Characteristics of Subject	N	%
Age		
Preschool-age	5	35.71
School-age	10	47.62
Total	**15**	**83.33**
Gender		
Male	7	38.89
Female	8	47.06
Total	**15**	**85.95**

Table 4 shows that, based on age, five preschool-age children (35.71%) and ten school-age children (47.62%) were infected. Meanwhile, based on gender, seven boys (38.89%) and eight girls (47.06%) were infected.

Table 5. STH infection distribution based on nutritional status

Nutritional Status	N	%
Underweight	9	39.13
Normal	6	54.55
Overweight	0	0
Total	15	93.68

Table 5 shows that based on nutritional status, nine underweight children (39.13%)

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and six normal children (54.55%) were infected.

Table 6. Sample distribution based on the infecting type of worm

Type of Worm	N	%
Ascaris lumbricoides	15	100
Trichuris trichiura	0	0
Hookworm	0	0

Table 6 shows that *Ascaris lumbricoides* caused STH infections in children.

Table 7. Correlation Test (Spearmen Test)

	STH Infection (p-value)
Nutritional Status	0.517
Age	0.614
Gender	0.637

Table 7 shows the p-value of > 0.05, which means that there is no significant relationship between nutritional status (p=0.517), age (p=0.614), and gender (p=0.637) on the incidence of STH infections.

DISCUSSION

The study shows that 15 children (42.86%) were infected with *Ascaris lumbricoides*. This result is similar to the research by Rahayu et al. in 2023 at the Ciliwung riverbank, Kampung Melayu, East Jakarta, in which 12 children (23.52%) were infected with STH. All infections were caused by *Ascaris lumbricoides*.[8] Djuardi et al. (2021) also found 160 children (58.8%) in the Nangapanda district, East Nusa Tenggara, infected with STH caused by *Ascaris lumbricoides*.[9] STH infection caused by *Ascaris lumbricoides* is transmitted orally and occurs when consuming food or drinks contaminated by infective eggs. Infective eggs can also enter the body via hands by sucking hands or biting unwashed fingernails.[10] The soil type at the research location greatly influences the high incidence of *Ascaris lumbricoides* infections. The correct type of soil for *Ascaris lumbricoides* and *Trichuris trichiura* eggs to become infective is clay, while *Necator americanus* and *Ancylostoma duodenale* need fertile soil to become infective.[11]

Apart from soil type, the number of eggs also influences the high incidence of *Ascaris lumbricoides* infections. This type of worm produces more eggs than other species, and the eggs produced can survive in dry soil at 40–50^{o}C. Eggs can survive because they have a thick layer of hyaline and albuminoid, which protects the eggs. *Ascaris lumbricoides* infections are most commonly found in areas with moist soil, while *Trichuris trichiura* is more commonly found in coastal areas and hookworm.[11]

Based on age, more school-age children were infected with STH (47.67%). This result is similar to the research by Tapiheru and Nurfadly (2021) at Public Elementary School 105296, North Sumatra, which found 34.7% positive cases in school-age children. Likewise, Irwan et al. (2023), who conducted a study in the working area of the Panambungan Health Center, Makassar, found 52.1% positive cases of STH infection.[4,12] The high number of STH infections in school-age children is because children at this age enjoy playing in the yards both at school and at home but have a low level of hygiene, risking them of being infected with STHs.[4,12,13,14] The Spearman test (statistics) in this study resulted in a p-value 0.614 (p> 0.05); thus, there is no significant relationship between age and STH infection. This result differs from the literature study by Novitasari and Fatah in 2021, which discovered that age is a risk factor that causes STH egg infections.[15]

Based on gender, girls are more susceptible to STH infection with 47.06% positive cases compared to 38.89% cases in boys. The result agrees with the study by Annisa et al. (2018) at Public Elementary School 200 Kemasrindo Village, Kertapati District, Palembang, which found 51.7% positive STH infection cases in girls and 48.3% in boys.[4,15]

A similar result was also obtained by Tapiheru and Nurfadly (2021) at Public Elementary School 105296 North Sumatra, which found 31.8% positive cases of STH in girls and 27.9% in boys. All children, either

boys or girls, can be infected with STH. Outdoor activities involving soil can be one of the causes of infection.[4] Based on the Spearman test (statistics), the p-value is 0.637 (p>0.05); thus, there is no significant relationship between gender and STH infection.[4]

Based on nutritional status, out of 35 children, 23 children (65.71%) were underweight, 11 children (31.43%) were normal, and one child (2.86%) was overweight. The incidence of positive STH infections in underweight children was 39.13% (9 children), while it was 54.55% (6 children) in the normal category. Based on the Spearman test (statistics), the p-value was 0.517 (p>0.05); thus, there is no significant relationship between nutritional status and STH infection. A similar result was also reported by Ramadhani et al. (2022), who found no relationship between STH infection and nutritional status (p= 0.196).[17]

CONCLUSION

The study shows no correlation between nutritional status (p=0.517), age (p=0.614), and gender (p=0.637) with the incidence of STH infections.

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Ключевые слова: Возраст, пол, инфицирование, статус питания, гельминт, передающийся через почву

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STH infections in Indonesia are caused mainly by roundworms (*Ascaris lumbricoides*), whipworms (*Trichuris trichiura*), and hookworms (*Ancylostoma duodenale* and *Necator americanus*).[4] Several studies show that most infections in Indonesia are caused by *Ascaris lumbricoides* rather than *Trichuris trichiura* and hookworm. The prevalence of *Ascaris lumbricoides* infection in each region is different. Areas with high prevalence include West Nusa Tenggara (92%), West Java 90%, Sulawesi (88%), Kalimantan (79%), and Sumatra (78%). The prevalence of *Trichuris trichiura* is relatively high in several areas, i.e., West Java (91%), West Nusa Tenggara (84%), Sumatra (83%), Kalimantan (83%), and Sulawesi (83%). Meanwhile, the prevalence of hookworm infection ranges from 30 to 50% in various regions, with a higher prevalence found in plantation areas.[3]

STH infections are transmitted through soil. STH eggs or larvae develop in warm and moist soil.[3] This infection is caused by several factors, including lack of clean water, soil contaminated with STH eggs or larvae, and poor personal hygiene, such as not keeping nails clean, not washing hands before eating and after defecating, and not defecating in the toilet.[4,5]

Chronic STH infection can cause delayed in the physical growth and cognition, anemia, and decreased stamina. Patients with mild infections show no symptoms, while severe infections cause various symptoms, including stomach pain, diarrhea, loss of appetite, intestinal bleeding, and malnutrition.[6]

MATERIAL AND METHODS

This study is a descriptive-analytical research with a cross-sectional approach. The study was conducted in July 2021. The sample population was children under 15 years old who lived in RT 014 RW 013, Warakas Village, Tanjung Priok District, North Jakarta. The inclusion criteria include children under 15 years old who have not taken any anthelmintics in the previous month.

The data used was primary data obtained from children's stools. The stools were examined at the Parasitology Laboratory of the Faculty of Pharmacy and Science, Prof DR HAMKA Muhammadiyah University, using the centrifugation flotation method with $ZnSO_4$ solution. The obtained data was processed using SPSS.

Tools And Materials For Identifying Sth Eggs

The tools used in this study include stirring rods, beakers, centrifuge, cover glasses, funnels, measuring cups, hot plates, stool sample pots, LAF, gauze, microscope, object glasses, centrifuge tubes, tube racks, test tubes, pipettes, stopwatch, ice cream sticks, refractometer, and amber bottles.

The materials used in this study include distilled water, 10% formalin solution, $ZnSO_4$ powder, filter paper, and stool samples.

Work Procedure for Identifying STH Eggs

1. Preparation of 33% $ZnSO_4$ Solution The solution was prepared by weighing 33 grams of $ZnSO_4$ powder, placing it into a beaker glass, and adding 100 ml of distilled water.
2. Identification of STH eggs using the centrifugation flotation method with 33% $ZnSO_4$ solution

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3. The stool sample was diluted by adding one milliliter of distilled water
4. The diluted stool sample was filtered using filter paper
5. The obtained supernatant was centrifuged at 3000 rpm for five minutes
6. The supernatant was discarded quickly
7. Ten milliliters of 33% ZnSO4 solution was added into the sample tube, and then the pellet was homogenized
8. The sample was centrifuged at 3000 rpm for four minutes
9. A cover glass was placed over the sample tube and then left for ten minutes
10. The cover glass was removed from the sample tube and then placed on the object glass
11. The specimen was observed under a microscope at 10- and 40-times field of views
12. The sample is positive if STH eggs are observed.[7]

RESULT

The samples in this study were 35 children. All children fulfilled the inclusion criteria.

Table 1. Sample distribution based on age and gender

Characteristics of Subject	N	%
Age		
Preschool-age	14	40
School-age	21	60
Gender		
Male	18	51.42
Female	17	48.58

Table 1 shows that the school-age children are more dominant, as many as 21 (60%). Moreover, boys are also dominant, as many as 18 (51.42%).

Table 2. Nutritional Status

Nutritional Status	N	%
Underweight	23	65.71
Normal	11	31.43
Overweight	1	2.86

Table 2 shows that 23 students (65.71%) are underweight, 11 students (31.43%) are normal, and one student (2.86%) is overweight.

Table 3. STH Infection Status

Infection Status	N	%
Negative	20	57.14
Positive	15	42.86

Table 3 shows that the number of students infected with STH is lower than those not infected. There are 15 students (42.86%) infected with STH and 20 students (57.14%) not infected.

Table 4. STH infection distribution based on age and gender

Characteristics of Subject	N	%
Age		
Preschool-age	5	35.71
School-age	10	47.62
Total	**15**	**83.33**
Gender		
Male	7	38.89
Female	8	47.06
Total	**15**	**85.95**

Table 4 shows that, based on age, five preschool-age children (35.71%) and ten school-age children (47.62%) were infected. Meanwhile, based on gender, seven boys (38.89%) and eight girls (47.06%) were infected.

Table 5. STH infection distribution based on nutritional status

Nutritional Status	N	%
Underweight	9	39.13
Normal	6	54.55
Overweight	0	0
Total	15	93.68

Table 5 shows that based on nutritional status, nine underweight children (39.13%)

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and six normal children (54.55%) were infected.

Table 6. Sample distribution based on the infecting type of worm

Type of Worm	N	%
Ascaris lumbricoides	15	100
Trichuris trichiura	0	0
Hookworm	0	0

Table 6 shows that *Ascaris lumbricoides* caused STH infections in children.

Table 7. Correlation Test (Spearmen Test)

	STH Infection (p-value)
Nutritional Status	0.517
Age	0.614
Gender	0.637

Table 7 shows the p-value of > 0.05, which means that there is no significant relationship between nutritional status (p=0.517), age (p=0.614), and gender (p=0.637) on the incidence of STH infections.

DISCUSSION

The study shows that 15 children (42.86%) were infected with *Ascaris lumbricoides*. This result is similar to the research by Rahayu et al. in 2023 at the Ciliwung riverbank, Kampung Melayu, East Jakarta, in which 12 children (23.52%) were infected with STH. All infections were caused by *Ascaris lumbricoides*.[8] Djuardi et al. (2021) also found 160 children (58.8%) in the Nangapanda district, East Nusa Tenggara, infected with STH caused by *Ascaris lumbricoides*.[9] STH infection caused by *Ascaris lumbricoides* is transmitted orally and occurs when consuming food or drinks contaminated by infective eggs. Infective eggs can also enter the body via hands by sucking hands or biting unwashed fingernails.[10] The soil type at the research location greatly influences the high incidence of *Ascaris lumbricoides* infections. The correct type of soil for *Ascaris lumbricoides* and *Trichuris trichiura* eggs to become infective is clay, while *Necator americanus* and *Ancylostoma duodenale* need fertile soil to become infective.[11]

Apart from soil type, the number of eggs also influences the high incidence of *Ascaris lumbricoides* infections. This type of worm produces more eggs than other species, and the eggs produced can survive in dry soil at 40–50°C. Eggs can survive because they have a thick layer of hyaline and albuminoid, which protects the eggs. *Ascaris lumbricoides* infections are most commonly found in areas with moist soil, while *Trichuris trichiura* is more commonly found in coastal areas and hookworm.[11]

Based on age, more school-age children were infected with STH (47.67%). This result is similar to the research by Tapiheru and Nurfadly (2021) at Public Elementary School 105296, North Sumatra, which found 34.7% positive cases in school-age children. Likewise, Irwan et al. (2023), who conducted a study in the working area of the Panambungan Health Center, Makassar, found 52.1% positive cases of STH infection.[4,12] The high number of STH infections in school-age children is because children at this age enjoy playing in the yards both at school and at home but have a low level of hygiene, risking them of being infected with STHs.[4,12,13,14] The Spearman test (statistics) in this study resulted in a p-value 0.614 (p> 0.05); thus, there is no significant relationship between age and STH infection. This result differs from the literature study by Novitasari and Fatah in 2021, which discovered that age is a risk factor that causes STH egg infections.[15]

Based on gender, girls are more susceptible to STH infection with 47.06% positive cases compared to 38.89% cases in boys. The result agrees with the study by Hanisa et al. (2018) at Public Elementary School 200 Kemasrindo Village, Kertapati District, Palembang, which found 51.7% positive STH infection cases in girls and 48.3% in boys.[4,15]

A similar result was also obtained by Tapiheru and Nurfadly (2021) at Public Elementary School 105296 North Sumatra, which found 31.8% positive cases of STH in girls and 27.9% in boys. All children, either

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boys or girls, can be infected with STH. Outdoor activities involving soil can be one of the causes of infection.[4] Based on the Spearman test (statistics), the p-value is 0.637 (p>0.05); thus, there is no significant relationship between gender and STH infection.[4]

Based on nutritional status, out of 35 children, 23 children (65.71%) were underweight, 11 children (31.43%) were normal, and one child (2.86%) was overweight. The incidence of positive STH infections in underweight children was 39.13% (9 children), while it was 54.55% (6 children) in the normal category. Based on the Spearman test (statistics), the p-value was 0.517 (p>0.05); thus, there is no significant relationship between nutritional status and STH infection. A similar result was also reported Ramadhani et al. (2022), who found no relationship between STH infection and nutritional status (p= 0.196).[17]

CONCLUSION

The study shows no correlation between nutritional status (p=0.517), age (p=0.614), and gender (p=0.637) with the incidence of STH infections.

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