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Mapping Intestinal Worm Infections and Their Relationship with Nutritional Status and Personal Hygine of School Age Children in Wori District, North Minahasa Regency

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ABSTRACT

Introduction: Parasitic infections cause health problems, including diarrhea, abdominal pain, malnutrition, general malaise and weakness, as well as impaired physical growth and development. These parasitic infections are generally higher in countries with high Factors that influence public health problems include weak economic conditions, limited access to sanitation and clean water, high rates of malnutrition among the population, population density, community habits that do not meet hygiene standards, low levels of education, and mothers' minimal insight into health.
Objective: This study aims to identify the distribution of intestinal worm infections in school-age children in Wori District, North Minahasa Regency, and to analyze the relationship between these infections and children's nutritional status and the implementation of clean and healthy living behaviors (PHBS).
Methods: A quantitative approach was used, integrating statistical analysis and distribution mapping. The study took place from January 2023 to May 2024, involving 14 elementary schools and 309 students selected via random sampling. Statistical analysis assessed the relationship between worm infections, nutritional status, and PHBS indicators.
Results: The study results indicated that respondents were infected with Ascaris lumbricoides and hookworm. Statistical tests showed a statistically significant association between infection incidence and handwashing habits and twice-daily bathing frequency, with a p-value <0.005.
Conclusions: Based on research findings, intestinal worm infections in elementary school children were identified in all village areas in Wori District, with the exception of Lansa Village which did not show any cases of infection. No significant association was found between intestinal worm infections and children's nutritional status. However, there was a statistically significant association between infection incidence and handwashing and bathing twice daily.

Introduction

Intestinal parasitic infections are among the most common infectious diseases with an estimated 3.5 billion cases annually. These infections are responsible for more than 450 million health problems, including symptoms such as diarrhea, abdominal pain, malnutrition, fatigue,

general weakness, and stunted growth and physical development (Octavia, Ericka., Sihombing, R, 2020). Approximately 24% of the world's population is estimated to be infected with soil-transmitted helminths. These infections commonly occur in areas with high poverty rates and limited access to adequate sanitation facilities (Soil-Transmitted Helminth Infections, 2023). Children are particularly vulnerable to these infections and are at high risk of recurrent infections (Kantzanou et al., 2021).

Parasites are generally divided into two main categories: protozoa and helminths (worms). Some of the most common types of worms that cause infections include Ascaris lumbricoides, hookworms such as Necator americanus and Ancylostoma duodenale, and Trichuris trichiura. These three species are categorized as soil-transmitted helminths (STH) (Soil-Transmitted Helminth Infections, 2023). Asia has a high prevalence of parasitic infections. These infections commonly occur in children, particularly in developing countries where environments are conducive to parasite survival and cycles. Countries with hot climates and high humidity tend to be ideal locations for parasite spread (Sari et al., 2021). Indonesia is one of the countries that shows a significant level of intestinal worm infectionSeveral studies on intestinal worm infections have been conducted in several regions in Indonesia, demonstrating a high prevalence of several types of parasites. Among these is Ascaris lumbricoides, with infection rates ranging from 40–60% in the general population and 60–80% in children aged 5 to 10 years. Furthermore, the prevalence of Trichuris trichiura is reported to be between 30–90%, while hookworm infections are recorded at 30–40%.
(Permenkes, 2017), *Blastocystis hominis*, *Entamoeba histolytica*, and *Giardia lamblia* (Wahdini et al., 2018). This parasitic infection is generally higher in countries with high Public health problems are influenced by various factors, such as high levels of poverty, limited sanitation facilities and access to clean water, high prevalence of malnutrition among the population, excessive population density, low public hygiene practices, and lack of formal education and health knowledge among mothers. (Sari et al., 2021). Currently, all of these factors still exist in Indonesia, so intestinal parasite infections are still high.

Malnutrition is caused by a lack of energy and nutritional intake in a person's diet. There is a strong link between nutritional status and intestinal worm infections. These infections remain a major factor in increasing morbidity and mortality in children, primarily due to their contribution to malnutrition. To date, intestinal parasitic infections remain a

major global public health challenge, particularly in developing countries, due to their significant impact on malnutrition (Sari et al., 2021). According to WHO in 2018, more than two-thirds of children under five who experience wasting live in Asia and more than a quarter live in Africa (UNICEF et al., 2019). Indonesia is among the countries with a relatively high prevalence of stunting and wasting globally. with a stunting rate of more than 30% and a wasting prevalence (Unicef, 2023). of 10–15% in children under five (Reinhardt & Fanzo, 2014). Malnutrition increases the chance of infection and its severity also slows recovery (Unicef, 2023). There is a close link between malnutrition and the immune system. Malnutrition can cause serious impairments in the development and function of the immune system, and conversely, immune system dysfunction can also increase a child's susceptibility to parasitic infections. Conversely, repeated intestinal infections can potentially damage the epithelial structure of the digestive tract, thus inhibiting optimal nutrient absorption. Thus, malnutrition and infection influence each other in a reciprocal relationship (Simon et al., 2015). By looking at the problems that have been identified previously, this study was conducted to determine the pattern of the spread of intestinal worm infections, examine the relationship between these infections and children's nutritional status, and assess the implementation of clean and healthy living behaviors (PHBS) in school-age children in Wori District, North Minahasa Regency.

Methods

The type of research is quantitative research using statistical analysis methods and making distribution maps. When the research began in January 2023 to May 2024, five schools were sampled in 2023 and nine schools were sampled in 2024. The study sample was taken from the Wori District, while infection testing was conducted at the Parasitology Laboratory, Medical Laboratory Technology Department, Manado Health Polytechnic, under the auspices of the Ministry of Health. The variables examined in this study included intestinal worm infections, nutritional status, and the implementation of clean and healthy living behaviors (PHBS) in school-age children. The study population included all elementary school students in the Wori District. The sample taken using random sampling technique amounted to 309 students. The samples collected met the criteria for examination.

Materials used include stool samples, 2% eosin solution, saturated NaCl, glycerin malachite green solution, cellophane tape measuring 2.5 cm wide, and aqaudest. The tools used are a microscope, slide slide, new clean glass deck, new clean sample pot,

clean stick, disposable pipette, mask, handscoon. Samples were stored at room temperature and examined immediately, if there was a delay, the samples were preserved in 10% formalin solution. Determination of the intensity of helminth infection is based on the recommended formula. Sample examination uses several methods, namely the native method, floating method, Kato Katz method, Baerman test method and Harada Mori method. Statistical analysis was carried out To examine the relationship between soil-transmitted helminth (STH) infections, nutritional status, and the adoption of clean and healthy lifestyles in school children.

This section explains the basis for selecting the specific approaches, methods, procedures, and techniques used in identifying, selecting, and analyzing relevant data to understand the research problem. This explanation aims to enable readers to critically evaluate the validity and reliability of the research process.

Results and Discussion

The samples collected from 309 respondents were samples that met the requirements, namely that the respondents had not taken worm medicine in the last three months, the samples had not been mixed with water, urine or soil.

Table 1. Respondent characteristics

Respondents		Freq (n=309)	Percentage (%)
Age (years)	6	13	4.2
	7	39	12.7
	8	47	15.2
	9	64	20.8
	10	40	12.9
	11	59	19
	12	36	11.7
	13	11	3.5
Gender	Male	144	46.7
	Women	165	53.3
Parent's Profecy	Farmer	164	53
	Fisherman	9	3
	Handyman	26	8.4
	Civil Servant	20	6.4
	Teacher	7	2.2
	Entrepreneur	9	3
	Housewife	68	22
	Soldier	4	1.2
	Driver	2	0.8

Table 1 This data presentation illustrates the distribution of respondent characteristics by age group. Alternatively, respondent characteristics can also be reviewed based on gender and parental occupation. Children are a group that is vulnerable to intestinal worm infections because they are not yet able to implement good clean living habits (Bedah & Syafitri, 2019). The risk level of intestinal worm infection in boys does not show any significant difference compared to girls. depending on the implementation of clean living behavior and other factors that are at risk of intestinal worm infection. Table 1 shows that the majority of respondents' parents work as farmers; This needs to be known because parents' work can be a risk factor for transmitting worm infections to children because parents play a role in providing children's basic needs such as food which is closely related to the transmission cycle of worm infections (Justine et al., 2024).

Table 2. Laboratory Result

Examination Results (species)	Natif		Flotation		Kato-Katz		Baermann		Harada Mori	
	Freq (n=309)	Percentage (%)	Freq (n=309)	Percentage (%)	Freq (n=309)	Percentage (%)	Freq (n=309)	Percentage (%)	Freq (n=309)	Percentage (%)
A.lumbricoides	18	5.1	7	2.2	2	0.8	2	0.8	0	0
Hookworm	0	0	2	0.7	0	0	1	0.3	0	0
Negative	291	94.1	300	97.1	307	99.3	306	99	309	100

Table 2 shows the results of various examination methods, namely the native method identified 5.1% of respondents as having *Ascaris lumbricoides* worm infection. Flotation tests showed that 2.2% of respondents were infected with Ascaris lumbricoides and 0.7% with hookworm. Meanwhile, the Kato-Katz method identified Ascaris lumbricoides infection in 0.8% of respondents. Furthermore, the Baermann test found the prevalence of Ascaris lumbricoides at 0.8% and other worm infections at 0.3%.

The native method is an examination that provides results with the highest positive presentation, showing the validity of the native method as the gold standard for examining intestinal worm infections. Almost all examination methods found *Ascaris lumbricoides* worm eggs and Hookworm worm eggs were found in the sedimentation method examination and found the larval stage in the Baermann examination. *Ascaris lumbricoides* infection is related to the implementation of clean and healthy living behavior where in general respondents have not implemented

clean and healthy living behavior. Hookworm infection was found only by the Baermann sedimentation and examination method; This is because the surface of the Hookworm worm eggs is thin so they are easier to identify by examining their deposition and larvae in the Baermann examination. The examination that is currently being developed is an examination with the help of artificial intelligence (Cure-Bolt et al., 2024). This inspection method is based on image-based artificial intelligence; This method has a low sensitivity but a specificity of more than 90% (Lundin et al., 2024). This method has the principle of producing images on fecal samples stored on the internet cloud but this method has lower sensitivity than the Kato Katz method (Moser et al., 2018).

Intestinal worm infections contribute to malnutrition, anemia, low birth weight babies, impaired growth and decreased academic achievement. *Ascaris lumbricoides* infections are more common in school-aged children than adults, while hookworm infections are more common in adults (Avokpaho et al., 2021). *Ascaris lumbricoides* infection causes impaired absorption of nutrients so that sufferers have the potential to experience malabsorption and loss of nutrients (Fabiana Meijon Fadul, 2019), Meanwhile, Hookworm infection can cause anemia because the Hookworm worm in the intestine will attach a pair of teeth or cutting plates to the surface of the intestine so that sufferers can lose blood. Apart from that, the Hookworm worm eats erythrocytes to survive. The results of the study show that there is a relationship between parasitic infections and the incidence of anemia in school-aged children (Deschutter et al., 2024).

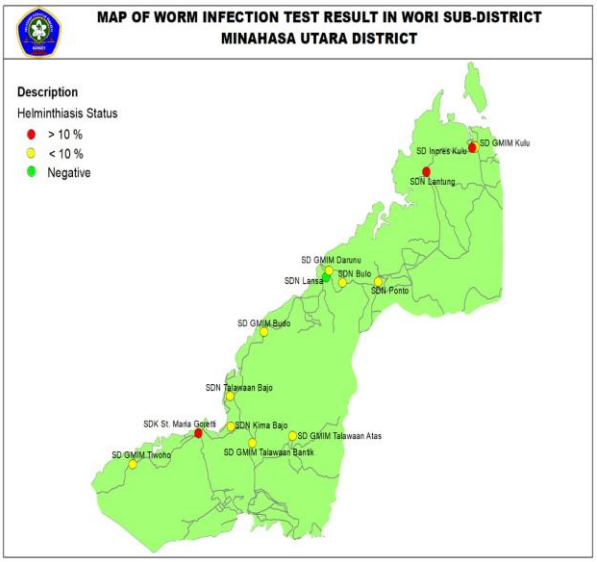

Figure 1. Mapping of Intensity of STH Infection

Figure 1 presents data on the number of cases of worm infections found in children at the elementary school level. This needs to be used as material for evaluating prevention efforts that have been implemented by the local government. The routine program of taking worm medicine twice a year needs special attention because even though it is implemented, if it is not balanced with awareness of implementing clean living habits and adequate sanitation then efforts to eliminate worms will not be successful.

Table 3. Relation of Nutrition status and Helminths Infection

Nutrition status	Helminths Infection				Total		P Value
	Positive		Negative				
	n	%	n	%	n	%	
Very Skinny	3	0.9	4	1.2	7	2.3	0,025
Thin	2	0.6	20	6.4	22	7.1	
Normal	23	7.4	243	78.6	266	86	
Fat	0	0	12	3.9	12	3.9	
Risk of Obesity	0	0	2	0.7	2	0.7	

Table 3 This presentation provides information on the results of a statistical analysis conducted to examine Correlation between respondents' nutritional status and the incidence of intestinal worm infections. Based on the results, no significant association was found between nutritional status and the incidence of intestinal worm infections. The results show that there is no relationship between nutritional status and the incidence of intestinal worm infections. The same results were shown by research conducted by Risa H *et all* (2017) that there was no relationship between nutritional status and infection but there was a relationship between respondent's implementation of clean behavior and the incidence of infection(Risa et al., 2017). This is also reinforced by the results of other research which shows that even though respondents live in slums, if they adopt clean living habits they can reduce the risk of worm infections (Octavia, Ericka., Sihombing, R, 2020).

Table 4. The Relationship between Respondents' Clean and Healthy Living Behavior (PHBS) and the Prevalence of Intestinal Worm Infections

Behavior		Worm Infection				Total	P Value
		Positive		Negative			
		n	%	n	%		
Hand Washing Habit	Yes	20	6,5	240	77,6	260	0,000
	No	12	3,9	37	12	49	
	Total	32	10,4	277	89,6	309	
Shower twice a day	Yes	26	8,4	248	80,3	274	0,000
	No	6	1,9	29	9,4	35	
	Total	32	10,3	277	89,7	309	
Finger Sucking Habit	Yes	13	4,2	83	26,9	96	0,271
	No	19	6,1	194	62,8	213	
	Total	32	10,3	277	89,7	309	
Eat Fallen Food	Yes	6	1,9	46	14,9	52	0,759
	No	26	8,9	231	74,8	257	

	Total	32	10,3	277	89,7	309	
The habit of playing soil	Yes	22	7,1	147	49,6	175	0,092
	No	10	3,2	124	40,1	134	
	Total	32	10,3	277	89,7	309	
Use of Footwear	Yes	18	5,8	147	47,6	165	0,733
	No	14	4,5	130	42,1	144	
	Total	32	10,3	277	89,7	309	
Nail-Biting Habit	Yes	14	4,5	77	24,9	91	0,061
	No	18	5,8	200	64,8	218	
	Total	32	10,3	277	89,7	309	
Availability of toilets at home	Yes	31	10	274	88,7	305	0,333
	No	1	0,3	3	1	4	
	Total	32	10,3	277	89,7	309	
Defecate in the toilet	Yes	31	10	275	89	306	0,189
	No	1	0,3	2	0,7	3	
	Total	32	10,3	277	89,7	309	
Take worm medicine every 6 months	Yes	25	8,1	241	78	266	0,169
	No	7	2,3	36	11,6	43	
	Total	32	10,4	277	89,6	309	
Eat raw/uncooked food	Yes	14	4,5	105	34	119	0,520
	No	18	5,8	172	55,7	190	
	Total	32	10,3	277	89,7	309	
Eating Unwashed Food	Yes	13	4,2	105	34	118	0,764
	No	19	6,1	172	55,7	191	
	Total	32	10,3	277	89,7	309	

Table 4 shows the implementation of clean and healthy living behavior with the incidence of intestinal worm infections. The table shows that the habit of washing hands and bathing twice a day is related to the incidence of intestinal worm infections. Apart from implementing clean and healthy living behavior (PHBS), the environmental sanitation conditions where respondents live are also related to the incidence of worm infections. The sanitation referred to includes the type of floor, availability of clean water, ownership of rubbish bins, and waste water disposal facilities (Mahmudah, 2017). This is in accordance with other research which shows a relationship between the incidence of infection and the habit of washing hands, cutting nails, consuming raw food, type of floor in the house and owning a toilet (Sidabutar, 2020). Other research shows the opposite result that the incidence of worm infections is not related to sanitation even though the highest incidence of infection is 22% (Oswald et al., 2017).

Conclusion

Based on the research results, it can be concluded that intestinal worm infections are still a health problem found among

elementary school children in school children are spread across all villages in Wori District except Lansa Village, there is no relationship between the incidence of worm infections and nutritional status, and there is a relationship between the incidence of infection and the habit of washing hands and bathing twice a day.

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Conflict of Interest

No conflict of interest in this study

References

Avokpaho, E. F. G. A., Houngbégnon, P., Accrombessi, M., Atindégla, E., Yard, E., Means, A. R., Kennedy, D. S., Littlewood, D. T. J., Garcia, A., Massougbodji, A., Galagan, S. R., Walson, J. L., Cottrell, G., Ibikounlé, M., Ásbjörnsdóttir, K. H., & Luty, A. J. F. (2021). Factors associated with soil-transmitted helminths infection in Benin: Findings from the deworm3 study. *PLoS Neglected Tropical Diseases*, *15*(8), 1–27. https://doi.org/10.1371/journal.pntd.0009646

Bedah, S., & Syafitri, A. (2019). Infeksi Kecacingan Pada Anak Usia 8-14 Tahun Di Rw 007 Tanjung Lengkong Kelurahan Bidaracina, Jatinegara, Jakarta Timur. *Jurnal Ilmiah Kesehatan*, *10*(1), 20–31. https://doi.org/10.37012/jik.v10i1.13

Cure-Bolt, N., Fernando Perez, M. D., Broadfield, L. A., Levecke, B., Hu, P., Oleynick, J., Beltrán, M., Ward, P., & Stuyver, L. (2024). Artificial intelligence-based digital pathology for the detection and quantification of soil-transmitted helminths eggs. *PLOS Neglected Tropical Diseases (In Review)*, 1–20. https://doi.org/10.1371/journal.pntd.0012492

Deschutter, E., Marczuk, R., Blanco, N.-G., & Ramos-Rincón, O.-M. (2024). Anemia and intestinal parasites in Mbya Guarani children, Misiones, Argentina. *Rev Inst Med Trop São Paulo*, *66*(January), 1–8.

Fabiana Meijon Fadul. (2019). *Guideline: preventive chemotherapy to control soil-transmitted helminth infec- tions in at-risk population groups. World Health Organiza- tion*.

Justine, N. C., Bhuko, J., Rubagumya, S. L., Basinda, N. S., Ruganuza, D. M., Zinga, M. M., Briet, M., Misko, V. R., Legein,

F., Mohamed, H., Mushi, V., Tarimo, D. S., Mazigo, H. D., & De Malsche, W. (2024). Prevalence, Infection Intensity, and Risk Factors for Soil-transmitted Helminth Infections among School Children in Northwestern Tanzania. *Pathogens*, *13*(8), 1–14. https://doi.org/10.3390/pathogens13080627

Kantzanou, M., Karalexi, M. A., Vrioni, G., & Tsakris, A. (2021). Prevalence of intestinal parasitic infections among children in europe over the last five years. *Tropical Medicine and Infectious Disease*, *6*(3). https://doi.org/10.3390/TROPICALMED6030160

Lundin, J., Suutala, A., Holmström, O., Henriksson, S., Valkamo, S., Kaingu, H., Kinyua, F., Muinde, M., Lundin, M., Diwan, V., Mårtensson, A., & Linder, N. (2024). Diagnosis of soil-transmitted helminth infections with digital mobile microscopy and artificial intelligence in a resource-limited setting. *PLoS Neglected Tropical Diseases*, *18*(4), 1–21. https://doi.org/10.1371/journal.pntd.0012041

Mahmudah, U. (2017). Hubungan Sanitasi Lingkungan Rumah terhadap Kejadian Infeksi Kecacingan pada Anak Sekolah Dasar. *Jurnal Kesehatan*, *10*(1), 32. https://doi.org/10.23917/jurkes.v10i1.5490

Moser, W., Bärenbold, O., Mirams, G. J., Cools, P., Vlaminck, J., Ali, S. M., Ame, S. M., Hattendorf, J., Vounatsou, P., Levecke, B., & Keiser, J. (2018). Diagnostic comparison between FECPAKG2and the Kato-Katz method for analyzing soil-transmitted helminth eggs in stool. *PLoS Neglected Tropical Diseases*, *12*(6), 1–13. https://doi.org/10.1371/journal.pntd.0006562

Octavia, Ericka., Sihombing, R, E. (2020). Hubungan Higiene Sanitasi Dengan Kejadian Infeksi Soil Transmitted Helminths Pada Pemulung Di Tps Jatibarang. *Riset Kesehatan Nasional*, *59*(1), 36–40.

Oswald, W. E., Stewart, A. E. P., Kramer, M. R., Endeshaw, T., Zerihun, M., Melak, B., Sata, E., Gessese, D., Teferi, T., Tadesse, Z., Guadie, B., King, J. D., Emerson, P. M., Callahan, E. K., Freeman, M. C., Flanders, W. D., Clasen, T. F., & Moe, C. L. (2017). Association of community sanitation usage with soil-transmitted helminth infections among school-aged children in Amhara Region, Ethiopia. *Parasites and Vectors*, *10*(1), 1–13. https://doi.org/10.1186/s13071-017-2020-0

Peraturan Menteri Kesehatan Republik Indonesia Tentang Penanggulangan

Cacingan, Pub. L. No. Nomor 15 Tahun 2017, Kementerian Kesehatan (2017).

Reinhardt, K., & Fanzo, J. (2014). Addressing Chronic Malnutrition through Multi-Sectoral, Sustainable Approaches: A Review of the Causes and Consequences. *Frontiers in Nutrition*, *1*(August), 1–11. https://doi.org/10.3389/fnut.2014.00013

Risa, H., Warganegara, E., Rachmawati, E., & Mutiara, H. (2017). Hubungan antara Personal Hygiene dan Status Gizi dengan Infeksi Kecacingan pada Siswa Sekolah Dasar Negeri di Natar. *J AgromedUnila*, *4*(2), 326–332.

Sari, I. P., Audindra, S., Zhafira, A. S., Rahma, A. A., Syarira, C. V., & Wahdini, S. (2021). Nutritional status of school-aged children with intestinal parasite infection in South Jakarta, Indonesia. *Open Access Macedonian Journal of Medical Sciences*, *9*(E), 95–100. https://doi.org/10.3889/oamjms.2021.5711

Sidabutar, S. (2020). Higiene Sanitasi dan Kejadian Infeksi Kecacingan pada Siswa Sekolah Dasar Sondang Sidabutar. *Jurnal Penelitian Kesehatan Suara Forikes*, *11*(3), 64–67.

Simon, A. K., Hollander, G. A., Mcmichael, A., & Mcmichael, A. (2015). Evolution of the immune system in humans from infancy to old age. *Proc. Biol. Sci.*, *282*(1821), 1–12.

Soil-transmitted helminth infections. (2023). World Health Organisation. https://www.who.int/news-room/fact-sheets/detail/soil-transmitted-helminth-infections

Unicef. (2023). *Undernourished and overlooked*. file:///C:/Users/Lenovo/Downloads/Undernourished-and-Overlooked.pdf

UNICEF, WHO, & World Bank. (2019). Levels and Trends in Child Malnutrition: key findings of the 2019 Edition of the Joint Child Malnutrition Estimates. In *UNICEF, WHO, The World Bank*.

Wahdini, S., Pratiwi Sudarmono, A. W. W., Irmawati, F. P., & , Rose A. Haswinzky , Yasmine A. Dwinastiti, S. S. (2018). Penyakit Parasitik pada Anak Sekolah Berasrama di Kabupaten Bogor. *Jurnal Kedokteran Indonesia*, *6*(3), 207–211. https://doi.org/10.23886/ejki.6.10109.Abstrak