Jurnal Riset Kesehatan, 14 (1), 2025, 49 - 60

DOI: 10.31983/jrk.v14i112367

Jurnal Riset Kesehatan

http://ejournal.poltekkes-smg.ac.id/ojs/index.php/jrk

LITERATURE REVIEW: RISK FACTORS AFFECTING THE INCIDENCE OF SOIL-TRANSMITTED HELMINTHS (STH) INFECTION IN ADULTS

Farras Arlinda Rachmawati[a*] ; Radi[b] ; Dwi Sarwani Sri Rejeki[a,c] ; Siwi Pramatama Mars Wijayanti[a,c]

[a] Jenderal Soedirman University ; Jl. Dr. Soeparno ; Purwokerto and 53122 ; Indonesia
[b] Gadjah Mada University ; Jl. Farmako, Sekip Utara ; Yogyakarta and 55281 ; Indonesia
[c] PUI Centre of Applied Sciences for Pharmaceutical and Health, Institute for Research and Community Service, Jenderal Soedirman University ; Jl. Dr. Soeparno ; Purwokerto and 53122 ; Indonesia

Abstract

Background: Soil-transmitted helminths (STH) infection is still a problem in many countries. Studies on risk factors for soil-transmitted helminths (STH) infection are still more focused on children, while studies in adults are limited. This study aims to summarize risk factors for soil-transmitted helminths (STH) infection in adults. Method: This study used a literature review method by collecting journals from Google Scholar, PubMed, and ScienceDirect. Data was collected using the keywords risk factor, soil-transmitted helmet, and adult. The article to be reviewed is a research conducted in 2019 - 2023. Result: The results of the article search were obtained as many as 861 articles which were then selected using inclusion and exclusion criteria so that as many as 10 articles were received for review. The results of the review of the entire article found that the risk factors for soil-transmitted helminths (STH) infection in adults are individual factors (Education level, gender, age, and type of occupation), socioeconomic (Community ethnicity, area of residence, and population density), and Personal hygiene (habit of washing food before consumption, nail hygiene, interaction with animals, waste or dirt removal, handwashing habit, soil-eating habit, and boiling drinking water)). Conclusion: Risk factors for soil-transmitted helminths (STH) are individual, socioeconomic, and personal hygiene

Keywords: *STH ; Risk Factors ; Adult*

1. Introduction

Soil-transmitted helminths (STH) infection is a neglected disease generally occurring in tropical and sub-tropical countries. STH is caused by a type of worm that normally lives in soil and will infect humans if it comes into contact with soil or eats food contaminated with worm eggs (Okoyo *et al.*, 2020). STH affects about a quarter of the world's population or 1.5 billion people in Asia, Africa, and South America (WHO, 2023).

Globally, STH infections are dominated by worms *Ascaris lumbricoides* (About 1.2 billion people), *Trichuris trichiura* (About 795 million people), hookworms (*Ancylostoma duodenal* and *Necator americanus*) (About 740 million people) (WHO, 2023). Adults with jobs in the agricultural and livestock sector are vulnerable to STH infection because this group interacts more with the soil, does not use footwear, and lacks good personnel hygiene practices

*) Corresponding Author (Farras Arlinda Rachmawatia)
E-mail: arlindafarras@gmail.com

DOI: 10.31983/jrk.v14i112367

(Kurscheid *et al*., 2020). STH infection can lead to various health problems such as nutritional deficiencies and iron deficiency anemia (Djuardi *et al*., 2021).

Many risk factors can trigger the onset of STH infection in several countries. Environmental factors in the form of soil affect the presence of worms, increasing the possibility of exposure to people who interact with the soil (Rahimi *et al*., 2022). Land polluted by various impurities can become a breeding habitat for worms, so the presence of worms will increase (Phonekeo *et al*., 2023). Individual factors that can increase STH infection include age, gender, and occupation (Kurscheid *et al*., 2020). Sex affected to increase risk helminths infection, the group of men has a lower awareness of hygiene behavior compared to women, this condition causes an increased risk of exposure to worm infections from the environment (Kache *et al*., 2020). Other individual factors include poor education and knowledge related to the risk of STH infection. This condition can cause low awareness to maintain the cleanliness of the environment so that it can become a breeding ground for worms (Akinsanya *et al*., 2021). Personal hygiene factors that can increase STH infection include poor personal hand-washing activity. Poor personal hygiene behavior can increase the entry of worm eggs into the body, especially in groups of workers who have intensive contact with the soil (Muslim *et al*., 2019). The ethnic group also becomes a risk factor for helminth infection because of the culture that increases susceptibility like eating raw meat and vegetables (Jin *et al*., 2021).

Previous studies of STH risk factors focused more on helminthic infections in the pediatric group while in the adult group were still limited. Adults also have a great risk of being infected with STH. Research conducted in Bali on farmers who raise pigs shows the prevalence of STH infection is 76.5%, most of which are Hokworn infections (68.5%), *Ascaris lumbricoides* (36.6%), and Trichuris sp (4.6%).8 Research conducted in Malaysia showed the prevalence of STH infection in the >12 age group was 28% of 190 respondents. STH infection is dominated by *Trichuris trichiura* (93.3%) and *Ascaris lumbricoides* (48.8%) (Agustina *et al*., 2022). Research in Ethiopia shows a prevalence of STH infection of 18.1%, dominated by *Ascaris lumbricoides* (88.5%) and Hokworn (2.1%) (Zeynudin *et al*., 2022).

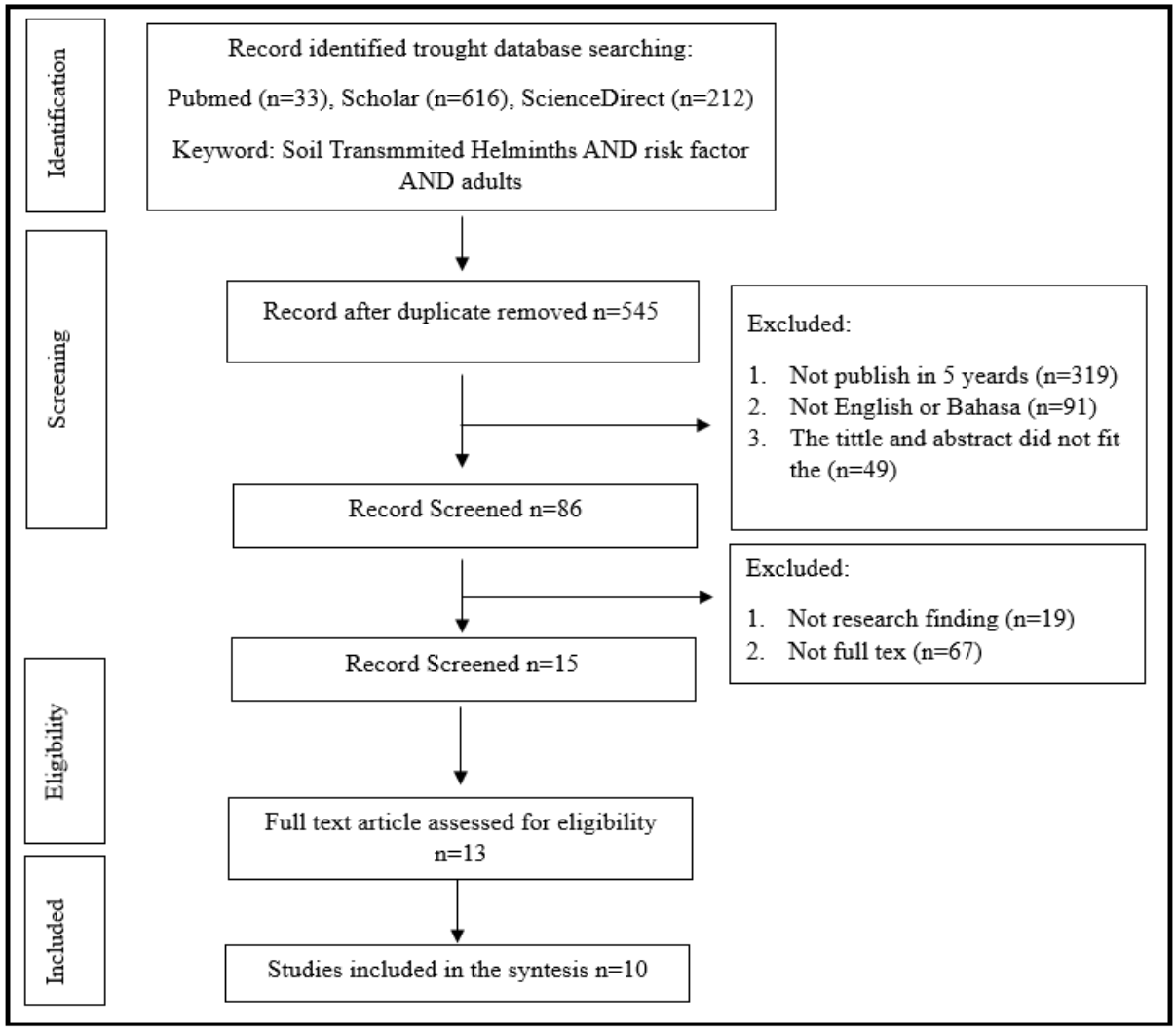
This study aims to summarize the risk factors of soil-transmitted helminths (STH) infection in adults

2. Method

This research uses the literature review method, which to identify what researchers have written on a subject or topic that is done selectively, to produce a comprehensive report on the current position of science related to a particular topic.

1. Preliminary question: What risk factors influence the incidence of STH in adults? With the keywords risk factor, STH, and Adult
2. Inclusion criteria: journals have titles and contents relevant to the destination, in English and Indonesian and full text, and research journals published between 2019 – 2023. Exclusion criteria: journals that do not have a complete structure, duplicate journals, review articles, journals that do not address STH risk factors in adults
3. The journal collection process is carried out using several search engines to find journals related to STH risk factors in adults. The journals used in this literature review were obtained through the database of health journal providers in the form of Pubmed, Google Scholar, ScienceDirect, and ResearchGate journal selection using the 2019-2023 Constraints filter. From the keywords used, 861 articles were obtained, then the title and abstract with the topic to be discussed. The remaining 15 journals were then read in their entirety so that 10 journals were selected according to the topic to be discussed.
4. Each of the 10 research journals was read carefully from abstracts, objectives, and data analysis, to obtain information about risk factors for STH events in adults (Figure 1).

DOI: 10.31983/jrk.v14i112367



3. Result and Discussion

After searching for articles using the keywords risk factor, STH infection, and adult, the results of articles that meet the criteria are reviewed and selected to ensure the articles to be reviewed are eligible. The results of livelihoods in reputable national journals and international journals related to risk factors for soil-transmitted helminth infection were then re-selected so that as many as 10 articles were obtained following the criteria and used as research material. (Table 1)

Table 1. Result of Synthesis Article

Author	Title	Country	Method	Result
Nisha M, Aiman M, Asyhira N, Syafiq H, Atiqah N, Kumarasamy, V Tan M.P and Davamani F. (Scopus)	Risk factors associated with soil-transmitted helminth (STH) infection in two Indigenous communities in Malaysia (2019)	Malaysia	Quantitative method with the crossectional approach with a sample of 90 respondents	The risk factor of STH infection is the habit of washing hands using soap (*p-value* 0.005; OR 8.350; 95%CI: 2.019–34.53). The research shows that communities that do not use soap when washing hands have a risk higher than people that use soap when hand washing.
Ahmed Zeynudin, Teshome Degefa, Million Tesfaye,	Prevalence and intensity of soil-transmitted	Etiopia	Quantitative method with a crossectional	The risk factor for STH incidence is health status (*p-value* 0.007; AOR = 2.7; 95%CI: 1.31–5.50), handwashing

DOI: 10.31983/jrk.v14i112367

Author	Title	Country	Method	Result
Sultan Suleman, Elias Ali Yesuf, Zuber Hajikelil, Solomon Ali, Khalide Azam, Abdusemed Husen, Jafer Yasin, Andreas Wieser. (Scopus)	helminth infections and associated risk factors among household heads living in the peri-urban areas of Jimma town, Oromia, Ethiopia: A community-based cross-sectional study (2022)		approach with a sample of 376 respondents	habits before meals (*p-value* 0.04; AOR = 2.8; 95%CI: 1.2 – 6.2), and nail condition (*p-value* 0.001; AOR = 2.99; 95%CI: 1.59–5.65).
Sengaloun Phonekeo, Sengchanh Kounnavong, Manithong Vonglokham, Latsamy Siengsounthone, Anousin Homsana, Sascha Gummin, Penelope Vounatsu, Prawat Nittiyanant, Suchin Worawichawong, Wichai Aekplakorn, Peter Odermatt, dan Somphou Sayasone (Scopus)	Intestinal helminth infections and associated risk factors among adults in the Lao People's Democratic Republic (2023)	Laos	Quantitative method with a crossectional approach with a sample of 2.800 respondents	Risk factors for STH incidence are community ethnic groups (*p-value* 0.001; AOR 4.3; 95%CI: 3.8–4.8), Occupation (*p-value* <0.001; AOR 1.3; 95%CI: 1.2–1.5), Level of well-being (*p-value* <0.001; AOR 1.9; 95%CI: 1.6 – 2.4), Area of residence (*p-value* 0.001; AOR 2.0; 95%CI: 1.8–2.2), and Regional regions (*p-value* <0.001; AOR 8.1; 95%CI: 6.8 – 9.7).
Kadek Karang Agustina, I Made Ady Wirawan, I Made Sudarmaja, Made Subrata dan Nyoman Sadra Dharmawan. (Scopus)	The first report on the prevalence of soil-transmitted helminth infections and associated risk factors among traditional pig farmers in Bali Province, Indonesia (2022)	Indonesia	Quantitative method with a crossectional approach with a sample of 238 respondents	Risk factors for STH incidence in Bali are community personal hygiene (*p-value* 0.008; OR 5.756; 95%CI: 2.96 – 11.193), sanitation (*p-value* <0.042; OR 1.914; 95%CI: 1.024 – 3.576), Education level (*p-value* 0.006; OR 7.579; 95%CI: 2.621 – 21.915), Income per household (*p-value 0*.025; OR 2,447; 95%CI: 1.122 – 5.338), and occupation (*p-value* 0.006; OR 2.95; 95%CI: 1.356 - 6,415).
Azdayanti Muslim, Sakinah Mohd Sofian, Syahrul Azlin Shaari, Boon-Peng Hoh, Yvonne Ai-Lian Lim. (Scopus)	Prevalence, intensity and associated risk factors of soil-transmitted helminth infections: A comparison between Negritos (indigenous) in inland jungle and those in resettlement at town peripheries (2019)	Malaysia	Quantitative method with a crossectional approach with a sample of 416 respondents	Risk factors for STH incidence in Malaysia are household income (*p-value* <0.001; OR 3.9; 95%CI: 2.0 – 7.5), waste or sewage disposal (*p-value* <0.01; OR 2.5; 95%CI: 1.3 – 4.8), hand washing (p-value <0.001; OR 3.4; 95%CI: 1.7 – 6.9), using footwear when leaving the house (*p-value* 0.04; OR 2.1; 95%CI: 1 – 4.2), washing fruit or vegetable before eating (*p-value* 0.03; OR 2.6; 95%CI: 1.0 – 8.9), and close contact with local animals (*p-value*: <0.001; OR: 6.6; 95%CI: 3.3 – 13.5).
Johanna Kurscheid, Budi Laksono, M. J. Park, Archie C. A. Clements, Ross Sadler, James S.	Epidemiology of soil-transmitted helminth infections in Semarang, Central Java,	Indonesia	Quantitative method with a crossectional approach with a sample	Risk factors for STH infection in Semarang are gender (*p-value*: 0.02; OR: 1.14; 95%CI: 1.02 – 1.29), age (*p-value*: <0.001; OR: 3.01; 95%CI: 1.02 – 1.29), poverty (*p-value:* <0.001; OR:

DOI: 10.31983/jrk.v14i112367

Author	Title	Country	Method	Result
McCarthy, Susana V. Nery, Ricardo Soares-Magalhaes, Kate Halton, Suharyo Hadisaputro, Alice Richardson, Le´a Indjein, Kinley Wangdi, Donald E. Stewart, Darren J. Gray. (Scopus)	Indonesia (2020)		of 6.466 respondents	2.14; 95%CI: 1.77 – 2.58), population density (*p-value:* <0.001; OR: 1.35; 95%CI: 1.27–1.44) and goat ownership (*p-value*: 0.02; OR: 1.61; 95%CI: 1.10–2.41).
Hanna Jin, Kyungshick Ryu, Dajeong Lee, Youthanavanh Vonghachack, Min-Ho Choi, Sung-Tae Hong, Hyun Beom Song. (Scopus)	Prevalence and Risk Factors of Intestinal Helminthiasis in Remote Mountainous Villages of Northern Lao PDR: A Cross-Sectional Study (2021)	Laos	Quantitative method with a crossectional approach with a sample of 161 respondents	The risk factor for the incidence of STH infection in Lao PDR is sex (*p-value*: 0.018; OR: 2.167; 95%CI: 1.143 – 4.108), ethnic group (*p-value*: 0.006; OR: 3.522; 95%CI: 1.433 – 8.656), and pets (*p-value*: <0.001; OR: 2.14; 95%CI: 1.77 – 2.58).
Franco Zacharia, Valeria Silvestri, Vivian Mushi, George Ogweno, Twilumba Makene, Lwidiko E. Mhamilawa. (Scopus)	Burden and factors associated with ongoing transmission of soil-transmitted helminths infections among the adult population: A community-based cross-sectional survey in Muleba district, Tanzania (2023)	Tanzania	Quantitative method with a crossectional approach with a sample of 522 respondents	Risk factors for STH infection in Tanzania are occupation (*p-value*: 0.05 AOR: 3.34; 95%CI: 1.45 – 7.70), footwear habits (*p-value:* 0.007 AOR: 5.11; 95%CI: 1.55 – 16.87), and field activities (*p-value:* 0.010 OR: 4.89; 95%CI: 1.47 – 16.28).
Ratee Kache, Nonthapan Phasuk, Parnpen Viriyavejakul dan Chuchard Punsawad. (Scopus)	Prevalence of soil-transmitted helminth infections and associated risk factors among elderly individuals living in rural areas of southern Thailand (2020)	Thailand	Quantitative method with a crossectional approach with a sample of 439 respondents	Risk factors for STH infection in Thailand are sex (*p-value*: 0.027 AOR: 1.85 95%CI: 1.07 – 3.19), washing fruit before eating (*p-value*: <0.001 AOR: 3.19 95%CI: 1.70 – 6.00) and open defecation (*p-value*: 0.023 AOR: 2.66 95%CI: 1.14 – 6.15).
Akinsanya B, Adubi Taiwoa, Macauley Adedamola, Okonofua C. (Scopus)	An investigation on the epidemiology and risk factors associated with soil-transmitted helminth infections in Ijebu East Local Government Area, Ogun State, Nigeria (2021)	Nigeria	Quantitative method with a crossectional approach with a sample of 136 respondents	Risk factors for STH infection in Nigeria are the habit of washing fruit before eating (OR: 5.60 95%CI: 0.654 – 47.984), the habit of eating soil (*p-value*: <0.001 OR: 2.386 95%CI: 0.276 – 20.584), the habit of boiling water before drinking (OR: 1.042; 95%CI: 0.118 – 9.231) and the habit of not using footwear (OR: 1.73 95%CI: 0.200 – 15.053).

DOI: 10.31983/jrk.v14i112367

Based on the results of the review article, risk factors for STH infection in adults can be grouped into three factors, namely individual, socioeconomic, and personal hygiene factors.

1. Individual Factors

Individual factors that become risk factors for STH infection include education level, gender, age, and type of occupation. Education is a risk factor for STH infection based on research by Agustina et al., (2022) conducted in Bali, Indonesia. In this study, respondents who had a low level of education had a 7.579 times higher risk of being infected with STH than respondents with higher education (*p-value* 0.00; OR 7.579; 95%CI: 2.621 – 21.915). This condition is because low education will affect the level of knowledge about STH infection, and low knowledge will affect the prevention behavior of STH infection.

Research conducted by Phonekeo et al (2023), Jin et al (2021), Keche et al (2020), and Kurscheid et al (2020) showed that work is a risk factor for STH infection in adults. Research by Phonekeo et al (2023) conducted in Laos shows that male adults have a 1.3 times greater risk of STH infection compared to female adults (*p-value* <0.001; AOR 1.3; 95%CI: 1.2–1.5). The results of Jin et al., (2021) research in the same country also found that people with male sex have a 2.16 times greater risk of STH infection than women (p-value: 0.018; OR: 2.167; 95%CI: 1.143 – 4.108). Kache et al., (2020) study in Thailand showed that sex was 1.85 times more likely to be infected with STH (p-value: 0.027 AOR: 1.85 95%CI: 1.07–3.19). Research conducted in Semarang Kurscheid et al (2020) showed that the male group was at risk 1.14 times more likely to be infected with STH than women (p-value: 0.02; OR: 1.14; 95%CI: 1.02 – 1.29).

The four studies show that the sex that is susceptible to STH infection is male. Men are more at risk of STH infection because they have a higher level of outdoor activity compared to women, this condition increases the vulnerability of men infected with STH. In addition, men tend to have poor personal hygiene than women thus resulting in worm eggs more easily entering the body both through skin and food that is less clean. In addition, men in rural areas tend to have jobs that interact more directly with the soil such as farmers, this condition increases the possibility of contact with the soil that is the habitat of worms. In addition, most rural residents who work in the agricultural sector also raise livestock such as goats, goat-keeping activities and close contact with domestic goats increase the risk of STH infection. This condition is caused because people who raise goats interact more with dirt and soil which is the habitat of STH. In addition, male sports activities can also affect the susceptibility to STH infection, sports habits such as football that are favored by men cause the risk of exposure to STH infection to increase (Alemu, Aschalew, and Zerihun, 2018).

Age is also one of the risk factors for STH infection, research by Kurscheid et al (2020) in Semarang Indonesia shows that productive age groups are 3 times more likely to be infected with STH (*Hookworm, Ascaris lumbricoides,* and *Trichuris trichiuria*) compared to children and the elderly (p-value: <0.001; OR: 3.01; 95%CI: 1.02 – 1.29). Age is a risk factor for STH infection because the productive age group that was the majority of the study respondents worked in the agricultural sector, this condition increases susceptibility to STH infection. Work is a risk factor for STH infection in adults based on the results of research conducted by Phonekeo et al (2023), Agustina et al (2022), and Zacharia et al (2023). Research by Phonekeo et al (2023) shows farmers have a 1.3 times greater risk of STH infection compared to other occupational groups (p-value <0.001; AOR 1.3; 95%CI: 1.2–1.5). conducted on traditional pig farmers in Bali shows that farmers who have the main job as pig farmers have a 3 times greater risk of being infected with STH compared to farmers whose main occupation is not pig farmers (p-value 0.006; OR 2.95; 95%CI: 1.356 – 6.415). Research by Zacharia et al (2023) conducted in Tanzania shows that working as a farmer is 3.34 times greater risk of STH infection than other occupational groups (*p-value*: 0,05 AOR: 3.34; 95%CI: 1.45 – 7,70). Work is one of the risk factors for STH Research conducted in Tanzania and Laos states that farmers are a group at risk of STH infection. This condition is caused by the increased vulnerability of farmers due to high interaction with the soil that is the habitat of worms. Research in Bali shows that people who have the main job of raising pigs are at higher risk of STH infection. This condition is caused because raising pigs can increase the susceptibility to interacting with livestock manure that can contain worm eggs that are ready to infect humans.

DOI: 10.31983/jrk.v14i112367

2. Socioeconomic Factors

Socioeconomic factors are one of the risk factors for STH infection in the community, socioeconomic factors that are risk factors for STH infection include community ethnicity, welfare level, area of residence, and population density. These results are contained in research conducted by Phonekeo et al (2023), Jin et al (2021), Kurscheid et al (2020), Agustina et al (2022), and Muslim et al (2019).

Ethnic communities are one of the social factors that can increase the risk of STH infection, research conducted by Phonekeo et al (2023) in Laos shows that people from Lao-Tai ethnicity are at 4.3 times greater risk of STH infection (p-value 0.001; AOR 4.3; 95%CI: 3.8–4.8). This condition is caused because the Lao-Tai ethnic group has lived in the lowlands around the Mekong River, Lao-Tai people have a traditional food culture in the form of Lappa and Koipa made from raw fish mixed with herbs. Both foods are mandatory foods served in Lao-Tai ethnic cultural ceremonies, these conditions increase the vulnerability of worm eggs through food consumed by Lao-Tai ethnic people.

Similar to this study, the results of a study conducted by Jin et al (2021) showed that people who usually consume raw meat are 11.75 times more infected with Taneia sp (*p-value* 0.11 OR: 11.750 95%CI: 1.542 – 1.508, 773). People who have the habit of eating raw meat are more susceptible to STH infection because *Taneia sp* worms can be found in the meat of infected livestock such as pigs and buffaloes, eating raw meat or undercooked meat causes this parasite not to die and will infect humans who eat it. The study also showed that the Hang: Leu ethnic group was 3,552 times more likely to be infected with hookworm than other ethnic groups (p-value 0.006 OR:3.552 95%CI: 1.433 – 8.656). The Hang: Leu ethnic group lives in lowland areas that make rivers the center of activity, community habits such as defecating in rivers and bathing in rivers cause STH infections to be high. The Lao:Tai ethnic community also mostly works as traditional farmers who rely on simple tools to cultivate land around the Mekong River, increasing the vulnerability of STH infection. In addition, many people keep dogs, the results of the examination of parasitic infections in dogs of Lao: Tai ethnic residents show that there are still dogs infected with Hokworm, this condition can also increase the vulnerability of the community to be infected with STH.

The level of well-being is a risk factor for STH infection in the community, the results of research by Kurscheid et al (2020) in Semarang Indonesia show that poor people are at 2.14 times greater risk of STH infection than people who live prosperous lives (p-value: <0.001; OR: 2.14; 95%CI: 1.77 – 2.58).

Poverty increases the risk of STH infection because it causes the person to have limited access to clean water sources, poor sanitation, poor house hygiene, and high house density so the population is vulnerable to STH infection. Low-income people generally have home conditions that do not meet health aspects, one of which is the condition of the floor that is not permanent and not easy to clean (Aemiro *et al.*, 2022). Soil conditions made of non-permanent materials such as compacted soil can increase the risk of its inhabitants being infected with worm eggs in the soil. This condition is exacerbated by the personal hygiene behavior of residents who do not maintain personal hygiene.

This research is in line with the results of research conducted by Phonekeo et al (2023), which shows people who are below the poverty line are at 1.9 times greater risk of STH infection than people with high incomes (*p-value* <0,001; AOR 1.9; 95%CI: 1.6 –2.4). Poverty rates associated with the employment of people in Laos who are mostly traditional farmers, low incomes, and high exposure to soil lead to higher vulnerability to STH infection.

The results of a study by Muslim et al (2019) in Malaysia show that households with low incomes are 3.9 times more likely to experience STH infection compared to high-income households (*p-value* <0,001; OR 3.9; 95%CI: 2.0 – 7.5). This condition is caused because households that have low incomes do not get good access to drinking water sources, and low-income people tend to have low personal hygiene.

Another study by Agustina et al (2022) shows that low-income farmers are 2,447 times more likely to experience *Ascaris lumbriciodes* infection compared to high-income farmers (*p-value* 0,025; OR 2,447; 95%CI: 1,122 – 5,338). This condition is because low-income farmers are generally traditional pig farmers who are more susceptible to STH infection than modern farmers whose rearing systems

DOI: 10.31983/jrk.v14i112367

are more integrated. Traditional farmers carry out the maintenance and cleaning of cages using makeshift equipment so that the possibility of contact with animal feces is higher.

Area of residence is a risk factor for STH infection, research conducted by Phonekeo et al (2023) respondents living in rural areas have a 2.0 times greater risk of STH infection compared to respondents in urban areas (p-value 0.001; AOR 2.0; 95%CI: 1.8–2.2). Respondents living in the southern and central regions were at 8.1 higher risk of being infected with Hokworn compared to respondents living in the northern regions (p-value <0.001; AOR 8.1; 95%CI: 6.8 – 9.7).

The region of residence can affect the high and low incidence of STH infections, this condition is related to the sociodemographic conditions that accompany it. Residents in rural areas are at higher risk of STH infection because most of the population works in agriculture which is more susceptible to STH infection than residents in urban areas (Lebu *et al.*, 2023). Respondents in the southern and central regions tend to have activities around the Mekong River flow, this condition makes respondents more susceptible to STH infection considering the habits of people in the region who still defecate in rivers and bathe in rivers.

Population density is a risk factor for STH infection, according to research conducted by Kurscheid et al (2020) in Semarang Indonesia, showing respondents living in areas with high population density have a risk of 1.35 times STH infection compared to people living in sparsely populated areas (p-value: <0.001; OR: 1.35; 95%CI: 1.27–1.44). This condition is caused because areas with high population density tend to have poor environmental sanitation conditions, increasing the risk of STH infection.

Poor sanitation conditions include access to drinking water contaminated with sewage, thus reducing the quality of drinking water that is widely consumed by the community.

3. Personal Hygiene Factors

Personal hygiene is one of the factors that influence the incidence of STH infection, research conducted by Zacharia et al (2023), Kache et al (2020), Akinsanya et al (2021), Zaynudin et al (2022), Nisha et al. (2020), Agustina et al (2022), and Muslim et al (2019) show personal hygiene to be a risk factor for STH infection. Personal hygiene behaviors that can affect STH infection include the habit of washing foodstuffs before consumption, nail hygiene, interaction with animals, waste or dirt removal, hand washing habits, the habit of using footwear when leaving the house, the habit of consuming soil, and the habit of boiling drinking water. The sanitation factor that affects STH infection is the habit of boiling drinking water.

The habit of washing foodstuffs can increase the risk of being infected with STH, research conducted by Akinsaya et al (2019) in Nigeria showed respondents who had the habit of not washing fruit before eating had a 5.6 times greater risk of being infected with STH than respondents who washed fruit before consumption (OR: 5.60 95%CI: 0.654 – 47.984). The habit of eating fruit before washing increases the risk of being infected with STH, this condition is caused because fruits can be contaminated by worm eggs so that they can enter the human body when eaten.

Research by Kache et al (2020) shows that respondents who eat vegetables before washing have a 3.19 times greater risk of STH infection compared to respondents who wash fruit first before eating (p-value: <0.001 AOR: 3.19 95%CI: 1.70 – 6.00). This condition is caused by the results of examinations conducted in southern Thailand show that 35% of fresh vegetables are contaminated with worm eggs. This condition is caused by the high habit of the community, especially around the river flow, to open defecate carelessly in the river. Polluted river water is also used by the community to wash vegetables and fruits so that vegetables and fruits are contaminated.

A similar study conducted by Muslim et al (2019) in Malaysia showed that respondents who did not wash fruits and vegetables before consumption had a 2.6 times greater risk of STH infection than respondents who washed vegetables and fruits first (p-value 0.03; OR 2.6; 95%CI: 1.0 – 8.9). This condition is caused because fruits and vegetables that are not washed first after being purchased from the market can be contaminated with worm eggs. This condition is strengthened by the condition of residents who are still cultivating around the river flow which is also used by residents to defecate, this increases the vulnerability of fruits and vegetables produced by farmers in the region contaminated with worm eggs carried by the river.

DOI: 10.31983/jrk.v14i112367

Nail hygiene can affect STH infection, research conducted by Zeynudin et al (2022) in Malaysia shows respondents with poor nail hygiene are three times more likely to have STH infection compared to respondents with good nail hygiene (p-value 0.001; AOR = 2.99; 95%CI: 1.59–5.65). This condition is caused because nails that are not kept clean can be a place for parasitic worm eggs to be attached, this condition is supported by the livelihood conditions of people who mostly work as farmers to allow soil containing worm eggs to be between the nails.

Farming communities in rural areas in Southeast Asia including Malaysia also have the habit of eating food using their hands, This behavior causes increased vulnerability to the entry of worm eggs between the nails into the body when eating.

Interaction with animals that can be intermediate hosts of STH increases the risk of infection in humans, based on research conducted by Jin et al (2021) shows respondents who raise pigs have a 2.14 times greater risk of being infected with STH compared to respondents who do not raise pigs (p-value: <0.001; OR: 2.14; 95%CI: 1.77 – 2.58). The pig-rearing system carried out by the community is generally in the form of an open cage so that pigs can still soak in the mud, this condition increases infection of worm eggs or larvae, especially in the rainy season. Eggs or larvae that are in pig manure or soil will be carried away by the flow of water so that people who live around the pigsty can also be affected. Pig farmers are also increasingly at risk of STH infection when raising pigs that have soaked in mud.

Another study conducted by Kurscheid et al (2020) in Semarang Indonesia showed that respondents who had goats had a 1.61 times greater risk of being infected with STH compared to respondents who did not raise goats (p-value: 0.02; OR: 1.61; 95%CI: 1.10–2.41). This condition is caused because respondents who raise goats have higher interactions with pets that can be infected with STH. STH eggs or larvae that infect livestock can come out into the environment through feces, livestock care activities including cleaning livestock manure can increase contact with STH infection.

Research in Malaysia conducted by Muslim et al (2019) showed contact with animals kept at home increased the risk of STH infection by 6.6 times (p-value: <0.001; OR: 6.6; 95%CI: 3.3 – 13.5). This condition is caused because pets can host for STH worms and can release STH eggs or larvae when the animal excretes feces. Pet feces containing eggs or larvae can increase the vulnerability of a nurturing person if they do not clean them properly.

Poor hand-washing habits before eating are also a factor of STH infection risk in the community, research by Zeynudin et al (2022) shows respondents who have a habit of not washing their hands have a 2.8 times greater risk of STH infection compared to respondents who wash their hands before eating (p-value 0.04; AOR = 2.8; 95%CI: 1.2 – 6.2). Unclean hands can be a place to attach dirt including worm eggs that can enter the human body when eating, coupled with most people who work as farmers allowing the attachment of soil containing worm eggs higher. This condition increases vulnerability for people who do not wash their hands thoroughly or do not use soap to become infected with STH.

Research conducted by Nisha et al (2019) in the same country shows that respondents who do not wash their hands using soap have an 8.35 times greater risk of being infected with STH compared to respondents who wash their hands using soap (p-value 0.005; OR 8.35; 95%CI: 2.019–34.53). The use of soap to wash hands can clean hands better than just washing hands using water. The use of soap to wash hands can clean worm eggs that stick both to the fingers and between the nails, especially to the hookworm. People who do not use soap to wash their hands will be more susceptible to STH infection compared to people who wash their hands using soap.

Research conducted by Muslim et al (2019) in the same country also showed respondents who did not have the habit of washing their hands after contact with soil had a 3.4 times greater risk of STH infection than respondents who had hand washing habits (p-value <0.001; OR 3.4; 95%CI: 1.7 – 6.9). Hand-washing habits can reduce STH infection because it can clean worm eggs attached to hands after activities in the field.

The behavior of not using footwear when doing activities outside the home is a risk factor that increases the incidence of STH infection based on the results of research by Muslim et al (2019), Zacharia et al (2023), and Akinsanya et al (2021). Soil is an intermediary medium for STH infection, in a study conducted by Muslim et al (2019) in Malaysia showed respondents who had the habit of leaving the house without using footwear were twice as likely to experience STH infection compared

DOI: 10.31983/jrk.v14i112367

to respondents who had the habit of using footwear when leaving the house (p-value 0.04; OR 2.1; 95%CI: 1 – 4.2). Footwear can prevent direct contact between the feet and soil that can contain STH eggs or larvae, the habit of people who do not use footwear will increase the vulnerability of the entry of worm eggs or larvae in the soil into the human body through the skin. People's habit of not using footwear is usually caused by various conditions such as work, where most of the study respondents work as farmers. In carrying out their work in the fields, farmers will usually remove footwear to make it easier to walk in the mud and to prevent damaging crops.

Research by Zacharia et al (2023) shows that respondents who do not use footwear when leaving the house have a 5.11 times greater risk of developing Hokworn infections compared to respondents who use footwear (p-value: 0.007 AOR: 5.11; 95%CI: 1.55 – 16.87). The increase in Hokworn infection in respondents who do not use footwear when leaving the house is caused by Hokworn worms, which are worms that can enter the human body through the skin, not using footwear will increase the vulnerability of being infected with Hokworn due to direct contact between the feet and the ground.

Research by Akinsanya et al (2023) shows that respondents who do not use footwear have a 1.73 times risk of STH infection compared to respondents who use footwear (OR: 1.73 95%CI: 0.200 – 15.053). This condition is related to the activities of people in Nigeria who do not use footwear when working in agriculture and playing football, this condition increases susceptibility to infection with Hokworn worms that can infect humans by entering through the skin.

Open defecation (free defecation) is a risk factor for STH infection, according to research by Kache et al (2020) in Thailand, respondents who have defecation habits are 2.66 times more likely to be infected with STH (p-value: 0.023 AOR: 2.66 95%CI: 1.14 – 6.15). In this study, it is known that respondents who have the habit of open defecation are more susceptible to *S. stercoralis* and Hokworn infections that can infect the human body through the skin in the filariform larval stage.

Research in Malaysia by Muslim et al (2019) shows respondents who practice open defecation have a 2.5 times greater risk of being infected with STH compared to respondents who do not defecate openly (p-value <0.01; OR 2.5; 95%CI: 1.3 – 4.8). Open defecation can increase the vulnerability of the spread of STH, open defecation behavior in river bodies can make river water contaminated and increase the possibility of infection when used by residents to bathe and wash foodstuffs.

Soil eating habits are one of the risk factors for STH infection, processed soil eating habits are found in African countries and some Asian countries. According to research conducted in Nigeria by Akinsanya et al (2021) people who have soil eating habits are at risk (p-value: <0.001 OR: 2.386 95%CI: 0.276 – 20.584). High poverty rates cause limited access to highly nutritious food so many people in Africa, including Nigeria, consume food made from mud mixed with salt. This condition increases the risk of worm infection considering that soil is an intermediate medium for infection with various types of STH, people will be susceptible to STH infection when consuming soil contaminated with worm eggs or larvae.

The habit of boiling water for drinking is a risk factor for STH infection in Nigeria, research conducted by Akinsanya et al (2019) showed respondents who had the habit of drinking unboiled water had a risk of 1,042 times STH infection (OR: 1,042; 95%CI: 0.118 – 9,231). Unboiled water allows the presence of various parasitic organisms such as larvae or eggs of STH worms that can infect humans when drunk. Many people in Nigeria still do not pay attention to sanitation hygiene including not boiling water first before drinking, other conditions are caused by limited clean water so that people drink water contaminated with parasites.

4. Conclusion and Suggestion

The results of the research show that three factors influence soil-transmitted helminths (STH) in adults. Individual factors include low education level, ~~gender~~, age, and type of occupation. Socioeconomic factors include the ethnic community, level of welfare, area of residence, and population density. Personal hygiene and sanitation factors include the habit of washing foodstuffs before consumption, nail hygiene, interaction with animals, waste or dirt removal, hand washing habits, habits of using footwear when leaving the house, soil eating habits ~~habits of consuming land~~, ~~habits of boiling drinking water~~, and habits of boiling drinking water. Based on the result, we suggest that the

DOI: 10.31983/jrk.v14i112367

community adopt a clean and healthy lifestyle and maintain environmental cleanliness as an effort to minimize soil-transmitted helminth infections.

5. Acknowledgments

The authors would like to thank all those who provided valuable insights and suggestions during the preparation of this literature review. Appreciation is also extended to the institutions and platforms that granted access to the academic resources used in this study..

6. References

Aemiro, A. *et al.* (2022) 'Prevalence of Soil-Transmitted Helminthes and Associated Risk Factors Among People of Ethiopia: A Systematic Review and Meta-Analysis', *Infectious Diseases: Research and Treatment*, 15, p. 117863372110554. Available at: https://doi.org/10.1177/11786337211055437.

Agustina, K.K. *et al.* (2022) 'The first report on the prevalence of soil-transmitted helminth infections and associated risk factors among traditional pig farmers in Bali Province, Indonesia', *Veterinary World*, 15(5), pp. 1154–1162. Available at: https://doi.org/10.14202/vetworld.2022.1154-1162.

Akinsanya *et al.* (2021) 'An investigation on the epidemiology and risk factors associated with soil-transmitted helminth infections in Ijebu East Local Government Area, Ogun State, Nigeria', *Scientific African*, 12, p. e00757. Available at: https://doi.org/10.1016/j.sciaf.2021.e00757.

Alemu, G., *et al.* . (2018) 'Burden of intestinal helminths and associated factors three years after initiation of mass drug administration in Arbaminch Zuria district, Southern Ethiopia', *BMC Infectious Diseases*, 18(1). Available at: https://doi.org/10.1186/s12879-018-3330-3.

Djuardi, Y. *et al.* (2021) 'Soil-transmitted helminth infection, anemia, and malnutrition among preschool-age children in Nangapanda subdistrict, Indonesia', *PLoS Neglected Tropical Diseases*, 15(6). Available at: https://doi.org/10.1371/journal.pntd.0009506.

Jin, H. *et al.* (2021) 'Prevalence and risk factors of intestinal helminthiasis in remote mountainous villages of northern Lao PDR: A cross-sectional study', *Korean Journal of Parasitology*, 59(2), pp. 131–138. Available at: https://doi.org/10.3347/kjp.2021.59.2.131.

Kache, R. *et al.* (2020) 'Prevalence of soil-transmitted helminth infections and associated risk factors among elderly individuals living in rural areas of southern Thailand', *BMC Public Health*, 20(1). Available at: https://doi.org/10.1186/s12889-020-09986-7.

Kurscheid, J. *et al.* (2020) 'Epidemiology of soil-transmitted helminth infections in Semarang, Central Java, Indonesia', *PLoS Neglected Tropical Diseases*, 14(12), pp. 1–17. Available at: https://doi.org/10.1371/journal.pntd.0008907.

Lebu, S. *et al.* (2023) 'Soil-transmitted helminths: A critical review of the impact of co-infections and implications for control and elimination', *PLoS Neglected Tropical Diseases*. Public Library of Science. Available at: https://doi.org/10.1371/journal.pntd.0011496.

Muslim, A. *et al.* (2019) 'Prevalence, intensity and associated risk factors of soil-transmitted helminth infections: A comparison between Negritos (indigenous) in the inland jungle and those in resettlement at town peripheries', *PLoS Neglected Tropical Diseases*, 13(4). Available at: https://doi.org/10.1371/journal.pntd.0007331.

Nisha, M. *et al.* (2020) *Risk factors associated with soil-transmitted helminth (STH) infection in two indigenous communities in Malaysia*, *Tropical Biomedicine*. Available at: https://landsatlook.usgs.gov/viewer.html.

Okoyo, C. *et al.* (2020) 'Prevalence, intensity and associated risk factors of soil-transmitted helminth and schistosome infections in Kenya: Impact assessment after five rounds of mass drug administration in Kenya', *PLoS Neglected Tropical Diseases*, 14(10), pp. 1–33. Available at: https://doi.org/10.1371/journal.pntd.0008604.

Phonekeo, S. *et al.* (2023) 'Intestinal helminth infections and associated risk factors among adults in the Lao People's Democratic Republic', *Infectious Diseases of Poverty*, 12(1). Available at: https://doi.org/10.1186/s40249-023-01112-0.

Rahimi, B.A. *et al.* (2022) 'Prevalence and associated risk factors of soil-transmitted helminth

DOI: 10.31983/jrk.v14i112367

infections in Kandahar, Afghanistan', *BMC Infectious Diseases*, 22(1). Available at: https://doi.org/10.1186/s12879-022-07336-z.

WHO (2023) *Soil-transmitted Helminth Infections*, *WHO*. Available at: https://www.who.int/news-room/fact-sheets/detail/soil-transmitted-helminth-infections (Accessed: 1 January 2024).

Zacharia, F. *et al.* (2023) 'Burden and factors associated with ongoing transmission of soil-transmitted helminths infections among the adult population: A community-based cross-sectional survey in Muleba district, Tanzania', *PLoS ONE*, 18(7 July). Available at: https://doi.org/10.1371/journal.pone.0288936.

Zeynudin, A. *et al.* (2022) 'Prevalence and intensity of soil-transmitted helminth infections and associated risk factors among household heads living in the peri-urban areas of Jimma town, Oromia, Ethiopia: A community-based cross-sectional study', *PLoS ONE*, 17(9 September). Available at: https://doi.org/10.1371/journal.pone.0274702.