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Identification of Soil-Transmitted Helminth Eggs on the Fingernails of Roof Tile Craftsmen in Urek-Urek Village, Gondanglegi District

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ABSTRACT

*Soil-transmitted helminths (STHs) are intestinal parasites transmitted through contaminated soil and remain a significant public health concern, particularly among workers who frequently come into direct contact with soil, such as roof tile craftsmen. This study aimed to identify the presence of soil-transmitted helminth eggs on the fingernails of roof tile craftsmen in Urek-Urek Village, Gondanglegi District. A qualitative descriptive study design was employed using a purposive sampling technique. The study population consisted of 35 roof tile craftsmen, of whom 29 respondents met the inclusion criteria. Fingernail samples were examined using the 10% potassium hydroxide (KOH) sedimentation method. The results showed that 2 out of 29 respondents (6.9%) tested positive for Soil-Transmitted Helminth eggs, specifically *Ascaris lumbricoides*. One respondent (R16) was found to have fertile *Ascaris lumbricoides* eggs, while another respondent (R17) had infertile *Ascaris lumbricoides* eggs. Cross-tabulation analysis between personal hygiene practices and examination results demonstrated that respondents with moderately adequate personal hygiene accounted for both positive findings (9.5%). Most respondents with inadequate hygiene practices did not use footwear while working and washed their hands and feet only with water without soap. These findings indicate that poor personal hygiene and inadequate use of personal protective equipment may increase the risk of STH contamination among roof tile craftsmen. Therefore, health education regarding proper handwashing practices and the use of personal protective equipment, such as footwear and gloves during work activities, is strongly recommended to reduce the risk of STH infection.*

Keywords: Soil-Transmitted Helminths, Roof Tile Craftsmen, Personal Hygiene, Occupational Exposure, Nail Contamination

ABSTRAK

Soil Transmitted Helminth (STH) merupakan kelompok parasit usus yang ditularkan melalui tanah dan masih menjadi masalah kesehatan masyarakat, terutama pada pekerja yang sering melakukan kontak langsung dengan tanah seperti pengrajin genteng. Penelitian ini bertujuan untuk mengidentifikasi adanya telur cacing *Soil Transmitted Helminth* pada kuku pengrajin genteng di Desa Urek-Urek Kecamatan Gondanglegi. Penelitian ini menggunakan desain deskriptif kualitatif dengan teknik purposive sampling. Populasi penelitian terdiri dari 35 pengrajin genteng, dengan 29 responden yang memenuhi kriteria inklusi. Pemeriksaan sampel kuku dilakukan menggunakan metode sedimentasi kalium hidroksida (KOH) 10%. Hasil penelitian menunjukkan bahwa 2 dari 29 responden (6,9%) positif mengandung telur cacing *Soil Transmitted Helminth* spesies *Ascaris lumbricoides*. Responden R16 ditemukan mengandung telur *Ascaris lumbricoides* fertil, sedangkan responden R17 ditemukan mengandung telur *Ascaris lumbricoides* infertil. Analisis tabulasi silang antara personal hygiene dan hasil pemeriksaan menunjukkan bahwa seluruh responden positif memiliki tingkat personal hygiene yang cukup. Sebagian besar responden dengan personal hygiene kurang baik tidak menggunakan alas kaki saat bekerja dan hanya mencuci tangan serta kaki menggunakan air tanpa sabun. Temuan ini menunjukkan bahwa personal hygiene yang kurang baik serta rendahnya penggunaan alat pelindung diri dapat meningkatkan risiko kontaminasi STH pada pengrajin genteng. Oleh karena itu, edukasi mengenai praktik cuci tangan yang benar dan penggunaan alat pelindung diri seperti alas kaki dan sarung tangan selama bekerja sangat diperlukan untuk menurunkan risiko infeksi STH.

Kata kunci: Soil Transmitted Helminth, Pengrajin Genteng, Personal Hygiene, Paparan Kerja, Kontaminasi Kuku

INTRODUCTION

Helminthiasis remains one of the most common infectious diseases affecting communities, particularly in developing countries. This disease is mainly caused by intestinal nematodes classified as Soil-Transmitted Helminths (STHs), which are transmitted through contaminated soil. These parasites are capable of surviving and developing in soil, where their eggs mature from non-infective to infective stages before entering the human body (1). Soil-transmitted helminth infections are among the most prevalent infections worldwide, affecting more than 1.5 billion people or approximately 24% of the global population. The disease predominantly affects populations with poor socioeconomic conditions, limited access to clean water, inadequate sanitation, and poor hygiene practices. STH infections are highly prevalent in tropical and subtropical regions, including Sub-Saharan Africa, the Americas, China, and Southeast Asia (2).

In Indonesia, helminth infections remain widely distributed, with prevalence rates ranging from 2.5% to 62%. These infections are commonly found among populations with low socioeconomic status and poor environmental sanitation. Several species are known to infect humans, including *Ascaris lumbricoides*, *Trichuris trichiura*, *Ancylostoma duodenale*, and *Necator americanus*(3). The high prevalence of STH infections in Indonesia is strongly associated with environmental conditions that support parasite development, such as high temperature and humidity levels(4). Each species of helminth has an optimal temperature range for development; for example, *Ascaris lumbricoides* eggs develop optimally at temperatures between 20°C and 25°C (5). In addition, open defecation practices in areas such as rivers and household surroundings contribute to soil contamination with infective helminth eggs, thereby increasing the risk of transmission. STH infections may cause impaired nutrient absorption, digestive disturbances, anemia, decreased nutritional status, reduced cognitive performance, and lower work productivity due to chronic loss of carbohydrates, proteins, and blood(4).

Individuals who frequently come into direct contact with soil are considered highly vulnerable to STH infection. One occupational group at risk is roof tile craftsmen. The roof tile production process involves intensive contact with moist clay soil mixed with red brick soil, which is manually processed, molded, dried, arranged, and eventually burned. The soil used during this process may serve as a suitable medium for the development of helminth eggs such as *Ascaris lumbricoides* and *Trichuris trichiura*. Hookworm larvae may also survive in sandy soil conditions that facilitate oxygen exchange and larval development.

Most roof tile craftsmen perform their work manually without using personal protective equipment such as gloves and footwear. The risk of STH infection may increase due to inadequate personal hygiene practices, including failure to wash hands properly after work and before meals. Soil particles containing infective helminth eggs or larvae may remain attached to the skin and beneath the fingernails and may subsequently be ingested unintentionally. Therefore, fingernails may serve as an important medium for the transmission of Soil-Transmitted Helminths among workers who are continuously exposed to contaminated soil.

Urek-Urek Village, Gondanglegi District, is one of the areas where the majority of residents work as roof tile craftsmen. Preliminary observations indicated that many craftsmen still work without personal protective equipment such as gloves and footwear. In addition, personal hygiene practices remain inadequate, as workers generally wash their hands using water only without soap after work activities. Furthermore, most production areas still have soil floors, which may increase the risk of environmental contamination. According to information obtained from the helminthiasis program officer at Ketawang Public Health Center, routine helminth examinations among adult workers, particularly roof tile craftsmen, have never been conducted. Existing prevention programs mainly target children through school health and community health posts. Previous studies on STH infections have predominantly focused on school-aged children, farmers, or plantation workers, while studies involving roof tile craftsmen remain limited. Therefore, this study provides scientific novelty by specifically investigating the presence of Soil-Transmitted Helminth eggs on the fingernails of roof tile craftsmen in a traditional occupational setting with prolonged soil exposure. This study also emphasizes the role of personal hygiene and occupational exposure as potential risk factors for STH contamination among informal workers.

Based on the background described above, this study aimed to identify the presence of Soil-Transmitted Helminth eggs on the fingernails of roof tile craftsmen in Urek-Urek Village, Gondanglegi District. The findings of this study are expected to provide information regarding the level of STH contamination among roof tile craftsmen and serve as a basis for preventive measures and occupational health promotion programs to reduce the risk of helminth infection in this population.

METHODS

This study employed a descriptive analytic research design to identify the presence of Soil-Transmitted Helminth (STH) eggs on the fingernails of roof tile craftsmen in Urek-Urek Village, Gondanglegi District. The study population consisted of 35 roof tile craftsmen working in the village. A total of 29 fingernail samples from both hands and feet were collected from respondents selected using a purposive sampling technique. The inclusion criteria included roof tile craftsmen who were willing to participate as respondents, had intact fingernails, and allowed sample collection.

Examination of helminth eggs was performed using the 10% potassium hydroxide (KOH) sedimentation method. Nail samples were collected and processed through standardized laboratory procedures to identify the presence of Soil-Transmitted Helminth eggs microscopically. The variables observed in this study included the presence of helminth eggs, age, working duration, sex, and personal hygiene practices among respondents.

Data analysis was conducted descriptively using percentage analysis to determine the distribution of respondents with positive and negative findings of Soil-Transmitted Helminth eggs. The results were subsequently presented in the form of cross-tabulation to describe the

relationship between the presence of helminth eggs and respondent characteristics, including personal hygiene practices. Statistical data processing and tabulation were performed using Statistical Package for the Social Sciences (SPSS). This study received ethical approval from the Health Research Ethics Committee (KEPK) of Yayasan Ngudia Husada Madura, Universitas Noor Huda Mustofa (UNHM), with ethical clearance number 2726/KEPK/UNIV-NHM/EC/VII/2025.

RESULTS

A total of 29 fingernail samples from roof tile craftsmen in Urek-Urek Village, Gondanglegi District, were examined using the 10% KOH sedimentation method to identify the presence of Soil-Transmitted Helminth (STH) eggs. The examination results showed that 2 respondents (6.9%) tested positive for *Ascaris lumbricoides* eggs, while 27 respondents (93.1%) showed negative results for all examined STH species. The identified positive samples consisted of one fertile *Ascaris lumbricoides* egg and one infertile *Ascaris lumbricoides* egg. No eggs of *Ancylostoma duodenale*, *Necator americanus*, *Trichuris trichiura*, or *Strongyloides stercoralis* were detected.

Table 1. Examination Results of Soil-Transmitted Helminth Eggs on the Fingernails of Roof Tile Craftsmen

Result	Frequency (n)	Percentage (%)
Positive	2	6.9
Negative	27	93.1
Total	29	100

The microscopic examination identified fertile *Ascaris lumbricoides* eggs in respondent R16 and infertile *Ascaris lumbricoides* eggs in respondent R17. The fertile eggs were characterized by the presence of albuminoid, hyaline, and vitelline layers, whereas infertile eggs appeared more elongated with irregular internal structures.

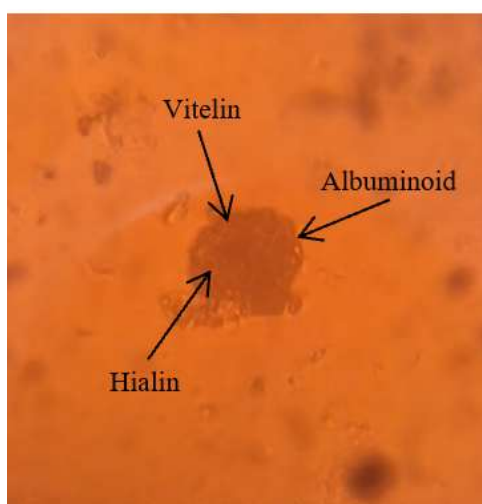


Figure 1. Fertile *Ascaris lumbricoides* Egg Identified in Respondent R16 (40× Magnification)

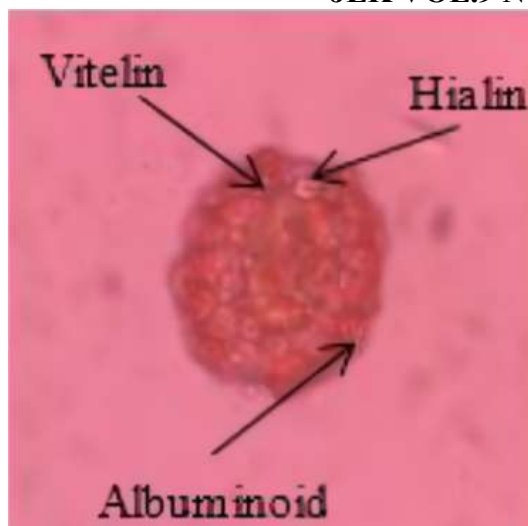


Figure 2. Reference Image of Fertile *Ascaris lumbricoides* Egg



Figure 3. Infertile *Ascaris lumbricoides* Egg Identified in Respondent R17 (40× Magnification)

The distribution of STH egg contamination based on respondent age is presented in Table 2. Positive findings were identified among respondents aged 56–65 years and above 65 years. No STH eggs were detected among respondents aged below 55 years.

Table 2. Cross-tabulation of Soil-Transmitted Helminth Egg Presence Based on Age Group

Age Group	Positive n (%)	Negative n (%)	Total n (%)
26–35 years	0 (0%)	4 (100%)	4 (100%)
36–45 years	0 (0%)	5 (100%)	5 (100%)
46–55 years	0 (0%)	6 (100%)	6 (100%)
56–65 years	1 (12.5%)	7 (87.5%)	8 (100%)
>65 years	1 (16.7%)	5 (83.3%)	6 (100%)
Total	2 (6.9%)	27 (93.1%)	29 (100%)

Based on Table 2, STH egg contamination was found in one respondent aged 56–65 years (12.5%) and one respondent aged above 65 years (16.7%). These findings suggest that older workers may have a higher risk of exposure to Soil-Transmitted Helminths. The distribution of STH egg contamination based on sex is shown in Table 3. Positive findings were identified in both male and female respondents.

Table 3. Cross-tabulation of Soil-Transmitted Helminth Egg Presence Based on Sex

Sex	Positive n (%)	Negative n (%)	Total n (%)
Male	1 (7.1%)	13 (92.9%)	14 (100%)
Female	1 (6.7%)	14 (93.3%)	15 (100%)
Total	2 (6.9%)	27 (93.1%)	29 (100%)

Table 3 demonstrates that one male respondent (7.1%) and one female respondent (6.7%) tested positive for STH eggs. The findings indicate that both sexes have relatively similar risks of STH contamination in this occupational setting. The relationship between working duration and the presence of STH eggs is presented in Table 4. Positive findings were identified among respondents with longer working duration.

Table 4. Cross-tabulation of Soil-Transmitted Helminth Egg Presence Based on Working Duration

Working Duration	Positive n (%)	Negative n (%)	Total n (%)
5–15 years	0 (0%)	2 (100%)	2 (100%)
16–26 years	0 (0%)	4 (100%)	4 (100%)
27–37 years	0 (0%)	11 (100%)	11 (100%)
38–48 years	1 (14.3%)	6 (85.7%)	7 (100%)
>48 years	1 (20%)	4 (80%)	5 (100%)
Total	2 (6.9%)	27 (93.1%)	29 (100%)

Based on Table 4, positive STH egg contamination was identified among respondents with working duration of 38–48 years and more than 48 years. These findings indicate that prolonged occupational exposure to soil may increase the risk of STH contamination among roof tile craftsmen. Personal hygiene practices were also analyzed to determine their relationship with the presence of STH eggs. The results are presented in Table 5.

Table 5. Cross-tabulation of Soil-Transmitted Helminth Egg Presence Based on Personal Hygiene Level

Personal Hygiene	Positive n (%)	Negative n (%)	Total n (%)
Good	0 (0%)	5 (100%)	5 (100%)
Fairly Good	2 (8.3%)	22 (91.7%)	24 (100%)
Poor	0 (0%)	0 (0%)	0 (0%)
Total	2 (6.9%)	27 (93.1%)	29 (100%)

Based on Table 5, all respondents who tested positive for STH eggs were categorized as having fairly good personal hygiene, accounting for 2 respondents (8.3%). No positive findings were identified among respondents with good personal hygiene. Observational findings revealed that most respondents categorized as having fairly good hygiene practices did not use footwear while working and washed their hands and feet using water only without soap. These findings suggest that inadequate personal hygiene practices and insufficient use of personal protective equipment may contribute to the risk of Soil-Transmitted Helminth contamination among roof tile craftsmen.

DISCUSSION

Soil-Transmitted Helminths (STHs) are intestinal nematodes that develop and survive in soil environments, where their eggs mature from non-infective into infective stages before infecting humans(6). Transmission commonly occurs through soil contaminated by human feces containing helminth eggs. Poor sanitation practices, such as open defecation, may increase soil

contamination and facilitate the spread of STH infections. Infective eggs or larvae may enter the human body through ingestion or skin penetration, particularly among individuals who frequently come into direct contact with contaminated soil(7).

The results of this study demonstrated that 2 out of 29 respondents (6.9%) tested positive for Soil-Transmitted Helminth eggs on their fingernails. The identified species were fertile *Ascaris lumbricoides* eggs in respondent R16 and infertile *Ascaris lumbricoides* eggs in respondent R17. No eggs of hookworm species (*Ancylostoma duodenale* and *Necator americanus*) or *Strongyloides stercoralis* were identified in the nail samples. These findings suggest that the clay soil used in roof tile production may provide favorable environmental conditions for the development of *Ascaris lumbricoides* eggs. Clay soil with high moisture content and temperatures ranging from 25–30°C has been reported to be an optimal medium for the maturation of *Ascaris lumbricoides* eggs into infective forms(8). Furthermore, the moisture-retaining properties of clay soil may protect helminth eggs from direct sunlight exposure, thereby prolonging egg survival and increasing the potential for transmission to humans.

The absence of *Trichuris trichiura* eggs in this study may be associated with the relatively low environmental prevalence and greater environmental sensitivity of this species. Previous environmental studies conducted in Selangor, Malaysia, reported that *Ascaris lumbricoides* eggs were detected in 90% of soil samples, whereas *Trichuris trichiura* eggs were identified in only 15% of samples (9). Similar findings were reported in Addis Ababa, Ethiopia, where *Ascaris lumbricoides* eggs were detected more frequently than *Trichuris trichiura* eggs in contaminated soil(10). Unlike *Ascaris lumbricoides*, *Trichuris trichiura* eggs require more specific environmental conditions, including humid and shaded environments, for survival and development. Exposure to direct sunlight and high temperatures may cause desiccation and death of *Trichuris* eggs, thereby reducing their survival in open clay soil environments commonly found in roof tile production areas (9). No hookworm eggs were identified in this study because the environmental characteristics of clay soil may not support the development of hookworm larvae. Hookworm species generally develop optimally in loose sandy soil mixed with organic matter and protected from direct sunlight(8).

Similarly, no *Strongyloides stercoralis* larvae or eggs were detected because the free-living stage of this parasite is relatively short. The rhabditiform larvae rapidly develop into infective filariform larvae within 2–3 days and require immediate host contact, reducing the likelihood of prolonged survival in environmental samples such as fingernails(11).

The distribution of STH contamination based on age demonstrated that positive findings were identified among respondents aged 56–65 years and above 65 years. However, age alone cannot be considered a determining factor for STH infection because all occupational groups exposed to contaminated soil may experience similar risks of contamination. Previous studies have indicated that STH infections may occur across all age groups, particularly among workers with frequent soil exposure(12). Older roof tile craftsmen may experience prolonged cumulative exposure to contaminated environments due to long-term occupational activities involving direct contact with clay soil.

Based on sex characteristics, one male respondent (7.1%) and one female respondent (6.7%) tested positive for STH eggs. These findings suggest that both male and female workers have relatively similar risks of exposure because they perform comparable work activities involving direct contact with clay soil during the roof tile production process. Previous studies among roof tile craftsmen and adult populations also reported no significant differences in intestinal parasitic infections between males and females, indicating that occupational exposure may play a more important role than biological sex in STH transmission(12).

Working duration was also associated with the presence of STH eggs. Positive findings were identified among respondents who had worked for 38–48 years and more than 48 years. These findings indicate that prolonged occupational exposure to contaminated soil may increase the likelihood of STH contamination among roof tile craftsmen. However, several previous studies reported inconsistent findings regarding the relationship between working duration and STH infection, suggesting that environmental sanitation and personal hygiene practices may also

contribute substantially to infection risk (13). Personal hygiene practices were identified as one of the most important factors influencing STH contamination in this study. Most respondents were categorized as having fairly good personal hygiene, although positive findings were still identified among this group. Respondents generally washed their hands and feet after work activities; however, most of them used water only without soap. Improper handwashing practices may allow helminth eggs to remain attached beneath fingernails and between fingers, thereby increasing the possibility of accidental ingestion during eating activities. Previous studies reported a significant association between proper handwashing with soap and reduced STH contamination among workers exposed to soil (14).

In addition, many respondents did not use personal protective equipment such as gloves and footwear during work activities because such equipment was considered uncomfortable and interfered with roof tile production. Continuous direct contact with contaminated soil without protective equipment may facilitate the attachment of helminth eggs to fingernails and allow infective larvae to penetrate the skin. Previous studies demonstrated that not wearing footwear and protective clothing significantly increased the risk of Soil-Transmitted Helminth infection among workers exposed to contaminated environments (15).

Another important finding of this study was that respondents with fairly good personal hygiene still tested positive for STH eggs. This condition may be associated with inadequate nail hygiene, incomplete handwashing practices, and failure to use gloves or boots during work activities. Long fingernails may facilitate the accumulation of dirt and parasite eggs, thereby increasing the risk of contamination. Previous studies reported that individuals with long fingernails had a significantly higher risk of helminth contamination compared to individuals with short and clean fingernails(15). These findings reinforce the importance of maintaining proper nail hygiene among workers exposed to soil.

Conversely, no STH eggs were identified among respondents categorized as having good personal hygiene. This finding supports previous studies demonstrating a significant relationship between good personal hygiene practices and reduced STH contamination among workers exposed to soil and environmental pollutants. Proper handwashing with soap, routine nail cleaning, and consistent use of personal protective equipment may substantially reduce the risk of Soil-Transmitted Helminth infection.

The novelty of this study lies in its focus on roof tile craftsmen as an occupational group with prolonged exposure to clay soil in a traditional work environment. Previous studies predominantly investigated STH contamination among school-aged children, farmers, or plantation workers, whereas studies involving roof tile craftsmen remain limited. This study demonstrates that fingernails may serve as an important transmission medium for Soil-Transmitted Helminths among informal workers exposed to clay soil. Furthermore, this study highlights that fairly good personal hygiene alone may not be sufficient to prevent contamination when workers do not use personal protective equipment or apply proper handwashing techniques with soap. These findings provide important scientific evidence regarding occupational risk factors and reinforce the need for workplace health promotion programs targeting informal workers in traditional industries.

Overall, the findings indicate that occupational exposure to contaminated soil, inadequate personal hygiene practices, and limited use of personal protective equipment contribute to the risk of Soil-Transmitted Helminth contamination among roof tile craftsmen. Therefore, continuous health education regarding proper handwashing practices, nail hygiene, and the consistent use of personal protective equipment such as gloves and footwear is strongly recommended to reduce the risk of STH infection in this occupational group.

CONCLUSION

This study concluded that Soil-Transmitted Helminth (STH) eggs were identified in 2 out of 29 respondents (6.9%) among roof tile craftsmen in Urek-Urek Village, Gondanglegi District, while 27 respondents (93.1%) showed negative results for STH egg contamination on their fingernails. The identified helminth species was *Ascaris lumbricoides* (6.9%), consisting of fertile

Ascaris lumbricoides eggs in respondent R16 and infertile *Ascaris lumbricoides* eggs in respondent R17. These findings indicate that occupational exposure to clay soil during the roof tile production process may contribute to the risk of Soil-Transmitted Helminth contamination among craftsmen. Based on personal hygiene assessment, most respondents demonstrated fairly good personal hygiene practices (82.8%), while 17.2% were categorized as having good personal hygiene. However, positive findings of STH eggs were still identified among respondents with fairly good hygiene practices, indicating that incomplete handwashing practices and inadequate use of personal protective equipment may still increase the risk of contamination.

This study highlights the importance of improving occupational hygiene practices among roof tile craftsmen, particularly through proper handwashing with soap, regular nail hygiene, and the consistent use of personal protective equipment such as gloves and footwear during work activities. Future studies are recommended to investigate the prevalence and intensity of helminth infections using fecal samples to obtain a more comprehensive understanding of Soil-Transmitted Helminth infections among roof tile craftsmen and other informal workers exposed to contaminated soil.

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