



Knowledge and Behavior as Risk Factors for Intestinal Worm Contamination on Raw Vegetables Food Traders in Pakusari District Jember Regency

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A B S T R A C T

Intestinal parasites are one of the leading public health problems worldwide, with an incidence of 24% worldwide and 45-65% in Indonesia. Intestinal parasites, especially intestinal worms, or soil-transmitted helminths (STH), significantly contribute to gastrointestinal diseases worldwide. Intestinal worm infections occur in rural and urban populations, especially in people who have the habit of eating with dirty hands, using unhygienic toilets, and consuming contaminated food, water, or soil. Fresh vegetables are a means that support parasitic intestinal infections, especially for traders who must be able to prevent intestinal worm contamination in fresh vegetables. Consumption of raw vegetables can be a source of intestinal worm infection, thereby increasing the prevalence of foodborne diseases. This type of research is analytic observational with a cross-sectional study design. Samples in the form of fresh vegetables were taken from fresh vegetable traders in Pakusari District, Jember Regency and then processed by the sedimentation method and then observed using a microscope to identify intestinal protozoa. Food safety knowledge was assessed using a questionnaire, and the behavior of food traders was assessed by researchers using observation sheets. The bivariate analysis showed that proper handwashing behavior was related to intestinal worms in fresh vegetables ($p < 0,05$). Other knowledge and behavior variables were unrelated to intestinal worms' presence. The intestinal worm species found is a type of Hookworm.

INTRODUCTION

Intestinal parasites are one of the leading public health problems worldwide, with an incidence of 24% worldwide and 45-65% in Indonesia (Nasution et al., 2019). Fresh vegetables are a means that support the occurrence of parasitic intestinal infections, especially for traders who must be able to prevent intestinal worm contamination in fresh vegetables supported by contamination as much as intestinal worms have contaminated 61.2% of fresh vegetables in 128 samples (Karuppiah, 2017).

Intestinal worms, especially the Soil Transmitted Helminths (STH) group, are highly infectious microbes that can cause disease, especially in developing countries. Roundworms (*Ascaris lumbricoides*), hookworms (*Necator americanus* and *Ancylostoma duodenale*), and whipworms (*Trichuris trichiura*) are worms that cause infections in the human intestine. Infections due to intestinal worms seriously impact health problems, especially in Indonesia. Intestinal worm contamination in fresh vegetables can occur due to traders' lack of food safety knowledge regarding intestinal worm contamination in fresh vegetables sold and traders' need for hygiene behavior in cleaning fresh vegetables, handling unhealthy food, and unclean food equipment (Alfiani & Ginandjar, 2018).

Research result (Alfiani and Ginandjar, 2018) 22 samples were examined, and there were 12 positive samples contaminated with parasites in fresh vegetable. Prior research (Wantini et al., 2019) found that there were 12 samples, and there were (58.3%) parasites in all samples tested on cabbage and (91.7%) on basil in this study. (Adrianto, 2018) there are four samples with a parasitic contamination level of (61.9%). Based on statistical data from Pakusari District, Jember Regency, the number of residents who work as the second largest trader in Jember Regency and the geographical location of Pakusari Subdistrict, which is the main road between Jember Regency and Banyuwangi Regency makes Pakusari Subdistrict widely traversed by vehicles and stop by to buy food containing fresh vegetable. The lack of research on food safety knowledge and clean and healthy hygiene behavior among traders in Pakusari District, Jember Regency, makes researchers want to discuss knowledge and behavior as risk factors for intestinal worm contamination in fresh vegetable in Pakusari District, Jember Regency.

METHOD

This research is an observational analytic study with a cross-sectional approach. The population in this study were food sellers who contained fresh vegetables in Pakusari District, Jember Regency. Sampling in this study used a simple random sampling technique. Calculation of the sample size in this study using the Dahlan formula obtained a sample size of 30 samples. In this study, a questionnaire sheet was used to interview the respondents' food safety knowledge, and an observation sheet was used to observe the individual behavior of the respondents. The data used in this study consists of the results of the inspection of fresh vegetable samples related to soil-transmitted helminth (STH) contamination in Pakusari District, Jember Regency. The results of STH contamination were obtained from laboratory examinations using the sedimentation method. Data analysis used IBM SPSS Statistics 25 with the univariate test, bivariate test with chi-square and multivariate test with logistic regression.

RESULT

STH contamination in fresh vegetable is enforced by examining vegetable using the sedimentation method. The distribution of vegetables contaminated by STH is 10% or three samples. STH species that contaminate vegetable sold are Hookworms. The results of the distribution of STH contamination are in table 1.

The food safety knowledge was obtained through questionnaire interviews. The interview included the use of gloves when cooking; the use of jewellery on the hands, such as rings or bracelets; the use of different cooking utensils; the presence of animals in the cooking area, such as flies or rats; placing unprocessed food in the kitchen refrigerator, and raw vegetables are more likely to transmit disease. Food handler who

suffers from diseases such as diarrhea, sore throat, syphilis and flu, healthy food vendors can also be carriers of the disease. The table of food safety knowledge factors is in table 2.

Factors of food safety knowledge in fresh vegetable traders with the most yes answers were the components of the presence of animals and the risk of food contamination through disease (n=29; 96.7%). The statement with the most no answers, namely the components of healthy food sellers, can also be carriers of disease 21 (70%), and those who answered yes were only nine respondents (30%).

Individual behavioral factors of research subjects were obtained through observations which included food sellers wearing clean clothes/aprons or head coverings, food sellers washing their hands properly every time they wanted to touch food, traders keeping their nails clean (not dirty and long nails), traders not using jewelry (rings)/bracelet), the food seller has no wounds or ulcers on his hands. The table of individual behavioral factors is in table 3.

Individual behavioral factors in fresh vegetable traders with the best behavior were in the food seller component; there were no wounds or ulcers on the hands (n=29; 96.7%). Traders mostly did the behavior that was not carried out, namely the clothing component of traders wearing clean clothes or head coverings as many as 25 (83.3%) and only 5 respondents (16.7%) did.

The Chi-Square test was used to Analyze the data related to the relationship between the risk factors of food safety knowledge of fresh vegetable sellers and the presence of STH in the fresh vegetable. The inspection of fresh vegetables is taken from fresh vegetables sold by traders. The results of the analysis showed that there was no relationship between knowledge of food safety and the presence of STH, which consisted of the use of gloves (p=0.626), the use of jewelry (p=1,000), the use of different cooking utensils (p=0.626), the presence of animals (p=0.753), food storage (p=0.474), the potential for disease transmission from vegetables (p=0.414), risk of food contamination through traders' disease (p=0.753), and disease transmission from healthy traders (p=0.894).

Table 1. Distribution of STH Contamination on fresh vegetables

STH type	Total (n)	Percentage (%)
Ascaris lumbricoides	0	0
hookworm	3	10
Trichuris trichiura	0	0
None	27	90

Table 2. Food Safety Knowledge Factors

Rated components	Assessment results (n)		Percentage (%)	
	Yes	Not	Yes	Not
Use gloves when cooking	28	2	93.3	6.7
The use of jewelry on the hands, such as rings or bracelets	20	10	66.7	33.3
Use of different cooking utensils	28	2	93.3	6.7
Presence of animals in the cooking area such as flies or mice	29	1	96.7	3.3
Putting unprocessed food in the refrigerator	26	4	86.7	13.3
Raw vegetables are more likely to transmit disease	25	5	83.3	16.7
A food handler who suffers from illnesses such as diarrhea, sore throat, syphilis and flu	29	1	96.7	3.3
Healthy food vendors can also be carriers of disease	9	21	30	70

Table 3. Individual Behavior Factors

Rated components	Assessment Results (n)		Percentage (%)	
	Yes	Not	Yes	Not
Food vendors wear clean clothes/aprons, or head coverings	14	16	46.7	53.3
Food vendors wash their hands properly every time they touch food	21	9	70.0	30.0
Traders keep nails clean (nails are not dirty and long)	23	7	76.7	23.3
Traders do not use jewelry (rings/bracelets)	20	10	66.7	33.3
The food seller has no wounds or ulcers on his hands	29	1	96.7	3.3

Table 4. Bivariate Test Results of Food Safety Knowledge with STH Contamination on Fresh Vegetables

Rated components	Negative STH contamination		Positive STH Contamination		Odds Ratio	p-value
	n	%	n	%		
	Use gloves when cooking					
Not	2	7.4	0	0	-	0.626
Yes	25	92.6	3	100		
Use jewelry such as rings or bracelets					1,000	1,000
Not	9	33.3	1	33.3		
Yes	18	66.7	2	66.7		
Use different cooking utensils					-	0.626
Not	2	7.4	0	0		
Yes	25	92.6	3	100		
Presence of animals such as flies or mice in the cooking area					-	0.753
Not	1	3.7	0	0		
Yes	26	96.3	3	100		
Putting unprocessed food in the refrigerator					-	0.474
Not	4	14.8	0	0		
Yes	23	85.2	3	100		
Raw vegetables are more likely to transmit disease					-	0.414
Not	5	18.5	0	0		
Yes	22	81.5	3	100		
A food handler who suffers from illnesses such as diarrhea, sore throat, syphilis, and flu					-	0.735
Not	1	3.7	0	0		
Yes	26	96.3	3	100		
Healthy food vendors can also be carriers of disease					1,188	0.894
Not	19	70.4	2	66.7		
Yes	8	29.6	1	33.3		

Table 5. Results of Bivariate Test of Individual Behavior with STH Contamination on Fresh Vegetables

Rated components	Negative STH contamination		Positive STH Contamination		Odds Ratio	p value
	n	%	n	%		
Food vendors wear clean clothes/aprons or head coverings						
Not	14	51.9	2	66.7	0.538	0.626
Yes	13	48.1	1	33.3		
Food vendors wash their hands properly every time they touch food						
Not	6	22.2	3	100	-	0.005
Yes	21	77.8	0	0		
Traders keep nails clean (nails are not dirty and long)						
Not	6	22.2	1	33.3	0.571	0.666
Yes	21	77.8	2	66.7		
Traders do not use jewelry (rings/bracelets)						
Not	9	33.3	1	33.3	1,000	1,000
Yes	18	66.7	2	66.7		
The food seller has no wounds or ulcers on his hands						
Not	1	3.7	0	0	-	0.735
Yes	26	96.3	3	100		

The Chi-Square test was used to analyze the relationship between risk factors for the behavior of fresh vegetables sellers and STH in the fresh vegetable. The inspection of fresh vegetables is taken from fresh vegetables sold by traders. The analysis showed a relationship between knowledge of food safety and the presence of STH on the handwashing behavior factor ($p = 0.005$). Details of the risk factors for the behavior of fresh vegetable sellers with STH contamination can be seen in table 5.

A multivariate test was performed on variables that met the requirements of the bivariate test ($p < 0.25$). This study shows that there is only one variable with a significance value of < 0.25 , so the data in this study cannot be tested with multivariate.

DISCUSSION

Factors of Food Safety Knowledge and Individual Behavior

The knowledge factor of using gloves when cooking can reduce the risk of food contamination in this study was dominated by respondents who agreed with the statement, namely 28 respondents (93.3%) and two respondents (6.7%). The percentage is the same as the research conducted by Irianti (2022), which is equal to (93.3%) who agree and (6.7%) who disagree. The understanding of fresh vegetable sellers regarding the use of gloves when processing food, of course, can prevent the transmission of STH from humans to vegetables and vice versa.

The knowledge factor about the use of jewellery on the hands can increase the risk of food contamination in this study; most of them agree with the 20 respondents (66.7%), and those who do not agree with as many as 10 respondents (33.3%). These results align with Sitepu's research (2015), with 62.5% agreeing we should not use jewellery such as rings when touching food. Vegetable sellers regarding the use of

jewellery when touching food can lead to cross-contamination between jewellery and food. The skin under jewellery is a good place for microbes to breed (Triandini, 2015).

The knowledge factor of respondents in using different cooking utensils in handling raw and cooked food can minimize the risk of food contamination. In this study, 28 respondents (93.3%) agree, and 2 respondents (6.7%) disagree. This study aligns with research conducted by Ncube (2020), in which as many as 81.2% of respondents agree to use different tools when handling food. Using the same utensils when handling food can contaminate raw food with cooked food and vice versa (Abdul-Mutalib et al., 2012).

The knowledge factor regarding the presence of animals in the cooking area can increase the risk of food contamination. In this study, 29 respondents (96.7%) agreed, and only 1 (3.3%) disagreed. This study is in line with the Ncube research, (2020) with the percentage of respondents who agree that animals can cause food contamination as much as 85.1%. Food contamination can be in the form of microbes, especially parasites that can come from dirty places that can be carried by animals such as flies, cockroaches, to rats (Restianida, 2018).

The knowledge factor about putting unprocessed food in the refrigerator can prevent food poisoning in this study. Most respondents agreed with 26 (86.7%) respondents, and 4 disagreed (13.3%). These results are slightly different from the research conducted by Khotimah (2015), with results with all respondents agreeing to all respondents (100%). The difference in results can be caused by the number of respondents being much less than in this study, and the respondents in this study were under the supervision of certain agencies.

The knowledge about raw vegetable is more potentially infectious than as many as 25 respondents answered cooked vegetables agreed (83.3%), and 5 respondents disagreed (16.7%). This study result is more than the research conducted by Akabanda (2017), in which only 40.9% agree. Vegetables served cooked will eliminate the benefits of these vegetables than served raw. Raw and fresh vegetables can potentially transmit the disease; therefore, raw vegetables must be washed using running water to avoid the transmission (Adrianto, 2017).

The knowledge factor about a food handler who suffers from diseases such as diarrhea, sore throat, syphilis and flu poses a risk of food contamination in this study, almost all respondents agreed with a total of 29 respondents (96.7%), and only one disagreed (3,3%). This study is the same as the research conducted by Ncube (2020), with 99% of respondents agreeing. Pathogens in traders who suffer from infectious diseases can contaminate the food these traders are processing. These pathogens can transfer to food consumers from processing traders with infectious diseases (Okarini, 2017).

The sellers' knowledge that healthy food can be a carrier of diseases was disagreed with by most respondents (70%), and only 9 respondents agreed (30%). This research is in line with research conducted

by Ncube (2020), with the percentage of respondents who agree as much as 78.2%. Food handlers who carry pathogens can contaminate the products or foodstuffs they process and endanger consumers' health. The habit of smoking, whistling, coughing, sneezing, and not wearing PPE when touching food can contaminate food even though the food handler is in good health (Tappes et al., 2019).

The behavioural factors of food sellers who wear clean clothes/aprons or head coverings in this study were 14 respondents (46.7%), and more respondents who did not do so were 16 respondents (53.3%). The results of this study are less than the research conducted by Suryani (2019), with as many as 60% of respondents wearing clean clothes or head coverings. Food handlers are recommended to use clean clothes/aprons when processing food so that no remnants of dirt attached to the clothes do not transfer to the processed food and the use of head coverings for traders, can avoid the risk of dirt on the head hair being transferred to the processed food (Nurhayati, 2020).

The results of the observation of the behavior of food sellers who wash their hands properly each time they want to touch food in this study are as many as 21 respondents washing their hands properly (70%) and respondents who still have not washed their hands properly and correctly, as many as 9 respondents (30%). The behavior of the respondents in this study was more than the research conducted by Mulyani (2020); as many as 41.9% of the respondents had clean and healthy handwashing behavior. Proper handwashing behavior is significant for traders before and after processing food. Because proper handwashing can eliminate microorganisms on hands, prevent cross-infection, and maintain sterile conditions (Kurniawati et al., 2022).

The behavior of traders who keep their nails clean when processing food in this study, 23 respondents (76%), and those who have not kept their nails clean are 7 respondents (23.3%). This study aligns with research conducted by Augustin (2015), which is as much as 80% of traders' behavior in maintaining nail hygiene. Traders with long nails can make it easier for microbes to stick to and increase the risk of transferring these microbes to processed foods, so keeping nails clean by trimming them regularly can prevent and reduce the risk of contamination of food (Retno Hestingsih et al., 2019).

The behavior of traders who do not use jewelry in this study 20 respondents (66.7%) and traders who use jewelry are 10 respondents (33.3%). Fewer respondents in this study do not use jewelry than in research conducted by Maywat (2019); as many as 83.1% of respondents do not use jewelry. Food contamination can be caused by traders who use jewelry such as rings or bracelets because jewelry can become a breeding ground for microbes through rings and bracelets. The importance of not wearing rings or bracelets, can reduce the risk of cross-contamination (Ardhayanti et al., 2018).

The results of observations on food vendors who did not have wounds or ulcers on their hands showed that 29 respondents did not have sores or ulcers on their hands (96.7%) and only 1 respondent had sores or ulcers on their hands (3.3%). This research is in line with the research conducted by Zakuan (2019), with

100% percentage results in 27 respondents. The cleanliness of traders, especially those with wounds such as boils on their hands, can contaminate the food processed by these traders. Wounds are a source of pathogens and a source in the chain of pathogen transfer into food (Rambe, 2021).

STH Contamination in Vegetables

Based on the examination conducted on 30 samples of fresh vegetable sold by fresh vegetables traders in Pakusari District, Jember Regency, positive results were obtained in 3 samples and negative in 27 samples, with a positive percentage of 10% and a negative sample of 90%. The results of STH findings in this study were relatively less compared to research conducted by Lobo (2019) which showed 26.7% of the fresh vegetable samples studied were contaminated with STH.

Natural factors and food sanitation hygiene can affect the presence of STH in fresh vegetables. Natural factors include soil, climate, and humidity (Safitri et al., 2019). The development of STH through soil media directly makes STH easily contaminate cabbage and basil which are planted directly in the soil. STH can enter between the leaves of cabbage vegetables and also stick to the basil leaves (Lobo, 2019). Climate factors and high humidity are suitable for developing STH eggs and larvae into infective forms (Nugraheni et al., 2018).

Sanitary hygiene also affects the presence of STH in food. The selection of good food ingredients, such as choosing clean and fresh vegetables, makes the possibility of finding STH in vegetables relatively low. Maintaining food hygiene and reducing the risk of food contamination can be done by suitable food processing methods, such as removing damaged parts of vegetables and washing fresh vegetables using running water before serving. Worm eggs on the ground or dust will reach the food if blown away by the wind. Serving fresh vegetables to fresh vegetable traders in an open place and next to the road can be exposed them to dust (Safitri et al., 2019). The finding of STH in this study was relatively less because most traders store food in closed containers/containers making the risk of food being exposed to dust less. Another study conducted by Mutianingsih (2016) and Safitri (2019) regarding STH identification obtained negative results; namely, no STH contamination was found in fresh vegetables. These results are also inconsistent when compared with this study. The absence of STH contamination in fresh vegetables could be due to the better sanitation of the research respondents and the smaller number of samples than in this study.

All STH species found in fresh vegetables in this study were hookworms. This research is in line with the research conducted by Amin (2021) conducted in Medan City, with all positive results of hookworm-type STH or hookworm.

The Relationship of Food Safety Knowledge and Individual Behavior with STH Contamination in Fresh Vegetables

This study found that the knowledge factor of using gloves when cooking showed that there was no significant relationship ($p=0.626$) to the presence of STH. Most respondents agreed that using gloves when cooking can reduce the risk of food contamination. Only 2 respondents disagreed, and 28 other respondents agreed. This study differs from Ulfa (2016) research which has significant results regarding the relationship between the use of PPE with gloves on and the incidence of worm disease. The factor absence of a relationship between knowledge of the use of gloves and the presence of STH in this study, which could be caused by respondents who did not know about the use of gloves, had a negative result of STH on the observation of fresh vegetable samples. This result can be caused during observation; respondents wash their hands properly before touching food. This study aligns with research conducted by Yamin (2021) regarding the relationship between handwashing behavior and STH contamination, which showed significant results.

The study's results regarding the knowledge factor about the use of jewelry on the hands with an increased risk of food contamination showed no significant relationship ($p=1,000$) to the presence of STH. Most respondents know that using jewelry on the hands can increase the risk of food contamination. Twenty respondents agree, and ten other respondents do not agree. This study is in line with research conducted by Sihombing (2017) with insignificant results ($p = 0.331$) regarding the relationship between the waiter's knowledge about hygiene, which contains the use of jewelry and the presence of STH in fresh vegetables. There is no significant relationship between knowledge of the use of jewelry on the hands and the presence of STH in this study,

The study's results regarding the knowledge factor of using different cooking utensils in handling raw food and cooked food can minimize the risk of food contamination, showing no significant relationship ($p = 0.626$) to the presence of STH. Most of the respondents knew about the use of different cooking utensils in handling raw and cooked food. Only 2 respondents did not know, and the other 28 respondents did. This study must align with Alfiani's research (2018) with significant results regarding the cleanliness of cooking utensils with STH contamination. Factors that cause no relationship between this study and their differences in results; can be because, in this study, as many as 92.6% of respondents had better knowledge of using cooking utensils.

The study's results regarding the knowledge factor about the presence of animals in the cooking area can increase the risk of food contamination in this study, which showed no significant relationship ($p = 0.753$) to the presence of STH. Twenty-nine respondents agree, and only one respondent does not agree. This study is in line with Yasmin (2011) with insignificant results ($p = 0.203$) on the incidence of STH infection with the habit of buying food served openly and then infested with flies. The absence of a significant relationship between knowledge about the presence of animals in the cooking area and the presence of STH in this study could be caused by 1 respondent who did not agree to have a negative result of STH

contamination in fresh vegetable samples. Covering food can reduce exposure to food in the form of dust, flies, or cockroaches that act as STH mechanical vectors. These eggs can then enter the human body through food or drink contaminated with worm eggs through the intermediary of flies or dust from soil contaminated with worm eggs (Pratama and Sudarmaja, 2018).

The study's results regarding the knowledge factor regarding placing unprocessed food in the refrigerator to prevent food poisoning showed no significant relationship ($p = 0.474$) to the presence of STH. Most of the respondents agreed about the knowledge that putting unprocessed food in the refrigerator can prevent food poisoning. 4 respondents disagree and 26 other respondents agree. This study is not in line with research conducted by Aristin (2014) with the results that there is a significant relationship ($p = 0.000$) in food storage with the presence of microbes. The absence of a relationship and differences between knowledge of putting raw materials in the refrigerator and the presence of STH in this study can be caused by four respondents who disagree with having a negative STH result on the observation of fresh vegetables samples. Traders already know that storing foodstuffs such as vegetables in a state of 10-15 degrees Celsius to avoid microbial contamination. In contrast, meat and fish types of food are stored in closed, frozen storage (Jiastuti, 2018).

The study's results regarding the knowledge factor about raw vegetables being more potentially infectious than cooked vegetables in this study showed no significant relationship ($p = 0.414$) to the presence of STH. Twenty-five respondents agree, and five other respondents do not agree. The absence of a significant relationship between knowledge about raw vegetables being more potentially infectious than cooked vegetables and the presence of STH in this study could be caused by five respondents who disagreed and did not have a positive result of STH contamination in fresh vegetable samples. Raw vegetables are more likely to spread food-borne diseases than vegetables processed at high temperatures (Adrianto, 2017).

The results of the study regarding the knowledge factor about a food handler suffering from diseases such as diarrhea, sore throat, syphilis and flu that can pose a risk of food contamination showed that there was no significant relationship ($p=0.735$) to the presence of STH. Most respondents know that a food handler who suffers from an illness can pose a risk of food contamination. Twenty-nine respondents agree, and only one respondent does not agree. The absence of a significant relationship in this study could be due to the absence of STH in the vegetable samples of respondents who disagreed. Food handlers who suffer from diseases that do not maintain personal hygiene, such as not washing their hands or wearing masks, can transmit the disease through faecal-oral (Jiastuti, 2018). Food contamination can occur due to pathogens in traders, which can be transferred to consumers who consume food (Okarini, 2017).

The research results on the knowledge factor about healthy food vendors can also be carriers of diseases caused by food, showing no significant relationship ($p = 0.894$) to the presence of STH. Most respondents disagreed that the seller of healthy food could also be a carrier of disease caused by food. There are only

nine respondents agree, and 21 other respondents do not agree. The absence of a significant relationship in this study could be caused by eight respondents who knew about disease carriers from healthy food vendors; only 1 was positive for STH in the observed fresh vegetable samples. Food handlers who carry pathogens can contaminate the products or foodstuffs they process. Unhygienic habits such as not washing hands (Tappes et al., 2019).

The study results of the relationship between the behavior of food sellers wearing clean clothes/aprons or head coverings on the presence of STH in the fresh vegetable sample showed no significant relationship ($p=0.626$). Fourteen respondents have the behavior of using clean clothes or head coverings, and 16 respondents do not have this behavior. This study aligns with research conducted by Ardhayanti (2018), which discusses the relationship between the use of PPE and STH contamination in food traders with insignificant results ($p = 0.464$). Factors that cause no significant relationship can be caused by respondents who do not use aprons or head coverings and continue to use other PPE such as masks and gloves. Although the use of masks by respondents when touching food can be caused by the government's obligation to use masks anywhere during the COVID-19 pandemic, this is in line with the completeness of PPE that must be used for food handlers. Based on Suryansyah's research (2018), the completeness of PPE food handlers must use is headgear, masks, aprons, gloves, and safety shoes to prevent microbial cross-contamination in food and the safety of traders when working as food traders.

The research results on the behavioral factor of washing hands properly every time touching food to STH contamination show a significant relationship ($p = 0.005$). A total of 21 respondents did it, and nine others did not. These results align with research conducted by Yamin (2021) with significant results on the relationship between proper hand washing and STH contamination. Hand washing behavior affects STH contamination can be caused by 21 traders who apply good hand washing behavior, namely using running water and soap. There is no STH contamination in the samples of fresh vegetables examined and from 9 other respondents who did not apply handwashing behavior properly. Excellent and correct, 3 of them had positive results of STH contamination in the vegetables examined. This result can be a means of transmitting contamination of STH worm eggs from hands that may be contaminated with STH to fresh vegetables. Research conducted by Anita (2013) also states that the habit of washing hands using running water and soap has an essential role in preventing worm infections, by washing hands using water and soap is more effective in removing dirt and STH worm eggs that stick to both hands.

The results of the study regarding the behavior of traders who kept their nails clean with the presence of STH in fresh vegetables did not have a significant relationship ($p = 0.666$). Twenty-three respondents keep their nails clean, and seven respondents still do not keep their nails clean. This study is in line with Alfiani (2018) research with the results that there is no significant relationship ($p = 0.195$) between the behavior of food traders who maintain nail hygiene and the presence of STH in fresh vegetables. Most of the

respondents in this study maintained good nail hygiene by 77.8%, which could be an insignificant relationship factor to STH contamination in fresh vegetables. Food handlers have a massive role in processing food and preventing food contamination by microbes (Pasanda, 2016).

The study's results on the behavioral factors of traders who did not use jewelry on their hands, there was no significant relationship ($p=1,000$) to STH contamination in fresh vegetables. Twenty respondents do not use jewelry on their hands, and ten respondents use it. Research conducted by Fitria (2018), which contains the use of jewelry on the hands of food handlers, shows that knowledge of food hygiene and poor food hygiene behavior can increase the risk of disease transmission from food. The insignificant results in this study can be caused by ten respondents using jewelry while maintaining good hygiene behavior such as washing hands (Anita et al., 2013).

The study's results on the behavior of traders who did not have wounds or ulcers on their hands, there was no significant relationship with the presence of STH in the sample of fresh vegetables ($p = 0.735$). Twenty-nine respondents do not have injuries, and only 1 respondent has wounds on his hands. These results are in line with research conducted by Efelieni (2022) with results in this study that there was no significant relationship between personal hygiene and the presence of STH in vegetables containing traders treating or closing wounds on their hands. The insignificant result in this study can be caused by respondents who have wounds on their hands and cover the wound using gloves. Wounds are a source of pathogens and a source in the chain of pathogen transfer into food (Rambe, 2021). The presence of wounds on the hands of food handlers can increase the risk of food contamination. Food handlers who have wounds on their hands must treat and cover the wounds to prevent cross-contamination.

CONCLUSION

The conclusion of this study based on the results and discussion related to factors of food safety knowledge and behavior of fresh vegetable traders with the presence of STH on fresh vegetable in Pakusari District, Jember Regency, namely the characteristics of fresh vegetables traders in Pakusari District, Jember Regency in this study dominated by women, aged 46-55 years, selling 6-10 years old, and most of them have higher education (SMA/equivalent), the distribution of STH species in fresh vegetables sold by traders in Pakusari District, Jember Regency, namely Hookworm, all factors of knowledge of food safety of fresh vegetables traders are not related to the presence STH, a behavioral risk factor associated with the presence of STH, is found in the behavioral factor of washing hands before touching food.

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