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Factors Influencing Food Handlers' Knowledge and Hygiene Behavior at Street Food Vendors in East Surabaya: A Cross-sectional Study

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Abstract

Introduction: Street food vendors play a significant role in providing ready-to-eat food in urban areas, including East Surabaya, which has hundreds of street food outlets. However, issues related to hygiene and sanitation practices among food vendors remain a significant challenge. This study aimed to examine the factors influencing the knowledge and hygiene practices of food handlers among street vendors in East Surabaya.

Methods: This observational study used a cross-sectional approach and included 86 food handlers. Samples were selected using a purposive sampling technique with predetermined inclusion (location, age, willingness, and work period) and exclusion criteria (not active, health condition). Data were collected using a structured questionnaires. The independent variables were age, gender, and education, and the dependent variables were knowledge and behavior. Statistical analysis was performed using the chi-square test, and the Spearman test was used for ordinal data analysis.

Results: The results showed that 68.6% of respondents exhibited inadequate hygiene behavior, a proportion that was particularly prominent among those aged ≤ 30 years (77.8%), males (83.3%), and high school graduates (79.3%). Respondents' knowledge varied by age, gender, and education. Strong knowledge was more prevalent among female respondents and those with higher levels of education. Significant relationships were identified between sex and education level with knowledge ($p = 0.000$ and $p = 0.005$), as well as between sex and hygiene behavior ($p = 0.002$).

Conclusion: Female gender was the determinant for better knowledge and hygiene behavior, while higher education was the determinant of knowledge of food handlers. This indicates the need for more targeted educational interventions to improve hygiene practices among informal food handlers.

Keywords: Hygiene, Sanitation, Knowledge, Behavior, Street vendors

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Introduction

Food hygiene and sanitation in food processing are crucial factors in ensuring the safety of food consumed by the public. For consumers of street food or food sold by street food vendors, the risk of exposure to biological (such as bacteria, viruses, and parasites), chemical, and physical contaminants is very high if the food is not processed, stored, and served hygienically. Food safety refers to the conditions and efforts required to prevent food from causing disturbances, harm, or danger to human health while ensuring that it does not conflict with religion, beliefs, or cultural values, making it safe for consumption. [1]

At the national level, food safety remains a significant public health concern in Indonesia. Between January 1 and October 16, 2023, 4,792 cases of food poisoning were reported nationwide. East Java ranked fourth in food poisoning cases, accounting for 6.2% of total cases, which were distributed across seven outbreaks. These data indicate that foodborne illnesses continue to pose a substantial risk, particularly in provinces with high population densities and active food trade. Further analysis of food poisoning outbreaks based on food handling locations showed that mobile food vendors and catering services accounted for the second-highest proportion of outbreaks (15%). This was followed by street food vendors (6%), packaged food (5%), restaurants (4%), and bakeries (1%). [2] The prominence of outbreaks associated with mobile and street food vendors highlights the critical role of hygiene and sanitation practices in the informal food sector.

These national and provincial trends are particularly relevant to urban areas such as Surabaya, including East Surabaya, where street food vendors are widespread and play an important role in meeting daily food needs of the population. High population mobility, dense residential areas, and the extensive presence of informal food vendors may further increase the risk of food contamination if adequate food hygiene and sanitation practices are not consistently implemented. Therefore, understanding food safety conditions at the local level is essential to reflect how broader national and provincial issues manifest in the East Surabaya.

Ready-to-eat processed foods are foods and/or beverages that have already been prepared and are ready to be directly served either on-site or off-site, such as those provided by catering services, restaurants, hotels, bakeries, street vendors, mobile food trucks, and eateries. [3] In urban areas such as Surabaya, street vendors are widely found providing fast, affordable, and easily accessible ready-to-eat food. However, many of these vendors fail to apply proper food hygiene and sanitation practices, increasing the risk of foodborne diseases caused by bacterial contamination. For example, an observational study of street food vendors on Jalan Arif Rahman Hakim in Surabaya found that a high proportion of vendors did not fully meet sanitation requirements, and bacterial contamination (such as *Salmonella* in fresh vegetables) was detected, with several consumers reporting health complaints associated with the consumption of these foods. This study concluded that hygiene and sanitation practices among the vendors were suboptimal and potentially hazardous to consumer health. [4]

Studies have shown that most street food vendors do not fully implement proper hygiene and sanitation practices. This situation increases the risk of cross-contamination, pathogenic microorganism growth, and foodborne diseases such as hepatitis. Research on the hygiene behavior of street food vendors in Surabaya identified significant associations between practices such as handwashing, glove use, access to clean water, and the risk of hepatitis, underscoring that inadequate hygiene behavior correlates with higher susceptibility to foodborne infections. [5] The low level of knowledge among street food vendors regarding hygiene and sanitation practices is one of the main contributing factors. A 2023 study on street food vendors in Tapos District, Depok City, revealed that knowledge and attitudes about hygiene and sanitation were significantly associated with personal hygiene behaviors.[6] Similarly, a 2024 study in the Mero Community Health Center working area also found a significant

relationship between knowledge and attitudes and the application of hygiene and sanitation practices among street food vendors. [7] A meta-analysis of 23 studies with 7,153 food handlers showed that only about half of the food handlers practiced good food hygiene (50.5%). The results varied widely among the studies. Good hygiene practices were more common among food handlers with formal education, adequate food safety knowledge, food hygiene training, and positive attitudes toward food safety. Regular medical checkups were strongly associated with better hygiene practices. These findings indicate that education, training, knowledge, attitudes, and health monitoring are key factors influencing food hygiene behaviors among food handlers. [8] This supports the KAP (knowledge, attitude, and practice) theory. The Knowledge-Attitude-Practice (KAP) model is a widely used theoretical framework in public health and behavioral research to understand how people's knowledge, attitudes, and practices are related. The model proposes that an individual's knowledge of a topic influences their attitudes and beliefs, which in turn shape their behavior or practices. [9]

East Surabaya, as an urban area with high economic growth and population mobility, has a significant presence in street food trading activities. Therefore, it is necessary to identify the factors influencing the level of knowledge and food handling behavior of street food vendors as a basis for targeted interventions to improve food safety and protect consumer health. Several previous studies have demonstrated a relationship between knowledge and hygiene behavior, but no research has been conducted in East Surabaya. Specific data on the determinants of hygiene behavior, such as demographic factors, knowledge, and behavior, remain unclear. Specific factors to be analyzed include gender, age, and education. The main problem underlying this research is that hygiene behavior among food handlers is still below standard, while the causal factors in East Surabaya have not been clearly identified yet. Therefore, this study aimed to analyze the determinants influencing food handlers' hygiene behavior in the area. The results of this study can be used to develop effective policies and educational programs in the field of food safety, particularly for street food vendors. The practical benefits of this research are also more specific, namely, helping to develop appropriate interventions such as routine training, certification of food handlers, and routine supervision. In addition, this research will form the basis for the creation of a pocket book containing personal hygiene information and educational posters displayed in the vendor area to remind them of proper hygiene.

Methods

Type of research

This cross-sectional study included food handlers from street food vendors in East Surabaya. Street food vendors are people or small companies that cook and serve food and drinks on the streets or in public areas, frequently from a cart, stall, or mobile unit.

Participants

The study population was conceptually defined as all street food vendors in East Surabaya. The sample consisted of 86 food handlers who met the inclusion criteria and were actively operating as street food vendors within the selected areas of East Surabaya at the time of data collection. The exact total population of street food vendors in East Surabaya could not be determined because of the absence of a formal and comprehensive population registry. Consequently, the overall population frame was not explicitly defined. Purposive sampling was employed to select respondents who met the inclusion criteria and were actively operating as street food vendors within the designated study areas, thereby overcoming this limitation of the study. This sampling approach was considered appropriate to ensure that the study captured relevant variations in food handlers' knowledge and hygiene behavior among street food vendors in the region. The inclusion criteria were as follows: (1) street vendors selling ready-to-eat food within East Surabaya; (2) aged 18 years or older; (3) operating their business for at

least six months; and (4) willing to provide written informed consent. The exclusion criteria were as follows: (1) vendors who were not actively operating during the data collection period; (2) those who were ill or had health conditions that could potentially influence the research results (e.g., visible skin infections or communicable diseases); and (3) those who declined to participate in the research process.

Data collection

Data were collected using a structured questionnaire divided into three main sections. The first section focused on the sociodemographic characteristics of the respondents, including age, gender, and educational background. The second section assessed food safety knowledge using a series of closed-ended questions. The third section evaluated hygiene behaviors related to food handling, such as hand hygiene, food storage practices, and the cleanliness of equipment and working surfaces.

The questionnaire used in this study was developed independently based on the conceptual framework of food safety knowledge and hygiene behavior of street food vendors. The final instrument consisted of 20 items measuring knowledge and 6 items assessing the behavior. To ensure measurement quality, the instrument underwent validity and reliability testing before data collection. The criteria for assessing food handlers' hygiene and sanitation were determined based on the percentage of compliance with all assessment components. Behavioral data were obtained through direct observations. The assessment components included the health condition of food handlers, food processing practices, the use of personal protective equipment, work behavior, and personal hygiene during food handling, as well as food control and monitoring measures (expiration date and packaging). Food handlers were considered to meet the requirements if they obtained a score of more than 70% of the total indicators assessed.

Data analysis

SPSS version 25.0 was used to process all data gathered. The respondents'sociodemographic characteristics were presented using descriptive statistics. The chi-square test for nominal variables and Spearman's rank correlation test for ordinal variables were used in the statistical analysis. A multivariate logistic regression model was employed in addition to bivariate analysis to identify independent factors linked to respondents' hygiene practices and to account for any confounding variables. The multivariate model contained variables with a p-value of less than 0.05 in the bivariate analysis.

Between May and July 2024, data were gathered from several East Surabaya districts. All prospective respondents were properly informed about the study's objectives, the procedures involved, and the confidentiality of their answers prior to data collection. Participation in the study was entirely voluntary. Prior to recruitment, each participant provided verbal and written informed consent in compliance with ethical research guidelines. Additionally, the University of Jember's Health Research Ethics Committee approved this study under approval number 3607/UN25.8/KEPK/DL/2025, guaranteeing that all practices adhered to ethical guidelines for research involving human subjects.

Results

Table 1 shows that most street food handlers in East Surabaya had a moderate level of knowledge, with 39 respondents (45.3%). This was followed by those with a good level of knowledge, totaling 27 respondents (31.4%). Only a small proportion had a low level of knowledge, with 15 respondents (17.4%) and a very good level of knowledge, with five respondents (5.8%).

In the behavior category, most street food handlers in East Surabaya demonstrated non-compliant hygiene practices, with 59 respondents (68.6%) demonstrating non-compliance. Meanwhile, those categorized as compliant comprised 27 respondents (31.4%). The study indicated that knowledge and safe food handling behaviors are generally poor among the broader public. This raises questions about whether those at high risk

of contracting a foodborne illness understand and follow safe food handling procedures. [10] In terms of gender, 49 (57%) of East Surabaya's street food handlers were men, while 37 (43%) were women. A study by Girma et al. (2025) revealed that gender, age, marital status, education, monthly income, and availability to handwashing facilities were linked with food handling behaviors.[11]

In terms of education, most street food handlers in East Surabaya had completed senior high school, with 53 respondents (61.6%). This was followed by those who had completed junior high school (n = 18, 20.9%). A smaller proportion had completed higher education/undergraduate, with 9 respondents (10.5%), and primary school, with 6 respondents (7%). In this context, education refers to formal education related to food processing and hygiene. A study conducted by Labović et al. (2023) found statistically significant differences (<0.05) between participants who completed schooling in food processing and those who did not, particularly in relation to handwashing practices. [12]

According to the findings in Table 2, street food handlers in East Surabaya with a moderate level of knowledge were more common among those under 30 (50%), while those with a strong level of knowledge were more common among those over 30 (35.7%). This suggests that among East Surabaya street food handlers, there is a correlation between age and awareness of food hygiene. The majority of street food vendors had poor levels of education and frequently lacked sufficient food safety knowledge and abilities, according to a research by Nkosi & Tabit (2021). The study also showed that these vendors tended not to observe food safety protocols during food handling and preparation, which could lead to food contamination. Poor cleanliness, incorrect food temperatures, and failure to follow adequate food preparation procedures are some of the variables linked to such infections. To successfully execute food safety measures at street food vending sites, it is essential to have the necessary infrastructure and equipment, in addition to sufficient food safety knowledge and abilities. [13]

In terms of educational background, street food handlers in East Surabaya with good knowledge were mostly those with tertiary education (55.6%). Meanwhile, handlers with only primary school education (83.3 %) had moderate knowledge. Correlation test results indicated a significant relationship between gender and educational level with food handlers' knowledge. However, age was not associated with food handling behaviors. This suggests that the level of education is related to food hygiene and sanitation knowledge among street food handlers in East Surabaya.

In terms of gender, street food handlers in East Surabaya with very good and good knowledge were more common among female handlers (13.5% and 45.9%, respectively) than among male handlers. In contrast, male handlers were more represented in the moderate knowledge category (51.1%). This indicates a relationship between gender and food hygiene and sanitation knowledge among street food handlers in East Surabaya. A scoping review conducted by Wallace et al. (2022) found that food safety behavior did not differ according to vendor age, gender, type of product sold, or geographic location.[14] The current study presents different findings, highlighting variations in knowledge based on vendor gender. This may be linked to gender-related interests that encourage individuals to acquire new information. In this study, women had better overall knowledge. This could be because women are generally more interested in healthy food information. These findings are supported by research on the influence of gender on nutritional knowledge and external eating styles, which reported that women tend to have better knowledge and external eating behaviors, thereby enabling them to make healthier choices when selecting and handling food. [15]

Based on the analysis results, the magnitude of the effect was shown by the value of the prevalence ratio/opportunity ratio (PR/OR), which indicated that female respondents had a higher probability of implementing good hygiene behavior than

male respondents. This study is consistent with other studies. Tohonon et al. (2025) found that gender did not significantly impact food safety knowledge, except among processors. Among the processors, men tended to have lower levels of knowledge than women. This may be explained by differing sociocultural roles, with women often being more involved in food processing and preparation activities. No significant differences were observed between men and women among producers, wholesalers, retailers, and consumers. This suggests that sex is not a primary determinant of food safety knowledge. [16]

Gender is shaped and influenced by crucial environmental factors, namely cultural factors. Interaction with others, performance, and cultural factors can strengthen a person's commitment to goals, improve academic performance, and encourage perseverance. [17] By exploring gender differences, leaders can gain a deeper understanding of how biological and social factors influence individual behavior and decision-making processes. [18] Research finds there are gender differences in health behavioral beliefs and practices. [19] Gender is a social and structural variable that spans a wide range of domains, each of which affects health: gender identity and expression, gender roles and norms, gender-based power relations, and gender equality and justice. Thus, sex has a broad impact on health. Gender is related to workload and the division of labor between males and females. [20]

The results in Table 3 show that street food handlers in East Surabaya who demonstrated non-compliant hygiene behavior were more common among those aged ≤30 years (77.8%). This indicates a relationship between age and the discipline or application of hygiene practices by food handlers. This is in line with the results of studies on people in their 20s who generally scored lower than adults in their 40s and older regarding knowledge, food storage, checking for the presence of mold, prevention of food poisoning, and checking expiration dates. There are several opinions on the relationship between knowledge and age. Several other studies have stated that younger age groups have better safety knowledge and practices than older adults. This can happen due to differences in study design and research objectives. In addition, younger individuals tend to prefer foods that are prepared quickly and ignore food safety regulations. [21] Good food safety practices in young age groups can occur due to increased food handling education among young people. However, age may not be related to food safety knowledge, as many other factors may be involved. [22] Age can be inversely related to intellectual curiosity, as we age, future time becomes more limited, curiosity becomes less appreciated; Therefore, curiosity is negatively associated with increasing age. [23] This shows that there are differences in the level of food safety knowledge, emphasizing the need for education in young age groups in order to improve food safety behaviors and adherence to hygiene practices.

Discussion

In terms of educational background, street food handlers in East Surabaya with non-compliant hygiene behavior were more prevalent among those with senior high school education (79.3%). Meanwhile, compliant hygiene behavior was observed among those with primary and junior high school education (50%). Nevertheless, the highest proportion was still dominated by those with higher education levels. This suggests that education level may be a contributing factor for street food handlers in East Surabaya to meet hygiene requirements. According to Ariga (2022), education level has a positive relationship with healthy living behaviors; the higher the education, the better the healthy lifestyle, including practices in managing consumed food. [24]

Education plays a big role in influencing a person's health behavior. Education affects cognitive abilities. Cognitive abilities can lead to healthier behaviors. Cognitive abilities can be how a person processes information. Higher-educated people will have a lower risk of reluctance than less educated people. Basically, everyone wants to improve health behavior, but implementation is often difficult. Environmental conditions in

the community will be healthier for people with higher education. [25] In developed countries, variations in health and well-being are largely explained by health behaviors rather than educational attainment. [26]

This study emphasizes the need for focused interventions to improve workers' knowledge and attitudes in food handling. Based on the findings, young workers and workers with low education tend to have suboptimal understanding and practices, so interactive training and hands-on practice that are easy to understand are needed. In addition, socialization materials need to be adjusted to the types of risks that male workers often face in production areas or kitchens, to increase awareness and compliance with hygiene and food safety standards. This approach allows for more effective interventions by targeting the groups that most need improved competence in food handling. This health education is important to be provided in order to provide learning, to produce a change in knowledge from what is not yet understood to be understood. [27]

Based on the results in Table 3, it shows that street food handlers in East Surabaya who demonstrated non-compliant hygiene behavior were more common among those aged ≤30 years (77.8%). This indicates a relationship between age and the discipline or application of hygiene practices among food handlers. The age group under 30 years old is classified as a young group or early adult. [28] The older a person lives, the more experience will increase so that it will increase his knowledge of an object. Maturity A person's age will also affect stability in acting. [29] Poor health behavior in the age group under 30 years old is possible because experience and maturity of thinking are still lacking compared to the older age group who are more mature.

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In terms of knowledge, street food handlers in East Surabaya who demonstrated compliant hygiene behavior were more common in the group with very good knowledge (60%). Conversely, non-compliant behavior was more prevalent in the group with moderate knowledge (76.9%). This indicates a relationship between knowledge and behavior among street food handlers in East Surabaya. Knowledge serves as the foundation for decision-making, including actions related to meeting hygiene requirements in food handling. Vendors with higher knowledge levels are more likely to practice healthy behaviors. This is consistent with a study conducted at Senggol Market in Gianyar, Bali, which found a significant relationship between food vendors' knowledge and the implementation of personal hygiene. This study was conducted using interviews and observations using a cross-sectional approach with a total sample of 40 respondents. The variables studied were knowledge and behavior regarding the application of personal hygiene. [30] This finding is highly relevant to the present study.

Knowledge is a factor that affects personal hygiene, because good knowledge related to personal hygiene can improve health. [31] Knowledge not related to hygiene behavior can be caused by the beginning it has become a habit of food processors who do not pay attention to hygiene, respondents do not know the truth about hygiene and food sanitation. They just know what equipment should be used when processing food without knowing what the benefits are, so some don't use it for uncomfortable and annoying reasons when working. [32]

In terms of gender, street food handlers in East Surabaya with compliant hygiene behavior were more common

among females (48.6%), while non-compliant behavior was more prevalent among males (83.3%). Correlation test results indicated a significant relationship between gender and the personal hygiene behavior of food handlers. However, age, education, and knowledge were not associated with food handling behavior. This suggests a relationship between behavior and gender among street food handlers in East Surabaya. This is the same as the research in the Depok Beach Area, gender has no relationship with the behavior of food handlers. This means that men and women have the same opportunity to behave in poor food safety. [33]

A study by Ma et al. (2019) indicated that street food sellers frequently performed poor food handling and often operated in unsanitary settings. To increase the safety of street food, training for street vendors should be given top priority. Disseminating policies and other initiatives is also necessary to enhance vendors' knowledge, attitudes, and food safety procedures. The study by Ma et al. was carried out in Handan, a regional center for a significant development area and a typical third-tier city in China. There were 90 street food stalls, 240 customers, and 100 street food merchants. In addition to demographic information including gender, age, education, income, food safety training, and particular aspects of suppliers' job experience, the factors under investigation included food safety knowledge and attitudes. A questionnaire was used for the measurements. [34]

Based on Table 4, which examines the multivariate analysis, it is known that gender influences hygiene behavior. Other factors such as knowledge, age, and education did not influence this. In this study, other factors may also be involved. Length of service and experience determine food handler compliance and knowledge. 36.0% of the 300 street food vendors in a research by Rahman et al. (2025) had three to five years of experience handling food, but only 1.7% had received training in food safety. Knowledge is also influenced by experience ($p \leq 0.05$), with handlers with more than five years of experience exhibiting superior knowledge (51.2% good). [35] Training also affects workers. Food safety training and education are important strategies for improving behavior and behavioral precursors (e.g., knowledge and attitudes). A comprehensive systematic review concluded the effects of training and education interventions on improving food handlers' knowledge in eight RCTs, but more evidence is needed on strategies to enhance behavior change. [36] Food safety training can enhance the microbiological safety and quality of processed foods in SMEs, as well as the knowledge and hygiene practices of food processing staff. However, this is only possible if food safety support resources, such as paper towels and hand washing soap, are made available. [37] Other research by Ncube et al (2020) showed food safety knowledge scores were significantly higher in food handlers who received basic food safety training compared to those who did not. [38]

Food handler knowledge and compliance are also influenced by workplace culture, financial incentives, and supervision. The type of workplace also influences this. The type of job is significant, with fast-food restaurant handlers demonstrating higher expertise compared to those in street food vendor [35]. Today's food safety culture has evolved from a limited, compliance-based idea to an all-encompassing corporate value that is crucial to guaranteeing food safety. Leadership philosophies, especially transformational leadership, can promote a proactive safety culture and raise employee engagement. Many different sectors deal with several problems. Because of legal requirements, high-risk industries typically have higher food safety concern, whereas other industries have problems with employee ownership and communication. [39]

This study has several limitations. It failed to explore structural factors such as water and sanitation facilities, supervision, and permits. Furthermore, the questionnaire used may be less sensitive when applied to other populations. This study was cross-sectional, meaning it could only demonstrate cause and effect at a single point in time, thus lacking in depth. There was bias in the compliance analysis

because respondents were aware that they were being studied. Furthermore, the sample size was small, weakening the study's strength. More targeted interventions are needed to improve the hygiene behavior of street food handlers in East Surabaya, particularly among those aged 30 years and under, men, and handlers with a high school education. For future research, it is recommended to use a study design with a larger sample size and a longitudinal or mixed-methods approach to further analyze causal relationships. Future research should also incorporate structural and environmental factors, such as the availability of facilities and monitoring systems, and use more sensitive measurement instruments to minimize observational bias and increase the robustness and generalizability of the research results.

Table 1. Characteristics of Street Food Handlers in East Surabaya

Characteristics	n	%
Knowledge		
Low	15	17,4
Moderate	39	45,3
Good	27	31,4
Very Good	5	5,8
Behavior		
Compliant	27	31,4
Non-compliant	59	68,6
Gender		
Female	37	43,0
Male	49	57,0
Age		
≤30 Yo	58	67,4
>30 Yo	28	32,6
Education		
Primary school	6	7,0
Junior high school	18	20,9
Senior high school	53	61,6
Undergraduate	9	10,5

Table 2. Determinants of Food Handlers' Knowledge of Street Food Vendors in East Surabaya

Characteristic	Knowledge								Total		p-value	OR
	Low		Moderate		Good		Very good					
	n	%	n	%	N	%	n	%	n	%		
Age												
≤30 Years old	9	15.5	29	50.0	17	29.3	3	5.2	58	100,0	0,671	1.229
>30 Years old	6	21.4	10	35.7	10	35.7	2	7.2	28	100,0		
Gender												
Female	1	2.8	14	37.8	17	45.9	5	13.5	37	100,0		
Male	14	28.5	25	51.1	10	20.4	0	0.0	49	100,0	0,000	0.195
Education												
Primary school	1	16.7	5	83.3	0	0.0	0	0.0	6	100,0		
Junior high school	7	38.9	6	33.3	5	27.8	0	0.0	18	100,0	0,005	2.744
Senior high school	6	11.3	26	49.1	17	32.1	4	7.5	53	100,0		
Undergraduate	1	11.1	2	22.2	5	55.6	1	11.1	9	100,0		

Table 3. Relationship between Individual Characteristics and Food Handling Behavior among Street Food Vendors in East Surabaya

Characteristic	Hygiene Behavior				Total		p-value	OR
	Compliant behavior		Non-compliant behavior					
	n	%	N	%	N	%		
Age								
≤30 Years old	12	22,2	42	77,8	54	100,0	0,642	0.589
>30 Years old	11	39,3	17	60,7	28	100,0		
Gender								
Female	18	48.6	19	51,4	37	100,0	0,002	4.211
Male	8	16.7	40	83,3	48	100,0		
Education								
Primary school	3	50,0	3	50,0	6	100,0	0,165	3.133
Junior	9	50,0	9	50,0	18	100,0		
High	11	20,7	42	79,3	53	100,0		
Undergraduate	4	44,4	5	55,6	9	100,0		
Knowledge	5	33,3	10	66,7	15	100,0	0,245	0.594
Poor								
Moderate	9	23,1	30	76,9	39	100,0		
Good	10	37,1	17	62,9	27	100,0		
Very Good	3	60,0	2	40,0	5	100,0		

Table 4. Multivariate analysis results

Variable	B	Sig.	Exp(B)	95% C.I.for EXP(B)	
				Lower	Upper
Knowledge	-0.010	0.978	0.990	0.481	2.039
Age	-0.131	0.806	0.877	0.308	2.499
Gender	1.436	0.013	4.203	1.361	12.980
Education	0.463	0.201	1.590	0.782	3.233

Conclusion

Most food handlers from street vendors in East Surabaya exhibited non-compliant hygiene behavior, particularly among younger individuals (≤30 years), males, and those with a senior high school education. The level of knowledge among food handlers also varied, with good knowledge being more prevalent among respondents aged >30 years, females, and those with tertiary education. Gender and education level were related to food handlers' knowledge. Gender was related to hygiene behavior.

These findings emphasize the need for educational interventions tailored to demographic characteristics, such as interactive training for young workers, visual materials and hands-on practice for workers with less education, and relevant risk-specific socialization for male workers. These findings are contextualized to the East Surabaya area and street vendors, so generalization to other areas or other informal food sectors should be approached with caution. Programs such as interactive training for young workers, such as handwashing simulations, proper food storage, and hands-on practice using clean cooking utensils, are recommended. Additionally, simple visual materials for workers with less education, such as posters, short videos, or live demonstrations that emphasize basic

hygiene procedures, can be developed. Risk socialization can also be conducted specifically for male workers, focusing on areas or production stages most prone to contamination, such as meat or vegetable handling.

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Conflict of interest

The authors also declare explicitly that there is no conflict of interest with any parties involved in this research.

Availability of data and materials

All data generated or analysed during this study are included in this published article

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Author Contribution

F.S.I.N. contributed to the conceptualization, methodology design, and drafting of the original manuscript. R.D. participated in data collection, data analysis, and manuscript review and editing. H.B.D. was involved in field investigation, data visualization, and final manuscript review. M.S. was responsible for software management, data validation, and overall supervision of the research process. S.A.F. supported resource provision and project administration. N.A.R. contributed to data collection and processing. S.R. conducted the literature review and assisted in writing the initial manuscript draft. All authors have read and approved the final version of the manuscript.

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