

Sanitary Hygiene and Behavior of Food Handlers in the Presence of *Escherichia coli* Bacteria

Cucu Herawati^{1*} , Heni Endayani¹ , Suzana Indragiri¹ , Iin Kristanti¹ , Supriatin¹ , Nuniek Tri Wahyuni¹ , Awis Hamid Dani¹  and Isna Hikmawati² 

¹College of Health Sciences Cirebon, Cirebon, West Java, Indonesia.

²Muhammadiyah University Purwokerto, Purwokerto, Central Java, Indonesia.

Abstract

Maintaining proper sanitation and behavior of food handlers is crucial in determining the quality of food. In addition, the presence of *Escherichia coli* indicates food contamination, which can lead to foodborne illness. Therefore, this study aimed to analyze the role of sanitation hygiene and food handlers' behavior on the occurrence of *Escherichia coli* contamination in food served to children at Elementary Schools and Madrasah Ibtidaiyah (MI). In this study, an analytical survey method with a cross-sectional design was employed. The population consisted of 78 individuals involved in selling children's food during the January 2023 period. The sample consisted of 43 food vendors who were selected using a purposive sampling. The inclusion criteria were respondents who sell food in Elementary Schools and MI, and the exclusion criteria were those who sell covered or packaged food. Data were collected through observation sheets and interviews, and data analysis involved both univariate and bivariate methods, using the Chi-Square test. The results showed that 31 respondents (72.1%) adhered to sanitary hygiene requirements, 33 respondents (76.7%) fulfilled the criteria for food handlers' behavior, and 9 respondents (20.9%) had their food contaminated with *Escherichia coli*. There is a relationship between sanitation hygiene and *Escherichia coli* contamination in children's food in Elementary Schools and MI (p -value = 0.00). Additionally, a correlation was observed between food handlers' behavior and *Escherichia coli* contamination in food served at both types of schools (p -value = 0.00). These results emphasized the importance of street food vendors consistently prioritizing and implementing proper food sanitation, hygiene and healthy practices. This method was crucial to prevent *Escherichia coli* contamination and ensure the safety of the food served to children.

Keywords: Hygiene Sanitation, Behavior Handlers Food, *Escherichia coli*

*Correspondence: cucueherawatie@gmail.com

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INTRODUCTION

Food and drink are essential for humans because they are basic survival needs. The nutritional content of these items, encompassing protein, carbohydrates, fats, vitamins, and minerals, is vital, and their composition should be devoid of harmful components.¹ It is important to note that food is a medium for the proliferation of microbes which can cause health problems when consumed by humans.²

The overarching goal of food sanitation is to ensure the safety of food and safeguard consumers' health.¹ Maintaining high standards of food hygiene and sanitation will also produce good quality food.³ Street food refers to readily available food items sold by vendors in open-air settings, typically on streets or other public areas.⁴ School Children's Food Food (PJAS) is known as fast food, available in the school environment, and routinely consumed by school children.⁵

Escherichia coli is one of the main species of gram-negative bacteria. In general, these bacteria are known to exist usually in the digestive tract of humans and animals. The presence of *Escherichia coli* in water or food is highly correlated with the discovery of disease germs (pathogens) in food.⁶

The presence of this bacteria can be indicative of noisy sanitation practices due to its potential transmission through hand-to-mouth contact or passive transfer through various consumables such as food, water, milk, and related products. Consumption of *Escherichia coli*, found in food or drink can lead to ailments such as cholera, dysentery, gastroenteritis, diarrhea, and other digestive tract diseases.⁷

According to the study conducted by Ristoyo *et al.*, *Escherichia coli* contamination was identified in about 15 out of 30 samples (50%). The result showed that there was a relationship between sanitary hygiene behavior and contamination of *Escherichia coli* on food with sauce in Elementary School.⁸ Another study conducted by Dwi Apriany *et al.* also showed the presence of *Escherichia coli* in dogger ice in about 8 samples (80%) out of 10. In conclusion, there is a significant relationship between vendors sanitation practices and food contamination by *Escherichia coli*.¹

In a preliminary investigation involving 14 samples, 5 were found to be contaminated with *Escherichia coli*. These types of food are dogger ice, milk ice, chocolate ice, fried food, and fried noodles. The results of observations regarding hygiene and sanitation and the behavior of food handlers found that food hygiene and sanitation were still lacking. This could be observed from vendors directly serving the buyer or holding food after holding money, smoking, scratching limbs without using tools (food tongs or spoons), without washing hands first, and without using gloves. Therefore, this study aimed to analyze the effect of sanitation hygiene and food handlers' behavior with *Escherichia coli* in children's food in Elementary Schools.

MATERIALS AND METHODS

This is an analytical survey study with a Cross-Sectional design, and the population was all 78 children's food vendors in Elementary Schools and Madrasah Ibtidaiyah (MI). The sample size consisted of 43 street vendors, selected through purposive sampling method. The inclusion criteria included respondents who sell food in Elementary Schools and MI and are willing to become respondents. The exclusion criteria were respondents who sell covered or wrapped food.

The measurement of the bacterial content of *Escherichia coli* was carried out in the laboratory. The data analysis techniques used included univariate analysis as well as bivariate analysis. The statistical test used is Pearson Chi-Square.

As shown in Table 1, it can be seen that out of the 43 respondents with sanitary hygiene who met the requirements, most of respondents, namely 31 respondents (72.1%), and those who did not meet the conditions were a small portion of the respondents, 12 respondents (27.9%). The behavior of food handlers who met the requirements of the majority of respondents, namely 33 respondents (76.7%), and those who did not meet the conditions were a small portion of the respondents, 10 respondents (23.3%). Concerning the contamination status of *Escherichia coli* in foods, 9 respondents (20.9%) had contaminated food, while the majority—34

Table 1. Distribution sanitation hygiene frequency, behavior of food handlers, and *Escherichia coli* contamination in food (n=43)

Hygiene Sanitation	Frequency	Percentage (%)
Fulfill Condition	31	72,1
No Fulfil condition	12	27,9
Behavior of Food Handlers		
Fulfill Condition	33	76.7 %
No Fulfil Condition	10	23.3 %
<i>E. coli</i> Contamination		
No Contaminated	34	79.1%
Contaminated	9	20.9 %
Total	43	100.0 %

respondents (79.1%)—had food that was not contaminated.

As shown in Table 2, these results highlighted that among food intended for school children that adhered to the defined sanitary hygiene criteria, no bacterial presence was observed in 100% of 31 respondents. However, in food that did not meet the hygiene criteria, bacteria were detected in a larger portion (75%) of 12 respondents. The statistical analysis indicated a significant result, with a *p-value* of 0.000.

The results showed that the behavior of food handlers in school children's food that met the requirements did not find 100% bacteria in 33 respondents. However, among food that did not meet the behavior criteria, a substantial portion—90%—of the 10 respondents had detectable bacterial presence. The associated *p-value* for this analysis was also 0.00.

DISCUSSION

This study shows a relationship between sanitary hygiene and the contamination of *Escherichia coli* in children's food (*p-value* = 0.00). The results were in line with the results of the investigation by Ristoyo *et al.*, which showed a relationship between two variables, namely sanitation hygiene with the existence of *Escherichia coli* on savory food in Elementary School with *p-value* = 0.023.⁸ The investigation by Dwi *et al.* also stated that there was a relationship between food sanitation hygiene and the existence of *Escherichia Coli*, the dogger ice vendors

obtained *p-value* = 0,002.1 There is a significant relationship between hygiene and sanitation of cooking utensils with food contamination by *Escherichia coli*.⁹

This study showed that among respondents who maintained sanitary hygiene practices, the majority 31 showed no detection of bacteria. However, respondents not meeting the sanitation criteria had a higher bacterial presence, with 75% of them exhibiting such contamination. Analysis of observations conducted among children's food vendors in Elementary Schools and MI unveiled factors influencing poor sanitation hygiene. These factors encompassed handlers not wearing clean clothes when handling food, handlers' having dirty hands and long nails, cooked food stored openly, and handling food without employing utensils or gloves. These practices contribute to the potential increase of *Escherichia coli* contamination in food. Subsequently, there was a strong relationship between kitchen equipment and microbial quality.¹⁰

The application of sanitary hygiene should be carried out in the entire process, both in the selection of raw materials used for the processing and serving stage, including food handlers and the processing environment.¹¹

Based on observations in the field, it was found that 6 hawker vendors wore less clean clothes while handling food at trading locations in Elementary School environment. The use of clean work clothing is important in ensuring food processing remains sanitary and hygienic by preventing the accumulation of dust or dirt that could inadvertently lead to food contamination.¹² This study also highlighted additional factors such as handlers with dirty hands, long fingernails, and those who handled food without using tongs or gloves were identified as contributing elements. These results align with the observations made by Sakdiyah, which stated that most food handlers did not use tongs or gloves when taking finished/cooked food. The act of touching with hands is a primary source of food contamination.¹² Microorganisms attached to the hands will move into the food and multiply, specifically in prepared food. Diseases that arise when a person consumes food or drink can be caused by several factors, including the presence of disease-causing

Table 2. Relationships hygiene sanitation and behavior of food handlers with *Escherichia coli* contamination in food (n=43)

Hygiene Sanitation	<i>Escherichia coli</i> Contamination						P-value
	No There is		There is		Amount		
	n	%	n	%	n	%	
Fulfill Condition	31	100	0	0	31	100	0.00
No Fulfill Condition	3	25	9	75	12	100	
Total	34	79,1	9	20,9	43	100.0	
Behavior of Food Handlers							
Fulfill Condition	33	100	0	0	33	100	0.00
No Fulfill Condition	1	10	9	90	10	100	
Total	34	79,1	9	20,9	43	100	

agents during food processing.¹³ The presence of *Escherichia coli* microorganisms in street vendors' food shows the level of ignorance of food handlers toward hygienic sanitation practices.¹⁴

The presence of *Escherichia coli* in water or food serves as an indicator of contamination, rendering it a microbiological marker for water and food safety. The stipulated permissible count for *Escherichia coli* in processed food is zero per gram of food sample. The presence of *Escherichia coli* in water or food is highly correlated with the incidence of diseases such as mild to severe diarrhea or food poisoning.¹⁵ The principle of food and drink sanitation hygiene is controlling the four factors of food health, namely places or buildings, equipment, people, and food ingredients.¹⁶

Based on the theory and several other studies that align with this study, it can be concluded that sanitary hygiene greatly influences *Escherichia coli* contamination on food. The application of poor sanitation hygiene affects the quality of street food. To minimize contamination, *Escherichia coli* in street food vendors are always promoted to apply food sanitation hygiene to maintain food safety.

This study showed a connection between food handlers' behavior and *Escherichia coli* contamination of children's food (p -value = 0.00). The results are in line with the results of Ristoyo *et al.*, which stated that there is a relationship between the behavior of food and the presence of *Escherichia coli* on savory food in Elementary School with p -value = 0.003.⁸ In line with the

investigation by Dwi, Apriyani *et al.* also stated that there is a relationship between the behavior of food handlers and the presence of *Escherichia coli* on dogger ice with p -value = 0.002.¹

Based on the results, it was found that a significant portion of respondents adhering to proper food handling practices did not encounter 100% bacterial presence, with a total of 31 individuals falling into this category. However, among respondents exhibiting inadequate food handling behaviors, the majority, comprising 9 individuals (75%), reported bacterial presence (75%). This study's observation on poor food handling behavior showed that 9 respondents failed to wash their hands before and after handling food, while 4 individuals stored finished/cooked food in open containers, and an additional 4 used rings or jewelry.

Health behavior entails individuals' reactions to illness-related stimuli, food, drink, and the environment.¹⁷ In the context of food handling, hygiene behavior is one of the most critical factors. The hygiene behavior of vendors greatly influences the presence of microbes in food.¹⁸ The lower the food handlers' ability to practice hygiene, the greater the possibility that the food handled will be contaminated.¹²

Storing cooked food in open containers also affects the survival of *Escherichia coli* on food. The act of storing finished/cooked food in uncovered containers contributes to a twofold increase in *Escherichia coli* contamination.¹³ The use of any form of jewelry is prohibited

for food handlers due to the potential risk of contamination.¹⁹ Food handlers play an essential role in protecting the food consumed from contamination caused by lousy food handlers' behavior.¹⁸ *Escherichia coli* is opportunistic germ commonly found in the human large intestine as normal flora. This bacteria can cause primary intestine infections, such as diarrhea in children, and its ability to cause disease in body tissues outside the intestine.²⁰ The lack of proper hand hygiene among handlers correlates with hand contamination, with 55.6% of fecal coliforms found on handlers' hands.²¹

To mitigate the risk of *Escherichia coli*-related food contamination, proper training for food handlers is important. This study underscores the substantial influence of behavior on *Escherichia coli* contamination in children's food, emphasizing the importance of consistent adoption of healthy practices, particularly in terms of behavior (personal hygiene) in handling food.

CONCLUSION

In conclusion, hygiene and sanitation for street food met the requirements of 31 respondents (72.1%), and 12 respondents (27.9%) did not meet the criteria. The behavior of food handlers who met the requirements were 33 respondents (76.7%) and those who did not meet the standards were 10 respondents (23.3%). Food with *Escherichia coli* contamination was reported by 9 respondents (20.9%) and those without was reported by 34 respondents (79.1%). There was a significant relationship between sanitation hygiene and *Escherichia coli* contamination on food (p -value = 0.00), and there was a substantial relationship between the behavior of food handlers and *Escherichia coli* contamination on food (p -value = 0,00). Street food vendors should consistently implement and improve sanitary hygiene and good behavior when handling food to reduce *Escherichia coli* contamination in street food sold. Subsequently, health workers were more intensive in conducting counseling, fostering and supervising hygiene and sanitation, as well as the behavior of food handlers for food vendors selling children's food at school.

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CONFLICT OF INTEREST

The authors declare that there is no conflict of interest.

AUTHORS' CONTRIBUTION

CH designs research procedures, HE and SI collect data, IK processes data, S analyzes and interprets data, NTW and AHD write manuscripts, and IH reviews manuscripts. All authors read and approved the final manuscript for publication.

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DATA AVAILABILITY

All datasets generated or analyzed during this study are included in the manuscript.

ETHICS STATEMENT

This study was approved by the Committee Health Research Mahardika College of Health Sciences, West Java, Indonesia, with Ethical Clearance number: No.001/KEPK.STIKMA/II/2023.

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