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RESEARCH ARTICLE

Salmonella Infection Among Food Handlers at Canteens in a Campus

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Abstract:

Background:

Salmonella is one of the pathogenic microorganisms that can contaminate food through cross-contamination (less hygiene of handlers and environment). In a campus, food management and food handlers have a very important role in the contamination of microorganisms, which can lead to the incidence of foodborne diseases.

Objective:

This study aimed to assess the incidence of salmonella infections among food handlers at a campus canteen in Depok City, Indonesia.

Methods:

The cross-sectional study was conducted in May-June 2017. The population of this study was all food handlers working in the canteen (N=260). The data were obtained through interviews and observation of the characteristics and behaviors of the food handlers. Blood samples were also collected from 49 food handlers (n=49).

Results:

This study revealed that 61.2% of food handlers included in the age group were not at risk, the proportion of female food-handlers was slightly more than men (51%), the majority of them were low educated (59.2%), and all respondents had never given typhoid immunization. The results of the fecal examination revealed that two food handlers had typhoid. In addition, the behavior and personal hygiene of most of the handlers are poor. Environmental factors such as canteen sanitation facilities are mostly qualified, and most of the food handlers have no history of contact with animals.

Conclusion:

There was no statistically significant relationship between characteristics, behavior, personal hygiene, sanitation facilities, and contact history with animals against pathogenic bacterial infections.

Keywords: *Salmonella*, Food-borne, Food handlers, Food contamination, Environment, Typhoid.

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1. INTRODUCTION

Salmonella is a pathogenic microorganism that can contaminate food by cross-contamination; for example, by poor hygiene amongst handlers and their contact with the environment. The contamination may occur as a result of buying food from unsafe sources, contaminated equipment, or conditions in which microorganisms readily grow and survive, such as inadequate cooking temperature or poor sanitation [1, 2].

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About 10-20% of extraordinary events of cases of in foodborne diseases are caused by contamination of foods and beverages by pathogenic microorganisms through food handlers [2, 3]. *Salmonella* is a bacterium that often causes contamination of snacks [4 - 6] and is considered the most important foodborne disease agent in the world. Hundreds of cases of *salmonellosis* outbreaks occur in most countries around the world each year [7].

The hygiene of food handlers is one of the factors that contribute to the incidence of foodborne diseases [3], such as food handlers who have low personal hygiene [8], have

suffered from typhoid, and poor handwashing behavior [9, 10]. A study conducted in 2009 by Hedican *et al*. of food handlers in a restaurant showed that the testing of *Salmonella* contamination amongst them was positive [11]. Based on a study conducted in 2008 by Susanna *et al*. on the campus canteen in question, it was found that most food groups (90.15%) were contaminated by *E. coli*, which was found in foods which contained chili sauce [12]. Similarly, most beverages were contaminated by *E. coli*. This occurred because of the contamination of the cutlery by the hands of the handlers [12]. In 2010, a study was again conducted in the same canteen, which again found that most of the samples examined (59.54%) were contaminated by *E. coli*, with the main reason for this being the method of storing leftover food and raw poultry. Forty types of raw materials are likely to have nine times the risk of *E. coli*, contamination during storage and presentation [13].

In addition, the results of a study on the location conducted in 2014 found that 54% of the and 68% of the food samples were contaminated by *E. coli*, and that 5% of the food samples and 4% of the beverages tested positive for *Salmonella* [14]. In 2016, a study of the same place was conducted to establish if parasitic infections were present in the food handlers, finding that four handlers were infected with intestinal parasites [15]. The results of these studies show that management and food handlers play a very important role in controlling contamination by microorganisms, which can lead to the incidence of foodborne diseases. However, a study of pathogenic bacteria in handlers at the campus canteen has never been conducted. Therefore, this study aims to ascertain the incidence of *Salmonella* infection amongst food handlers at the canteen.

2. METHODS

The study used a cross-sectional study design, in which the dependent variable was *Salmonella* infection, and the independent variables were the characteristics of respondents' age, sex, education, health training, immunization status, handler behavior, personal hygiene, sanitation facilities, and animal contact. The study population was all food handlers working full time at the canteen of a campus in Depok, consisting of 260 people (N= the total of canteens). The inclusion criteria for the population were that they were willing to be research respondents; willing to be interviewed and have a blood sample taken; were not sellers of packaged food, and were working in the canteen at the time of the study. The minimum sample number was 40; however, to avoid missing data, the sample size for the study was 49 (n=samples). The sample selection method was systematic random sampling. Primary data were obtained from interviews, observations, and the results of blood tests in the laboratory. *Salmonella* infection was identified qualitatively by examining IgM and IgG in the blood of the food handlers using the rapid diagnostic test. The individual blood samples were taken by personnel from the Regional Health Laboratory, Bogor City.

The data analysis began with univariate analysis, which was conducted descriptively to show the characteristics of the respondents, their behavior and personal hygiene, the sanitation facilities available, and animal contact. The assessment of the indicators of sanitation facilities was made by scoring each variable. If the score obtained was more than 70%, this indicated that it "met the requirements", while if the score obtained was less than 70%, this indicated that it "did not meet the requirements". Bivariate analysis was conducted to establish the relationship between the characteristics, behavior, personal hygiene, sanitation facilities, and contact with animals and *Salmonella* infection amongst the handlers.

3. RESULTS

The distribution of respondents infected by Salmonella based on their characteristics

The laboratory results of the *Salmonella* IgM and IgG examination of the handlers showed that two people (4.1%) indicated positive for *Salmonella* IgM in their blood tests, which shows the existence of *Salmonella typhi* infection in the food handlers. Both suspects had low and middle educational levels, as shown in Table **1**.

Table 1. Distribution of respondents infected by *salmonella* based on characteristics of food. handlers at the canteens.

Code	Sex	Age	Education	Food Sold	*IgM Salmonella*
006	Male	21	Elementary	*Warteg** food	Positive
021	Female	38	Primary	Fried Food	Positive

*Warteg: the name of food stall selling any kind of traditional meals.

The relationship between respondent characteristics and Salmonella infection in the canteen food handlers

The study found no significant relationship between the characteristics of the handlers (age, sex, education, health training, and immunization status) and *Salmonella* infection based on Fisher's exact test (p-values> 0.05), as shown in Table **2**. Based on the results of the study, in general, the hygiene behavior of the food handlers was mostly poor (85.7%), which included handwashing with soap for various activities; washing fruit and other food before eating; not using tools when handling food; eating outside; the habit of consuming foods sourced from meat, chicken and eggs; and the habit of consuming ice. Additionally, 55% of the respondents did not wash their hands with soap after cleaning their nose and 66.7% did not wash their hands with soap after handling raw meat and poultry.

Regarding the behavior and personal hygiene of the respondents, those who were infected by *Salmonella* also showed poor behavior; moreover, one also had poor personal hygiene. However, no statistically significant relationships were found between behavior and *Salmonella* infection among the respondents. Surprisingly, the results indicate that those who were found to be infected by *Salmonella* had good sanitation facilities, while those who were not infected had poor facilities. Similarly, contacts with animals were found among those who were not infected by *Salmonella*, but were absent in those who positively infected.

Table 2. Relationships between characteristics and *Salmonella* infection in food handlers at the canteens.

Characteristics	*Salmonella* Infection				Total		p-value
	Positive		Negative				
	n	%	n	%	n	%	
Age							
Risky (<30 years and >50 years)	1	5.3	18	94.7	19	100	1.0
Not Risky (30 – 50 years)	1	3.3	29	94.4	30	100	
Sex							
Male	1	4.2	23	95.8	24	100	1.0
Female	1	4.0	24	96.0	25	100	
Education							
Low (< Secondary)	2	6.9	27	93.1	29	100	1.0
High (≤ Secondary)	0	0	20	100	20	100	
Health Training							
Never	1	4.0	24	96.0	25	100	1.0
Ever	1	4.2	23	95.8	24	100	
Status of Typhoid Immunization							
Not immunized	2	4.1	47	95.0	49	100	1.0
Already immunized	0	0	0	0	0	100	

Based on the results, it shows that of the interviews, two handlers complained of fever, headache, a sore throat, dry cough, and diarrhea, which are clinical symptoms of typhoid disease, but neither had taken any treatment. One of the respondents who was found to be positively infected with *Salmonella* was a food handler who served many consumers at the canteen.

4. DISCUSSION

The result of this research finding is very important considering that *Salmonella* bacteria can be transmitted through the fecal-oral route to other humans through contamination of food and drink by the hands, which can then lead to disease outbreaks. Food handlers must pay attention to their health and behavior when handling and processing food served so that they do not spread the disease to consumers. As stated in the Decree of the Minister of Health of the Republic of Indonesia Number 1098 concerning hygiene requirements for sanitation in cafes and restaurants, as well as the Decree of the Minister of Health of the Republic of Indonesia Number 942 of 2003 concerning guidelines for snack requirements, food handlers should not be suffering from infectious diseases, for example, diarrhea, and sick food handlers must not handle food. Moreover, food handlers must always wash their hands with soap every time they handle food to prevent the transmission of disease [16]. The studied canteens at which the incidence was found are visited by many customers every day. According to this study, both students and campus employees who used the canteen were at risk of contracting *Salmonella typhii* if the food handlers were sick and continuing to serve food.

The study did not find a significant relationship between participant characteristics and the incidence of *Salmonella* infection. On the contrary, a previous study showed that the incidence of *Salmonella* infection was more commonly found amongst young people (<20 years old) [17]. This age group generally has a weak immune system, so it is more sensitive, even to a low infection dose, it can become infected and the disease can become severe [18]. Therefore, the food handlers working in the canteen were in an age group (30 – 50 years) less at risk of *Salmonella* infection.

Both the infected respondents had low and middle educational levels, although no significant relationship was found between educational level and *Salmonella* infection. However, it was found that 51% of the food handlers had not yet received training on hygiene and sanitation. Such training can improve their knowledge and behavior in the management of healthy food.

In the Decree of the Minister of Health of the Republic of Indonesia Number 1098 of 2003 concerning hygiene requirements for sanitation in cafes and restaurants, food handlers carry out immunized against typhoid. In this study, it was found that none of the handlers (100%) had received typhoid immunization, which was due to the lack of typhoid immunization awareness in the community [19]. The level of sensitivity of the body is the predisposing factor for the incidence of infection, and the immune system plays a major role in the entry of *Salmonella* [18, 19]. Typhoid immunization is expected to provide protection both directly to the handlers and indirectly to consumers who are being served.

Hand-washing with soap is an important factor in preventing disease transmission, especially after contact with sick people [20, 21], before eating [22, 23], after going to the toilet, before preparing the food, when handling raw food and manure, after cleaning the nose, after touching the body, and after touching dirty material [24, 25].

In terms of nail cutting habits, only 5% of the handlers always cut their nails short; the observation results show that the nails of most handlers were long and some were even dirty. In addition, most of them had outdoor eating habits, and all the respondents often consumed chicken, eggs, meat, and ice.

These are known to be risk factors for the incidence of *salmonellosis* [9, 10, 21 - 23].

In terms of the personal hygiene of the respondents, more than half (51%) had good practices. It is expected that good personal hygiene can prevent the incidence of *Salmonella* infection, both for the handlers and for the customers served, as poor personal hygiene can potentially contribute to the transmission of *Salmonella* [26].

In terms of health, it was established that several respondents were still working, even though they were sick. This was proven by the results of the interviews, in which two respondents were identified as being infected by *Salmonella* and reported that they were suffering from symptoms such as diarrhea, fever, sore throat, and coughing, but still performing food processing activities in the canteen. However, referring to the Decree of the Minister of Health No. 1098 of 2003 concerning hygiene requirements for cafes and restaurants and the Decree of Minister of Health No. 942 of 2003 concerning guidelines for the hygiene and sanitation requirements with regard to snacks, handlers are not allowed to handle food when sick and suffering from infectious diseases.

From this study, both the respondents who were found to be infected with *Salmonella* displayed low education. They were found doing food processing activities to be served to consumers or buyers. This is a very risky factor in the incidence of disease transmission. A study by Yang *et al.* from 2010 of a case of salmonellosis outbreak in a boarding school found that they occurred due to transmission by food handlers who had been identified as *Salmonella* carriers [6]. Infection can also occur due to contact with a sick person [25].

Based on the results of the study, it was found that the environmental factors related to sanitation facilities were adequate. Most of the existing facilities met requirements, such as the provision of clean water, waste-water disposal, toilets, and handwashing facilities. Based on the findings of the previous study, concerning canteen hygiene quality, several canteen locations had high values with low levels of *E.coli* [14]. For the better quality of food safety in the future, research to evaluate basic sanitation on the campus could be conducted to protect the member of campus against *Salmonella* infection.

In addition to sanitation facilities, contact with animals is one of the risk factors for *Salmonella* infection, such as with dogs and cats that are infected with *Salmonella* [9]. Moreover, *salmonellosis* generally occurs due to eating contaminated food from animals (especially eggs, poultry, meat, and milk), but it can also be caused by vegetables contaminated with manure from infected animals [25].

The results of this study reveal that 16.3% of the respondents were often in contact with animals. However, the two respondents who were found to be positively infected claimed that they had no contact with animals. Even though only two people were infected with *Salmonella*, we know that the *Salmonella* pathogen is very dangerous, so it is necessary to conduct research more comprehensively to find the source of the contamination and to explore the extent of the spread of the transmission among the university member as consumers.

The study had several limitations, such as the type of food outlet only being a canteen, the limited number of food handlers as subjects and the *Salmonella* test being qualitative using the rapid diagnostic test. The survey was only conducted in canteens, while restaurants and street vendors, for example, could be included. The total sample was only 49 subjects, which could affect the results of the statistical analysis of which the relationships between the dependent and independent variables. Therefore, the data cannot be generalized for either other canteens on the campus or food handlers in general. The qualitative *Salmonella* blood test should be followed by molecular characterization for more precise results.

CONCLUSION

In this study, out of the 49 food handlers working at the campus canteen in Depok who had a blood test related to *Salmonella* infection, two were found positive. This might be a result of a low level of education, personal hygiene, or lack of health check. Therefore, besides the sick handlers themselves, they can also contaminate the food and drinks served in the canteen and become a source of infection in the food chain. Based on the findings in the study, to break the chain of transmission of pathogenic bacteria, food handlers are recommended to practice good behavior and personal hygiene, which should be standard procedures for handling food. Education and training to improve hygienic behavior should be provided sustainably. In addition, strict regulations to require food handlers to have regular health checks to identify their health status should be introduced.

LIST OF ABBREVIATIONS

CDC	=	Centers for Disease Control and Prevention
E. coli	=	*Escherichia coli*
IgM	=	Immunoglobulin M
IgG	=	Immunoglobulin B

AUTHORS' CONTRIBUTIONS

D.S. and E.P. contributed to the main idea/topic of this study. D.S. and E.P. are responsible for the development of the study report and manuscript development. D.S. supervised the whole process of this study, including the manuscript publication. E.P. gave contributions to the interpretation and analysis of the findings. S.P.R. was responsible for developing the manuscript and publication.

ETHICS APPROVAL AND CONSENT TO PARTICIPATE

Ethics approval was obtained from the Ethics Committee and Community Engagement of Faculty of Public Health, Universitas Indonesia (in Bahasa Indonesia) 257/UN2.F10/PPM.00.02/2017.

HUMAN AND ANIMAL RIGHTS

No animals were used in this research. All human research procedures followed were in accordance with the ethical standards of the committee responsible for human experimentation (institutional and national), and with the Helsinki Declaration of 1975, as revised in 2013.

CONSENT FOR PUBLICATION

Written informed consent has been obtained from all participants.

AVAILABILITY OF DATA AND MATERIALS

Derived data supporting the findings of this study are available from the corresponding author [DS] on request.

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CONFLICT OF INTEREST

The authors declare no conflict of interest, financial or otherwise.

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