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A linkage of personal, food, and environmental hygiene to presence of *E. coli* in Warmindo Food Stall☆

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ABSTRACT

Objective: This study aims to identify pathogenic microbes of foods served by Warmindo and to assess the relationship of environmental sanitation, which is facilities and food, also personal hygiene factors to presence of *E. coli*.
Methods: This study utilizes a cross section design, data sheet is provided consisting questionnaire and observation results. Chromocult Coliform Agar (CCA) is applied to know positive E. coli contamination.
Results: Based on the chi-square analysis, relationship between food sanitation and the presence of *E. coli* ($p = 0.03$), facilities sanitation ($p = 0.077$), and personal hygiene that there is a significant relationship between hygienic behavior and the presence of *E. coli* ($p = 0.046$). The laboratory test results show 6 (9.1%) from 33 food samples from Warmindo positive contaminated with *E. coli*. No meaningful differences between re-heating and direct-cooking food.
Conclusions: There is a relationship between food sanitation, facilities sanitation, and hygienic behavior with *Escherichia coli* contamination in food sold at Warmindo.

Introduction

Inexpensive and convenient food stalls in developing countries such as Indonesia still become one of main issues rather than nutritious and hygiene food consumption. Warmindo is a food stall that proves various instant noodles menu as well as other menus, for example, egg rice, sardines rice, instant beverages, and so on. Firstly, initiated from West Java Province, recent Warmindo can be reached in big cities such as Jakarta, Yogyakarta, Semarang, Surakarta, etc. As fast food and simple-eating places, affordable prices, 24 h operating time make Warmindo is ubiquitous food stall around college and workplaces.[1]

Warmindo reflects traditional cultures based on eating and gathering culture among dwellers. Special Region of Yogyakarta called Student City in Indonesia comprising thousands of students from many universities who live there. So that Warmindo is famed for having a meal, making small discussion groups, chit chat meetings with no time limit for students. According to Elvinstudy, along with not requiring high-skill expertise and low-funding establishment, Warmindo especially in Yogyakarta City in a decade has increased by around 100 units, from 1600 to 1700 Warmindo.[2] The findings also addition facts that Warmindo is one of middle enterprises, named UMKM, which plays a significant role in the economic growth of Yogyakarta Government.[3,4] Moreover, Warmindo is being a benchmark for basic necessities price in Yogyakarta area. Notwithstanding foods served by Warmindo is very popular, health safety of those foods and drinks is not guaranteed. Based on several observations, there are some Warmindo possessing poor sanitary conditions.

Most of the students or the lower incomes of many cities' dwellers prefer that cheap and delicious meal is more important than food hygiene conditions. Its understanding leads to foodborne disease which is identified by the disorder of the digestive tract with symptoms of nausea, heartburn, vomiting, and diarrhea. Another developing country in South-east Asia, five thousand food poisoning cases in Malaysia faces foodborne diseases due to inappropriate clean handling during serving food.[5] Supported by Lambrechts states that approximately 97% of foodborne disease is caused by a lack of personal hygiene.[6]

On the other hand, in Indonesia, the incidences of several diseases are transmitted through food is relatively high, for instance, typhoid, cholera, dysentery, diarrhea, and so on.[7,8] Ministry of Health points out that diarrhea is a top ten disease identified by health facilities and generates rising high-mortality of children under five years old. As much as 10,086 cases were multiplied-increase compare the previous year occurred in all ages in Yogyakarta.[9] Unhygienic food management and sanitation is able to trigger eat contaminated by pathogenic microorganisms, such as *Escherichia coli*. Research explains there is a relationship between cooking utensils and *E. coli* existence in Canteen of Semarang State University.[10] Then, personal hygiene factors

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Fig. 1. Environmental sanitation.

show the most dominant factor influencing *E. coli* contamination from food handlers.[11] This study conducts to highlight the pathogenic microbes of foods served by Warmindo, in addition, an interview completing a questionnaire survey is undertaken to assess the linkage of environmental sanitation, which is facilities and food, also personal hygiene factors to presence of *E. coli*. By identifying the relationship, the results obtained are able to reduced diarrhea outbreaks, specifically in student circle area and to be utilized as evaluation material to improve hygiene food-serving.

Methods

Cross sectional method approached univariate and bivariate analysis. Those detailed parameters referred to the Indonesian Ministry of Health Rules, i.e. 1098/2003 concerning sanitation hygiene of restaurants. Interview data was interpreted by scoring and describing food stall hygiene conditions. The results were explained in percentages that have good, medium, and poor categories that explored previous study with modified the methods.[11,12] Sampling was carried out randomly as many as 33 Warmindo located within a radius of 500 m from a University in Sleman, Special Region of Yogyakarta.

Microbiological analysis

One gram of food samples was homogenized with 9 mL of 85% salt solution. Next, the samples were mixed by 0.85% NaCl solution using a vortex mixer. After being homogeneous, the samples were diluted inside test tubes containing 9 mL of 0.85% of NaCl. The dilution series was employed for 8 times, from 10^{-1} to 10^{-8}. The only series of 10^{-2}, 10^{-4}, and 10^{-6} solution as much 0.1 mL were taken and spread into a plate containing 10 mL of Chromocult Coliform Agar (CCA) medium in sterile condition inside Laminar Air Flow (LAF). After inoculated, the media was going to be incubated for 24 h in an incubator with a temperature of 37 °C. The presence of *E. coli* is able to be indicated from purplish night blue colonies. To ensure the existence of *E. coli*, an Indol test was carried out using the Kovacs reagent. Indol testing only was applied specifically for positive on CCA media. The Kovacs reagent dropped directly on the suspected colony therefore it changed to cherry red color around the suspected colony.

Result

Analysis of environmental sanitation

Fig. 1 explains environmental sanitation observing from facility and food sanitation variables. Overall, from 33 samples, 46% owns medium quality, and the rest up to 36% has low proper facilities. Thus, it can be said that there are still numerous Warmindo that have inappropriate facilities. Furthermore, all variables of facilities and food sanitation are analyzed by information collected from the questionnaire. Table 1 gives a summary each parameter in a percentage of frequency.

Analysis of personal hygiene condition

Fig. 2 explains personal hygiene of food handlers in Warmindo. The assessment results indicate that food handlers are good attitude peaked on 84.80% while two others, hygiene knowledge and behavior pointed on 57.60% and 54.60%, respectively. Contrary, no applying Personal Protective Equipment (PPE), such as mask, hair covering, and apron during cooking and serving food is the most dominance reached up 81.80%.

Analysis of E. coli *presence*

By testing in laboratory, two samples of re-heating food are positive of *E. coli* in each Warmindo X and Y therefore totally 4 food samples (6.1%) are contaminated. In addition, Table 2 presents *E. coli* contamination also happened in direct-cooking food which is two samples (3.0%). Thus, the difference test employed by Kolmogorov–Smirnov *Z* method describes no meaningful differences between re-heating and direct-cooking food. All kind of foods possess equal potency to be contaminated. Positive test results are continued by confirmation test marked by the appearance of cherry red color on test medium that imagined in Fig. 3.

Analysis of bivariate between two variables

Table 3.

Discussion

It can be seen from Table 1, there are five factors of facilities hygiene that drive on an increase of food contamination by bacteria. The first variable is the kitchen location. Twenty-six kitchens of Warmindo equal to 75.8% are beside the pollution sources, such as toilet, trash basket, main road, waste treatment plant, and so on.

Table 1
Environmental sanitation: food and facilities hygiene ($n = 33$).

Parameters	Frequency, *n* (%)	
	Yes	No
Facilities sanitation		
Kitchen location close to pollution sources	**27 (75.8)**	9 (24.2)
Closed and water-proof material of trash bin	**2 (6.1)**	34 (20.9)
Hand washing facility	**0 (0.0)**	100 (100.0)
Building construction separated from the main house	**8 (21.2)**	28 (78.8)
Building construction saved from animal carrier invention		
Insect	**8 (21.2)**	28 (78.8)
Rats	**16 (45.5)**	20 (54.5)
Sufficient clean water	100 (100.0)	0 (0.0)
Good quality of clean water	35 (97.0)	1 (3.0)
Washing standard processing of kitchen stuffs	23 (63.6)	13 (36.4)
Unbroken kitchen stuffs	33 (90.9)	3 (9.1)
Periodically rubbish transported	31 (84.8)	5 (15.2)
Rubbish basket	100 (100.0)	0 (0.0)
Wastewater drainage system	34 (93.9)	2 (6.1)
Sufficient of kitchen stuffs washing	25 (69.7)	11 (30.3)
Clean toilet	22 (60.0)	14 (40)
Toilet location near kitchen	18 (50.0)	18 (50.0)
Permanent construction	36 (100.0)	0 (0.0)
Food sanitation		
Suitable temperature and moisture of food keeping condition	**10 (27.3)**	16 (72.7)
Covered food keeping	**14 (39.4)**	22 (60.6)
Covered food serving	**1 (3.0)**	35 (97.0)
Good quality of raw material food	34 (93.9)	2 (6.1)
Registered raw material	100 (100.0)	0 (0.0)
Separation place between raw material and cooked-food	100 (100.0)	0 (0.0)
Clean food keeping	15 (42.4)	21 (57.6)
Food saving in a food rack	25 (69.7)	11 (30.3)
Appropriate clothes for food buyers	34 (93.9)	2 (6.1)
Tweezers using to take the foods	35 (97.0)	1 (3.0)
Appropriate kitchen stuffs handled by food serving	34 (93.9)	2 (6.1)
Suitable food condition	100 (100.0)	0 (0.0)
Bacteria contamination	6 (9.1)	30 (90.9)
Suitable temperature and time period of cooked-food keeping	100 (100.0)	0 (0.0)
Freshly food serving	100 (100.0)	0 (0.0)
Clean plating when food served	100 (100.0)	0 (0.0)
Clean food container	34 (93.9)	2 (6.1)

Source: Primary Data, 2018.

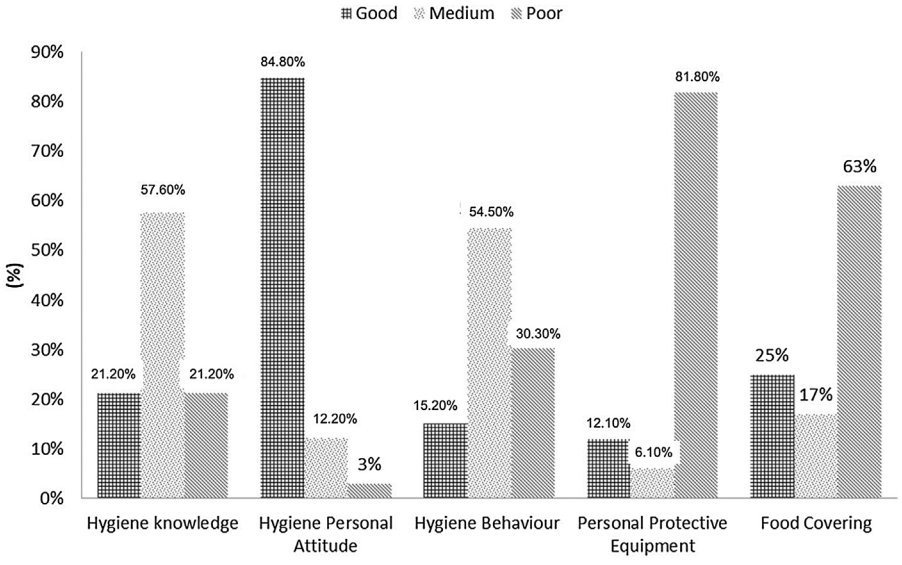

Fig. 2. Personal hygiene.

The fact is made worse by using a poor quality of trash basket in the second position. The majority of Warmindo utilize a rubbish basket that unclosed and non-waterproof material. Approximately 93.9% of vendors apply reusable plastic bags or cardboard as a trash basket. Applying those media indicates unsaved and non-standard solid waste collecting facilities. Unclosed trash bin excites pathogen animal carriers, for instance, insects and rats that are possible to spread germs through the food. Equally important, unsafe leachate produced by the organic waste decomposition process that spilled from non-waterproof material of trash basket generates

Table 2
Analysis of *E. coli* presence in Warmindo Food ($n = 33$).

Kind of foods	Most extreme differences			Kolmogorov–Smirnov *Z*	Frequency *n*, %	*p*-value
	Absolute	Positive	Negative			
Re-heating food	0.03	0	−0.03	0.123	4(6.1)	0.077
Direct-cooking food					2(3.0)	0.030
Total contamination					6(9.1)	0.384

Source: Primary Data, 2018.

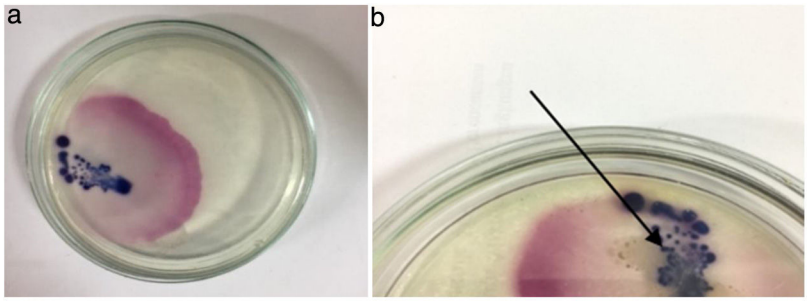

Fig. 3. (a) Positive test and (b) confirmation test of *E. coli*.

Table 3
Analysis of bivariate using Chi-square between hygiene variable and the presence of *E. coli*.

Parameters	*E. coli* (*n*)			α; 95% confidence interval	*p*-value
	(+)	(−)	Total		
Facilities sanitation			33	0.1	0.1
Good	3	9			
Medium	0	15			
Bad	0	6			
Food sanitation			33		0
Good	0	22			
Medium	3	11			
Bad	0	0			
Knowledge worker			33		0.4
Good	1	6			
Medium	1	18			
Bad	1	6			
Attitude worker			33		0.4
Good	2	26			
Medium	1	3			
Bad	0	1			
Behavior worker			33		0
Good	0	5			
Medium	0	18			
Bad	3	7			
Protective Personal Equipment (PPE)			33		0.5
Good	0	5			
Medium	0	18			
Bad	3	7			
Covered food			33		0.6
Good	2	16			
Medium	0	9			
Bad	1	6			

Source: Primary Data, 2018.
(*)Asymp. and exact Sig (two-tailed) mean 1.

soil pollution. As third factors, unfortunately, none of Warmindo (0%) facilitates handwashing places for food buyers. Even though, hand hygiene owns a pivotal role that prevents the movement of pathogenic bacteria causing food-borne disease.[5]

On the other hand, in food sanitation, the first factor is temperature and humidity of food keeping pointed to only 27.3% that is fit the basic hygiene standard. Then, other observations, the variables of food storage and food serving have bad scores, 39.4%, and 3%, respectively. Low percentages are reflected in the food containers that are not protected from disease-vector carryings, such as flies and rats. Many Warmindo do not apply food storage cabinets, closing curtains, and yet only placed on the table, openly. In the same way, Romanda investigated that opened food container is going to double rising *E. coli* contamination.[11] This fact is proven by the presence of *E. coli* (9.1%) on the Warmindo food in Table 1. Other food sanitation aspects depict well enough conditions so that the frequencies show values mostly above 70%.

On personal hygiene aspects, limited food handlers who use PPE during food processing show the awareness of Warmindo vendors are inadequate. In some countries, the condition equally occurrs, complementary to this, in Uganda, the Aerobic Plate Count (APC) exhibits a high number of bacteria exceeding the permitted

standard quality because of no applying PPE during food serving process.[12] In Indonesia, the Ministry of Health through PERMENKES RI 1096/2011 already has regulated and recommended implementing PPE as personal hygiene terms. More than 50% of food serving knows how important to use PPE but it is not implemented in their behavior.[13,14] Conversely, the bivariate test notes that applying PPE correlate to the presence of *E. coli*. The impression of data is indicated by another reason, as an example, many food handlers who use gloves to avoid food contamination, actually have the amount of Coliform that exceeds the minimum standard. In case, the dirty gloves however increasing of risk contamination.[5]

Subsequently, Table 3 explains the absence of a relationship between facilities sanitation and the presence of *E. coli* is in line with research by Rahman who states the difference between statistical test and the observation findings owing to slight and indirect correlation among those variables.[15] As educational background also gives unconnected relations. Food handlers who are knowledgeable regarding hygiene exactly are still contaminated with *E. coli*. Several factors are probable to affect someone's knowledge, such as education level, age, experience, and workplace atmosphere. Although most of Warmindo food sellers graduated from junior to senior high school, it is thinkable that they have good knowledge through their experience.[16] Additionally, Zulkifly said that lack of knowledge about food safety does not affect attitudes and practices to prevent food from germs contamination.[17]

Differences from previous explanations, food sanitation, and behavior aspect contribute straightway to effects. Food storage and food quality are able to affect *E. coli* contamination supported by data in Table 1.[16] Then, by comparing attitude, the behavior is a long period and stable of accustomed attitude therefore it is not easily changed by the environment. Thus, the unpleasant behavior of food handlers automatically strikes up food-borne diseases. More than 70% of food handlers habitually did not wash their hands and cooking stuff properly with soap and sufficient water. Furthermore, during cooking the meal they often make conversation with each other without masks and freely smoking too. Those behavior conduct extremely susceptible to bacterial contamination and food poisoning.[18–20]

Conclusion

To conclude, a strong linkage between third factors, food sanitation, facilities sanitation, behavior hygiene, and the presence of *E. coli* compared to other variables. Along with the findings, 3 out of 33 Warmindo food samples are identified as positive contaminated by pathogen microorganisms, *E. coli*. No meaningful differences between re-heating and direct-cooking food.

Conflicts of interests

The authors declare that they have no conflict of interest.

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