BKM Public Health & Community Medicine
(Berita Kedokteran Masyarakat)

Volume 39 **Number** 8, 2023, **Pages** e9195
DOI: 10.22146/bkm.v39i08.9195

Factors influencing the implementation of food sanitation hygiene in the canteen at Kendari Port

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Abstract

Purpose: Food handlers still need to routinely wash their hands with hand soap or wear aprons/masks, as there are dirty outdoor areas and many flies in canteens at Kendari port. Previous studies found that education level, knowledge, attitude, training, and availability of facilities affect the implementation of food sanitation hygiene. However, there has yet to be research on the combination of these factors in influencing the implementation of food sanitation hygiene, and research on the application of food sanitation hygiene in port areas in Indonesia is still rare. The study aimed to identify one factor that must be present for the implementation of food sanitation hygiene that meets the requirements and does not meet the requirements and identify a combination of factors that influence the implementation of food sanitation hygiene. **Methods:** The study design was cross-sectional, and 16 canteens and 16 food handlers participated using total sampling techniques. Education level, knowledge, attitude, training, and availability of facilities were analyzed using Qualitative Comparative Analysis (QCA). **Results:** No single factor was mandatory for implementing food sanitation hygiene that meets or does not meet the requirements. QCA identified three pathways for implementing eligible and not-eligible food sanitation hygiene. **Conclusion:** Frequent or regular training and adequate facilities are essential to implement food sanitation hygiene that meets the requirements. Meanwhile, poor attitudes, never or rarely-received training, and inadequate facilities were essential factors that led to implementing food sanitation hygiene, which was needed to meet the requirements.

Keywords: food; hygiene; port; QCA; sanitation

Submitted:
July 28th, 2023
Accepted:
August 27th, 2023
Published:
August 30th, 2023

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INTRODUCTION

Food is one of the primary human needs, but under certain conditions, it can become a medium for disease transmission and affect a country's economic growth [1]. Foods contaminated with bacteria, viruses, parasites, and chemicals have caused 600 million sick people and 420,000 deaths every year worldwide due to poisoning and foodborne diseases, with estimated economic losses and medical costs of more than 100 billion United States Dollars [2].

In Indonesia, the trend of food poisoning outbreaks fluctuates and is still high. Food poisoning outbreaks that occurred sequentially during 2018 – 2020 were 122 incidents (6,713 cases), 133 incidents (5,958 cases), and 100 incidents (6,044 cases), with a Case Fatality Rate of 0.1%, 0.4%, and 0.1%, respectively [3]. The investigation showed that the risk factor of food poisoning outbreaks was the food management process

that did not meet the food sanitation hygiene requirements [4].

Implementing food sanitation hygiene is critical to preventing food poisoning and foodborne diseases [5]. Food sanitation hygiene is an effort to control food handlers, equipment, food management, and facilities in food premises to prevent physical, biological, and chemical contamination of food [6]. Therefore, food producers must implement sanitation hygiene and food free of *Escherichia coli* (*E. coli*) [7]. Besides, the supervision of food hygiene and sanitation needs to be improved in line with the development of the number of food producers, such as canteens, in the port area [8].

Port as a marine transportation infrastructure has a strategic role in Indonesia's industry, trade, economy, and national development [9]. Kendari port is the entry point for shipping, passenger, and goods traffic for industrial and other activities in Kendari City. Kendari port area, shown in Figure 1, located in the center of Indonesia, also plays a role in the Sea Toll program as a link for the mobility of passengers and goods between regions and islands, both in the western and eastern of Indonesia.

The canteen is a public facility at the Kendari Port that the public, passengers, laborers, and fishermen often use. However, in some canteens, there are still conditions that do not meet food hygiene sanitation requirements, such as food handlers who do not wash their hands regularly and do not wear aprons/masks/hairnets, open garbage bins, there no dishwashing facilities with running water, open sewage drains, and lots of flies. Furthermore, laboratory results showed six samples of canteen food positive for *E. coli* [10]. *E. coli* in food indicates fecal contamination and poor food sanitation hygiene [11]. These conditions can be a risk factor for food poisoning and foodborne diseases, which can be fatal for passengers and fishermen due to the absence of medical personnel and the inadequate number of medicines and toilets in the event of an outbreak on board.

Several studies have shown factors of individual characteristics such as level of education, behavioral determinants such as knowledge and attitudes, and other factors influencing the implementation of food sanitation hygiene. Previous studies have shown that food handlers who graduated from high school apply food sanitation hygiene well [12]. Another study found that a good attitude correlated with implementing food sanitation hygiene in the canteen [13]. Lack of knowledge and sanitation facilities leads to poor hygiene of food sanitation in a restaurant [14]. Besides that, food sanitation hygiene training significantly affects the implementation of food sanitation hygiene in restaurants [15]. Thus, implementing food sanitation hygiene is related to various internal and external factors, requiring a comprehensive approach due to their complex relationship [16].

Implementing food sanitation hygiene is crucial in preventing poisoning and foodborne diseases, but conditions that do not meet the requirements remain in canteens at Kendari port. Several studies have examined the relationship of a factor in implementing food sanitation hygiene. However, studies have yet to discuss the combination of various factors influencing the implementation of food sanitation hygiene. In addition, research still needs to be conducted on the factors that influence the implementation of food sanitation hygiene in port areas in Indonesia, even though Indonesia has many ports as a maritime country. This research aims to identify a single factor (causal condition) that must exist to implement food sanitation hygiene that meets the requirements and does not meet the requirements and to identify a combination of various factors (pathways) that influence the implementation of food sanitation hygiene in canteens in the Kendari port area.

Figure 1. Kendari port area [17]

METHODS

This research is an observational study with a cross-sectional design. This research was conducted in May - June 2023 in the Kendari Port area, and 16 canteens and 16 food handlers participated using total sampling techniques.

The dependent variable in this research was the implementation of food sanitation hygiene. Meanwhile, the independent variables were the level of education, knowledge, attitudes, training, and availability of facilities.

Data were collected using Environmental Health Inspection (EHI) form, checklists, and questionnaires. In addition, *E. coli* testing is carried out in the laboratory on samples of drinking water, food, and

cutlery as part of the EHI form assessment. The EHI form used in this research consisted of 4 sections (outside canteen area, consumer area, kitchen area, and microbiology quality standards) which contained 63 assessment items. The value of the non-conformance of the assessment items is added up and then calculated according to the formula = 100 – ((Total non-conformance/220) x 100). Canteens with inspection scores ≥80 are declared eligible. Meanwhile, canteens with inspection scores < 80 are declared not eligible. The checklist consists of 15 items on the availability of sanitation facilities and PPE. If the facility exists, it is given a value of 1; if it does not, it is given a value of 0. A canteen with a score of ≥70% is declared to have adequate facilities. Conversely, the canteen with a score of <70% is stated to have inadequate facilities.

Respondents filled in the questionnaire by selecting one of the available answers to determine the variable level of education, knowledge, attitudes, and training. The knowledge section consists of 10 statements and the attitude consists of 20 statements. In the knowledge section, true choices are given a value of 1 and wrong decisions are given 0 for a favorable statement and vice versa for an unfavorable statement. In the attitude section, the choices strongly disagree, disagree, agree, and strongly agree are respectively given a value of 1, 2, 3, and 4 for a favorable statement and vice versa for an unfavorable statement. Respondents with a score of ≥80% were declared to have good knowledge and attitudes. In contrast, respondents with a score of <80% were declared to have poor knowledge and attitudes.

The EHI Form, checklists, and questionnaires used in this research were adapted from the Regulation of the Minister of Health of the Republic of Indonesia Number 14 in 2021 and a previously published research article [18].

Univariate analysis was used to determine the frequency distribution of the level of education, knowledge, attitudes, training, facility availability, and implementation of food sanitation hygiene.

Qualitative comparative analysis (QCA) was used to identify one causal condition that must exist for the implementation of food sanitation hygiene that meets the requirements and does not meet the requirements and identifies a combination of causal conditions in influencing the implementation of food sanitation hygiene in canteens in the Kendari port area. QCA is an analytical method based on set theory and Boolean algebra to determine the necessary and sufficient conditions to achieve an outcome from certain causal conditions [19]. A necessary condition is a causal condition that is always present for an outcome to occur. Meanwhile, sufficient conditions are combinations of causal conditions (pathways) that produce outcomes [20,21].

In QCA, causal conditions are determinants or variables that affect outcomes or can be termed independent variables. Meanwhile, outcomes are effects or variables influenced by causal conditions or dependent variables [22,23]. The parameters of fit resulting from the necessary condition and sufficient condition analysis are determined based on consistency and coverage with a value of 0 – 1 [24]. Consistency is the proportion of a causal condition or pathway that produces an outcome.

Table 1. The calibration of causal conditions and outcomes

Variables (Outcome and Causal conditions)	Codes and threshold
The implementation of food sanitation hygiene	1: Eligible: Canteen with an inspection score of ≥80 and the food produced is free of *E. coli* 0: Not eligible: Canteen with an inspection score of <80 and/or the food produced contains *E. coli*
Level of education	1: Food handlers with undergraduate education 0.8: Food handler with diploma education 0.6: Food handlers with high school education 0.4: Food handlers with junior high school education 0.2: Food handlers with elementary school education 0: Food handlers do not go to school
Knowledge	1: Food handler knowledge is good, with a score of ≥80% 0: Food handler knowledge is poor, with a score of <80%
Attitude	1: The attitude of the food handler is good, with a score of ≥80% 0: The attitude of the food handler is bad, with a score of ≥80%
Training	1: Food handlers always (every month) receive training 0.67: Food handlers often receive training 0.33: Food handlers rarely receive training 0: Food handlers never receive training
Availability of facilities	1: Adequate: Canteen with an inspection score of ≥70% 0: Inadequate: Canteen with an inspection score of <70%

Meanwhile, coverage is the proportion of outcomes explained by certain causal conditions or pathways. Consistency and coverage can be analogous to assessing significance and strength in correlation analysis [25]. A causal condition is considered necessary if it has a consistency value of ≥0.9 and a coverage value of ≥0.6 [26]. Meanwhile, pathways are considered a sufficient condition if they have a consistency value of ≥0.8 and a coverage value of ≥0.2 [19].

This research used fuzzy-set QCA (fsQCA), which encodes causal conditions and outcomes at 0 and 1 or 0 – 1 with 0.5 as the intersection point of the membership level of the set (e.g., 0, 0.33, 0.67, and 1 or 0, 0.2, 0.4, 0.6, 0.8, and 1) [25,26]. The assignment of codes or scores (calibration) is based on theory, in-depth knowledge, and empirical evidence [24]. The calibration of causal conditions and outcomes in this study is described in Table 1. This research used fs/QCA 4.0 software. In addition, Microsoft Excel is also used to create calibration tables stored in comma-separated values (*.csv) format as input for fs/QCA 4.0 software.

RESULTS

Table 2 shows that of the 16 canteens and food handlers, most respondents had elementary school education (43.8%). Most respondents have good knowledge about food sanitation hygiene (75%). Percentage of respondents who have good and bad attitudes towards balanced food sanitation hygiene (50%).

Table 2. Characteristics of respondents

Variables	n (%)
Level of education	
Undergraduate	0
Diploma	0
Senior high school	5 (31.2)
Junior high school	4 (25.0)
Elementary school	7 (43.8)
No school	0
Knowledge	
Good	12 (75)
Poor	4 (25)
Attitude	
Good	8 (50)
Bad	8 (50)
Training	
Always	3 (18.8)
Often	7 (43.8)
Rarely	5 (31.2)
Never	1 (6.2)
Availability of facilities	
Adequate	7 (43.8)
Inadequate	9 (56.2)
The implementation of food sanitation hygiene	
Eligible	7 (43.8)
Not eligible	9 (56.2)

Table 3. Necessary condition analysis for the implementation of eligible and not eligible food sanitation hygiene

Causal conditions	Implementation of eligible food sanitation hygiene		Implementation of not eligible food sanitation hygiene	
	Consistency	Coverage	Consistency	Coverage
Level of education	0.34	0.40	0.40	0.60
~Level of education	0.66	0.46	0.60	0.54
Knowledge	0.86	0.50	0.67	0.50
~Knowledge	0.14	0.25	0.33	0.75
Attitude	0.86	0.75	0.22	0.25
~Attitude	0.14	0.13	0.78	0.86
Training	0.81	0.61	0.41	0.39
~Training	0.19	0.19	0.59	0.80
Availability of Facilities	0.86	0.86	0.11	0.14
~Availability of Facilities	0.14	0.11	0.89	0.89

Most of the respondents often and always receive training (62.6%). In addition, the same percentage of respondents have inadequate facilities, and implementing food sanitation hygiene needs to meet the requirements (56.2%).

Table 3 shows the results of the necessary condition analysis on all causal conditions, including the negation of causal conditions (marked "~") for the implementation of eligible and not-eligible food sanitation hygiene. In the implementation of food sanitation hygiene that meets the requirements, the highest consistency score is in three causal conditions, the availability of facilities (adequate), attitude (good), and knowledge (good), then followed by training (often and always) and ~level of education (no school, elementary, junior high). However, the availability of facilities (adequate) has the highest coverage. In addition, the unique result is that ~level of education (no school, elementary, junior high school) has a consistency value higher than the level of education (senior high school, diploma, undergraduate).

As for the implementation of food sanitation, hygiene does not meet the requirements, causal conditions with a consistency value the highest was ~availability of facilities (insufficient), then followed by ~attitude (bad), knowledge (good), ~level of education (no school, elementary, junior high school), and ~training (never, rarely). A unique result is that knowledge (good) has more consistency than ~knowledge (bad). Overall, there are no causal conditions with a consistency value above 0.90 and coverage above 0.60, which means that no causal condition must exist to implement food sanitation that meets the requirements and does not meet the requirements.

Figure 2 and Figure 3 show three pathways for implementing eligible and not-eligible food sanitation hygiene. Of the 16 cases (canteens) studied, 61% met the requirements for implementing food sanitation hygiene, and Pathways with Consistency 1 explained 78% of cases where food sanitation did not meet the requirements. All pathways exceed the consistency and coverage value threshold, which means adequate pathways to produce food sanitation hygiene that meet the requirements and do not meet the requirements.

Concerning implementing food sanitation hygiene that meets the requirements, pathway 1 represents those canteens with food handlers with elementary and junior high school education but have good knowledge and often or always receive training and adequate facilities (Cases 11, 12, and 16). Pathway 2 shows that canteens with food handlers have elementary and junior high school education but have good attitudes and often or always receive training and adequate facilities (Cases 2, 12, and 16).

Finally, pathway 3 shows canteens with food handlers who have good knowledge and attitudes and often or always receive training and adequate facilities (Cases 3, 12, 13, and 16). Overall, pathways 1, 2, and 3 show the availability of facilities (adequate) and training (often, always). This result indicates that the availability of facilities (adequate) and training (often, always) are necessary causal conditions in implementing eligible food sanitation hygiene.

As for implementing food sanitation hygiene that does not meet the requirements, pathways 1 represent canteens with food handlers with elementary or junior high school education who have poor knowledge and attitudes and have never or rarely received training (Cases 6, 8, and 15). Pathways 2 represents canteens with high school-educated food handlers who have good knowledge but rarely receive training, and the facilities need to be improved. (Cases 5 and 9).

Pathways 3 represents a canteen with food handlers with good knowledge but needs better attitudes and adequate facilities (Cases 1, 4, 7, and 9). Overall, ~ the availability of facilities (inadequate), ~attitude (bad), and ~training (never, rarely) appear in the two pathways. This result shows that ~the availability of facilities (inadequate), ~attitude (bad), and ~training (never, rarely) are necessary causal conditions for implementing not eligible food sanitation hygiene.

DISCUSSIONS

The education level of food handlers in the Kendari Port area canteens is mainly elementary and junior high school. This finding is the same as the results of research by [27] on food handlers in food courts in Malaysia. Food handlers' knowledge of food hygiene in the Kendari port

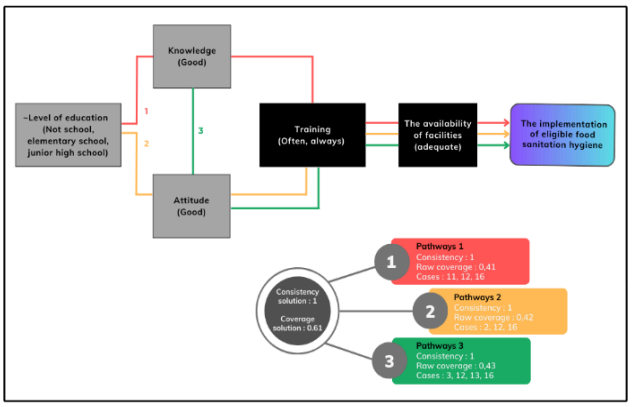

Figure 2. Pathways for implementing eligible food sanitation hygiene

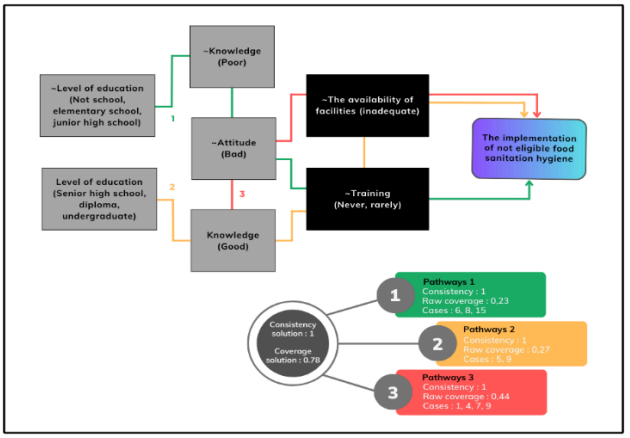

Figure 3. Pathways for implementing not eligible food sanitation hygiene

area canteens is generally good, with an average score above 80. This finding is the same as a study by [28], who found the average knowledge score in restaurant food handlers in Malaysia was 83.9. All food handlers know well that sick food handlers must not process food, food processing rooms must be separated from toilets and bathrooms, and handling food without using tongs will contaminate food. Sick food handlers may not process food because it has the potential to transmit pathogens to food [29].

In addition, to prevent cross-contamination of food, the kitchen must be separate or not directly related to the toilet, and food handlers must use food tongs or gloves in food processing activities [8]. However, many food handlers still need to understand that the water used for washing equipment should be flowing. Using running water in washing equipment helps rinse and remove residual soap and dirt or grease [8].

Attitudes towards food sanitation hygiene in canteen food handlers in the Kendari port area are generally good, with an average score of more than 80.

This finding is the same as the research results by [13], who found that the average attitude score of campus canteen food handlers in Malaysia was 89.3. All food handlers believe in the importance of using clean water that meets drinking water requirements for cooking. According to [30], using clean water free of microorganisms and chemicals is one of the five keys to producing safe food. However, many food handlers still do not care about the need to provide covered trash bins in the canteen. Closed trash cans are important to prevent access to vectors and disease-carrying animals [31].

According to [32], port health authorities can actively provide training on food sanitation hygiene at food premises locations. Food handlers in canteens in the Kendari port area generally stated that they often and always (every month) received health workers' training regarding food hygiene and sanitation. However, some food handlers said they rarely received food hygiene and sanitation training. This condition could be due to the canteen being closed, the food handlers not being in the canteen, or the replacement of new food handlers when health workers inspected and trained at the ports.

The availability of sanitation facilities and PPE in the Kendari port area canteens could be more robust, with an average total score of 59.6. The facilities that are not owned by all canteens are sewers that are watertight closed, and equipped with grease traps, sinks with hand washing soap, running water, and tissues in the consumer's dining area and kitchen area, as well as covered trash cans unopened by hand and covered in a plastic bag. According to [8], liquid waste from washing and cooking activities in the kitchen can contain hazardous substances, so it needs to be managed with adequate wastewater disposal facilities not to cause environmental pollution odors and become a breeding ground for vectors and disease-carrying animals. Adequate hand-washing sink facilities are essential in maintaining hand hygiene for everyone, especially food handlers, and need to be located in an easily accessible location [29]. Trash bins with a lid are opened with a foot pedal and covered with plastic bags to prevent access to vectors, disease-carrying animals, and cross-contamination [31].

Implementing food sanitation hygiene in canteens in the Kendari port area is generally classified as failing to fulfill the requirements, with an average total inspection score of 78.2. All food handlers do not conduct health checks at least once a year. This result differs from most restaurant food handlers in Kuwait who carry out and have health examination cards in the study [33]. In addition, most food handlers do not routinely wash their hands with hand soap before cooking, before packing food, and after touching money, do not wear masks, and do not maintain food temperatures above 60°C. According to [29], food handlers must always maintain personal hygiene by using personal protective equipment and constantly washing hands at every stage of food production, especially before handling food, after using the toilet, after touching objects that may be contaminated, and others. In addition, inadequate time and temperature control in the food serving process is a frequent failure. It allows the growth of microorganisms that can cause food spoilage and foodborne diseases.

The results of the necessary condition analysis show that no single causal condition must exist for the implementation of food sanitation hygiene that meets the requirements and does not meet the requirements in the canteen in the Kendari port area. This result is due to the absence of any causal conditions that are perfectly consistent, resulting in the implementation of food sanitation that meets the requirements and does not meet the requirements so that the consistency value and coverage value of any causal condition below the necessary condition threshold value. The findings of this study follow the research of [16], which states that the implementation of food sanitation hygiene cannot be realized with just one factor but by the interaction between internal factors (personal factors) and external factors (food premises or environment factors).

The results of the sufficient condition analysis show that each of the three pathways is sufficient to explain the implementation of food sanitation that meets the requirements and does not meet the requirements in canteens in the Kendari port area. In addition, all pathways also show interactions between internal and external factors, as the research results [16]. These internal factors include the level of education, knowledge, and attitudes of food handlers, and these external factors include food sanitation hygiene training, which food handlers get from health workers, and the availability of facilities.

This study found that the interaction of factors of low education level (elementary or junior high school), good knowledge, good attitude, frequent or routine food sanitation hygiene training, and adequate facilities can result in implementing food sanitation hygiene that meets the requirements. On pathways 1 and 2, canteens with food handlers with elementary or junior high school education can result in the implementation of food hygiene and sanitation that meets the requirements. It is also evident that a high level of education is only sometimes necessary for a qualified implementation of food sanitation hygiene.

The results of this study are the same as those of the study's research [28], which found no significant relationship between higher education level and good practice in food hygiene. However, [34] found that food handlers with a high level of education would apply food sanitation hygiene that was good, and food handlers with a low education level would apply food hygiene and sanitation bad.

On pathways 1 and 3, canteens with food handlers who have good knowledge of food sanitation hygiene can result in the implementation of food sanitation hygiene that meets the requirements. The results of this study are the same as those of the research by [33], which states that food handlers with good knowledge tend to practice good food sanitation hygiene as well. In addition, good knowledge is also a precursor of good attitudes and practices in food hygiene [28].

On pathways 2 and 3, canteens with food handlers who have a good attitude towards food sanitation hygiene can result in the implementation of food sanitation hygiene that meets the requirements. The findings of this study are the same as those of the research by [35], which states that food handlers with a good attitude tend to practice good food sanitation hygiene as well. [28] also stated that having good knowledge and attitudes will result in implementing good food sanitation hygiene. A good attitude is important in translating knowledge into good food sanitation and hygiene practices [36].

Adequate facilities and frequent and routine training are necessary causal conditions in implementing food sanitation hygiene that meet the requirements. This result follows several previous studies which stated that the existence of adequate sanitation facilities and PPE could support food handlers to practice good food sanitation hygiene [37,38], and frequent and periodic training of food handlers helps increase knowledge, attitudes, and hygiene practices of food sanitation [39,40].

The results of the analysis in this study showed that there was an interaction between low (elementary or junior high school) and high (senior high school) education levels, good and bad knowledge, bad attitudes, never or rarely received food sanitation hygiene training, and inadequate of facilities with the implementation of food sanitation hygiene that does not meet the requirements. In Pathway 1, canteens with food handlers with low education levels can result in the implementation of food sanitation hygiene that needs to meet the requirements. This finding is the same as the research of [41], which states that food handlers with a low education level tend to practice food sanitation hygiene, which is terrible. In contrast, in pathway 2, canteens with food handlers with high-level education can also result in the implementation of food sanitation hygiene that does not meet the requirements. The findings of this study differ from those of [42], which state that canteens with high school-educated food handlers tend to implement good food hygiene and sanitation.

In canteens with food handlers who have poor knowledge (pathways 1) and good knowledge (pathways 2 and 3) about food hygiene and sanitation, food sanitation hygiene needs to be appropriately applied. This finding follows the research of [43], which states that a lack of knowledge of food handlers causes poor food sanitation hygiene practices in food premises. Pathways 2 and 3 show that good knowledge of food handlers is only sometimes guaranteed to implement good sanitation hygiene. This finding follows the research of [13,36], which revealed that good knowledge alone is insufficient to realize good food sanitation hygiene practices. A bad attitude can influence this. This study's findings align with [18] research that shows that food handlers with bad attitudes tend to practice food sanitation hygiene that does not meet the requirements.

In pathways 1 and 2, canteens with food handlers who have never or rarely received food sanitation training can implement food sanitation hygiene that does not meet the requirements. This result follows the research of [44], who found that food handlers who had never received food sanitation hygiene training tended to have poor knowledge and practice of food sanitation hygiene.

In pathways 2 and 3, canteens with inadequate facilities can result in the implementation of food sanitation hygiene that does not meet the requirements. This result follows the research of [45], who found that the unavailability of sewerage channels, trash cans, and toilets results in poor implementation of hygiene and sanitation in food premises. The absence of adequate facilities makes it difficult and impossible for food handlers to implement sanitation hygiene practices even though they know the obligation to carry out good sanitation practices [27].

CONCLUSION

Each factor is optional when implementing eligible and non-eligible food sanitation hygiene for canteens in the Kendari port area. There are three paths for implementing food sanitation hygiene that meet the requirements in canteens in the Kendari port area, with frequent or monthly food sanitation hygiene training and adequate facilities as essential factors. In addition, three pathways for implementing food sanitation hygiene must meet the requirements in

canteens in the Kendari port area with bad attitudes, never or rarely receiving food sanitation hygiene training, and inadequate facilities as important factors. Thus, stakeholders and canteen owners are required to intervene in these factors.

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