

Food safety training influence on food service workers' knowledge and compliance to Malaysia Food Hygiene Regulations 2009

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Abstract

This study was conducted to evaluate the influence of food safety training on the knowledge and compliance of food service workers with Malaysia Food Hygiene Regulations 2009 in Cyberjaya, Selangor, Malaysia. Data were collected from 261 food service workers (108 casual dining restaurant owners and 153 food handlers) through a survey by means of a questionnaire which consisted of questions on business and premises profiles, history of premises inspection and knowledge of food hygiene aspects as outlined in the Malaysia Food Hygiene Regulations 2009. The results showed that there was a significant positive association ($p < 0.05$) between attending food safety training and the level of respondents' knowledge of Malaysia Food Hygiene Regulations 2009. There was a significant positive association ($p < 0.05$) between respondents' knowledge and the level of compliance with Malaysia Food Hygiene Regulations 2009 with different food safety training providers. There was also a significant positive association ($p < 0.05$) between respondents' knowledge and the level of compliance with Malaysia Food Hygiene Regulations 2009 with food safety training sources. In conclusion, over half of the food service workers showed satisfactory food safety knowledge and compliance with Malaysia Food Hygiene Regulations 2009. This study found that there was a significant relationship ($p < 0.05$) between food service workers' knowledge and compliance with Malaysia Food Hygiene Regulations 2009. A significant relationship ($p < 0.05$) was also found in knowledge and level of compliance with all food safety training factors (food safety training attendance, food safety training providers and food safety training sources) in the Malaysia Food Hygiene Regulations 2009. Hence, hypotheses H1, H2 (H2a, H2b, H2c) were accepted. It is suggested that in related future research, data are collected from a larger sample size and at different locations to gain more comprehensive outcomes.

1. Introduction

Food is essential to life and undoubtedly the food industry plays a very important role. The industry has evolved in recent years whereby a high level of hygiene is warranted. It is therefore imperative to set up standard regulations. These regulations will provide an infrastructure to control the hygiene and safety of food sold to consumers. In view of this fact, the Malaysian government through the Ministry of Health outlined the Malaysia Food Hygiene Regulations 2009. The regulations include requirements for registration of food premises, conduct and maintenance of food premises, training, medical examination and health condition, clothing and personal hygiene of food handlers,

handling, preparing, packing, serving, storing and selling specific food, carriage of food, and offences (FAO and WHO, 2002). Malaysia Food Hygiene Regulations 2009 are conferred to ensure food service workers are well-trained and adopt good hygiene practices when handling and preparing food for public consumption (Tirmizi *et al.*, 2018). A food service worker is the personnel in charge of food preparation, service and general maintenance in the kitchen and dining area (Osaili *et al.*, 2017). Examples of food service workers include food handlers, food premises owners and food premises supervisors. Compliance with the Malaysia Food Hygiene Regulations 2009 is essential as the policies under the legislation emphasise food service workers to

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provide safe and hygienic food for the public (Kunasegaran *et al.*, 2020). This concurs with Saad *et al.* (2018) who implied that adherence to Malaysia Food Hygiene Regulations 2009 could lead to high-level hygiene practices amongst food service workers, thus reducing foodborne illnesses originating from food premises.

Food hygiene cannot be neglected in handling and preparing food at food premises. Lee *et al.* (2017) implied that hygienic food preparation and the training of food service workers are important factors to reduce the risk of foodborne illness. Despite training and awareness provided by the Ministry of Health (MOH) to educate food service workers on food safety, personal hygiene, and cleanliness in the food premises (MOH, 2018), unfortunately, there continues to be a rise in the report of non-compliance with food safety regulations. In May 2018, an Indian restaurant in Bangsar was shut down, for failing to meet many health requirements after the MOH evaluated the restaurant (Loh, 2018). In June 2018, two banana leaf restaurants and a Chinese Kopitiam in Seksyen 5, Petaling Jaya were shut down for their filthy practices and environment. It was revealed that during a general inspection by Petaling Jaya City Council (MBPJ) health officers, three restaurants which served Indian cuisine were found to be infested with pests like rats and cockroaches (Zomato and Vkeong, 2018). Since January 2018, MBPJ inspected 250 restaurants around Petaling Jaya and 59 (23%) of them have been closed for uncleanliness, unhygienic practices, and a dirty environment. The challenge of ensuring food safety is immense and in this time of increasing food safety concerns and shrinking resources, it is essential to examine food workers' compliance with food safety regulations.

Failure to adhere to food safety regulations has led to an increase in reported food poisoning cases in Malaysia. 17,480 cases were reported in 2016 which amounted to 55.21 cases per 100,000 population and in 2017, 13,686 cases were reported, i.e., 42.25 cases per 100,000 population (DOS, 2018). In Malaysia, food poisoning cases have increased by 3.2% in 2019 compared to 2018 (Nor Ain, 2020). One possibility may be due to food service workers' failure to comply with food safety regulations. Other reasons may include offences related to improper handling of cooked foods which is prone to cross-contamination or operating in dirty conditions. Among the gross offences detected causing those premises to be shut down were placing pots of exposed marinated chicken on top of drain covers, laying containers filled with fried chicken next to uncovered rubbish bins, and rat faeces scattered in the raw materials' storeroom. Also, most of the foreign workers

employed in the 32 premises inspected across Malaysia work without food handling certificates and have not received typhoid vaccinations (Masry, 2015).

Pei *et al.* (2016) suggested that 3 key factors responsible for the poor knowledge acquisition of food handlers are poor participation in food safety training programmes, low education level and language barriers for foreign workers. It is recommended that food safety knowledge acquisition should be improved to ensure better compliance with food safety regulations. Several pieces of research have been conducted on food safety knowledge in Malaysia by Low *et al.* (2016), Abdullah Sani and Siow (2014), Tan *et al.* (2013), Mazni *et al.* (2013) and Abdul Aziz and Mohd Dahan (2013). Their findings that show moderate knowledge of food safety among respondents indicate the necessity to educate them to improve their background knowledge on food safety. Most of the researchers conclude that education is one of the means that can be used to enhance the knowledge of food safety among stakeholders. For the food safety knowledge enhancement programme to be effective, it must be able to provide the widest possible coverage to the population. To provide continuity to such programmes, the government's involvement is crucial. The use of new media and emerging technology may be necessary as the means to promulgate knowledge on food safety.

As stated in the preceding paragraphs, food safety training is crucial to equip food service workers with sufficient food handling knowledge and to alert them to comply with Malaysia Food Hygiene Regulations 2009. Various studies to investigate food handlers' compliance with food safety have been carried out in many countries including Vietnam (Huynh-Van *et al.*, 2022), Kuwait (Moghnia *et al.*, 2021) and the United States (Harris *et al.*, 2019). However, a review of existing literature revealed that limited empirical studies on food handlers' compliance with food safety have been conducted in Malaysia. There was a study carried out in Kedah, one of Malaysia's northern states (Jalani *et al.*, 2020). This study disclosed that food handlers' knowledge influenced their compliance with food safety, and this concurs with Gruenfeldova *et al.* (2019) who implied that food handlers' compliance with food safety regulations was influenced by their knowledge acquired in food safety training. This encourages this current study as there is a lack of research on food service workers' food safety knowledge and compliance with Malaysia Food Hygiene Regulations 2009. Therefore, it is very important to assess the extent of food safety knowledge and compliance of food service workers with the Malaysia Food Hygiene Regulations 2009 in order to ensure all food service workers adopt a high level of

hygiene and sanitary practices at food establishments. Considering that no study has been carried out to assess food safety training's influence on food service workers' knowledge and compliance with Malaysia Food Hygiene Regulations 2009, this study is aimed to evaluate the knowledge and compliance of food service workers with Malaysia Food Hygiene Regulations 2009 in the Cyberjaya area.

2. Materials and methods

2.1 Study design

This study was conducted in a total of 108 restaurants registered with the Ministry of Health in Cyberjaya, Selangor, which was distributed in 17 different locations (MP Sepang, Neocyber, Glomac, CBD Perdana 1, CBD Perdana 2, Prima Avenue, Prima 15, Shaftsbury Square, Gem In Mall, Cottage Walk, Galleria, Cyber Square) within the city. Purposive sampling location was chosen for the sampling procedure. The restaurants selected are casual dining restaurants with various cuisines, namely Malay, Chinese, Indian, Arabian, Western, Indian Muslim, Japanese and Thai Casual dining restaurants are restaurants that offer and serve moderate and decent-priced menu selections in a casual atmosphere (Baek and Choe, 2020). Malaysian casual dining restaurants can be classified into two groups: 1) the higher price range outlets which usually receive guest payment averaging from RM40 to RM50, 2) the lower price range outlets averaging between RM10 and RM20 per person (Euromonitor International, 2013). Casual dining restaurants are popular amongst customers in Cyberjaya, possibly due to the various menus offered at these restaurants, their pleasant environment and clean premises. Convenience sampling was used to choose samples for this study. A total of 261 food service workers (108 restaurant owners, 153 food handlers working in restaurants) participated and data were collected through questionnaires. Before distributing the questionnaire, the researcher determined whether the participants had attended food safety training and found that all 261 participants had already attended. The respondents were given sufficient time (approximately 15 mins) to answer the questionnaire. The sample size ($n = 261$) was sufficient as the minimum sample size required for a survey-based study is 200 (Louanglath, 2017). This study was carried out according to the guidelines stated in the Declaration of Helsinki, and respondents were asked for their consent to participate in this survey. Respondents were also informed that their participation was voluntary and they could withdraw from this study at any point in time or choose not to answer any questions. No respondents withdrew from this study. All respondents provided informed consent

and their answers were guaranteed anonymity.

2.2 Questionnaire design

The study was conducted using a well-structured paper-based questionnaire in two languages (Malay and English). The questionnaire was designed based on related past studies, modified to meet the aim of the present study, tested, and validated (Norazmir *et al.*, 2012). The first strata of the questionnaire were divided into six (6) sections: the first section collected the respondents' socio-demographic data (age, gender, race, work experience and education, position, vaccination status) (Lee *et al.*, 2017; Pei *et al.*, 2014). Section 2 aimed to gather the business and premises profiles (Rebouças *et al.*, 2017). The respondents were asked to choose from three answer options – “Yes”, “No” or “Don't know” to reduce the probability of answers selected by chance. Section 3 was designed to assess the history of premises inspection. The respondents were asked questions on the frequency of inspection of the restaurant, and its premises, and to choose from three optional answers – “Yes”, “No” or “Don't know” as adopted from the Malaysia Food Hygiene Regulations 2009. Section 4 was designed to assess the level of knowledge of food hygiene aspects outlined in the Malaysia Food Hygiene Regulations 2009 such as the display of a certificate of registration with the Malaysia Ministry of Health, the practice of clean food processing, the practice of clean food storage and distribution, and practice of clean restaurant premises. This section was measured using a dichotomous scale with an answer option of “Yes”, “No” or “Not sure” as adapted from Tan *et al.* (2013) and Pivarnik *et al.* (2011). The respondents were asked questions on the cleanliness or hygiene of the restaurant, its premises, food handlers' attitude toward safe food handling, prevention of foodborne illnesses and practices during food handling. Section 5 was designed to evaluate the level of compliance with Malaysia Food Hygiene Regulations 2009 using three optional answers – “Yes”, “No” or “Not sure”. The original categorical scales were converted into a continuous scale (scores) which allows the researcher to conduct a correlation analysis. This conversion during analysis provides certain benefits. First, it enhances greater statistical power. Second, it provides a simpler interpretation (e.g. a change in the predictor variable by x units leads to a change in the response variable of y units), and this is usually more informative as well. Finally, there is the added flexibility of allowing transformations of the predictor variable (Taherdoost, 2019).

2.4 Pilot test

A pilot study was performed on 10 selected respondents, who were not among the actual test samples. The result of the pilot test was analyzed to establish the reliability and validity of the questionnaire. The analysis of the pre-test revealed only one (1) issue for Section B of the questionnaire, which is question 11; where the respondents were asked to “rank the following sources to obtain information of food safety based on their preference on the scale of 1 to 8: 1 being the least preferred while 8 being the most preferred choice”. Three (3) respondents (30%) of the total pre-test sample ticked only one choice, instead of ranking the eight (8) choices in the order of preferences from 1 – 8. Three (3) respondents (30%) gave a confusing ranking (by giving the same rank to more than one choice). Four (4) of the respondents (40%) answered the question correctly by ranking each choice accordingly. The researcher concluded this misunderstanding occurs because questions related to the ranking scale can be difficult to administer. When there are various options in a ranking scale, it may take respondents much time to complete it. The respondents may be subjected to survey fatigue, thereby providing unreliable responses (Levordashka, 2006). Hence, this question was properly debriefed to the respondents during the main data collection to reduce the bias in respondents’ responses. It is important to be reminded that the provision of many options in a ranking scale can lead to survey fatigue amongst respondents, but it will increase the data reliability. The result’s reliability increases as the number of response options increases (Taherdoost, 2019).

2.5 Theoretical background and hypotheses development

Two hypotheses were developed based on the relationship between knowledge and compliance with Malaysia Food Hygiene Regulations 2009. Another two hypotheses were aimed to test the association between food service workers’ knowledge, compliance, and barriers level of Malaysia Food Hygiene Regulations 2009 with food safety training variables. This study is theoretically supported by the compliance theory. Theories about compliance provide accounts of why different actors – firms and individuals– comply with or do not comply with laws and regulations. The theory of compliance and enforcement was proposed by Becker (1968), to address the enforcement of criminal law. His basic insight is that potential offenders respond to both the probability of detection and the severity of punishment if detected and convicted. Thus, deterrence may be enhanced either by raising the penalty, by increasing monitoring activities to raise the likelihood that the offender will be caught, or by changing legal rules to increase the probability of conviction (Mark,

2000).

Apart from compliance theory, the theory of planned behaviour (TPB) suggests that intention to act and objective situational factors as determinants of behaviour (Ajzen, 2002). The intention itself is considered summarising the interplay of cognitive variables which includes (knowledge and skills) as well as personality variables (locus of control, attitudes and personal responsibility). The theory of planned behaviour originated from the theory of reasoned action, and it suggests that human behaviour is influenced by three belief constructs: beliefs about consequences, expectations of others and factors that may support or prevent behaviour (Hammond *et al.*, 1995). The application of this model to this study is that the model provides further explanations of the connection between knowledge, training, training sources and actual behaviour as they influence compliance. Knowledge is not a specific component in the model but “training and food safety training sources” are a function of compliance (Schifter and Ajzen, 1985) since in this context, compliance refers to knowledge about a specific behaviour. Azjen’s model, therefore, allows for the representation of cognitive elements through affective elements by their influence on compliance. For instance, when a person understands that he or she has control over a certain situation, his or her behavioural intentions reflect this understanding as much as his or her beliefs as to the outcome of certain behaviour. These discussions have led to the development of hypothesis 1, as stated below:

Hypothesis 1 (H1): There is a significant relationship between food service workers’ knowledge and compliance with Malaysia Food Hygiene Regulations 2009 in Cyberjaya restaurants.

Past studies have shown the effect of food safety training on the knowledge and compliance level of food handlers with regulations. Abdullah Sani and Siow (2014) conducted a study to determine the level of knowledge, attitudes and practices of food handlers who worked at Universiti Kebangsaan Malaysia. They reported that there is a significant relationship between knowledge, attitudes and practices in ensuring the safety of food provided. Campos *et al.* (2009) assessed the effect of personal hygiene and practices of food handlers in a municipal public school and they concluded that proper hand hygiene can significantly reduce the infections caused by microorganisms. Safe food handling is an essential part of food handlers’ job responsibilities. Tan *et al.* (2013) evaluate the hand hygiene knowledge, attitudes and practices among food handlers at primary schools. They reported that there is a slight positive relationship between hand hygiene, knowledge, and self-

reported practices of food handlers. Food handlers' attitude toward hand hygiene is a very important aspect of food safety but many restaurant workers may not really be aware of the importance of personal hygiene during work.

Based on the evidence discussed above, hypothesis 2 is set as below:

Hypothesis 2 (H2): There is a significant association between food service workers' knowledge and compliance level of Malaysia Food Hygiene Regulations 2009 with the food safety training variables in Cyberjaya restaurants.

H2a: There is a significant association between food service workers' knowledge and compliance level of Malaysia Food Hygiene Regulations 2009 with the attendance of food safety training in Cyberjaya restaurants.

H2b: There is a significant association between food service workers' knowledge and compliance level of Malaysia Food Hygiene Regulations 2009 with the food safety training provider in Cyberjaya restaurants.

H2c: There is a significant association between food service workers' knowledge and compliance level of Malaysia Food Hygiene Regulations 2009 with the food safety training source in Cyberjaya restaurants.

Based on the outlined hypotheses stated in the previous section, the conceptual framework is designed to enable the researcher to link the findings to the body of knowledge as shown in Figure 1. Figure 1 indicates the variables for this study. There are two main hypotheses were tested in this study as discussed above. H1 aims to examine the relationship between the independent variable which is the 'food service workers' knowledge level of Malaysia Food Hygiene Regulations 2009' and the dependent variable which is the 'food service workers' compliance level of Malaysia Food Hygiene Regulations 2009'. H2, another aim of this study is to examine the association of training factors with the food service workers' knowledge and compliance level of Malaysia Food Hygiene Regulations 2009'.

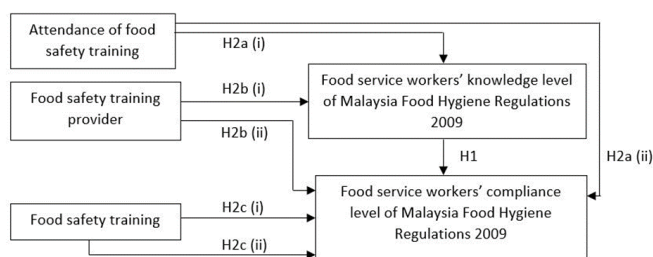


Figure 1. Conceptual framework of the present study.

2.6 Statistical analysis

The statistical analysis of all collected data was performed using the IBM Statistical Package for Social Science (SPSS) version 27. The socio-demographic characteristics of respondents and their scores concerning food service workers' compliance with Malaysia Food Hygiene Regulations 2009 were summarised using descriptive statistics. The collected data were described using measures of central dispersion and tendency, frequency distribution tables and percentages to achieve the research objectives. Correlation analysis was used to test the relationship between an independent (food safety knowledge scores) and a dependent variable (compliance with Malaysia Food Hygiene Regulations 2009) of this study which aimed to test hypothesis 1 to hypothesis 2. Chi-square tests were used to investigate the association between knowledge and compliance level of Malaysia Food Hygiene Regulations 2009 with the food safety training-related variables. All the significant tests for the hypotheses were at a 95% confidence level ($p < 0.05$).

3. Results and discussion

3.1 Demographic characteristics of respondents

Respondents' demographic information was used to characterise this study's samples. A total of 261 completed questionnaires were collected. The 261 food service workers were composed of 108 casual dining restaurant owners and 153 food handlers. As shown in Table 1, this study revealed that the number of male respondents ($n = 181, 69.3\%$) was higher than female respondents ($n = 80, 30.7\%$). Most respondents were between 20 to 29 years old ($n = 94, 36.0\%$), followed by those from 30 to 39 years old ($n = 77, 29.5\%$), 40 to 49 years old ($n = 54, 20.7\%$) and less than 20 years old ($n = 36, 13.8\%$). Most respondents are Malay ($n = 112, 42.9\%$), followed by others ($n = 91, 34.9\%$), Indian ($n = 47, 18.0\%$) and Chinese ($n = 11, 4.2\%$). From the perspective of respondents' educational level, they were discovered to be college or university graduates ($n = 131, 50.2\%$), secondary school leavers ($n = 109, 41.8\%$), primary school leavers ($n = 18, 6.9\%$) and others ($n = 3, 1.1\%$). Most respondents' marital status was single ($n = 134, 51.3\%$) compared to married ($n = 127, 48.7\%$). In terms of religion, most respondents were Muslim ($n = 196, 75.1\%$), followed by Hindu ($n = 45, 17.2\%$), Buddhist ($n = 11, 4.2\%$), Christian ($n = 7, 2.7\%$) and no religion ($n = 2, 0.8\%$). In regards to restaurant operation and involvement in the food service operation's years, the highest percentage was 'not applicable' options ($n = 176, 69.3\%$), followed by less or equal to 5 years ($n = 43, 16.5\%$), 6 to 10 years ($n = 35, 11.5\%$), 11 to 15 years ($n = 6, 2.3\%$) and 16 to 20 years ($n = 1, 0.4\%$),

Table 1. Demographic characteristics of the respondents (n = 261)

Characteristic	n (%)	Characteristic	n (%)
Gender		Food safety training source	
Male	181(69.3)	Malaysia	196 (75.1)
Female	80(30.7)	Abroad	25 (9.6)
Age (n = 261)		Online	18 (6.9)
< 20 years old	36(13.8)	Media	11 (4.2)
20-29 years old	94(36.0)	Not sure	11 (4.2)
30-39 years old	77(29.5)	Food safety training experience	
40-49 years old	54(20.7)	Yes	174 (66.7)
Race		No	76 (29.1)
Malay	112(42.9)	Don't know	11 (4.2)
Chinese	11(4.2)	Food safety provider	
Indian	47(18.0)	Local health department	189 (72.4)
Others	91(34.9)	National restaurant association	11 (4.2)
Education		The restaurant	61 (23.4)
Primary	18(6.9)	Food safety information source rating	
Secondary	109(41.8)	News in mass media	18 (6.9)
College/University	131(50.2)	News in electronic media	22 (8.4)
Others	3(1.1)	News in social media	40 (15.3)
Marital Status		Articles from Ministry of Health published online or offline	169 (64.8)
Single	134(51.3)	Articles from medical practitioner	11 (4.2)
Married	127(48.7)	Others	1 (0.4)
Divorce	0	Frequency of inspection of premises in the past 12 months	
Religion		Once	69 (26.4)
Islam	196 (75.1)	Twice	83 (31.8)
Hindu	45 (17.2)	More than twice	62 (23.8)
Buddhist	11 (4.2)	None	15 (5.7)
Christian	7(2.7)	Don't know	32 (12.3)
No religion	2 (0.8)	Agreement with food safety inspector conduct the inspection at your premise	
Years of restaurant operation		Yes	199 (76.3)
≤5 years	43 (16.5)	No	22 (8.4)
6-10 years	35 (11.5)	Don't know	40 (15.3)
11-15 years	6 (2.3)	Satisfy with food safety inspector conduct the inspection at your premise	
16-20 years	1 (0.4)	Yes	189 (72.4)
Not applicable	176 (69.3)	No	15 (5.8)
Years involved in the food service operation		Don't know	57 (21.8)
≤5 years	43 (16.5)	Easy to follow food safety inspector's instruction	
6-10 years	35 (11.5)	Yes	170 (65.1)
11-15 years	6 (2.3)	No	18 (6.9)
16-20 years	1 (0.4)	Don't know	73 (28.0)
Not applicable	176 (69.3)	Premise inspection is helpful in preventing foodborne illness	
Years of working in food and beverage industry		Yes	206 (78.9)
≤5 years	127 (48.7)	No	15 (5.8)
6-10 years	91 (34.9)	Don't know	40 (15.3)
11-15 years	11 (4.2)	Food safety training is effective to obtain good premise cleanliness grading status during premise inspection	
16-20 years	25 (9.6)	Yes	221 (84.7)
> 20 years	7 (2.6)	No	4 (1.5)
Food Safety Plan		Don't know	36 (13.8)
Yes	203 (77.8)		
No	29 (11.1)		
Don't know	29 (11.1)		
Food Traceability System			
Yes	152 (58.2)		
No	58 (22.2)		
Don't know	51 (19.6)		
Written standard of operating procedures			
Yes	148 (56.7)		
No	65 (24.9)		
Don't know	48 (18.4)		

respectively. From years of working in the food and beverage industry point of view, most respondents worked less or equal to 5 years ($n = 127, 48.7\%$), 6 to 10 years ($n = 91, 34.9\%$), 16 to 20 years old ($n = 25, 9.6\%$), 11 to 15 years old ($n = 11, 4.2\%$), and more than 20 years ($n = 7, 2.6\%$). For the food safety plan, most respondents answered 'Yes' ($n = 203, 77.8\%$), followed by 'No' and 'Don't Know' options ($n = 29, 11.1\%$), respectively. 58.2% ($n = 152$) of the respondents answered 'Yes' for food traceability system, followed by 'No' option ($n = 58, 22.2\%$) and 'Don't know' option ($n = 51, 19.6\%$). 56.7% ($n = 148$) of the respondents answered 'Yes' for written standard of operating procedures, followed by 'No' option ($n = 65, 24.9\%$) and 'Don't know' option ($n = 48, 18.4\%$). 66.7% ($n = 174$) of the respondents had attended food safety training previously, whilst 29.1% ($n = 76$) did not attend food safety training and 4.2% ($n = 11$) answered 'Don't know' option. Based on this study's findings as depicted in Table 1, it is shown that 29.1% ($n = 76$) of the respondents had not attended food safety training although they already had working experience in food and beverage industry. This implies their lack of adherence to Malaysia Food Hygiene Regulations 2009 whereby food service workers are necessitated to attend food safety training programmes once in a lifetime. The comprehensive detail of the demographic characteristics of the respondents is shown in Table 1.

The percentage distribution of the various casual dining restaurants operating in Cyberjaya is shown in Table 2. Table 2 depicts that the majority of the casual dining restaurants in Cyberjaya served Malay cuisine ($n = 29, 25.9\%$). There were casual dining restaurants serving Arabic and Western cuisine that both showed similar results ($n = 20, 18.5\%$), Indian Muslim cuisine ($n = 15, 13.9\%$), Chinese cuisine ($n = 11, 10.2\%$), Indian cuisine ($n = 9, 8.3\%$), Japanese cuisine ($n = 3, 2.8\%$) and Thai cuisine ($n = 2, 1.9\%$). Based on these findings, it is observed that Malay cuisine restaurants were preferred by patrons in Cyberjaya and this could be due to food costs at these restaurants which are lower compared to other casual dining restaurants, as depicted in Table 2.

Table 2. Percentage distribution of casual dining restaurants in Cyberjaya

Restaurant Type	n (%)
Malay	29 (25.9)
Chinese	11 (10.2)
Indian	9 (8.3)
Arabic	20 (18.5)
Western	20 (18.5)
Mamak	15 (13.9)
Japanese	3 (2.8)
Thai	2 (1.9)

Notably, Arabic and Western cuisine are also popular among patrons. It is important to note that Cyberjaya is densely populated by foreign expatriates and international students, which undoubtedly makes Arabic and Western restaurants in this area popular.

3.2 Food safety plan, food traceability system and written standard of operating procedures

A food safety plan, food traceability system and standard of operating procedures are very important in any restaurant to enhance food service workers' compliance with Malaysia Food Hygiene Regulations 2009. A total of 261 respondents were asked if these three major items (food safety plan, food traceability system, written standard of operating procedures) were available in their respective restaurants.

Figure 2 shows the results for the food safety plan, food traceability system and standard of operating procedures. Among the 261 respondents participating in the study, 77.8% ($n = 203$), 58.2% ($n = 152$) and 56.7% ($n = 148$) agreed to have a food safety plan, food traceability system and standard of operating procedures in their restaurants, respectively. It is observed that most of the respondents knew the necessity to have a food safety plan, food traceability system and standard of operating procedures in food premises. A possible explanation is that the monitoring by Health Department officers influenced respondents to implement these aspects in their restaurants, thus indicating that they understood that it is imperative to retain good compliance with Malaysia Food Hygiene Regulations 2009 to reduce the risk of restaurants' closure by the Health Department officers asserted.

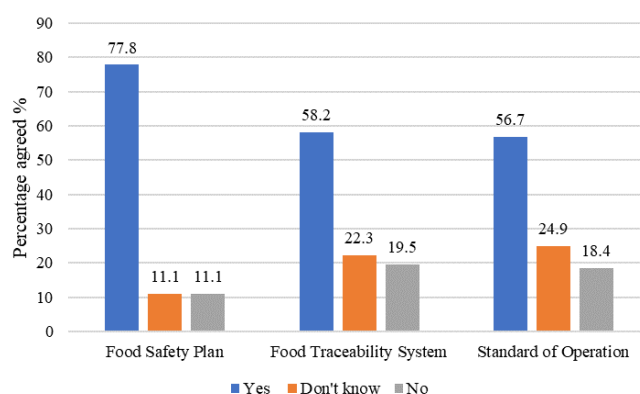


Figure 2. The results for the food safety plan, food traceability system and standard of operating procedures.

3.3 Premise inspection

Figure 3 shows the ratings from 261 respondents. A total of 170 out of 261 (65.1%) respondents agreed that the food safety inspector's instructions during the inspection were easy to follow. This is very important in the sense that it could significantly affect their

compliance with the Malaysia Food Hygiene Regulations 2009. A total of 28% (n = 73) of the respondents did not know whether the food safety instructions were easy to follow, while 6.9% (n = 18) stated the instructions were not clear at times. The majority of the respondents agreed that the inspector's instructions were easy to follow. It was revealed that most respondents had good academic backgrounds whereby 49.8% of them attained higher education from college or university and 41.8% from secondary school. Apart from that, 51.4% had been in the business for more than 5 years. It is important to note that 66.7% (n = 174) of the respondents had attended food safety training in the past. Based on these findings, it is implied that formal education, training and work experience in the food service industry could affect respondents' abilities to understand the food safety inspector's instructions during the inspection. Food safety inspector's instructions must be well-understood by food service workers because workers might neglect poorly delivered instructions by the inspectors during food premises' inspections and consequently they would handle food improperly. Proper instruction delivery during health inspection is thus essential because the food safety inspector is one of the main sources of food safety knowledge provision to food handlers.

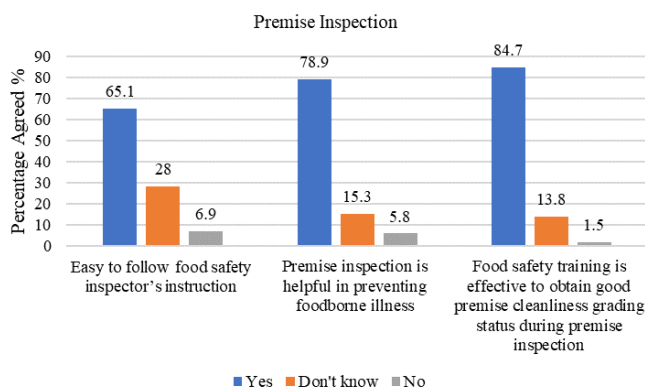


Figure 3. Easy to follow food safety inspector's instruction.

It was disclosed that 206 respondents (78.9%) believed that premises inspection was helpful in preventing foodborne illnesses, 5.7% (n = 15) however, did not agree with this statement, whilst 15% (40) had no idea. The respondents' ratings are shown in Figure 2. The majority of the respondents recognised that disease-causing microorganisms could get into food through the premises and knowledge of keeping the food premises clean as it might be a possible reason for foodborne diseases to occur is essential to prevent cross-contamination of food during handling and preparation. Cross-contamination of foods through the premises is well-established as a major factor in the spread of diseases in the food industry (Kunadu *et al.*, 2016). The majority (n = 221, 84.7%) of the respondents agreed that food safety training is effective in obtaining good

premises cleanliness grading status during premises inspection, 1.5% (n = 4) disagreed and 13.8% (n = 36) said they did not know that food safety training is effective to obtain good premises cleanliness grading status. This study's findings emphasised the need for regular food safety courses to educate and train food service workers continuously regarding their responsibilities in handling food safely, which will also strengthen the fact that knowledge retention in a longer time could increase food service workers' compliance with Malaysia Food Hygiene Regulations 2009 (Lee *et al.*, 2017).

3.4 Descriptive statistics of knowledge and compliance of Malaysia Food Hygiene Regulations 2009

The respondents' knowledge and compliance with Malaysia Food Hygiene Regulations 2009 are shown in Table 3.

It was revealed that respondents showed satisfactory knowledge of most items outlined in Malaysia Food Hygiene Regulations 2009. However, Table 3 also depicts that 6 out of 39 items were answered wrongly and the scores were less than 70%. These items are: item 3 "displayed a notice that disallows animal into food premises" (40.6%), item 14 "free from any pest" (59.8%), item 17 "Use impervious, non-absorbent, washable and nontoxic floor material" (67.8%), item 28 "Use doors which are smooth, with non-absorbent surface and self-closing" (65.5%), item 36 "wash-basin with running water, soap/suitable liquid detergent in a dispenser or paper towel/automatic hand dryer" (68.6%), and item 37 "wash-basin which is kept clean, well-maintained and equipped with non-hand operated taps" (66.3%). Two possible reasons why these questions were answered wrongly by the respondents are: the respondents' lack the understanding of these items, and there is possibility that their knowledge regarding those items has decreased over time.

In terms of compliance, more than 70% of the respondents indicate that 29 out of 39 items of Malaysia Food Hygiene Regulations 2009 are complied on their premises. Meanwhile, 10 items that have lower than 70% compliance are: item 2 "Displayed notice to wash hands thoroughly." (68.2%), item 3 "Displayed notice that disallows animal into food premises." (52.9%), item 14 "Free from any pest" (59.4%), item 17 "Use impervious, non-absorbent, washable and nontoxic floor material" (57.1%), item 18 "Floor is adequately drained" (67.4%), item 19 "Walls are in good condition and easy to clean" (67.8%), item 20 "Use impervious, non-absorbent, washable and nontoxic wall material" (68.6%), item 28 "Use doors which are smooth, with non-absorbent surface and self-closing

Table 3. The food handlers' and restaurant management's knowledge and compliance.

Items	Knowledge			Compliance		
	Yes	No	Not Sure	Yes	No	Not Sure
Displayed certificate of registration with the Ministry of Health Malaysia.	189(72.4)	72(27.6)	-	189(72.4)	72(27.6)	-
Displayed notice to wash hands thoroughly.	188(72)	73(28)	-	178(68.2)	83(31.8)	-
Displayed notice that disallows animals into food premises.	106(40.6)	155(59.4)	-	138(52.9)	123(47.1)	-
Used clean food packaging.	204(78.2)	57(21.8)	-	213(81.6)	48(18.4)	-
Practised clean food processing.	200(76.6)	61(23.4)	-	210(80.5)	51(19.5)	-
Practised clean food storage.	200(76.6)	61(23.4)	-	201(77)	60(23)	-
Practised clean food distribution.	196(75.1)	65(24.9)	-	206(78.9)	55(21.1)	-
Be located away from sources of contamination.	201(77.0)	60(23.0)	-	209(80.1)	52(19.9)	-
Be designed to facilitate cleaning and disinfection.	204(78.2)	57(21.8)	-	211(80.8)	50(19.2)	-
Have ample supply of potable water and adequate facilities for its storage and distribution.	258(98.9)	2(0.8)	1(0.4)	249(95.4)	12(4.6)	-
Be maintained in good condition, clean and tidy.	249(95.4)	11(4.2)	1(0.4)	247(94.6)	14(5.4)	-
Have adequate facilities for cleaning and suitable cleaning agents.	231(88.5)	30(11.5)	-	230(88.1)	27(10.3)	-
Disposed waste as soon as possible.	197(75.5)	64(24.5)	-	191(73.2)	70(26.8)	-
Free from any pest.	156(59.8)	105(40.2)	-	155(59.4)	106(40.6)	-
Have a suitable agent for control treatment of pests.	246(94.3)	14(5.4)	-	245(93.9)	12(4.6)	4(1.5)
Have floor in good condition and easy to clean.	260(99.6)	-	1(0.4)	259(99.2)	2(0.8)	-
Have impervious, non-absorbent, washable and nontoxic material floor.	177(67.8)	84(32.2)	-	149(57.1)	112(42.9)	-
Have floor that is adequately drained.	200(76.6)	61(23.4)	-	176(67.4)	85(32.6)	-
Have walls in good condition and easy to clean.	195(74.7)	66(25.3)	-	177(67.8)	84(32.2)	-
Have impervious, non-absorbent, washable and nontoxic material wall.	197(75.5)	64(24.5)	-	179(68.6)	82(31.4)	-
Have wall surface smooth up to the appropriate height.	201(77)	60(23)	-	190(72.8)	71(27.2)	-
Have entire wall angles sealed (without the presence of holes) and covered.	205(78.5)	56(21.5)	-	195(74.7)	66(25.3)	-
Have adequate natural/artificial lighting, which does not lead to contamination of food?	206(78.9)	55(21.1)	-	205(78.5)	56(21.5)	-
Have suitable and sufficient ventilation system, which does not lead to contamination of food.	251(96.2)	10(3.8)	-	247(94.6)	14(5.4)	-
Have airflow of the ventilation system flowing from a contaminated area to a clean area.	239(91.6)	22(8.4)	-	228(87.4)	33(12.6)	-
Have ceiling/interior surface of the roof constructed to prevent the accumulation of dirt and shedding of particles.	259(99.2)	2(0.8)	-	261(100)	-	-
Have doors which can be easily cleaned and disinfected if necessary.	257(98.5)	4(1.5)	-	254(97.3)	7(2.7)	-
Have doors which are smooth, non-absorbent surfaces and self-closing.	171(65.5)	90(34.5)	-	152(58.2)	109(41.8)	-
Have furniture and fittings which are well maintained and kept clean at all times.	255(97.7)	4(1.5)	2(0.8)	252(96.6)	9(3.4)	-
Have furniture and fittings which are impervious, non-absorbent, washable and nontoxic material.	251(96.2)	9(3.4)	1(0.4)	250(95.8)	11(4.2)	-
Have adequate toilet, clean and free from malodour.	257(98.5)	3(1.1)	1(0.4)	259(99.2)	2(0.8)	-
Have toilet with running water, soap/suitable liquid detergent in a dispenser or paper towel/automatic hand	255(97.7)	4(1.5)	2(0.8)	255(97.7)	6(2.3)	-
Have toilet which is not directly open to any room or compartment for the storage, production and serving of	255(97.7)	4(1.5)	2(0.8)	253(96.9)	8(3.1)	-
Have adequate washbasin.	256(98.1)	4(1.5)	1(0.4)	261(100)	-	-
Have wash basin which is suitably located and designed.	258(98.9)	3(1.1)	-	258(98.9)	3(1.1)	-
Have wash-basin with running water, soap/suitable liquid detergent in a dispenser or paper towel/automatic hand	179(68.6)	82(31.4)	-	142(54.4)	119(45.6)	-
Have wash-basin which is kept clean and well maintained and equipped with non-hand operated taps.	173(66.3)	88(33.7)	-	138(52.9)	123(47.1)	-
Have adequate drainage system and equipped with smooth type material fitted with food trap.	249(95.4)	10(3.8)	2(0.8)	247(94.6)	14(5.4)	-
Have drainage which is designed and constructed to avoid any risk of contamination.	254(97.3)	4(1.5)	3(1.1)	256(98.1)	5(1.9)	-

(58.2%), item 36 “Have wash-basin with running water, soap/suitable liquid detergent in a dispenser or paper towel/automatic hand dryer” (54.4%), item 37 “Have wash-basin which is kept clean, well-maintained and equipped with non-hand operated taps” (52.9%). One possible reason why a satisfactory compliance score was recorded is that most of the respondents had attended food safety training in the past (Gruenfeldova *et al.*, 2019), which proves that the respondents' attendance in training indicates their willingness to comply with Malaysia Food Hygiene Regulations 2009 requirement.

It was also found that there is an increase in compliance score for several items of Malaysia Food Hygiene Regulations 2009, which are items 3, 4, 5, 7, 8, 9, 26, 31, 34 and 39. Nonetheless, the respondents' knowledge of those items was found to be lower than their compliance scores. This could be because the respondents knew that their premises are regularly monitored by Ministry of Health and Health Department officers, and therefore they had to show their adherence to Malaysia Food Hygiene Regulations 2009 because their lack of compliance can affect the premises' grades during inspections.

3.5 Relationships between knowledge and compliance of Malaysia Food Hygiene Regulations 2009

Table 4 shows a significant correlation ($r = 0.865$, $p < 0.05$) between food service workers' knowledge and compliance with Malaysia Food Hygiene Regulations 2009. This finding indicates that there is a relationship between the food safety knowledge of food service workers and their compliance with Malaysia Food Hygiene Regulations 2009. This shows that food service workers' compliance with Malaysia Food Hygiene Regulations 2009 is influenced by their knowledge of food safety. It is implied that the higher the food safety knowledge level of food service workers, the better their compliance with Malaysia Food Hygiene Regulations 2009. With this result, H1 is accepted. This concurs with de Freitas *et al.* (2019) who found that food handlers' compliance with food safety legislative requirements depended on their understanding of food safety. Satisfactory food safety knowledge levels shown by food handlers indicated their positive willingness to adhere to food safety regulations (Madaki and Bavorova, 2019). This could be because food handlers with proper food safety knowledge have better awareness regarding adherence to food safety regulations to minimise the risks of foodborne illnesses and protect public health and safety (Norshaidi *et al.*, 2019). This study's finding is consistent with the findings of past studies and proves that enhancing food service workers' knowledge will positively impact their compliance with Malaysia Food Hygiene Regulations 2009.

Table 4. Correlation between knowledge and compliance of Malaysia Food Hygiene Regulations 2009.

Category	Pearson correlation
Knowledge – Compliance of Malaysia Food Hygiene Regulations 2009	$r = 0.865^*$

*Significant at $p < 0.05$.

3.6 Association of knowledge and compliance level of Malaysia Food Hygiene Regulations 2009 with food safety training factors

The association between knowledge and compliance level of Malaysia Food Hygiene Regulations 2009 and food safety training factors of the food service workers was evaluated using the Chi-square test. There are three factors related to food safety training which are food safety training attendance, food safety training providers and source of food safety training. The results are simplified in Tables 5, 6 and 7.

Table 5 shows that the $X^2 = 182.402$, $df^* = 1$ and $p < 0.05$. *($df =$ degree of freedom) which indicates there is a significant association between attending food safety training and the level of respondents' knowledge of Malaysia Food Hygiene Regulations 2009, thus hypothesis H2a is accepted. This result indicates that training is critically needed as it significantly influences the knowledge of food service workers on food safety, as implied by many past studies (Rebouças *et al.*, 2017; Alqurashi *et al.*, 2019). This study's findings emphasised continuous training of food service workers to ensure longer retention of food safety knowledge obtained in the training for them to be able to recall the knowledge a long time after their training, consequently guaranteeing their safe practices in handling and preparation of foods. This concurs with McFarland *et al.* (2019) who implied that constant food safety refresher courses provided to food handlers improve their long-term food safety understanding. This study's findings, which are consistent with the outcomes of past studies, prove that continuously training food service workers is essential to strengthening them in the aspects that they lack after training completion.

Based on Fischer's exact test shown in Table 5 below, it was disclosed that training attendance has a significant association with compliance level at $p < 0.05$, indicating there was a significant association between food safety training and respondents' compliance level with Malaysia Food Hygiene Regulations 2009. The result is similar to the Chi-square test result which signifies the necessity of food safety training as the primary channel in educating food service workers and making sure they strictly adhere to the Malaysia Food Hygiene Regulations 2009 requirement. Dundes and Swann (2008) implied that well-trained food handlers

Table 5. Association between knowledge and compliance level of Malaysia Food Hygiene Regulations 2009 with attendance of training (n = 261).

	Attendance of Training		X ²	p-value	Fischer exact test value (if any)
	Yes n (%)	No n (%)			
Knowledge Level					
High	172 (65.9)	16(6.13)	182.4	0.000 ^a	
Low	2 (0.77)	71(27.2)			
Compliance Level					
High	174(66.7)	73(27.9)			0.000 ^b
Low	0(0)	14(5.4)			

Chi-square test of Fischer exact test is significant at $p \leq 0.05$

^a0 cells (0.0%) have expected count less than 5

^b1 cells (25%) have expected count less than 5

High: The score of between 19.6 to 39

Low: The score of between 0 to 19.5

Table 6. Association between knowledge and compliance level of Malaysia Food Hygiene Regulations 2009 with Food Safety Training Provider (n = 261).

	Food Safety Training Provider			X ²	p-value	Fischer exact test value (if any)
	Local Health Department n (%)	National Restaurant n (%)	The Restaurant n (%)			
Knowledge Level						
High	186 (71.3)	0(0)	2(0.8)	236.74	2	0.000 ^a
Low	3 (1.1)	11(4.2)	59(22.6)			
Compliance Level						
High	187(71.6)	11(4.2)	49(18.8)	32.13	2	0.000 ^b
Low	2(0.8)	0(0)	12(4.6)			

Chi-square test of Fischer exact test is significant at $p \leq 0.05$

^a0 cells (0.0%) have expected count less than 5

^b2 cells (33%) have expected count less than 5

High: The score of between 19.6 to 39

Low: The score of between 0 to 19.5

Table 7. Association between knowledge and compliance level of Malaysia Food Hygiene Regulations 2009 with food safety training sources (n = 261).

	Food Safety Training Sources			X ²	p-value	Fischer exact test value (if any)
	Local n (%)	Abroad n (%)	Others n (%)			
Knowledge Level						
High	133 (51)	25(9.6)	30(11.5)	11.58	2	0.000 ^a
Low	63 (24.1)	0(0)	10(3.8)			
Compliance Level						
High	182(69.7)	25(9.6)	40(15.3)	32.13	2	0.000 ^b
Low	14(5.4)	0(0)	0(0)			

Chi-square test of Fischer exact test is significant at $p \leq 0.05$

^a0 cells (0.0%) have expected count less than 5

^b2 cells (33%) have expected count less than 5

High: The score of between 19.6 to 39

Low: The score of between 0 to 19.5

df = degree of freedom

showed better food safety knowledge than those without food safety training, which is consistent with McIntyre *et al.* (2013) who disclosed similar results. Based on this present study and previous studies' findings, it is implied that food service workers who received food safety training are more knowledgeable on safe food handling and have better understanding to adhere to food safety regulations required to avoid the termination of food businesses by MOH and the premises' operations can be sustained over a longer period.

Table 6 shows that there is a significant association between knowledge ($X^2 = 236.74$, $p < 0.05$) and compliance level of Malaysia Food Hygiene Regulations 2009 ($X^2 = 32.13$, $p < 0.05$) with different food safety training providers. These findings indicate that the food safety knowledge of food service workers is associated with the food safety training providers, thus hypothesis H2b is supported. It is implied that respondents who received training with the local health department showed better food safety knowledge than other training providers. However, it is important to be reminded that the number of respondents who received training from those three training providers was disproportionate, so this result does not reflect the actual food safety knowledge level of respondents who received training from the training providers.

Table 7 shows there is a significant association between food safety training sources and the level of respondents' knowledge ($X^2 = 11.58$, $df^* = 2$ at $p < 0.05$) and compliance ($X^2 = 32.13$, $df^* = 2$ at $p < 0.05$) with Malaysia Food Hygiene Regulations 2009. Thus, hypothesis H2c is accepted. These findings indicate that food safety training sources are associated with respondents' level of food safety knowledge and their compliance with the Malaysia Food Hygiene Regulations 2009. It is implied that respondents who acquired knowledge from local food safety training sources showed better food safety knowledge and compliance with Malaysia Food Hygiene Regulations 2009 than respondents who acquired knowledge from food safety training sources from abroad. This is related to the respondents' demographic characteristics whereby most respondents are Malay, and they, therefore, comprehend better local sources of food safety training, which subsequently positively impacts their compliance with Malaysia Food Hygiene Regulations 2009. However, the number of respondents who received training from those three training sources was disproportionate. Therefore, this result does not reflect the actual food safety knowledge level of respondents who received training from the training sources.

4. Conclusion

In conclusion, over half of the food service workers showed satisfactory food safety knowledge and compliance with Malaysia Food Hygiene Regulations 2009. This study found that there was a significant relationship ($p < 0.05$) between food service workers' knowledge and compliance with Malaysia Food Hygiene Regulations 2009. A significant relationship ($p < 0.05$) was also found in the knowledge and compliance level of Malaysia Food Hygiene Regulations 2009 with all food safety training factors (food safety training attendance, food safety training providers and food safety training sources), hence hypotheses H1, H2(H2a, H2b, H2c) were accepted.

There may be several limitations of this research because the data used in this study were based on the food handlers' self-reporting procedure, which may contain certain biases as no confirmation could be made on the collected questionnaires by far. These results may not be a true representation of the whole of Selangor or Malaysia in general since the study only focuses on restaurants in the Cyberjaya area and because of the limited population of food handlers. Further study is required in order to have the true behaviour of restaurant managers and food handlers and thus their compliance with the Malaysia Food Hygiene Regulations 2009.

Conflicts of interest

The authors declare no conflicts of interest in this article.

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