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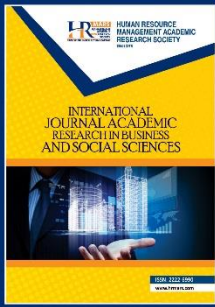
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Food Safety and Hygiene Knowledge, Attitude and Practices among Food Handlers at Boarding Schools in the Northern Region of Malaysia

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Abstract

Schools, more than any other premises that serve food, have recorded the highest cases of food poisoning in Malaysia. This is alarming since school students are being exposed to risk of foodborne illnesses. The purpose of this study is to evaluate the knowledge, attitude and practices (KAP) towards food safety and among food handlers from seven boarding schools in the Northern Region of Malaysia. Food safety and hygiene KAP surveys were administered (n=134) prior to observation of on-site practices. The current study shows that the food handlers have excellent knowledge, positive attitude and good self-reported practices regarding food safety and hygiene. The results also show significant differences between genders in their personal hygiene, cross-contamination knowledge and food safety attitudes. There were also marked differences between trained and untrained food handlers in terms of personal hygiene, temperature control, cross-contamination knowledge and self-reported food safety practices. Findings from this study present an insight into food safety and hygiene KAP among food handlers towards the implementation of the pre-requisite program and HACCP principles in schools' foodservice operations.

Keywords: Food Safety, Knowledge, Attitude, Self-Reported Practices, School Foodservice Operations

Introduction

Food safety has received much emphasis by agencies worldwide due to the threat of contracting foodborne illnesses. Foodborne illnesses cover a wide range of diseases and are a growing public health concern, which has caused morbidity and mortality worldwide. Foodborne

illness occurs as a result of consuming food contaminated with microorganisms or their toxins, cross-contamination from enterotoxigenic staphylococci through unhygienic handling practices and, or Hepatitis A infected food handlers (Baş, Ersun, & Kivanç, 2006; WHO, 2007). Contamination of food may occur at any point along the food production chain before it reaches the end consumer. Food safety, according to Scallan et al. (2011) is defined as the conditions and measures that are necessary along the food production chain to ensure that it is safe, sound and fit for human consumption. Food is considered safe when it is free from chemical, biological or physical hazards that may result in illnesses or even death to the consumers. Food safety is a concern as it poses risks to the population, especially to vulnerable groups such as infants and young children, elderly individuals and those with immunodeficiency disorder (Soon, Singh & Baines, 2011). The wide attention given to food safety is also due to the upward trend of foodborne illness incidence rates over the past 20 years both locally (Abdul-Mutalib, Syafinaz, Meftahuddin, 2002; MOH, 2012; Sakai, & Shirai, 2015; Sharifa Ezat, Netty, & Sangaran, 2013; Soon et al., 2011) and internationally (CDC, 2014). In the United States, it was estimated that 9.4 million episodes of foodborne illness were caused by 31 major pathogens, which led to 55961 hospitalizations and 1351 deaths (Scallan et al., 2011).

A review by Meftahuddin (2002) has shown that 66.5% of food poisoning outbreak from the year 1996 to 1997 occurred in schools. Food poisoning in Malaysian schools appear to be sporadic. There was an upward trend from the year 2009 to 2011, in which the number of food poisoning episodes increased by 59.2%, from 155 episodes in 2009 to 257 episodes in 2011. However, the number of food poisoning episodes occurring in schools reduced to 232 episodes (51%) in 2012 and climbed again to 244 episodes (48%) in 2013. Records from the Ministry of Health Malaysia (MOH) MOH indicate a clearer cause for concern, as 50% of the overall food poisoning episodes were from schools (MOH, 2011, 2012, 2015; Sharifa Ezat et al., 2013). In 2013, the largest percentage of (48%) of overall food poisoning cases were reported from schools (244 episodes), followed by other premises (43%), institutions (8%) and the National Service Training Programme (1%) (MOH, 2012, 2013). In all these cases, the causative agents could hardly identify because actual food samples for laboratory analysis are limited or unavailable. The food poisoning situation is worrying as school children are among the vulnerable groups with lower immunity levels compared to adults. This could potentially also affect their education as the time to recuperate from food poisoning may extend over several days.

Schools may have been recording the highest number of food poisoning cases over the years due to the type of kitchen system in place, which is the conventional kitchen. Conventional kitchen operators face constraints in handling foods that are perishable, as it requires proper treatment before, during and after preparation. The methods may also change daily according to the change in menu (Akabanda, Hlortsi & Owusu-Kwarteng, 2017; Stinson, Carr & Nettles, 2010). Marzano and Balzaretto (2011), whose findings show that due to the short time requirement to prepare daily mass meals in a conventional kitchen, support this. Food handlers tend to prepare food very early in the morning or even the day before, which usually increases the chances of bacterial growth.

Little research has documented the knowledge, attitude and practices of food handlers who worked in boarding schools' kitchens. The purpose of this research was to evaluate the current knowledge, attitude and practices towards food safety and hygiene among food handlers in boarding school kitchens that prepare five to six meals daily for students. It is also to investigate the inter-relationship between knowledge, attitudes and practices in the study group. Findings from this study will be used as a baseline data to design a comprehensive food safety and quality management system towards developing a centralized kitchen model in boarding schools. With the implementation this system, food safety will be monitored through the control of biological, chemical and physical hazards, starting from the raw material procurement until consumption of finished product.

Literature Review

The importance of food safety and hygiene knowledge, attitude and practices among food handlers have been assessed in past studies from around the world (Abdul-Mutalib et al., 2012; Abdullah Sani & Siow, 2014; Almanza & Sneed, 2003; Baş et al., 2006; Henroid & Sneed, 2004; Lee, Chik, Bakar, Saari, & Mahyudin, 2012; Rebouças et al., 2016; Tan, Abu Bakar, Abdul Karim, Lee, & Mahyudin, 2013). This involves different types of food service establishments such as schools, hospital, restaurants and catering and different types of kitchen system (conventional, centralized and satellite kitchens). Having good knowledge, positive attitude and good practices towards food safety plays a very important role to determine the safety of products disregard to any food service establishments one is working with (Al-Shabib, Mosilhey, & Husain, 2015). The vast volume of past studies carried out to assess food safety knowledge, attitude and practices, show that it is very crucial to possess sufficient data in moving forward.

Food safety knowledge is largely obtained through training in food safety. This includes attending certified training course where participants were exposed on the importance of time-temperature control, personal hygiene, safe food handling and causes of foodborne illnesses. Other sources of food safety knowledge are from printed education materials and the use of new media where information on food safety can be found at the tip of the finger. In order to have good food handling practices, the food handlers must be trained and have knowledge in food safety. Some studies have shown that increased knowledge on food safety will result in positive food handling practices (Abdul-Mutalib et al., 2012; Toh & Birchenough, 2000). However, there are also studies that show that having good level of knowledge did not always result in positive behaviour towards hygienic practices (Akabanda et al., 2017; Clayton, Griffith, Price, & Peters, 2002). This suggests that transfer of knowledge to practices is not predictable.

Youn and Sneed (2003) and Ansari-Lari, Soodbakhsh and Lakzadeh (2010) pointed out that high proportion of reported foodborne disease outbreaks were caused by mishandling in foodservice establishments, food processing operations and homes. Proper cooking and processing can reduce the risk of foodborne illness. It has also been found that almost 70% of food poisoning outbreaks were caused by time and temperature abuse and cross-contamination (Baş, Ersun & Kivanç, 2006). This includes preparing food way in advance, incorrect thawing method, improper food holding temperature and malfunction cooling equipment (Bou-Mitri, Mahmoud, El Gerges, & Jaoude, 2018; Liz Martins & Rocha, 2014; Osaili et al., 2013). Many basic

food handling practices were also found to be missing in the routines of food handlers in schools. In Clayton and Griffith (2004), observations on food handling represents the most accurate and reliable method to assess food handlers practices on food safety. Research by Abdul-Mutalib et al. (2012) showed that food handlers often had poor personal hygiene practices such as improper handwashing technique. This is seconded by other studies that have shown the same results (Baş, Ersun, & Kivanç, 2006; Tan, Cheng, Soon, Ghazali, & Mahyudin, 2013). Rebouças et al. (2016) have observed improper practices such as handling and distributing foods without using gloves and talking while handling food. Hands plays an important role in transporting pathogenic microorganisms, therefore effective hand washing will prevent such things to happen.

Methods

Subject

This study evaluated the foodservice operations at seven boarding schools in the Northern Region of Malaysia. The schools were selected using purposive sampling, where approximately 800-1000 meals were being served for five to six times daily. All food handlers (n=134) from the seven kitchens were involved in this study. Informed consent was given to respondents prior to data collection.

Questionnaire development

Quantitative and qualitative evaluations were conducted in assessing the food handlers' self-reported and observed practices, knowledge and attitude towards food safety and hygiene. A written questionnaire consisting of close-ended questions pertaining to the food handlers' knowledge, attitude and self-reported practices on food safety and hygiene were adapted and modified from previously published works (Akabanda et al., 2017; Garayoa, Vitas, Díez-Leturia, & García-Jalón, 2011; Giampaoli, Cluskey, & Sneed, 2002; Rebouças et al., 2016; Tan, Abu Bakar, et al., 2013; Tokuç, Ekuklu, Berberoğlu, Bilge, & Dedeler, 2009; Yardimci, Hakli, Cakiroglu, & Ozcelik, 2015). The questionnaire was structured into four distinctive parts; demographic (10 questions), knowledge on food safety and hygiene (25 questions), food safety attitude (10 statements) and self-reported food hygiene practices (6 statements).

Knowledge on food safety and hygiene were evaluated through three possible answers; "true", "false" and "do not know". The questions specifically dealt with respondents' knowledge on personal hygiene, temperature control, cross contamination, food storage and equipment hygiene. For every correct answer, a score of "1" was given whereas score "0" was given for every incorrect or unanswered question. A scale ranging between 0 and 25 was used to evaluate the overall knowledge of respondents. Food handlers' were asked to indicate their level of agreement based on a range with statements describing attitudes towards food safety (1=strongly disagree, 2=disagree, 3=neutral, 4 =agree and 5=strongly agree.) A score of "1" was given to answers with "agree" or "strongly agree" whereas a score of "0" was given to answers with "strongly disagree", "disagree" or "neutral". Missing response towards the statements were treated as "no opinion" and assigned a neutral value.

Self-reported practices on food hygiene were graded on scale of five with 1 indicating "never", followed by 2 "seldom", 3 "sometimes", 4 "frequently" and 5 "always". Each correct

practice (frequently or always) was given a score of “1” while incorrect practices (never, seldom or sometimes) were given a score of “0”. All knowledge, attitude and self-reported practices scores were converted into percentage and the mean scores obtained were considered good if above 50% and poor if below 50%. To avoid bias in answering the questions, the developed questions included negative statements alongside positive statements (Tan et al. 2013). For negative statements, the scoring is vice versa from the positive statements. In addition, observed food hygiene practices were conducted using the food safety assessment form from Henroid and Sneed (2004) and Giampaoli, Cluskey and Sneed (2002). Modifications comprise translation from English to ‘Bahasa Melayu’ language and based on suitability with local practices. The modified questionnaire has undergone content and expert validation.

Pilot test

The questionnaire was pilot tested on 24 food handlers from three non-participating institutions to ensure clarity of interpretation. Cronbach- α was used to measure internal consistency or reliability. The pilot test showed each section achieved Cronbach- α more than 0.70 (knowledge=0.851, attitude=0.912, practice=0.747), indicating that the instrument is reliable to be used. As a result, only minor modifications were done to enhance the subjects’ understanding of statements in the questionnaire.

Data collection

Data collection was conducted between March and April 2018. Since it was a self-administered survey, respondents were informed of the purpose of the survey prior to answering it. Enumerators were tasked to interview illiterate respondents. Food hygiene practices were observed for two working shifts (5.30am-3.30pm and 3.00pm-11.00pm), which comprised before, during and after food preparation for lunch, tea and dinner.

Statistical analysis

Data was analysed using IBM SPSS Statistics version 19. Statistical significance for all tests were set at the level of $p < 0.05$. Means, standard deviations and frequencies were computed for all variables. Both parametric and non-parametric analysis was used where applicable for comparison and correlation of food handler’s knowledge, attitude and practices on food safety and hygiene. Multiple linear regressions were conducted to determine the predictor variables for food handlers’ knowledge, attitude and practice level.

Results and Discussion

Demographic profile

The results show that 53.7% of the respondents are female and from the age group of 20 to 29 years old (44.0%) (Table 1). More than 85% completed secondary education (11-12 years of education). About 41.8% of the respondents have 6 to 10 years of working experience with mean working experience of 5.3 ± 5.1 years. The three most interviewed respondents worked as a waiter or server (40.0%), assistant cook, butcher or pastry chef (26.9%) and cook (16.4%). Although typhoid vaccination and food handlers’ training certification from certified trainer appointed by the Ministry of Health Malaysia is a compulsory requisite for all food handlers,

however, only 98.5% and 92.5% of food handlers were vaccinated and possessed valid training certification.

Table 1: Demographic profile of food handlers in boarding school food service operations (n=134)

Variables	Respondents	%	
Gender	Male	62	46.3
	Female	72	53.7
Age	<20 years old	3	2.2
	20-29 years old	59	44.0
	30-39 years old	25	18.7
	40-49 years old	22	16.4
	>50 years old	25	18.7
Highest education level	Primary school	6	4.5
	Secondary school	114	85.1
	Tertiary education	14	10.4
Working experience in food service (years)	Less than 1 year	16	11.9
	1-5 years	54	40.3
	6-10 years	56	41.8
	>10 years	8	6.0
Role in food service facility	Cook	22	16.4
	Asst. cook/ butcher/ pastry chef	36	26.9
	Waiter/server	55	41.0
	Steward/ Cleaner	13	9.7
	Others (general helper)	8	6.0
Typhoid vaccination	Yes	132	98.5
	No	2	1.5
Food handler's training certification	Yes	124	92.5
	No	10	7.5

Food safety and hygiene knowledge

Overall, the mean percentage score was 65.2 ± 12.7 , which shows that the respondents have good knowledge on food safety and food hygiene (>50%). This is in line with the study by Baş, Ersun and Kivanç (2006), Abdul-Mutalib et al. (2012), Tan et al. (2013) and Stenger et al. (2014) that showed good food handlers' knowledge score (>50%) among food handlers in school food operations and catering. Although the knowledge on personal hygiene scored the highest (75.4 ± 17.7), and are similar to the findings by Tan et al. (2013) (79.71 ± 13.36) and Yardimici et al. (2015) (76.5%), this study found that 50% of food handlers lacked knowledge about the steps involved in proper hand washing procedures, indicating that food handlers were still unclear

about the basic steps of hand washing. Missing steps in hand-washing might transfer pathogenic microorganisms from the hands to anything that they come into contact with as hands are a common vehicle in microorganisms transfer (de Almeida et al. 2014; Tan et al. 2013). Most of the respondents answered incorrectly on usage of masks, as they viewed masks to be only necessarily worn by waiters or servers. It was also observed that only the waiters or servers wore masks when serving food to students. Face mask or sneeze guards, as one of the protective equipment should be worn by food handlers during food processing as a cross-contamination pre-caution (Ayçiçek, Sarimehmetoğlu, & Çakiroğlu, 2004).

Knowledge on temperature control yielded among the lowest scores compared to other areas, averaging at only 56%. A large proportion of food handlers gave incorrect answers for the following statement, "Frozen beef are defrosted by soaking in water" (73.1%). This finding is agreeable to that of Abdullah Sani and Siow (2014), Thelwell-Reid (2014), Stenger et al. (2014) and Henroid and Sneed (2004) which found that food handlers mostly answered incorrectly in statements related to thawing practices. One possible factor contributing to this could be the lack of written manuals to describe the correct procedures for thawing and storing of foods. This is an important requirement in HACCP program, which should be outlined in food preparation for the school hostel kitchens and complied with.

Many of the respondents are aware of the refrigerator and freezer temperature (76.1%) and its effect in controlling microbial growth in foods (76.9%). This is in accordance with the study by Abdul-Mutalib et al. (2012) that showed a high-level of knowledge on importance of knowing refrigerator and freezer temperature to reduce the risk of food spoilage and effects on food safety. Conversely, some past studies have showed a majority of their respondents lacking knowledge about acceptable refrigerator temperature ranges and temperature danger zones for food (Abdullah Sani & Siow, 2014; Baş et al., 2006; Ko, 2013; Tokuç et al., 2009). Regarding the topic of cross-contamination, food handlers in this study show a good knowledge (>50%) on the handling of vegetables. Vegetables can be potential health hazards due to high microbial load such as *Salmonella spp.* and pathogenic spore forming bacteria (Awang Salleh et al., 2003; Carlin et al., 2000; Marzano & Balzaretto, 2013). Some 85.8% of the food handlers responded correctly on the statement about advance food preparation. Abdul-Mutalib et al. (2012) pointed out that the practice of preparing food in advance has been a norm in the food service establishments. The same observation was found in the present study where food was ready to be served as early as 3 hours before serving time. It was also observed that the establishments did not use water baths to keep the food hot and dishes were left on the serving table for a considerable period of time before consumption. This practice could led to multiplication of harmful microorganisms (Smigic et al., 2016).

Food handlers know that defrosted or thawed foods cannot be refrozen (64.2%). Microbial growth is stopped when food stored at temperature of below -18°C. The number of bacteria in the food may increase when it is repeatedly thawed and frozen. During thawing, food temperature increases until it reaches a suitable condition and this may allow bacteria to multiply. Refreezing the food again creates an inactive condition for the bacteria (Abdul-Mutalib et al., 2012; Nesbitt et al., 2014; Tokuç et al., 2009), which is why thawed food is not supposed

to be returned to the refrigerator. A lack of knowledge among food handlers on equipment hygiene was observed. Majority did not know that dishtowels were not suitable for wiping wet equipment (70.9%). Almanza and Sneed (2003) reviewed food handlers in some kitchens reusing towels to wipe plates instead of allowing the utensils to air dry. Reusing dishtowels is not advisable practice due to the potential of cross-contamination, which might occur from the dish towel to the clean equipment (Ali & Spencer, 1996). ‘

Most of the food handlers from this study answered incorrectly on effective cleaning of equipment (64.9%), as they believed that using detergent alone is sufficient to ensure effectiveness of cleaning equipment. The main reason for this lack of knowledge in cleaning and sanitation may be due to limited written procedures or even training on effective equipment cleaning and sanitation. Most of the food handlers (77.6%) knew that separate sinks should be used for hand washing and cleaning of raw materials. However, non-existent separate facilities in the processing area force the food handlers to combine hand washing and raw materials cleaning in the same sink. As discussed by Sun and Ockerman (2005), poor cleaning practices could result in cross-contamination to the food.

Table 2: Food handlers' knowledge related to food safety and hygiene (n=134)

No.	Statements	Respondents, n (%)			Mean percentage score \pm SD
		Yes	No	Do not know	
Knowledge					65.2 \pm 12.7
Personal hygiene					75.4 \pm 17.7
1	There are 6 steps in hand washing procedures (-)	67 (50.0)	64 (47.8)	3 (2.2)	
2	Food handlers who are suffering from foodborne illnesses can continue working without informing to their manager (-)	17 (12.7)	115 (85.8)	2 (1.5)	
3	Bacteria are normally found on the surfaces of human skin	109 (81.3)	15 (11.2)	10 (7.5)	
4	Only waiter should wear mask (-)	69 (51.5)	58 (43.3)	7 (5.2)	
5	Hair contains various types of bacteria and can be a main source of food contamination	103 (76.9)	23 (17.2)	8 (6.0)	
6	Dishcloths can replace hand towels for wiping hands (-)	7 (5.2)	125 (93.3)	2 (1.5)	
7	There is no need to wash hands before using gloves (-)	15 (11.2)	119 (88.8)	0 (0)	
8	The same gloves used when handling fruits can also be used to handle meat (-)	14 (10.4)	117 (87.3)	3 (2.2)	
Temperature control					56.9 \pm 24.0
9	Frozen beef are defrosted by soaking in water (-)	98 (73.1)	30 (22.4)	6 (4.5)	
10	Freezing process of foods does not kill bacteria but prevent their growth	103 (76.9)	18 (13.4)	13 (9.7)	
11	Food can be stored at room temperature after cooking it for 2 hours before storing it in the refrigerator	70 (52.3)	48 (35.8)	16 (11.9)	

12	The correct temperature for refrigerator is 1-4°C and freezer is below -18°C	102 (76.1)	10 (7.5)	22 (16.4)	
Cross contamination					67.0 ± 24.1
13	Vegetables should be first chopped and then washed (-)	64 (47.8)	69 (51.5)	1 (0.7)	
14	Fresh vegetables should be washed by soaking it in vinegar water (-)	39 (29.1)	84 (62.6)	11 (8.2)	
15	Bacteria cannot enter smashed canned food (-)	23 (17.2)	109 (81.3)	2 (1.5)	
16	Staff cannot eat and drink in food preparation area	98 (73.1)	32 (23.9)	4 (3.0)	
Food storage					64.1 ± 21.0
17	Raw food should be stored in lower shelves within cold storage	75 (56.0)	49 (36.5)	10 (7.5)	
18	Preparation of food in advance is likely to contribute to food-borne illnesses	115 (85.8)	14 (10.4)	5 (3.7)	
19	Samples are taken from each meal for quality controls, and these samples are stored in refrigerator for 48 hours	115 (85.8)	16 (11.9)	3 (2.2)	
20	Frozen food cannot be frozen again after being defrosted in the chiller	86 (64.2)	39 (29.1)	9 (6.7)	
Equipment hygiene					54.4 ± 22.4
21	Bacteria can grow on broken or cracked dishes	95 (70.9)	28 (20.9)	11 (8.2)	
22	Rinsed containers and equipment should be wiped with a dish towel (-)	95 (70.9)	34 (25.4)	5 (3.7)	
23	The action of a detergent is sufficient to ensure effectiveness of cleaning equipment (-)	87 (64.9)	31 (23.1)	16 (12.0)	

24	Cold storages should be opened and ventilated frequently (-)	25 (18.7)	103 (76.9)	6 (4.5)
25	Sinks used for washing raw materials can also be allowed to wash hands in the production area (-)	25 (18.7)	104 (77.6)	5 (3.7)

Food Safety Attitude

The mean score for food safety attitude was 92.3 ± 16.2 (Table 3). Most of the respondents agreed and strongly agreed with all of the statements listed (32.8% - 62.7%), although there were still a small percentage of food handlers who showed negative attitudes (0-6.7%). The present study towards food safety attitude shows a high mean score and some past studies have shown similar results (Abdul-Mutalib et al., 2012; Abdullah Sani & Siow, 2014; McIntyre, Vallaster, Wilcott, Henderson, & Kosatsky, 2013; Sharif, Obaidat, & Al-Dalalah, 2013; Tan, Abu Bakar, et al., 2013; Tokuç et al., 2009). Comparatively, there is also study, which shows lower mean score in food safety attitude (Baş et al., 2006).

A positive attitude was detected in a large majority (89.4%) of the food handlers who either agreed or strongly agreed that proper food handling is an essential part of a food handler's responsibility at work. Similar results were found by McIntyre et al. (2013), Sharif, Obaidat, and Al-Dalalah (2013) and Tokuç et al. (2009) where more than 90% of respondents agreed that safe food handling is a part of one's job responsibilities. Approximately 95.5% respondents thought that it is good to maintain personal cleanliness while working. Maintaining short fingernails, covering hair with a hair cap and washing hands effectively are important habits to prevent cross-contamination. About 94.7% food handlers agreed on the importance of food hygiene training to reduce risk of contamination. Abdullah Sani and Siow (2014) found that attitude scores of trained food handlers is higher than those who have not attended any food safety training. However, it has been reported that, although food hygiene training may increase food safety knowledge, it is not the main factor that influences food handling behaviour and practice changes (McIntyre et al., 2013).

This study indicated that 90.3% of food handlers responded positively towards separation of raw and cooked food but surprisingly, 8.2% food handlers responded negatively towards the statement. Separation of raw and cooked foods is important as raw food contains high level of microorganisms that may be pathogenic. If kept together with cooked or ready-to-eat foods, cross-contamination may occur, thus making it dangerous for consumption. Studies conducted in elementary school establishments resulted in the detection of food borne pathogens such as *Escherichia coli* O157:H7, *Salmonella* spp., *Bacillus cereus* and *Listeria monocytogenes* in raw vegetables and meats (Marzano & Balzaretto, 2013; Shin, Hong, & Lee, 2008). Few studies have been conducted locally on the prevalence of *Salmonella* spp. in the raw vegetables, chicken and beef (Arumugaswamy, Rusul, Abdul Hamid, & Cheah, 1995; Awang Salleh et al., 2003; Shafini, Son, Mahyudin, Rukayadi, & Tuan Zainazor, 2017).

Although 89.6% stated that they agree that cleaning hands effectively could prevent foodborne diseases, some 6.7% of the respondents showed negative attitude. Regarding the usage of gloves, 91.9% food handlers either agreed or strongly agreed that hand washing is required before putting on gloves. Some 97.0% of the respondents have positive attitudes in that they should wear gloves when touching ready-to-eat foods to reduce contamination. Effective hand washing and gloves are also necessary in handling ready-to-eat foods since hands are in regular contact with the environment and likely vehicle transmission for bacteria such as

Staphylococcus aureus and *Escherichia coli* (Ayçiçek, Sarimehmetoğlu, & Çakiroğlu 2004; Tan et al. 2013).

High percentage (96.3%) of the food handlers responded positively that one should take leave if suffering from any foodborne illness. Foodborne illness is a communicable disease because it is easily transmitted if precautions are not taken. Therefore, food handlers with foodborne illness should refrain from handling foods since it is well known that food handlers play a significant role in transmission of foodborne pathogens to the public during food preparation (Smigic et al., 2016). Almost 90.3% of the food handlers were certain that well-cooked foods are free from contamination. The present study also showed 10.4% of the respondents who disagreed and another 7.5% being uncertain. The responses given by those who disagreed is that, cooked foods might be contaminated from the utensils and equipment used to serve cooked foods. A study on hygienic control in mass catering establishments showed unsatisfactory result for environmental swabs and suggested for further improvement on good manufacturing practices (Legnani, Leoni, Berveglieri, Mirolo, & Alvaro, 2004). Other studies have showed poor hygiene of equipment, utensils and work surface (Rodriguez et al., 2011; Yousif, Ashoush, Donia, & Hala Goma, 2013) and thus suggest that cross-contamination may occur from unhygienic equipment to well-cooked foods.

About 90.3% agreed that it is important to check the refrigerators or freezers periodically to ensure it is well functioning. Abdullah Sani and Siow, (2014) mentioned that 56.9% of respondents also agreed that not monitoring refrigerator and freezer temperatures might be harmful to health. As reviewed by Ndraha et al. (2018), most temperature abuse has been reported is in cold chains in developed countries. In a study by Li, Huang, and Yuan (2017), *Salmonella* Paratyphi A has been found to grow at the minimum temperature of 8.9°C in roasted marinated chicken. Maintaining proper temperature of the refrigerator is important to maintain microbiological and sensory quality in food thus keeping it safe and better for consumption.

Table 3: Food handlers' attitude towards food safety (n=134)

No.	Statements	Respondents, n (%)					Mean ± SD
		Strongly disagree	Disagree	Uncertain	Agree	Strongly agree	
1	Properly food handling is an essential part of my responsibility at work	5 (3.7)	2 (1.5)	7 (5.2)	49 (36.5)	71 (52.9)	92.3 ± 16.2
2	I think that it is good to maintain a high degree of personal cleanliness while working	3 (2.2)	0 (0)	3 (2.2)	44 (32.8)	84 (62.7)	
3	Food hygiene training for handlers is an important issue to reduce the risk of food contamination	3 (1.5)	2 (1.5)	2 (2.2)	59 (44.0)	68 (50.7)	
4	Raw foods should be kept separately from cooked foods	7 (5.2)	4 (3.0)	2 (1.5)	62 (46.3)	59 (44.0)	
5	Cleaning my hands effectively can prevent foodborne diseases	2 (1.5)	6 (5.2)	6 (3.7)	58 (43.3)	62 (46.3)	
6	I should wash my hands before putting gloves	3 (2.2)	3 (2.2)	5 (3.7)	70 (52.2)	53 (39.6)	
7	The use of gloves could reduce the contamination risk while handling ready-to-eat foods	1 (0.7)	3 (2.2)	0 (0)	61 (45.5)	69 (51.5)	
8	I should take leave and should not work on the food premises if I am suffering from foodborne illness	1 (0.7)	1 (0.7)	3 (2.2)	58 (43.3)	71 (53.0)	
9	Well-cooked foods are free from contamination	5 (3.7)	9 (6.7)	10 (7.5)	60 (44.8)	50 (37.3)	
10	It is necessary to check the temperature of refrigerators/ freezers periodically to ensure it if functioning properly	1 (0.7)	2 (1.5)	10 (7.5)	55 (41.0)	66 (49.3)	

Self-reported food hygiene practices

Most outbreaks occur from improper food handling practices. Table 4 shows the mean score of self-reported food safety and hygiene practices at 73.0 ± 15.0 . This score shows that the food handlers show good food safety practices (>50%). This result is compatible with the good level of self-reported hygiene practices in the findings of Abdul-Mutalib et al. (2012), Sharif, Obaidat, and Al-Dalalah (2013) and Tokuç et al. (2009), but contradicts with the findings of Baş, Ersun, and Kivanç (2006b) and Kibret and Abera (2012). Only 85.9% of the food handlers reported that they often or always washed their hands before and after doing work. Handwashing is important because hands can be the main transporter for bacteria or virus transmission due to poor personal hygiene or cross-contamination (Kibret & Abera, 2012). It has also been pointed out by McIntyre et al. (2013) that food handlers who fail to wash hands have contributed to foodborne illnesses. A systematic review also showed that the risk of diarrhoea disease is reduced by 42-47% when washing hands with soap (Curtis & Cairncross, 2003).

Merely 52.2% of the food handlers often or always checked the refrigerators' temperature before food storage. Temperature plays a crucial role in bacterial growth and ensures safe food products. Malfunctioning refrigerator blowers and heating elements were quoted by workers and managers as barriers to proper food holding, hence hindrance to safe food preparation (Green & Selman, 2005). It was reported that time of storage and temperature in refrigerator influenced the growth of bacteria in foods and the shelf life of foods kept in the refrigerator (Derens-Bertheau, Osswald, Laguerre, & Alvarez, 2015). When responding to the question regarding storage of raw and ready-to-eat foods together, the respondents (88.8%) reported that they never or rarely engaged in this practice. Based on the study conducted by Sharif et al. (2013) and Abdul-Mutalib et al., (2012), about 90% and 85.9% respondents, respectively do not apply with this unhygienic practice. Separation of storage dictate that raw food should be kept separate and underneath ready-to-eat or cooked foods. For example, raw meat should be stored in the compartment below fresh-cut fruits. Nevertheless, if there are enough refrigerators, separate refrigerators should be used.

On "eating or drinking at the food preparation area", 70.9% respondents reported that they never or rarely engaged in such practice. This response is commendable since effective handwashing, which includes washing hands with soap, water and later drying it with paper towel is required after eating or drinking (Green & Selman, 2005). A high percentage of food handlers have good practices on cleaning the work area at the end of their duties (95.5%). For food production in a school, handlers may inadvertently spill as they prepare and cook food. Grease from the cooking process may also become adhered to the floor and walls of the kitchen area. Such a situation is ideal for bacterial growth since there is nutrition and suitable temperature for the microbes (Yardimci et al., 2015). Therefore, regular cleaning of the workstation is necessary to maintain a hygienic working environment.

A high percentage of the respondents are often or always putting on clean and suitable uniforms for work (97.0%). In comparison, only 46.6% of respondents from Abdullah Sani and Siow (2014) responded that they maintained safe practices on personal hygiene. Donning clean uniform aids to prevent cross-contamination to the food as a dirty uniform could become a

source of contamination when a food handler touches it (Clayton et al., 2002; Lestantyo, Husodo, Iravati, & Shaluhiah, 2017).

Table 4: Food handlers' self-reported practices on food hygiene (n=134)

No.	Statements	Respondents, n (%)					Mean ± SD
		Never	Rarely	Sometimes	Often	Always	
							73.0 ± 15.0
1	Do you wash your hands before and during work?	5 (3.7)	3 (2.2)	11 (8.2)	40 (29.9)	75 (56.0)	
2	Do you check the refrigerator's temperature before storage?	14 (10.4)	10 (7.5)	40 (29.8)	37 (27.6)	33 (24.6)	
3	Do you store raw food and ready-to-eat food together? (-)	112 (83.6)	7 (5.2)	8 (6.0)	5 (3.7)	2 (1.5)	
4	Do you eat/drink in the food preparation area? (-)	60 (44.8)	35 (26.1)	23 (17.2)	9 (6.7)	7 (5.2)	
5	Do you clean your working area after work?	1 (0.7)	4 (3.0)	1 (0.7)	11 (8.2)	117 (87.3)	
6	Do you put on a clean and suitable uniform before starting work?	0 (0)	2 (1.5)	2 (1.5)	13 (9.7)	117 (87.3)	

Observation on food hygiene practices

Observation on food hygiene practices was carried out using a checklist. The results from the observed practices were reported in Table 5 and shows inconsistencies in the self-reported practices ($p < 0.05$). For example, 56% of the food handlers reported that they washed hands before and after doing work, but in actuality, none of the food handlers washed their hands according to the seven steps of hand washing before or after doing work. This finding is similar to Tan, Abu Bakar, et al. (2013) where 100% of the food handlers in their study did not wash hands using the proper technique.

Some 83.6% of the respondents admitted to storing raw and cooked foods in separate compartments while 100% of the respondents were observed to comply with the practice. The difference is merely statistically significant ($p < 0.001$). Separate storage of raw and cooked or ready-to-eat foods should be practiced to prevent cross-contamination. Surprisingly, 44.8% respondents self-reported that they never eat or drink in the food preparation area, but when observed, 100% comply with such practices. This is most likely because presence of outsiders causes sudden changes in food hygiene practices.

Almost 87% of the respondents stated that they always cleaned their work stations however 100% were observed to leave their work areas cleaned upon completion of duties. The detergents for cleaning the school kitchens were found to be mainly cleaning agents without any bactericidal or disinfectants properties. This may result in ineffective cleaning. The difference between self-reported practice and observed practice of using clean uniforms and hair restraints is only 3% for self-reported and observed practice on using clean uniforms and restraint hairs, despite of this fact; significant differences were observed between the self-reported and observed practices. Since all respondents in the present study are Muslims, similar observation were observed in Tan, Abu Bakar, et al. (2013) whereby Muslim women wore headscarves to cover their head and thus complied with the "hair restraints" requirement. The respondents only showed consistently in their self-reporting and observed behavior towards one statement, which is checking of refrigerator temperatures ($p = 0.198$).

Table 5: Comparison between observed and self-reported food hygiene practices

Observed practices	Yes	No	NA	t	p-value
1. Employees observed washing hands according to 7 steps of hand washing	-	134 (100)	-	-28.37	0.000 ^a
2. Refrigerator temperatures are checked and recorded at daily	61 (45.5)	73 (54.5)	-	-1.294	0.198
3. Raw and cooked foods are stored separately	134 (100)	-	-	4.094	0.000 ^a
4. Employees do not eat or drink in food preparation/storage/dishwashing areas	134 (100)	-	-	7.389	0.000 ^a
5. Food contact materials and utensils are cleaned and sanitized after each use	-	134 (100)	-	2.497	0.014 ^b
6. Employees observed with hair restraints and clean uniforms	134 (100)	-	-	2.023	0.045 ^b

^aSignificantly different at $p < 0.001$, ^bSignificantly different at $p < 0.05$

Comparison of demographic profiles with knowledge, attitude and self-reported practices

When the knowledge scores were compared by demographic profiles, only gender and training showed significant difference in the knowledge score for food safety and hygiene (Table 6). Female food handlers scored significantly higher knowledge scores on personal hygiene ($U=1504.5$, $p=0.046$) and cross-contamination knowledge ($U=1359.5$, $p<0.001$) compared to their male colleagues. This is similar to the respondents in the study by Abdullah Sani and Siow (2014) where female food handlers scored higher in food safety knowledge. Conversely, findings by Yardimci et al. (2015), showed male food handlers having significantly higher mean scores on personal hygiene knowledge although the mean score difference between the male and female food handlers is small. Trained food handlers have relatively higher knowledge on personal hygiene ($U=235.0$, $p=0.005$), temperature control ($U=222.0$, $p=0.009$) and cross-contamination ($U=279.0$, $p=0.032$) than untrained food handlers. The result of similar studies support the findings of the present study (Abdul-Mutalib et al., 2012; Abdullah Sani & Siow, 2014; Baş et al., 2006; McIntyre et al., 2013; Saad, See, & Adil, 2013; Toh & Birchenough, 2000; Yardimci et al., 2015) where the knowledge score for trained food handlers is significantly higher than that of untrained food handlers.

There is no difference ($p>0.05$) in attitude scores among the demographic profiles, apart from gender, which showed significant difference in attitude score (Table 6). Female food handlers' food safety attitudes ($U=1624.0$, $p=0.014$) were statistically significantly higher than their male counterparts. Findings from this study is identical to that of Baş, Ersun, and Kivanç (2006), which revealed little difference in attitudes scores between trained and untrained food handlers ($p>0.05$). The difference in knowledge score between these two groups did not always produce positive change in food safety attitudes (Ehiri et al., 1997). This may be due to attitude being measured by a person's favourable or unfavourable view towards certain behaviours and what the person thinks will affect their decision towards the behaviour (Abdul Aziz & Mohd Dahan, 2013).

Trained food handlers have relatively higher self-reported food safety and hygiene practices ($U=388.0$, $p=0.026$) than those who have not obtained any training (Table 6). A study in Turkey suggested that food safety training is a determinant for food safety practices, where the food safety practices between trained and untrained food handlers differed significantly ($p<0.05$) (Baş et al., 2006). In the present study, other demographic profiles do not show any significant difference between self-reported and observed practices regarding food safety and hygiene ($p>0.05$). However, past studies have found that female respondents possessed considerably higher food safety practice levels compared to their male counterparts (Abdullah Sani & Siow, 2014; Sharif et al., 2013). This study however shows no difference between genders in their self-reported practices. Self-reported food safety and hygiene practice scores were not affected by education level. Although the number of respondents with secondary education levels generated similar, this demographic variable is again contra to past studies by Sharif, Obaidat, and Al-Dalalah (2013) where they found that respondents with secondary education scored higher practice score than other education levels ($p<0.05$).

Table 6: Comparison of demographic profiles with food handlers' knowledge, attitude and self-reported practices on food safety and hygiene

Demographic	Food safety and food hygiene knowledge					Food safety attitude	Self-reported food hygiene practice
	Personal hygiene	Temperature control	Cross-contamination	Food storage	Equipment hygiene		
Gender	0.046 ^b	0.914	0.000 ^a	0.221	0.522	0.014 ^b	0.470
Age	0.059	0.325	0.112	0.548	0.905	0.063	0.641
Educational level	0.471	0.303	0.964	0.936	0.896	0.993	0.803
Role in food service	0.963	0.586	0.429	0.786	0.975	0.667	0.412
Food service working experience	0.642	0.726	0.841	0.442	0.310	0.884	0.864
Food handlers' training certification	0.005 ^b	0.009 ^b	0.032 ^b	0.109	0.272	0.582	0.026 ^b

^aSignificant difference at $p < 0.001$, ^bSignificant difference at $p < 0.05$

Relationship between food safety knowledge and attitude with self-reported practices

The Spearman's rho correlation among knowledge, attitude and self-reported practices of food handlers on food safety and hygiene is showed in Table 7. From the results shown, knowledge on equipment hygiene is positively correlated with personal hygiene ($r_s=0.247$, $p=0.006$) and temperature control knowledge ($r_s=0.253$, $p=0.005$). Food safety attitude has a positive significant relationship with overall food safety knowledge ($r_s=0.196$, $p=0.040$) and personal hygiene knowledge ($r_s=0.200$, $p=0.029$). This indicates that food handlers' attitude towards food safety increases with increasing knowledge on food safety. These results are in agreement with other studies that found significantly positive correlation with knowledge and attitude (Abdul-Mutalib et al., 2012; Acikel et al., 2008; Al-Shabib, Mosilhey, & Husain, 2015; Ansari-Lari, Soodbakhsh, & Lakzadeh, 2010). In Al-Shabib et al. (2015), which studied only male food handlers in a Saudi Arabia University, food safety attitude was positively correlated with food safety knowledge ($r_s=0.371$, $p<0.05$) and personal hygiene knowledge ($r_s=0.173$, $p<0.05$).

This study also revealed a similarity between attitude and practices. Self-reported food safety and hygiene practice have a positive significant relationship with overall food safety knowledge ($r_s=0.264$, $p=0.005$), equipment hygiene knowledge ($r_s=0.198$, $p=0.023$) and food safety attitude ($r_s=0.214$, $p=0.015$) showing that food handlers' food hygiene practices will improve with better food safety knowledge and translated from positive food safety attitude.

Based on Toh and Birchenough, (2000), significant correlation exists between food safety knowledge and food handling practices ($r=0.000$, $p<0.01$) of hawkers. Another study by Abdul-Mutalib et al. (2012) have found positive correlation between food hygiene practices and knowledge ($p=0.007$) with food safety attitude ($p=0.041$). Findings from both studies corroborate the results of this study.

Table 7: Association among food handlers' knowledge, attitude and self-reported practices on food safety and hygiene

	Food safety knowledge	Personal hygiene	Temperature control	Cross-contamination	Food storage	Equipment hygiene	Food safety attitude	Self-reported food safety and hygiene practice
Food safety knowledge	-							
Personal hygiene	0.000 ^a	-						
Temperature control	0.000 ^a	0.103	-					
Cross-contamination	0.000 ^a	0.207	0.152	-				
Food storage	0.000 ^a	0.270	0.070	0.157	-			
Equipment hygiene	0.000 ^a	0.006 ^b	0.005 ^b	0.082	0.594	-		
Food safety attitude	0.040 ^b	0.029 ^b	0.351	0.099	0.049 ^b	0.504	-	
Self-reported food safety and hygiene practice	0.005 ^b	0.233	0.355	0.067	0.440	0.023 ^b	0.015 ^b	-

^aStatistically significant at $p < 0.001$, ^bStatistically significant at $p < 0.05$

Multiple linear regression predicting food handlers' self-reported practice

Multiple regression analysis was conducted to predict the self-reported food hygiene practices score based on two variables; the food handlers' knowledge and food safety attitude score. These variables significantly predicted food safety and hygiene knowledge, $F(2,107)=29.474$, $p<0.001$, $R^2=0.355$, where both variables explained 35.5% of the variance. This model predicts that self-reported food hygiene practice score increased 0.222 with the knowledge score and 0.415 with attitude score (Table 8). Hence, food handlers' food safety and hygiene knowledge and attitude scores are good predictors for self-reported food hygiene practices score.

These findings is supported by the logistic regression model by Abdul-Mutalib et al. (2012) where good knowledge levels and attitude will lead to good practices ($p=0.034$). This is further confirmed by Ko (2013) who found a relationship between knowledge, attitude and HACCP practices. In that study, knowledge did not influence practices directly but is reflected through attitudes, which in the end influenced HACCP practice intentions. Hence, this shows that food safety attitude is a crucial factor that influences food safety practices.

Table 8: Coefficients table for self-reported food safety and hygiene practices score regression model

Model	B	SE	β	t	p
1 (Constant)	20.979	7.135		2.940	0.004 ^a
Knowledge score	0.222	0.094	0.198	2.348	0.021 ^a
Attitude score	0.415	0.071	0.490	5.800	0.000 ^b

^aStatistically significant at $p<0.05$, ^bStatistically significant at $p<0.001$

Conclusion

In conclusion, this study suggests that although the knowledge, attitude and practices of food handlers were excellent, observed practices show otherwise. Written procedures on prerequisite programs of good manufacturing practices (GMP), continuous training and monitoring should strengthen food handlers' practices. In addition, implementation of the GMP and HACCP system will help school kitchens to identify any problems along their food process operation and thus aid in reducing the incidences of foodborne illness.

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