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Food Safety Knowledge, Attitude, and Practices of Food Handlers in Restaurants in Malé, Maldives

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Abstract: Poor hygiene in the food service industry is a critical public health concern in the Maldives, and is caused by several issues, such as limited inspections and monitoring, inadequate training and knowledge, and a lack of a regulatory framework. Thus, this study aims to identify the levels of knowledge, attitude, and practice (KAP) of food handlers in the Maldives as well as the potential association between the variables (knowledge, attitude, and practice). A total of 290 food handlers from restaurants were surveyed for four months through a quantitative questionnaire; most of them are male, Bangladeshi, and aged 26–35 years old. The result demonstrates that the food handlers have an acceptable level of knowledge ($55.5\% \pm 1.51$), an acceptable attitude (3.62 ± 0.51), and a good level of practice (4.18 ± 0.54) in food safety. The food handlers in Malé have poor practices in time and temperature control, especially in thawing and storage, resulting from a lack of training in the temperature danger zone. Work experience influences the level of knowledge, education impacts attitude and training, and work experience and education impact practice. A positive moderate association was observed between knowledge and practices ($r_s = 0.536, p < 0.05$), knowledge and attitudes ($r_s = 0.407, p < 0.05$), and practices and attitudes ($r_s = 0.317, p < 0.05$). Despite the good scores obtained in practices from the self-report questionnaire, the results of the observational assessment made on 102 restaurants exhibit overall poor practices, including deficient time and temperature control, and other categories of food safety need further attention in the design of training processes. This study can help policymakers to review and improve law enforcement to address the current food safety situation in the Maldives and can help businesses to selectively plan food safety training based on the KAPs of Maldivian food handlers.

Keywords: food safety; food security; knowledge, attitude, and practice; food handlers; training; Maldives



Citation: Halim-Lim, S.A.; Mohamed, K.; Sukki, F.M.; David, W.; Ungku Zainal Abidin, U.F.; Jamaludin, A.A. Food Safety Knowledge, Attitude, and Practices of Food Handlers in Restaurants in Malé, Maldives. *Sustainability* **2023**, *15*, 12695. <https://doi.org/10.3390/su151712695>

Academic Editor: Filippo Giarratana

Received: 8 June 2023

Revised: 28 July 2023

Accepted: 10 August 2023

Published: 22 August 2023



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1. Introduction

The consumption of food contaminated with microorganisms such as bacteria, viruses, parasites, and organic and inorganic chemical substances causes over 200 diseases globally [1]. The latest records estimate that 600 million people become ill due to eating contaminated food, resulting in 420,000 deaths annually, especially in low- and middle-income countries [1]. Food safety ensures the proper handling, storage, and preparation of

food, thus preventing foodborne illnesses. It is considered a major global concern [2] and is described as a critical component of sustainable development [3].

Food establishments, such as restaurants, are an important source of foodborne diseases through various sources, including bacteria, viruses, parasites, chemical contaminants, and allergens. Among the sources of food contamination, such as cross-contamination and food additives, food handlers are recognized as a major vehicle for certain microorganisms that cause foodborne diseases, and it was reported that improper food handling practices, including poor personal hygiene and inadequate cooking temperatures, can lead to disease outbreaks [4,5]. It is important to acknowledge that the restaurant industry has made dramatic efforts to ensure safe food handling practices, but perfection is still unattainable due to certain challenges, such as dealing with food handlers who are still sick when they are working and poor food preparation practices [6–10]. Food handlers' behaviour is a crucial factor in food contamination due to potential improper food handling practices, such as improper holding times and temperatures, inadequate cooking, cross-contamination, and food from unsafe sources [11–13].

Food safety practices and regulations in restaurants in the Maldives are overseen by the Ministry of Health and the Maldives Food and Drug Authority (MFDA). The MFDA is responsible for implementing food safety standards and regulations in the country and conducting inspections of restaurants to ensure that they comply with these standards. According to the registration list provided by the Health Protection Agency (HPA), there are 179 registered restaurants in Malé, Maldives [14], and food handler training is required, whereby every food handler should undertake a basic food safety training programme to be an eligible food handler [15]. Additionally, the hygiene and sanitation of food establishments and services are regularly inspected by the HPA and Ministry of Health, Maldives [14]. In the Maldives, the official statistics on foodborne outbreaks are limited due to a lack of a surveillance and reporting system [16], and a legislative framework is not established. Although there is no current data regarding foodborne illnesses in the Maldives, poor hygiene in the food services industry is a major public health concern, with an average of 35 public complaints per month regarding the poor hygienic conditions of the restaurants in Malé, the capital city of the Maldives [16].

To address the problems concerning poor hygienic conditions and their possible consequences, this study assesses the KAPs of food handlers and their association with sociodemographic characteristics in the restaurants of Malé, Maldives. This study can be an important investigation of the KAPs of food handlers in Malé and the potential risk of foodborne illnesses.

2. Materials and Methods

2.1. Study Design

This is a cross-sectional study aimed at describing the knowledge, attitudes, and practices of food handlers concerning food safety in Malé restaurants. A quantitative approach was used to evaluate the levels of knowledge, attitude, and practice of the food handlers, the relationship between those variables, and the impact of sociodemographic characteristics on the KAPs by collecting a questionnaire through a survey for four months. A qualitative approach through observations of the food handling practices was conducted by five trained inspectors with a checklist of observations [16].

2.2. Study Area and Sample Size

This study was conducted in Malé, the capital of the Maldives, which contains 179 registered restaurants [17]. However, there is no available document showing the number of food handlers working in the restaurants in Malé; therefore, a census of the food handler population was made during the pilot of the questionnaire, recording an average of ten food handlers per restaurant. The target sample size of 84 was calculated using the G-Power software version 3.1.9.7; however, the total number of respondents for this study

was 290, which exceeded the target sample size. A total of 120 restaurants were selected randomly from the registration list provided by the HPA of the Maldives.

2.3. Inclusion and Exclusion Criteria

The inclusion criteria are food handlers that work at a restaurant in Malé, Maldives, and that can communicate in the local language “Dhivehi” or English. Meanwhile, eligible food handlers were randomly selected and briefed about the objectives of the study, the contents of the questionnaire, and the observational checklist, with the assurance that their identities would be anonymous. The exclusion criteria are employees who do not have any direct contact with the food or who handle the food.

2.4. Questionnaire Design and Pilot Study

A structured questionnaire was designed to assess the KAPs of food handlers regarding a few risk factors for food safety [18,19]. The questionnaire consisted of ten questions regarding socio-demographics and sixteen questions to assess knowledge. The responses were “true”, “false”, or “do not know” to reduce the participants’ selection of answers by chance. Each correct answer was given a mark, while incorrect answers and the answers with the “do not know” option were given no mark. Following the scoring categories, 50% was the cut-off point, where any score below 50 was considered poor. A score between 50 and 75 was considered an acceptable level of knowledge, and a score above 75 was considered good [18]. For practice, only the “Always” response was considered a point. “never”, “not often”, “sometimes”, and “most of the time” were given a score of zero [20], and the calculation was performed based on the individual score for each variable (knowledge, attitude, and practice) [21].

Attitude and practice were assessed using sixteen questions and scored based on a five-point Likert scale, with the attitude section scoring labels being “strongly disagree”, “disagree”, “undecided”, “agree”, and “strongly agree”, and the practice section scoring labels being “never”, “not often”, “sometimes”, “most of the time”, and “always”. The final average score is the lowest at 1 and the highest at 5, as shown in Nee et al. (2011) [22].

The questionnaire was piloted by 50 food handlers, and the Cronbach’s alpha values were 0.78, 0.87, and 0.79 in knowledge, attitude, and practice, respectively, indicating the stability and reliability of the questionnaire [23]. For samples of 25–40 per group, the observed alpha should be at least 0.75 to have reasonable confidence that the population value is at least 0.70 [20]. The questionnaire was modified to improve clarity and was translated into Bengali and English.

2.5. Data Analysis

A statistical analysis was conducted using SPSS software version 20.0 and XLSTAT 2021. Descriptive statistics were used to summarise the demographic factors and the knowledge, attitudes, and practices of the respondents. In order to assess the statistical comparison in average KAP scores with respect to sociodemographic characteristics, the Kruskal–Wallis H test and Mann–Whitney U test were employed due to the non-normal distribution of the data. Furthermore, the acquired observational data were subjected to analysis to further assess the various dimensions of practise. This analysis was conducted using an observation checklist that encompassed aspects such as personal hygiene, time and temperature management, and cross-contamination.

3. Results and Discussion

3.1. Food Handlers’ Sociodemographic Descriptions

The sociodemographic characteristics of 290 food handlers in restaurants in Malé, Maldives, are characterised in Table 1. Most respondents were male (84.8%), which is a result that is consistent with the information reported by the low rate of female participants in the accommodation and food industries, as shown by the 2014 population and housing census from the National Bureau of Statistics [24]. More than half of the respondents (57.9%)

were young adults (26 to 35 years old), while most of the respondents were Bangladeshis (47.9%), and only 15.5% were Maldivians. Half of the respondents were married (53.1%), with 33.1% having a college or university education, while 19.7% had not received any formal education. Another critical characteristic concerns food safety training and experience. Half of the respondents had 1 to 5 years' experience as food handlers; 64.5% were food serving staff; approximately half of the respondents did not receive food safety training; and only 37.9% received basic training such as handwashing.

Table 1. Demographic characteristics of food handlers ($n = 290$).

Demographic Characteristics	Variables	Number of Respondents (n)	Percentage (%)
Age	>25	90	31.7
	26–35	168	57.9
	36–45	27	9.3
	<45	5	1.7
Gender	Male	246	84.8
	Female	44	15.2
Marital state	Married	154	53.1
	Not married	136	46.9
Nationality	Bangladesh	139	47.9
	India	34	11.7
	Indonesia	1	0.3
	Maldives	45	15.5
	Nepal	16	5.5
	Philippines	10	3.4
	Singapore	1	0.3
	Sri Lanka	38	13.1
	Thailand	6	2.1
Level of education	No formal education	57	19.7
	Primary school	56	19.3
	Secondary school	81	27.9
	College or university	96	33.1
Work experience	>1 year	40	13.8
	1 to 5 years	145	50.0
	6 to 10 years	68	23.4
	>10 years	37	12.8
Job responsibilities	Cooking	45	15.5
	Cleaning and washing dishes	58	20.0
	Food serving	187	64.5
Food safety training	Trained	139	47.9
	Not Trained	151	52.1
Areas of training	Handwashing	110	37.9
	Cross-contamination	64	22.1
	Cleaning and sanitization	90	31.0
	Health	65	22.4
	Temperature danger zone	48	16.6
	Glove use	78	26.9
	Allergens	32	11
Training hours	Periodic job training	30	10.3
	<1 h	11	3.8
	1 to 2 h	28	9.7
	3 to 5 h	26	9.0
	6 to 10 h	21	7.2
	>10 h	23	7.9

3.2. Food Safety Knowledge

The food safety knowledge of the food handlers is presented in Table 2, with an average score of 60%. The questions regarding knowledge related to personal hygiene were answered correctly by most respondents (93.85%), showing that the respondents could identify separate occasions for handwashing (98.6%), the risk of wearing jewellery (91.7%), the importance of handwashing after using disposable gloves (87.2%), and handwashing after handling garbage (97.9%). The findings in terms of handwashing agree favourably with similar studies conducted in restaurants in Kuwait [25], Malaysia [26,27], and Pakistan [21]. Since food handler training programmes were conducted in the Maldives [28], the personal hygiene knowledge of food handlers could be maintained at a prominent level [26]. In the Maldives, knowledge concerning personal hygiene is commonly conveyed to the public in health-promoting events; for example, the correct handwashing procedure is frequently displayed in public areas and food-serving premises [16,17].

Table 2. Food handlers' knowledge concerning food safety in restaurants in Malé, Maldives ($n = 290$).

Category	Questions	Response Frequency (%)		
		True	False	Do not Know
Personal hygiene	1. Hands should be washed before and after preparing food, using toilets, and cleaning the table	286 (98.6%)	2 (0.7%)	2 (0.7%)
	2. Jewellery should not be worn by food handlers when preparing food, as it can contain dirt and bacteria	266 (91.7%)	10 (3.4%)	14 (4.8%)
	3. It is necessary to have thoroughly washed hands if you use single-use gloves to handle food	253 (87.2%)	26 (9.0%)	11 (3.8%)
	4. It is essential to wash hands after handling the garbage	284 (97.9%)	5 (1.7%)	1 (0.3%)
Cross-contamination	5. Wiping cloths can spread microorganisms	250 (88.0%)	14 (4.9%)	20 (7.0%)
	6. The same cutting board can be used for raw and cooked foods if it looks clean	63 (21.7%)	217 (74.8%)	10 (3.4%)
	7. The ideal place to store raw fish, chicken, and beef in the refrigerator is the bottom shelf	97 (33.4%)	134 (46.2%)	59 (20.3%)
	8. It is necessary to wash the food contact surface with water and soap, then apply sanitiser	214 (73.8%)	47 (16.2%)	29 (10.0%)
Time and temperature control	9. The best way to defrost meat is by keeping the meat on a dry countertop	165 (56.9%)	83 (28.6%)	42 (14.5%)
	10. The correct temperature for storing easily spoiled foods such as vegetables and fruits is 10 °C	136 (46.9%)	61 (21.0%)	93 (32.1%)
	11. Hot, ready-to-eat food should be kept above the temperature of 60 °C	166 (57.2%)	30 (10.4%)	94 (32.4%)
	12. The refrigerator operating temperature should be between 5 °C and 10 °C	136 (46.9%)	62 (21.4%)	92 (31.7%)
Foodborne pathogen	13. Hypertension can be caused by eating contaminated food	218 (75.2%)	29 (10.0%)	43 (14.8%)
	14. The best temperature for foodborne microorganisms to grow is between 25 °C and 60 °C	163 (56.2%)	22 (7.6%)	105 (36.2%)
	15. Salmonella, Shigella, Hepatitis a virus, and Staphylococcus aureus are related to foodborne diseases	177 (61.0%)	17 (5.9%)	96 (33.1%)
	16. Microbes are in the skin, nose, and mouth of food handlers	101 (34.8%)	74 (25.5%)	115 (39.7%)

Bold: Correct answer food safety knowledge.

The lowest mean food safety knowledge score of 7.6% was recorded in response to the fact that the best temperature for foodborne microorganisms to grow is between 25 °C and 60 °C. Previous studies in Malaysia [25,26], Kuwait [27], and Brazil [29] showed that food handlers lacked adequate knowledge concerning the recommended operating temperatures of food refrigerators. A study in Petaling Jaya [26] showed that food handlers had poor

knowledge regarding food storage temperature and storage. This observation indicates an urgent need for training to enhance the proper cold storage practices for vulnerable food items. Furthermore, this study showed that time and temperature control are the least taught topics given to food handlers in the Maldives, which may have impacted their level of knowledge, as suggested by [30]. This underscores the need to improve food handlers' food safety awareness by providing basic food safety training, as most of them have never received such training [20]. The government is responsible for establishing and enforcing regulations, providing guidance and education, conducting inspections, and promoting compliance with food safety standards [29,31,32].

3.3. Food Safety Attitudes

Measuring food handlers' attitudes towards food safety is critical, as their attitudes influence their behaviour and practices accordingly [33]. Table 3 shows that the overall attitude of the respondents was acceptable [22], with an overall average scale of 3.62 ± 0.5 or a total mean score of 72.33 ± 9.00 . The full analysis of food safety attitude is presented in Table S1.

Table 3. Food safety attitude of the food handlers of restaurants in Malé, Maldives ($n = 290$).

Question	Agree	Disagree	Undecided	Mean \pm SD
1. Frequent handwashing during food preparation wastes time	102 (35.2%)	179 (61.7%)	9 (3.1%)	3.33 ± 1.48
2. A simple finger ring is safe to wear during food preparation	35 (12.1%)	241 (83.1%)	14 (4.8%)	4.01 ± 0.99
3. I do not need to thoroughly wash my hand if gloves are used to handle food	87 (30%)	166 (57.2%)	37 (12.8%)	3.34 ± 1.26
4. Handling garbage bags which are well covered does not make the hands dirty	70 (37.9%)	213 (73.4%)	7 (2.4%)	3.65 ± 1.21
5. It is okay to use the same wipe cloths to clean tables and dishes	14 (4.9%)	266 (91.7%)	10 (3.4%)	4.38 ± 0.85
6. It is safe if the cutting board used to cut raw chicken is washed with water before using it to cut vegetables	71 (24.4%)	209 (72.1%)	10 (3.4%)	3.74 ± 1.42
7. Frozen raw meat can be kept in the freezer along with other food (e.g., ice-cream/cooked food)	38 (13.1%)	228 (78.6%)	24 (8.3%)	4.02 ± 1.15
8. Washing food contact surfaces with water and soap, followed by the application of a sanitiser is essential to prevent cross-contamination	212 (73.1%)	39 (13.5%)	39 (13.4%)	3.80 ± 1.02
9. Thawing frozen food (chicken/beef/fish) at room temperature is safe	93 (32.1%)	149 (51.4%)	48 (16.6%)	3.32 ± 1.41
10. Carrot, cabbage, and other vegetables can be stored at room temperature	137 (47.2%)	130 (44.8%)	23 (7.9%)	2.92 ± 1.27
11. Hot ready-to-eat food should be kept at 65 °C	172 (59.3%)	23 (8%)	95 (32.8%)	3.72 ± 0.93
12. The refrigerator temperature is safe below 10 °C	165 (56.9%)	49 (16.9%)	76 (26.2%)	2.45 ± 0.99
13. Foodborne disease is a serious issue	270 (93.1%)	7 (2.4%)	13 (4.5%)	4.28 ± 0.72
14. Foodborne pathogens can grow well at room temperature	183 (63.1%)	14 (4.9%)	93 (32.1%)	3.74 ± 0.88
15. Knowing about bacteria that cause food poisoning can help to prevent foodborne disease	252 (86.9%)	19 (6.6%)	19 (6.6%)	4.10 ± 0.83
16. Food handlers are free from germs that cause food poisoning if they are not sick	102 (35.1%)	157 (54.2%)	31 (10.7%)	3.16 ± 1.28

The present study indicates that over 75% of food handlers had positive attitudes towards foodborne disease as a grave issue, separating frozen raw meat from other food, and bacteria causing food poisoning. Among the participants, 61.7% did not view frequent handwashing during food preparation as a waste of their time. Handwashing after handling food with gloves was strongly agreed upon by 57.2% of the respondents, and 73.4% positively agreed that they must wash their hands if they touch the rubbish bags. This result in Malé is lower compared with the result of the studies conducted in Iran [17], Saudi Arabia (80%) [34], and Malaysia [23]. These results indicate that the food handlers'

attitudes towards personal-hygiene-related activities should be improved to facilitate proper food handling practices.

The food handlers' acceptable scores related to handwashing during food preparation indicate that the food handlers' attitudes towards personal-hygiene-related activities can be improved towards good attitudes and can facilitate proper food handling practices. Despite the high mean score of knowledge regarding personal hygiene, the attitudes of the food handlers in Malé restaurants towards personal hygiene issues was comparatively poor, and this may need an intervention via training that considers the influence of attitude towards food safety practice [2,33].

Poor attitudes towards the storage temperature of perishable food (44.8%) and a safe refrigerator temperature (16.9%) were identified. In contrast to this study, studies conducted in Pakistan [21] and Kuwait [25] identified that 71.3% and 59.2% of food handlers, respectively, have a fair idea of the importance of keeping the food stored below 4 °C. The results of this study show that food safety training regarding temperature control is limited in the Maldives, which can influence the attitudes towards it [35]. The Maldives have a year-round warm and humid climate [24]. In principle, perishable foods can be kept outside for no more than two hours before being subjected to refrigeration or disposal [18]. However, the perfect environment for bacteria to thrive even more quickly is created by hot and humid weather [24]. Cultural norms such as placing perishable food at room temperature for a long period of time might encourage the growth of hazardous bacteria [10,18,33].

3.4. Food Safety Practice

3.4.1. Self-Report Assessment

Table 4 shows that there is a good level of food safety practice among the respondents in this study; the overall mean score of food safety practice is 4.18 ± 0.54 with $83.52\% \pm 8.83$. The full analysis of self-reported food safety practices is presented in Table S2.

Table 4. Self-reported food safety practices of the food handlers of restaurants in Malé, Maldives ($n = 290$).

Question	Sufficient	Mean \pm SD
1. I wash my hands before and during food preparation	243 (83.8%)	4.79 ± 0.54
2. I do not wear jewellery like a finger ring or bracelets during the handling of food	239 (82.4%)	4.64 ± 0.89
3. I wear gloves when I touch ready-to-eat food	90 (31.0%)	3.32 ± 2.47
4. I wash my hands after touching the garbage	237 (81.7%)	4.65 ± 0.92
5. I do not use the same towel to wipe dish plates, knives, and chopping boards	226 (77.9%)	4.50 ± 1.11
6. I use separate cutting boards when preparing raw and cooked food	238 (82.1%)	4.61 ± 0.99
7. I store frozen raw meat separately from other food	179 (61.7%)	4.39 ± 0.95
8. I clean work surfaces before and after food handling	227 (78.3%)	4.71 ± 0.64
9. I thaw frozen food (e.g., chicken, beef, and fish) by keeping it at room temperature more than 2 h	110 (37.9%)	3.41 ± 1.50
10. I keep vegetables and fruits in the refrigerator below 5 °C	79 (27.5%)	3.32 ± 1.47
11. I check the temperature settings of chillers or freezers regularly	109 (37.6%)	3.71 ± 1.25
12. I avoid keeping cooked food at room temperature until served	103 (35.5%)	3.52 ± 1.38
13. I throw away food beyond its expiry date	226 (77.9%)	4.58 ± 0.99
14. I touch the food when I have a wound on my hand	191 (65.9%)	4.26 ± 1.26
15. I take sick leave when I have a fever, cough or cold	154 (53.1%)	4.30 ± 0.93
16. I read the instructions on the storage of packaged food	140 (48.3%)	4.11 ± 1.02

The use of gloves as a method for reducing the bacterial cross-contamination of food is suggested by Ahmed et al. (2021) [21] and Robinson et al. (2016) [36]. However, in this study, only 31% of the respondents always wear gloves when they touch ready-to-eat food. Nonetheless, the respondents demonstrated a good level of practice in other personal-hygiene-related practices, such as not wearing jewellery while handling food and washing

their hands after handling garbage. These show the effectiveness of the promotional events related to hand hygiene practices hosted by the Ministry of Health, Maldives. The storage of raw food (meat/poultry/fish) separately from other food in the freezer was reported to be always practiced by 61.7% of the respondents. The mixed storage of raw food with ready-to-eat food leads to cross-contamination [37]. The practices of the respondents were good in other cross-contamination-related areas, such as cleaning the workplace, separating cutting boards, and using wipe cloths accordingly.

The food safety practices concerning time and temperature control are alarmingly weak among the respondents of this study, with less than 40% of respondents always practising activities such as thawing food, storing perishables at the correct temperature, checking the temperature of the refrigerator, and keeping food at room temperature until served. These results indicate that inappropriate methods of thawing are practiced frequently, and studies commonly report these practices [27,38], due to poor knowledge and attitudes concerning time and temperature control. Therefore, food that is prepared and stored in the chillers in Malé restaurants is highly subjected to an environment where microbial growth is optimal, thereby increasing the risk of foodborne diseases.

Practices related to unsafe food (foodborne pathogens), such as throwing away the food after the expiration date, were practiced by 77.9% of the respondents. There is a high possibility of using unsafe food in the preparation of meals, increasing the risk of foodborne illnesses. The percentage of respondents who never touch the food when they have a wound on the hand was 65.9%, with only half of the respondents (53.1%) taking sick leave when they are sick, while the amount of respondents who always read the instructions on the label was low (48.3%). Reading labels provides critical information, such as allergens, storage temperature, and the expiration date, regarding the risk of the food. Moreover, the occurrence of food handlers going to work when ill could be due to two reasons. Firstly, food handlers are not aware of the risk associated with the practice, and secondly, they are not compensated for their loss of earnings when taking sick leave.

3.4.2. Observation of Food Safety Practice

The limitations of desirability bias as well as recall error are commonly reported in studies where the self-report method is the only alternative assessment [16]. Making observations to evaluate food safety practice is believed to be a more reliable method as it prevents desirability [30,39]. The observations were performed using the method from Griffith et al. 2010 [40], and an analysis was conducted to observe the discrepancies between the self-reported practices and the observed food safety practices at the restaurants. Inter-rater reliability was established through all observers making the same observations for two weeks ($\kappa = 0.85$; range of 0.75–1.00) at 102 restaurants.

Personal Hygiene

According to Table 5, there is a major discrepancy between the self-reported and observed food safety practices, especially in handwashing practices. It was observed that only half of the restaurants (54%) were equipped with adequate facilities for proper handwashing practices and food safety practices, despite there being a good level of practice reported in the self-report questionnaire. There is a disparity between the self-reported and reported observations [41]. In this study, all food handlers correctly answered that washing their hands before work reduces the risk of food contamination, and almost all (95%) claimed that they wash their hands before handling food. The observations show that only 50% of food handlers performed handwashing, and in middle-income countries [9], the data from the field observations are contrary to the self-reported handwashing information. The National Hygiene Survey 2018 conducted in Bangladesh reveals that the food handlers have poor hygiene practices due to a lack of access to proper supplies and information about good hygiene practices, where only 23% were observed washing their hands with soap and water before preparing food [26].

Table 5. Observation of the food safety practices at the restaurants ($n = 102$).

Aspects	Observation Practice	Percentage
Personal hygiene	Untrimmed fingernails	(57%)
	Do not wear jewellery while preparing food	(78%)
Handwashing facilities	Washbasin damaged	(5%)
	Detergent not provided	(25%)
	Hand-drying facilities not provided	(22%)
	Functional handwashing facilities	(54%)
Thawing of meat/chicken/fish	Kept in a bowl of water	(48%)
	Kept inside the sink without a running water supply	(22%)
	Kept in a tray/bowl without water	(23%)
	Use a microwave and chiller	(10%)
Temperature of chiller	Temperature above 5 °C	(57%)
	Temperature below 5 °C	(43%)
Availability of hot cupboard to keep hot food	Not available	(72%)
	Available but not used	(3%)
	Available and used	(27%)
Wipe cloths	Cloth dirty/smells bad	(39%)
	Separate cloths not identified by the food handlers	(3%)
	Same cloths used	(4%)
Separation of cutting boards for raw and cooked food	Separated but not identified by the food handlers	(8%)
	Separated but not used accordingly	(25%)
	Separated completely	(69%)
	Not separated	(3%)
Availability of gloves	Not available	(17%)
	Available	(83%)

Moreover, 50% of the observed food handlers had untrimmed and unclean fingernails, suggesting that the personal hygiene of the food handlers was not monitored by the management of the food businesses. However, only one of the restaurants practiced daily personal hygiene inspections with a documented personal hygiene policy and well-described personal hygiene procedures. This is a praiseworthy practice that can reduce the risk of food cross-contamination and should be a benchmark practice for other restaurants.

It was observed that in 42% of the sampled restaurants, the food handlers were not wearing appropriate outer garments. Similarly, Auad et al. (2019) [27] reported that their observations revealed that only 17.5% of the handlers adequately protected their hair with a cap and wore no adornments while performing food handling activities. Protective equipment such as head covers prevents foreign objects like hair from falling into prepared food. Foreign objects in food increases the risk of cross-contamination as well as being unappealing for consumers [41]. However, the observation of this study was found to be better than the observation study in Brazil, where it was found that 82.5% of the respondents practiced insufficient personal hygiene [41].

Time and Temperature Control

Alarming, the time and temperature control practices were poor, and the result were poor practice in the thawing process and in the storage temperature used for hot food, and these are aligned with the result from the self-report questionnaire. In contrast to this study, it was identified that there is a significantly higher level of inadequate food safety practice observed compared to the self-reported practice regarding the thawing of frozen food, as they are using hot water and room temperature [9].

The observed thawing conditions of meat/chicken/fish showed that a sink was used in 22 restaurants. It was also observed that in all these cases, running water was not provided, and in some cases, dirty utensils were kept inside the sink. Moreover, 48 restaurants thawed food in a bowl/tray at room temperature, and 29 restaurants used a bowl of tap water. The

practice of defrosting frozen food at room temperature promotes the optimum growth of food spoilage bacteria. It is therefore important that restaurant managers and regulatory agencies encourage the use of low refrigerator temperatures to defrost frozen food [35]. On rare occasions, microwaves or chillers were used, which are scientifically proven methods for safe thawing by the United States Department of Agriculture [42].

The results of the observation and self-reported practice are in line regarding the temperature of the refrigerators, as the refrigerator is above 5 °C in 57% of the restaurants, and they failed to maintain the temperature of the freezer. In the self-reported practice, almost 37% of the food handlers reported that they check the temperature of the refrigerator or freezer; however, only 21% of all the food handlers have knowledge of the right temperature at which to maintain the refrigerator.

It was also observed that a hot cupboard was not common in restaurants. These observations agree with the knowledge of food handlers, as the food handlers scored low in the time–temperature control aspect in the knowledge section. Food handlers or restaurant owners do not take adequate measures to address these issues. Moreover, when considering the enforcement of food safety, the inspections focus on the infrastructure and general availability of the temperature-maintaining equipment, while accuracy and appropriate practices are not adequately monitored. According to the World Health Organization, temperature abuse during food processing was responsible for 45.6% of foodborne outbreaks, while poor refrigeration and inappropriate storage temperatures of leftover or recently cooked meals accounted for 23.5% and 12.6% of cases, respectively.

Cross-Contamination

The observations concerning cross-contamination are shown in Table 5. Among these issues was the storage of high-risk food such as frozen meat/chicken/fish with low-risk or ready-to-eat food. Almost all restaurants have a freezer designated to store high-risk frozen food; however, some food handlers practice mixed storage of food in the freezer. Among the food items observed being stored in meat freezers were French fries, frozen vegetables, cheese, butter, frozen chapati (flatbread), cooked pasta/snacks, water bottles, ice cubes, and ice cream.

Separate cutting boards were satisfactorily practiced in 69 restaurants; 25 restaurants were observed to have separate cutting boards (different colours), but the food handlers did not use them accordingly despite being aware of the colour code separation. A previous study in a middle-income country showed that there is a significant difference in the self-reported and observed practices regarding using separate cutlery for raw and cooked food, where only 48% were reported to correctly perform this practice [9]. Cutleries such as cutting boards and knives are the source of cross-contamination of food [9].

When the observations and the self-reported practices are considered, in some respects, such as personal hygiene, the observations reflect the food handlers' self-reported practices. It is obvious that if an adequate facility is not available, knowledge cannot be effectively translated into practice. The reviews of the food safety inspections revealed that adequate facilities can be a key health protection measure to prevent foodborne illnesses [28]. However, when cross-contamination is considered, the self-reported practices are exaggerated, as most respondents scored high in the self-reported practices.

3.5. Impact of Sociodemographic Characteristics on Food Safety KAP

The differences in the levels of KAP based on sociodemographic characteristics is represented in Table 6 and the full analysis is presented in Table S3. A statistically significant difference in food safety knowledge, attitude, and practice was seen based on different education levels. The analysis showed that the respondents with no formal education had the poorest food safety practices and had significantly less knowledge compared to the higher-educated food handlers. Similar findings were found in Pakistan [21] and Ghana [20], with 21.3% of the respondents having no formal education. This underscores the importance of education and training programmes in improving food safety practices

in restaurants in the Maldives [1,43]. Moreover, across the different education levels, the respondents with no formal education showed significantly insufficient practice compared to the respondents with secondary school education as well as college- and university-level education ($p = 0.000$). This indicates that education levels enhance the capacity for learning and therefore have a high possibility of translating knowledge into practice. However, these findings contradicted those of the studies conducted by the authors of [38,43,44], where it was found that education level may not implicate food safety knowledge or practice due to several other factors such as job burnout and culture. Education level may also affect food safety training, as training may be less effective if it is administered to employees with inferior educational and/or socioeconomic backgrounds [2].

Table 6. Impact of sociodemographic characteristics towards knowledge, attitude, and practice.

Aspects	<i>p</i> -Values		
	Knowledge	Attitude	Self-Reported Practice
Age	0.861	0.642	0.083
Education levels	0.045	0.009	0.000
Work experience	0.007	0.125	0.016
Food safety training	0.014	0.000	0.000

Work experience is determined to influence food safety knowledge and practice. The test showed that the respondents with work experience of 1 to 5 years and >10 years had a significant difference ($p = 0.021$). The knowledge score of the respondents with work experience durations of 6 to 10 years and >10 years was high compared to the other two categories, indicating that the increased duration of working in the field can increase the individual's awareness through the accumulation of food safety protocols, problem-solving skills, and awareness of industry-specific requirements [38]. Similar results can be found in Bangladesh [33] and Kuwait [25], while they contradict a study conducted in Brazil [27].

Training is identified to influence the levels of knowledge, attitude, and practice of the food handlers, and effectively delivered food safety training is expected to exhibit an improvement in participants' food safety knowledge, attitudes, and practices [38]. The majority of KAP studies showed the significant influence of training on knowledge [3,10,15,19,20,23,25,27]. Hence, the number of untrained food handlers in this study is alarming as it affects food safety practices.

The findings of this study suggest that food safety training is an effective means of providing food handlers with the knowledge and skills necessary to perform safe food handling practices, such as correct handwashing and the avoidance of jewellery [28]. However, previous studies stated that knowledge from training may not reflect their attitude and behaviour, which is possibly due to the ineffective approach with which the knowledge was transferred, making it unable to be translated into good practice [38,44]. Practical training is crucial to effectively enhance the knowledge and performance of food handlers [28]. The food industry can use monitoring tools such as control charts to continuously maintain the performance of food handlers in food safety practices [29,45,46].

Overall, the results indicate that food handlers' KAPs can be greatly affected by their sociodemographic characteristics, such as education level, work experience, and food safety training. The results identified in this section can provide the restaurants with a strategy regarding the need for training and recruitment of food handlers in their restaurants.

3.6. The Association of Knowledge, Attitude, and Practice

The association between knowledge, attitude, and self-reported practice is summarised in Table 7. A significant positive correlation was found between knowledge and attitude ($r_s = 0.414$, $p < 0.01$), knowledge and self-reported practice ($r_s = 0.304$, $p < 0.01$), and a small-effect relationship was found between attitude and self-reported practice. However, the correlation was found to be significant ($r_s = 0.172$, $p < 0.01$). Cohen's rule benchmark effect size for Cramer's V value was applied in this study, showing that the small effect

was ≥ 0.1 , the moderate effect was ≥ 0.3 , and the large effect was ≥ 0.5 [18]. These results indicate that the food safety knowledge of food handlers influences their attitude formation as well as their food handling behaviour. These findings are supported by other studies that show a significantly positive correlation between the knowledge, attitudes, and practices of food handlers [10,15,25,34]. However, attitude has a small effect on the practice, and this is reflected by the good food safety practices shown in this study despite there being a moderate level of attitude. This result contradicted that obtained in the studies in Malaysia [23] and Saudi Arabia [15], where a higher correlation was identified between attitude and practice ($r_s = 0.559$, $p < 0.01$) compared to knowledge and practice ($r_s = 0.190$, $p = 0.49$) and knowledge and attitude ($r_s = 0.217$, $p = 0.024$). Poor attitudes were also identified in this study, which calls for motivation and training in addition to education. This is because poor attitudes towards food safety imply the need for behavioural changes in addition to food safety training [2].

Table 7. Association between food safety knowledge attitude and self-reported practice level of food handlers of restaurants in Malé ($n = 290$).

Level	Spearman's Rho	<i>p</i> -Value
Knowledge—attitude	0.414	0.000
Knowledge—practice	0.304	0.000
Attitude—practice	0.172	0.003

The positive association indicated that food handler practice can be influenced by knowledge and attitude, and those two dimensions may be impacted by food safety training, which is the most important intervention for food-borne disease prevention [1,22]. Although not all training is effective [2,25], as it is suggested that the training needs to be periodic [25], the module includes the elements of attitudes [2] and a customised module based on the food handlers' KAPs [10]. The recent development of digital technologies has enabled food safety training to be more effective, such as using simulations, artificial intelligence, and big data [47,48].

The findings had some limitations. Firstly, the food handlers' training was not measured enough, which can influence their food safety knowledge, attitudes, and practices. Secondly, only a univariate analysis was implemented in this study to achieve the research objective. Other limitations of this study included the use of a self-reporting tool, hence the desirability bias. Even though observations were performed to complement the self-reported practices, the presence of the observer, or the Hawthorne effect, can also be a considerable limitation. Furthermore, there is a limited population of food handlers since this study only focused on restaurants in Malé, so the findings cannot be generalised to the entire country and other food operations. Lastly, the assessment of some of the food safety practices at the restaurants was performed through observations rather than an interview to avoid information bias.

4. Conclusions

In conclusion, the food handlers of the restaurants in Malé, Maldives have an acceptable level of overall food safety knowledge and attitude. A good level of food safety practices was identified except for the factors of "time and temperature control" and "foodborne pathogens". The association between knowledge, practice, and attitude was found to be significant despite the weak association identified between attitude and practice. The education level, work experience, and food safety training significantly impacted the levels of KAPs among food handlers in Malé. The level of knowledge was significantly affected by work experience; attitude was significantly affected by the level of education; and the level of practice was impacted by age, education level, and work experience. The common factor that had a significant impact on all KAPs was the existence of food safety training.

Based on these findings, it is recommended that policymakers review the training module, training approaches, and regulations and implement procedures to address the current food safety situation in the Maldives. Training interventions should focus on temperature control, foodborne pathogens, and correcting undesirable personal hygiene practices. Implementing strict legislation to address food-safety-related issues is the primary requirement for the safety of consumers in the Maldives.

Future research is needed to compare the scores of other food handlers in all states in the Maldives to consider the overall quality of restaurant operation in the Maldives, thus ensuring that all restaurants comply with food safety standards and practices. As the current study provides baseline information on the knowledge, attitudes, and practices of food handlers in the Maldives, future studies should use these findings to formulate practical training modules and programmes that are appropriate for food handlers in the Maldives for the development of an effective national food safety system.

Supplementary Materials: The following supporting information can be downloaded at: <https://www.mdpi.com/article/10.3390/su151712695/s1>, Table S1: Food safety attitude of the food handlers of restaurants in Malé, Maldives. (n = 290), Table S2: Self-reported food safety practices of the food handlers of restaurants in Malé, Maldives. (n = 290), Table S3: Impact of sociodemographic characteristics towards knowledge, attitude and practice.

Author Contributions: Conceptualisation, K.M. and S.A.H.-L.; methodology, K.M., S.A.H.-L. and U.F.U.Z.A.; Funding acquisition, S.A.H.-L. and F.M.S.; data curation, K.M.; formal analysis, K.M., S.A.H.-L. and W.D.; writing—original draft preparation, K.M. and S.A.H.-L. writing—review and editing, S.A.H.-L., F.M.S. and A.A.J. All authors have read and agreed to the published version of the manuscript.

Funding: This work was funded by the Ministry of Higher Education Malaysia and Universiti Putra Malaysia under the research grant Fundamental Research Grant Scheme FRGS/1/2022/SS02/UPM/02/1.

Institutional Review Board Statement: The study protocol was approved by the National Health Research Council of the Ministry of Health, Maldives.

Informed Consent Statement: Not applicable.

Data Availability Statement: Not applicable.

Acknowledgments: The authors are grateful to the Islamic Development Bank (IDB) for providing scholarship support. The authors also appreciate the food handlers who participated in this study.

Conflicts of Interest: The authors declare no conflict of interest.

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