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Food Handlers' Knowledge, Attitudes, and Practices Regarding Food Safety in Sulaimani Governorate, Iraq: A Cross-Sectional Study

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Abstract

Objective: To determine the initial level of knowledge, attitude and practice of food handlers regarding food safety and to show the association between Knowledge, Practice and Attitude and various variables such as workers' socio-demographic characteristics.

Materials and Methods: A cross-sectional study was conducted in Sulaimani Governorate, Iraq, from May 2024 to December 2024, surveying 450 food handlers in restaurant to assess their KAP regarding food safety and hygiene. The WHO's Five Keys to Safer Food served as the basis for a pre-tested questionnaire which was confirmed by several experts. The Cronbach Alpha test for the questionnaire's reliability was 7.4. Age, gender, place of residence, level of education, marital status, ethnicity and monthly income were among the data collected.

Results: The study revealed poor knowledge, fair practice and positive attitude among food handlers in restaurants. Poor knowledge was identified in some issues, such as causes of foodborne illness, handling raw food, personal hygiene and cross-contamination (23.8%, 24.4%, 42.7% and 36.7%) respectively. Poor score was reported in the categories of washing hands 26.4%, wearing gloves 28%, storing leftovers 38% and changing work clothes 47.6%. A significant association was revealed between knowledge and practice with workers' education level ($P = 0.001$ and $P = 0.002$) respectively. A significant association was also found between knowledge and practice (P-value < 0.001). Furthermore, an association was found between knowledge and practice with employees who have participated in previous training (P-value < 0.001).

Conclusion: While food handlers had only poor knowledge (49.2%) and fair practices (47.3%), fair practices were significantly linked to their level of education. Employees who had participated in previous training had significantly better knowledge and practices.

Keywords: Food-borne diseases, practice, food handler, cross contamination, educational training

Introduction

Foodborne diseases encompass a broad spectrum of illnesses and are becoming increasingly common in both developed and developing countries, making food safety an ongoing public health issue.[1] One of the most important issues facing food-service establishments is food safety. According to the World Health Organization, 600 million people worldwide become ill with foodborne illnesses every year, the most common diseases caused by eating contaminated food, and 420,000 people die from them. In addition, many people, especially those living in low-income countries, are affected by the burden of foodborne illnesses.[2]

Contaminated food and water were the primary cause of most of these deaths. Over one-third of the population in developing countries suffers from foodborne illnesses each year, according to reports from the World Health Organization.[3] Since food safety and foodborne illnesses are closely related, strengthening food safety regulations is essential to halting the spread of foodborne illnesses. Consuming tainted food products is the cause of foodborne illnesses.[4]

Food handlers have a great role in maintaining food safety and avoiding food contamination at every stage of the food production, processing, storage, and preparation process.[5] Furthermore, eating out or ordering takeout has become a popular trend for many people due to increasing urbanization and a lack of time for cooking at home. Eating food from unidentified sources may raise the risk of microbiological hazards, particularly if hygienic standards are not followed.[6]

Food contamination can occur during any step of the processing of food. The primary source of contamination in manual food handling tasks is food handler error.[7] Main causes of the widespread prevalence of foodborne illnesses include the consumption of microbe-contaminated drinking water and food, inadequate food standard regulations, inadequate personal hygiene practices among food handlers and consumers, a lack of infrastructure for food storage, and the region's year-round high ambient temperature.[8] According to available data, food workers' improper food handling procedures are to blame for a significant portion of foodborne illnesses.[9] Foodborne infections, which result in high rates of morbidity and mortality as well as high costs, are still a major concern worldwide. Studies show that the behaviors, mindsets, and expertise of food handlers are critical in preventing foodborne illness. There are benefits to food handlers' knowledge, attitude, and practice from receiving food safety and hygiene education and training interventions.[10]

Methods and Materials

Study Design and Location

A cross-sectional design was conducted to assess the knowledge, attitude and practice of food handlers and their demographic characters in Sulaimani Governorate restaurants. Data was gathered between July, 2024, and November, 2024. A semi-structured questionnaire and face to face interviews were used to evaluate food handlers' KAPs. Five districts (Sulaimani center, Kalar, Sharbazher, Ranya and Saidsadq) were chosen at random from a total of 15 districts.

Sample Size and Sampling Technique

The sample size was calculated using G*Power software version 3.1. 9.7[11] assuming 95% confidence interval, alpha level

(α error probability) this is typically set at 0.05 for a two-tailed test, 95% power (1- β probability), the effect size (Cohen's d) d = 0.2 for small effect. According to the given information, the necessary sample size was approximately determined to be 380 participants. Approximately 10% of the sample size was added to account for non-respondents, increasing the total number of workers to 418 from the estimated sample size of 380 workers. Finally, 450 additional employees were included in the sample to ensure that it accurately represented the study population.

Study Variables

The study's dependent variable was the score for knowledge, attitudes, and practices related to food safety, while the independent variables were demographic characteristics such as age, gender, education level, marital status, ethnicity, prior training, wage satisfaction, and work experience.

Questionnaire Design and Pilot Study

A systematic multiple-choice questions covered assessment of knowledge, attitude and practice related to food safety and hygiene among food handlers restaurants, according to five categories related to food safety and hygiene, which were derived from the World Health Organization's five keys to safer food.[12] cleanliness, keeping raw and cooked food separate, sufficient cooking, safe storage temperatures, and safe water and materials; used survey tools in related research.[13,14]

The questionnaire divided into four sections:

Section one (Sociodemographic section)

Questions about participant agreement, date, restaurant name, location of the restaurant, the socio-demographic profile of food handlers included name, phone number, age, gender, place of residence, marital status, religion, ethnicity, education level, Job description, wage satisfaction, years of work experience, and previous food safety training & knowledge.

Section two (Knowledge section)

The knowledge section was designed to evaluate the knowledge of participants about food safety and hygiene. It includes 12 questions. Each question consisted of four optional answers.

Section three (Attitude section)

Six multiple-choice Likert scale-based questions were used to assess the participant's attitude and included the choices "Agree," "I don't know," and "Disagree".

Section four (Practice section)

This section consisted of ten questions with four multiple choice questions to determine the participants' level of practice.

To ensure content validity, the questionnaire was distributed to a number of experts who worked together on the research topic and had relevant experience. A pilot study was carried out with 23 food handlers, representing (5%) of the recruited study sample, prior to finalizing the questionnaire form and beginning data collection to ensure a properly constructed questionnaire. The Cronbach Alpha test of the questionnaire's reliability was 7.4.

Scoring System

Each knowledge and practice-related question was assigned a score of one for the correct answer and zero for the incorrect answer. For attitudinal questions, a score of one is given for the "Agree" answer and zero for the "Neutral, Disagree" answer. The score range was 0–12, 0–6 and 0–10 for knowledge, attitude and practice respectively.

Total score for questions measuring participants' knowledge, attitude and practice (12 questions, 6 questions and 10 questions) respectively: Correct answers were converted to 100 percent for knowledge with scores below 50 percent indicating poor knowledge values (score range 1–5), between 50 and 75 percent indicate fair knowledge (score range 6–8), and values above 75 percent indicate good knowledge (score range 9–12). For practice, with scores below 50 percent indicating poor practice values (score range 1–4), between 50 and 75 percent indicate fair practice (score range 5–7), and values above 75 percent indicate excellent practice (score range 8–10).

Inclusion Criteria

Employees of both genders who handle food in food service establishments and were part of the sample were recruited to participate in the study.

Exclusion Criteria

Employees whose work experience is less than 6 months and who intend to leave their job within the study period are excluded from the study.

Data Collection

Data were gathered through face-to-face interviews. Each participant was given a unique number to maintain anonymity, and the questionnaire took 15 to 25 minute to complete.

Data Analysis

To enable later data processing, the questionnaire was coded manually. Data were collected, edited, and entered into Microsoft Excel and then transferred to SPSS version 25 for analysis (Version 25.0). The independent sample *t* test is used to compare two variables and determine the mean ± SD of the variables. The 95% confidence interval for the mean or mean ± SD was used to report descriptive variables. To determine the mean differences between the initial assessment of the groups, the repeated measures ANOVA test was used. The Chi-square test was used to analyze categorical data, and $P < 0.05$ was considered statistically significant.

Ethical Considerations

The study was examined and approved by the College of Medicine / University of Sulaimani ethics committee. After explaining the purpose and benefits of the study to participants, the verbally and written informed consent was obtained from the workers and restaurants owners who participated in the study. The study was voluntary, anonymous and confidential, meanwhile participants were encouraged to withdraw at any time if they wished.

Results

Socio-Demographic Characteristics of Participants

A total of 450 employees were participated in the current study. The workers in the study ranged in age from 16 to 65 years,

the overall mean age ± SD was 29.04 ± 10.67 years, and the median was 26 years. The vast majority were men, while only 37 (8.2%) participants were female, compared to 413 (91.8%) male participants. The age group of 16–30 years old was the most common (64.7%), followed by 31–45 years old (25.1%) and 46–65 years old (10.2%).

Among the respondents, it was found that (21.6%) were illiterate, whereas (19.8%) had completed primary school, (38.2%) had completed secondary school, and (20.4%) completed university. Moreover, (64.7%) of food handlers had between 1 to 5 years of experience in the food service establishment, 6 to10 years of experience (17.1%), 11 to 15 years of experience (5.8%) and ≥ 16 years of experience (12.4%). Regarding work position, 14% were restaurant manager, 22.2% were chef, 12.0% were cook, 33.8% had waiter, 9.1% dishwasher and 8.9% salad chef. Concerning marital status, 42.7% were married, 55.3% were unmarried, 1.8% divorced, and 0.2% were widowed. Furthermore, (89.8%) of the respondents had never participated in a food safety training program, while the remaining (10.2%) had as shown in Table 1.

Table 1. **Participants socio-demographic characteristics**

Variables	Items	(*n* = 450)	%
Gender	Male	413	91.8
	Female	37	8.2
Marital status	Un Married	249	55.3
	Married	192	42.7
	Divorced	8	1.8
	Widowed	1	0.2
Age groups	16–30 Years	291	64.7
	31–45 Years	113	25.1
	46–65 Years	46	10.2
Education level	Illiterate	97	21.6
	Primary school	89	19.8
	Secondary school	172	38.2
	University & above	92	20.4
Ethnicity	Kurds	429	95.3
	Arabs & others	21	4.7
Previous training	Yes	46	10.2
	No	404	89.8
Wage satisfaction	Satisfied	401	89.1
	Un satisfied	49	10.9
Work experience	1–5 years	291	64.7
	6–10 years	77	17.1
	11–15 years	26	5.8
	≥ 16 years	56	12.4
Food handlers' position	Restaurant manager	63	14.0
	Chef	100	22.2
	Cook	54	12.0
	Waiter	152	33.8
	Dish washer	41	9.1
	Salad chef	40	8.9
Total		**450**	**100**

Respondents' Knowledge

The data of the study found significant performance differences between different categories in knowledge assessment of food handlers. The correct answer rate ranged from (23.8%) to (67.1%), while the incorrect answer rate ranged from (32.9%) to (76.2%). These results highlight important gaps in some areas that could threaten food safety.

Among food handlers demonstrated the highest level of personal health and safety knowledge. 302 (67%) respondents answered the question about the importance of vaccination for food handlers correctly, while 148 (32%) respondents answered incorrectly. Likewise, 297 (66%) respondents answered the question about the eligibility of routine medical examinations correctly, while 153 (34%) respondents gave an incorrect answer. Regarding methods for defrosting frozen meat, (56.7%) answered correctly and (43.3%) answered incorrectly. Moreover, 295 (65.6%) respondents gave correct answers about first aid for hand wounds, while 155 (34.4%) respondents gave incorrect answers. Moreover, in the category "removing microbes from kitchen surfaces," 306 (68%) of respondents gave incorrect answers and 144 (32%) gave correct answers. Additionally, 178 (39.6%) respondents answered incorrectly to the question about how to handle drippings from raw meat, compared to 272 (60.4%) respondents who gave the correct answer. The same applies to the high-risk food awareness category, where 268 (59.6%) respondents gave the correct answer and 182 (40.4%) respondents gave the wrong answer. Furthermore, 246 (54.7%) respondents answered correctly, while 204 (45.3%) respondents gave incorrect answers on pest control measures (insects and rodents). These results demonstrate that food handlers have fair level (46–68%) of knowledge about personal health.

However, the poor knowledge level (0–45%) were found about foodborne illness prevention. Of the respondents, 343 (76.2%) gave an incorrect answer, while only 107 (23.8%) correctly identified the causes of foodborne illness. Similarly, in the category "Washing raw fruits and vegetables," 110 (24.4%) respondents gave correct answers while 340 (75.6%) respondents gave incorrect answers. These results indicate significant knowledge gaps regarding basic hygiene practices for food safety.

Noticeable weaknesses were identified in other categories. For example, in the category "Assessing cross-contamination methods," only 165 (36%) of respondents gave the correct answer, while 285 (63%) of respondents gave the wrong answer. Among respondents, only 192 (42.7%) answered correctly regarding hand washing, while 258 (57.3%) food handlers incorrectly answered the question. These results show that there are important knowledge gaps regarding the precautions that must be taken to keep food handling environments safe.

Overall, the present study results show that while food handlers have relatively fair knowledge level about personal health and safety (vaccination importance, workers periodic medical examination necessary, food defrosting and first aid in work place), there are still poor knowledge in important food safety knowledge, particularly when it comes to knowing the causes of foodborne illness and how to properly clean and disinfect of food as well as hand washing and cross-contamination as shown in Table 2.

Table 2. **Knowledge of food handlers**

No.	Category	Response	Frequency	%
1	Hand washing situation.	Correct	192	42.7
		Incorrect	258	57.3
2	Cause of food borne diseases.	Correct	107	23.8
		Incorrect	343	76.2
3	Ways to thaw frozen meat.	Correct	255	56.7
		Incorrect	195	43.3
4	Vaccination importance for food handler.	Correct	302	67.1
		Incorrect	148	32.9
5	Regarding periodic medical examinations.	Correct	297	66
		Incorrect	153	34
6	Cross-contamination method.	Correct	165	36.7
		Incorrect	285	63.3
7	Way to kill microbes on surfaces of restaurants' kitchen.	Correct	144	32
		Incorrect	306	68
8	Dealing with raw meat juice drips onto a countertop.	Correct	272	60.4
		Incorrect	227	39.6
9	Food handlers' measures about pests (rodent & insect) in a restaurant.	Correct	246	54.7
		Incorrect	204	45.3
10	First aid concerning hand injury.	Correct	295	65.6
		Incorrect	155	34.4
11	Regarding high-risk foods.	Correct	268	59.6
		Incorrect	182	40.4
12	Dealing with washing raw foods.	Correct	110	24.4
		Incorrect	340	75.6
Total			450	100

Respondents' Attitude

The results of the study on food handlers' attitudes towards food safety and hygiene shows that they are generally very committed to adhering to food safety procedures and also agree on most key safety and hygiene standards. The vast majority of respondents (99.1%) clearly understand the importance of cleanliness in preventing contamination and agree that disinfecting kitchen utensils and equipment is essential.

With (98%) food handlers recognizing the importance of food safety training, it is clear that they understand the importance of training in maintaining safe food handling practices, while only (18%) of respondents were neutral and (0.2%) disagreed. While (98%) of respondents agreed that wearing clean and appropriate work clothing is important, a small percentage (0.4%) were neutral and (0.7%) disagreed, suggesting that there is some possibility to give more weight to this practice. (94.7%) of respondents supported the practice of not smoking or chewing gum while handling food, whereas (3.6%) disagreed and (1.8%) were neutral, suggesting that this practice might need more reinforcement. Comparatively fewer workers (80.4%) agreed that using different utensils for stirring and tasting food is necessary, while (14.7%) disagreed and (4.9%) were neutral. This indicates a significant gap in knowledge or understanding that requires attention.

Finally, (97.1%) employees agreed that it is important to wash hands after using the toilet; However, respondents (1.6%) who disagreed and respondents (1.3%) who were neutral indicated that ongoing monitoring and training is required to ensure full compliance. Although most food handlers have an overall positive attitude towards food safety, there are some neutral attitudes about certain categories that would benefit from additional giving knowledge to meet the highest hygiene standards, such as using separate utensils to prevent cross contamination and not smoking or chewing gum within work period as shown in Figure 1.

Participants' Practice

The study's assessment of food handlers' practice level revealed a number of findings as shown in Table 3. Regarding handwashing pattern, 309 (68.7%) participants answered correctly, while 141 (31.3%) answered inappropriately. Fair practices have been recorded, meaning most food handlers follow proper handwashing practice. A significant proportion of participants answered incorrectly regarding the duration of handwashing, with only 119 (26.4%) answering correctly and 331 (73.6%) answering incorrectly. In this category, participants recorded poor levels of practice. Regarding raw meat management, 267 food processors gave correct answers (59.3% of all respondents), while 183 workers gave incorrect answers (40.7%) of respondents. In responding to this request, fair dealing practices were generally observed. About the requirement that workers wear gloves, 215 (47.8%) food handlers gave correct answers while 235 (52.2%) gave wrong answers, indicating that the workers' poor outcome was documented. Another finding was a high compliance rate in cleaning and disinfecting cutting boards and knives, as 387 (86%) of the food handlers answered correctly, while 63 (14%) of them answered inappropriately. This result confirmed that the participants had achieved an excellent level of practice. However, storage of leftovers was a significant problem; only 171 (38%) participants gave the correct answer and 279 (62%) gave an inappropriate answer, indicating poor practice. Furthermore, 214 (47.6%) food processors answered correctly, while 236 (52.4%) answered inappropriately regarding the frequency of changing work clothes, indicating poor practice level of participants.

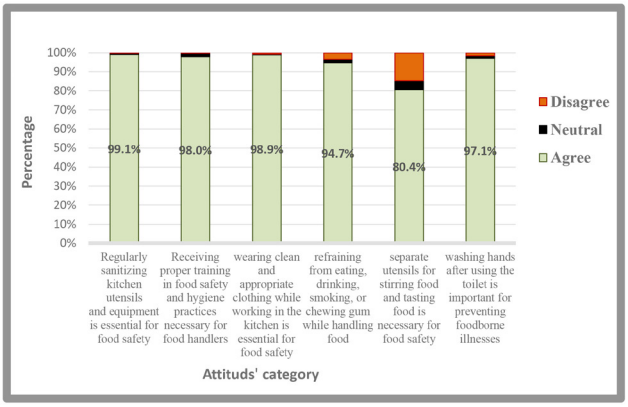

Fig 1. **Participants' attitude.**

A fair level of practice was also indicated by the fact that 261 (58%) of food handlers answered correctly about waste management (garbage), while 189 (42%) did not. It is concerning to note that only 126 (28%) of participants correctly answered the question regarding gloves changing procedures, while 324 (72%) gave an incorrect response. This indicates that the majority of food handlers engage in poor practice. Regarding measures against pests in the workplace, 264 (58.7%) food processors answered correctly, while 186 (41.3%) answered incorrectly. Fair level of practice identified by participants.

Table 3. **Practice of food handlers**

No.	Category	Response	Frequency	%
1	Pattern of washing hands.	Appropriate	309	68.7
		Inappropriate	141	31.3
2	Hand washing duration.	Appropriate	119	26.4
		Inappropriate	331	73.6
3	Dealing with raw meat handling in restaurant.	Appropriate	267	59.3
		Inappropriate	183	40.7
4	Conditions must wear gloves.	Appropriate	215	47.8
		Inappropriate	235	52.2
5	Cleaning and sanitizing cutting boards and knives.	Appropriate	387	86
		Inappropriate	63	14
6	Dealing with storing leftovers.	Appropriate	171	38
		Inappropriate	279	62
7	Frequency of changing work clothes.	Appropriate	214	47.6
		Inappropriate	236	52.4
8	Practice of handling garbage.	Appropriate	261	58
		Inappropriate	189	42
9	Situation of changing gloves.	Appropriate	126	28
		Inappropriate	324	72
10	Measures against pests in workplace	Appropriate	264	58.7
		Inappropriate	186	41.3
Total			450	100

Overall, these results indicate the existence of significant gaps in hygiene practices that need to be properly addressed, particularly with regard to the duration of hand washing, the use of gloves, the storage of leftover food and the change of work clothes. On the other hand, the level of fair practices among participants was documented, particularly in terms of hand washing behavior, handling of raw meat and measures against pests in restaurants. Lastly, only excellent practices level for cleaning and disinfecting knives and cutting boards were found based on the results of the current study.

As shown in Table 4A, the chi-square test was used to evaluate the association between sex and knowledge level (poor, fair, and good). A statistically significant association (P = 0.047) was revealed between knowledge levels and sex by the results. Males were more represented fair level (50.6%) and good level (10.7%) than females 32.4% and 8.1%, respectively, while a larger percentage of females (59.5%) and males (38.7%) were in the poor knowledge level.

Furthermore, the results of the chi-square test also show a statistically significant association between knowledge level and education level (P = 0.001). In contrast to the university and above group, which only had (21.7%) 20 of 92 participants, the illiterate; read and write group had poor knowledge (54.6%) 53 of 97 participants. On the other hand, employees with a university degree or higher were more likely to have good knowledge (16.3%) 15 of 92 participants or fair knowledge (62.0%) 57 of 92 participants than primary school group (fair: (49.4%), 44 of 89 participants; good: (9.0%) 8 of 89 participants) or secondary school group (fair: (49.4%) 85 of 172

Table 4A. **Association between knowledge scores and participants' socio demographic characteristics**

Variables	Knowledge level frequency (%)				χ^2	*P* value
	Poor	Fair	Good	Total (%)		
Sex						
Male	160 (38.7%)	209 (50.6%)	44 (10.7%)	413 (91.8)	6.09	**0.047**
Female	22 (59.5%)	12 (32.4%)	3 (8.1%)	37 (8.2)		
Age						
16-30 years	109 (37.5%)	150 (51.5%)	32 (11.0%)	291 (64.7)		
31-45 years	53 (46.9%)	51 (45.1%)	9 (8.0%)	113 (25.1)	3.97	0.410
46-65 years	20 (43.5%)	20 (43.5%)	6 (13.0%)	46 (10.2)		
Education level						
Illiterate, Read & write	53 (54.6%)	35 (36.1%)	9 (9.3%)	97 (21.6)		
Primary school	37 (41.6%)	44 (49.4%)	8 (9.0%)	89 (19.8)	23.17	**0.001**
Secondary school	72 (41.9%)	85 (49.4%)	15 (8.7%)	172 (38.2)		
University & above	20 (21.7%)	57 (62.0%)	15 (16.3%)	92 (20.4)		
District						
Sulaimani center	82 (37.1%)	108 (48.9%)	31 (14.0%)	221 (49.1)		
Saidsadq	11 (36.7%)	18 (60.0%)	1 (3.3%)	30 (6.7)		
Sharbazher	8 (32.0%)	13 (52.0%)	4 (16.0%)	25 (5.6)	15.487	> 0.05
Rania	53 (51.5%)	42 (40.8%)	8 (7.8%)	103 (22.9)		
Kalar	28 (39.4%)	40 (56.3%)	3 (4.2%)	71 (15.8)		

participants; good: (8.7%) 15 of 172 participants. According to this finding, greater levels of knowledge are associated with higher educational level. Finally, no significant association could be found concerning to age group, district, marital status, ethnicity and years of experience as shown in Table 4 (A and B).

As shown in Table 5A chi-square analysis revealed a significant association between sex and practice level ($P = 0.006$), with males comprising 413 (91.8%) and females 37 (8.2%) of the total. Compared to female (2.7%), higher percentages of male with (18.4%) showed excellent practice levels. With a *P*-value of 0.002, the analysis also demonstrates a statistically significant association between practice scores and educational level. Of those who had a university and above degree, (21.7%) achieved excellent practice results, while only (15.5%) of the illiterate; read and write group achieved excellent practice results. Additionally, the university and above group had the highest fair practice level (60.9%) compared to the secondary school, primary school, and illiterate groups (43.6%, 50.6%, and 38.1%, respectively). Meanwhile, the illiterate group had the highest prevalence of poor practice scores (46.4%) compared to the higher education, secondary school, and primary school groups (17.4%, 40.6%, and 32.6%, respectively).

According to this analysis, higher levels of education could have a positive impact on better practice outcomes. Furthermore, the analysis of the result demonstrated a significant association between district and practice level ($P < 0.001$). With 221 (49.1%) participants, Sulaimani Center had the largest percentage. The most common practice level was fair (53.8%), followed by poor (25.8%) and excellent (20.4%). Both Sharbazher 25 (5.6%) and Saidsadq 30 (6.7%) had low percentages of excellent level, while fair was the most common practice level (63.3% and 68.0%, respectively). The percentage of poor practice levels was highest in Rania (59.2%), while Kalar had a more even distribution, with the most common level being fair (45.1%). According to the results, targeted improvement efforts are needed for Rania and Kalar. This indicate that interventions to improve

Table 4B. **Association between knowledge score and participants' socio demographic characteristics**

Variables	Knowledge level frequency				χ^2	*P* value
	Poor	Fair	Good	Total (%)		
Marital status						
Un married	94 (37.8%)	128 (51.4%)	27 (10.8%)	249 (55.3)	7.25	0.298
Married	83 (43.2%)	91 (47.4%)	18 (9.4%)	192 (42.7)		
Divorce	5 (62.5%)	1 (12.5%)	2 (25.0%)	8 (1.8)		
Widowed	0 (0.0%)	1 (100.0%)	0 (0.0%)	1 (0.2)		
Ethnicity						
Kurds	174 (40.6%)	208 (48.5%)	47 (11.0%)	429 (95.3)	3.06	0.216
Arabs & others	8 (38.1%)	13 (61.9%)	0 (0.0%)	21 (4.7)		
Work experience						
1–5 years	122 (41.9%)	143 (49.1%)	26 (8.9%)	291 (64.7)	4.058	0.669
6–10 years	26 (33.8%)	41 (53.2%)	10 (13.0%)	77 (17.1)		
11–15 years	12 (46.2%)	10 (38.5%)	4 (15.4%)	26 (5.8)		
≥ 16 years	22 (39.3%)	27 (48.2%)	7 (12.5%)	56 (12.4)		

Table 5A. **Association between practice score and participants' socio demographic characteristics**

Variables	Practice level frequency				χ^2	*P* value
	Poor	Fair	Excellent	Total (%)		
Sex						
Male	139 (33.7%)	198 (47.9%	76 (18.4%)	413 (91.8)	10.38	**0.006**
Female	21 (56.8%)	15 (40.5%	1 (2.7%)	37 (8.2)		
Age						
16–30 years	99 (34.0%)	136 (46.7%)	56 (19.2%)	291 (64.7)	2.81	0.589
31–45 years	43 (38.1%)	55 (48.7%)	15 (13.3%)	113 (25.1)		
46–65 tears	18 (39.1%0	22 (47.8%)	6 (13.0%)	46 (10.2)		
Education level						
Illiterate, Read & write	45 (46.4%)	37 (38.1%)	15 (15.5%)	97 (21.6)	20.74	**0.002**
Primary school	29 (32.6%)	45 (50.6%)	15 (16.9%)	89 (19.8)		
Secondary school	70 (40.7%)	75 (43.6%)	27 (15.7%)	172 (38.2)		
University & above	16 (17.4%)	56 (60.9%)	20 (21.7%)	92 (20.4)		
District						
Sulaimani center	(57) 25.8%	(119) 53.8%	(45) 20.4%	(221) 49.1	46.70	**< 0.001**
Saidsadq	(10) 33.3%	(19) 63.3%	(1) 3.3%	(30) 6.7		
Sharbazher	(4) 16.0%	(17) 68.0%	(4) 16.0%	(25) 5.6		
Rania	(61) 59.2%	(26) 25.2%	(16) 15,5%	(103) 22.9		
Kalar	(28) 39.4%	(32) 45.1%	(11) 15.5%	(71) 15.8		

Table 5B. **Association between practice score and participants' socio demographic characteristics**

Variables	Practice level frequency				χ^2	*P* value
	Poor	Fair	Excellent	Total (%)		
Marital status						
Un married	83 (33.3%)	115 (46.2%)	51 (20.5%)	249 (55.3)	6.83	0.336
Married	73 (38.0%	93 (48.4%)	26 (13.5%)	192 (42.7)		
Divorce	4 (50.0%)	4 (50.0%)	0 (0.0%)	8 (1.8)		
Widowed	0 (0.0%)	1 (100.0%)	0 (0,0%)	1 (0.2)		
Ethnicity						
Kurds	156 (36.4%)	202 (47.1%)	71 (16.6%)	429 (95.3)	3.49	0.174
Arabs & others	4 (19.0%)	11 (52.4%)	6 (28.6%)	21 (4.7)		
Work experience						
1–5 years	113 (38.8%)	131 (45.0%)	47 (16.2%)	291 (64.7)	7.16	0.306
6–10 years	21 (27.3%)	39 (50.6%)	17 (22.1%)	77 (17.1)		
11–15 years	8 (30.8%)	16 (61.5%)	2 (7.7%)	26 (5.8)		
≥ 16 years	18 (32.1%)	27 (48.2%)	11 (19.6%)	56 (12.4)		

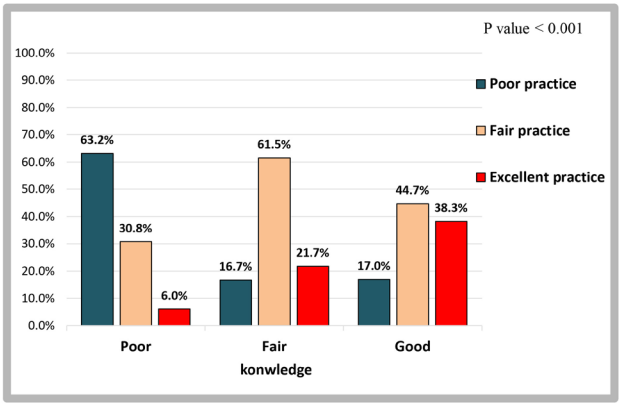

Figure 2. **Association between knowledge and practice.**

performance are needed. Additionally, no significant association was found between practice scores and participants' age, marital status, ethnicity, and work experience as illustrated in Table 5 (A and B).

Figure 2 reveal that the *P*-value < 0.001 confirms a statistically significant association between knowledge levels and practice levels. The results indicate that higher knowledge level leading to better practice achievements among food handlers. Of those with good knowledge levels, (38.3%) achieved excellent results, while only (6.0%) of those with poor knowledge level achieved excellent practice level. Besides, (21.7%) of workers achieved excellent practice compare to those who achieved poor practice score (16.7%) among fair knowledge workers.

Moreover, the results of the chi-square test showed a highly significant association between food handlers' knowledge, practice and their prior training concerning food safety was reported in the present study with *P*-value < 0.001. Food service employees who participated in previous training scored good knowledge result on the knowledge and practice assessment Figures 3 and 4.

Discussion

It is known that there is a connection between foodborne illnesses and food handling practices. Food safety and hygiene issues have become important public health issues. Therefore, it is important to promote safe food handling and good hygiene to prevent and control foodborne illnesses.[15,16]

A total of 450 food handlers participated in this study, aged 16–65 years. Of these, (64.7%, 25.1% and 10.2% were in the age groups 16–30, 31–45 and 46–65 respectively. The mean age of employees in the present study was 29.04 years ± 10.67 (SD), with a 95% confidence interval of 28.05–30.03.

The current findings revealed that food handlers had poor knowledge (overall correct response rate of 49.1% with a mean score of 5.9 ± 2.1 on a scale of 0 to 12). and fair practice (overall correct response rate of 51% with a mean score of 5.1 ± 2.3 on a scale of 0–10). Additionally, food handlers who scored 94.7% had a positive attitude, whereas the remaining 5.3% were categorized as neutral.

Based on the sociodemographic characteristics, the majority of respondents were male (91%). This finding is in consistent with the low proportion of female participants in food service establishments in other studies, including those conducted in Tehran and the Maldives[17,18] and contradicts the reported results in Brazil.[19] This result may be due to cultural commitment, as men still make up the majority of restaurant workers, even though the labor market is experiencing numerous changes in accepting women.

The overall knowledge level of the participants was approximately (49.1%) which regarded poor knowledge, while only (10.4%) of food handlers had good knowledge about food safety. The present finding is lower than previous study in Turkey, Morocco and United Arabic Emarat with knowledge level of (68%), (65.3%) and (70%) respectively.[14,20,21] The result was higher than other study performed in Ethiopia and Egypt with knowledge level of (34.1%) and (39.2) respectively.[22,23] Different study environments and the sociodemographic profile of food handlers may be the cause of the variation. The low level of knowledge in the current study may be due to the fact that most employees had a primary school and an illiterate level of the level of education (41.4%) and of 450 workers only (10.2%) of them received previous training about food safety and hygiene previously.

Concerning knowledge and sociodemographic of current study participants, there was significant associations between knowledge and gender (*P* = 0.04). The current study showed that a good knowledge score in men was higher (10.7%)

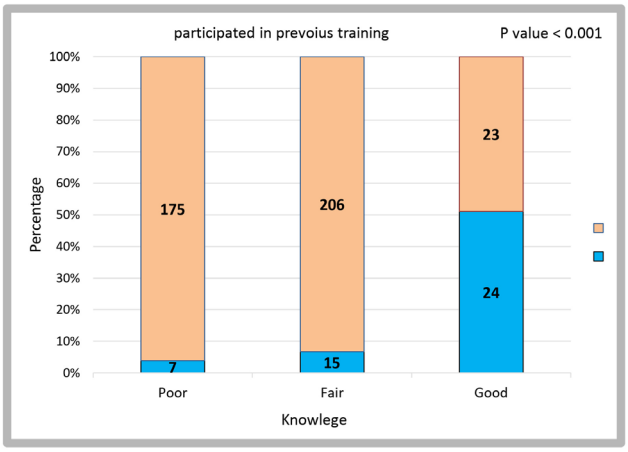

Figure 3. **Association between Knowledge and previously trained employee.**

Figure 4. **Association between practice and previously trained employee.**

compared to women (3%). Consistent results found in Saudi Arabia,[24] in Kenya.[25] Meanwhile, a study in Jordan inconsistently found that females (18.0%) had higher food safety KAP scores than males (5.6%).[26] This may be due to sample population which are university students in the study carried out in Jordan compared to the current study population which (79.6%) of them had education level below university. The variation in food safety knowledge scores between the genders in various studies could be the result of regional variations in socioeconomic, cultural and educational factors that affect information availability and awareness.

Moreover, significant association was found between participants education level and knowledge (P = 0.001). In particular, food handlers with university degrees and secondary education reported knowing more about food safety and hygiene (58.6% of all participants). This result consistent with studies conducted in Bangladesh[27,28] and in Morocco, Ethiopia respectively.[14,29] A possible explanation for this could be that compared to those who are not educated, food handlers who are educated may be better able to obtain information about food safety. Additionally, knowledgeable food handlers will be able to read more written messages about food safety from various information sources, like fliers, posters, and leaflets, which may enhance their understanding of food safety.[30] This finding highlights the importance of promoting education level among employees who want to work in food service establishments. Significant association was found between knowledge and previous participation of the current study participants in training related to food safety (P < 0.001). This finding was supported by previous studies.[22,31,32,28] This is because they could learn and get knowledge more about food safety when they receive training.

Regarding hand washing, only 42.7% of respondents answered correctly, which is significantly less than the (93.8%) which is reported in Maldives[18] and (93%) in Kuwait.[32] Consistent result was documented in Pakistan[33] with (40%) knowledge level about hand washing awareness. The low level can be related to the fact that the respondents do not know how important the hand washing of the hands are in preventing food. Hand washing is a simple but often ignored method to reduce the spread of food pathogens and cross contamination.[34]

Regarding knowledge of participants about food borne disease, poor level (23.8%) was documented. A study in China evaluated participants' understanding of foodborne diseases, the findings revealed that (89.3%) answered correctly.[35] The higher level may be due to that participants in China were college students which had higher level of education compare to the present study. Consistent result (39.8%), (27.9%) with the present study was recorded in Indonesia and India respectively.[36,37] The participants' poor level of knowledge regarding foodborne illnesses in the current study may be related to low awareness, low educational attainment, socioeconomic limitations, cultural beliefs, and insufficient public health education. Of the participants, (56.7%) gave the right response when asked about defrosting frozen food in restaurants. The studies conducted in Maldives and Italy only (15.9%) and (20.9%) of the food handlers properly defrosted food and had a good knowledge about thawing frozen foods (18, 38), while in Morocco (79.4%) was recorded.[14] The low level of knowledge in the current study may be related to that participants were not received prior knowledge and training on the proper methods for thawing frozen foods. Unsafe freezing or defrosting practices can promote the growth of dangerous bacteria in food, raising the risk of contracting a foodborne illness.[39]

The personal health of food handlers in restaurant can be maintained through vaccination process and regular medical examination. The participants were answered with the question of the importance of vaccination against infectious diseases in a pattern that have documented fair knowledge with (67.1%) and (66%) with regard to regular medical tests. The consistency was found In the study carried out in Ethiopia, the participants were record (65.5%) about understanding the importance of vaccinations.[29] The satisfactory knowledge among the participants can be related to that in the Kurdistan region in Iraq despite the inspection of restaurants, the health inspection and the supervisory department continuously visit the restaurants at regular intervals. Give health education about the importance of vaccination and medical examination for food traders.

(36.7%) of the respondents correctly answered the question regarding food cross-contamination, indicating poor knowledge. (81.90%) in Indonesia, (58.6%) in Ethiopia, (51.1%) in Malaysia, (86%) in Ethiopia and in South Africa (85%) were correct result finding regarding cross contamination.[5,36,40-42] Possible explanations for the low knowledge score in comparison to other studies include variations in the

sample size, study setting, sociodemographic of food handlers, or prior training. Study participants gave more correct answers to questions about importance of doing periodic medical examination (66%), dealing with meat drip juice on kitchen surface (60.4%), measures against pest (54.7%), injury first aiding (65.6%).

The fair knowledge about questions in periodic medical examinations, handling meat drip juice and injury first aid was reported. Result finding regarding high-risk foods knowledge demonstrated that (59.6%) of respondents correctly answered the question. Consistent level of knowledge was recorded in Iran (46.3%).[17]

The present study revealed poor knowledge about vegetables handling with (24.4%) of correct answer. Other studies recorded various percentages of correct answer dealing with washing vegetables such as in Ethiopia (72.1%),[43] in South Africa (90.7%).[42] Insufficient training, ignorance of food safety regulations, and unfavorable workplace policies may be the cause of food handlers' low knowledge score of (24%) about handling vegetables.

The present study show that majority (94.7%) of participants had a positive attitudes toward food safety, higher than the percentages (75.6%, 71%, 70% and 34.26%) reported by Amaiach et al.,[14] Iwu et al.,[44] Taha et al.[21] and Yusof et al.,[45] respectively. The current study reveals a strong commitment among food handlers to food safety and hygiene, with (94.7%) agreeing on key standards and only (5.3%) remaining neutral. The vast majority of respondents clearly understand the importance of cleanliness in preventing contamination, food safety training and wash hands after using the toilet. (94.7%) of respondents supported the practice of not smoking or chewing gum while handling food. Same result was found in a study in Ethiopia with (95.6%)[43] and in Montenegro with (88.8%).[46] Although most food handlers have an overall positive attitude towards food safety, there are some neutral attitudes about certain categories that would benefit from additional giving knowledge to meet the highest hygiene standards, such as using separate utensils to prevent cross contamination and not smoking or chewing gum within work period.

With regard to food safety practice of the participants, fair practice level was demonstrated among food handlers with a score percentage of (50.9%). Higher practice percentages was documented in Lebanon (81%),[47] in Kwait (82%)[32] and in Morocco (62.9%).[14] Meanwhile, low practice level was showed in in Malaysia (19.9%)[45] and in Ethiopia (55.3%).[29] The fair practices of the current study participants may be related to their partial compliance with safety and hygiene standards, which is probably caused by a lack of continuous supervision by restaurants manager or authority aspects, absent of adequate worker pre-employment and periodic food safety training courses or neglect by worker itself. Significant association was found between participants education level and practice ($P = 0.002$). Similar finding was found in previous study.[19,48,22,49] According to the current study's findings, better adherence to safe food practices is a result of higher education levels.

A significant association ($P < 0.001$) was observed between participants' practice and their prior involvement in food safety training. Previous studies supported this conclusion.[49-51] In this finding it is emphasized that the prior participation of food handlers in food safety training increases compliance with the safe food practices and emphasizes the importance of continuous training for the promotion of effective behavior in food safety field.

With regard to practice and sociodemographic of participants, the result revealed that there are significant association between practice and sex ($P = 0.006$). An excellent practice was rated in men (18.4%) compared to women who achieved them (2.7%). Similar finding documented in Ethiopia and Saudi Arabia.[50,52] Meanwhile, inconsistent study in Jordan and Iran mentioned that female food handlers had significantly higher practice scores compared to males.[26,53] The association between KAP and gender was not supported by a study conducted in Ghana.[54] According to these results, there is inconsistent evidence across studies regarding the association between food handlers' gender and their scores on food safety practices. The small number of females in the current study may be the reason for this variation, and as a result, we are unable to draw firm conclusions from it. On the other hand, the studies that indicated that females had higher scores may have been influenced by the sample size and population.

Concerning hand washing pattern, (68.7%) of them answered correctly. In Ethiopia (51.4%) of participants answered the question correctly.[55] Regarding duration of hand washing, (26.4%) of participants answered correctly on a question about perfect duration of hand washing. Higher percentage (82.2%) was documented in Saudi Arabia.[50] Meanwhile, lower percentages (17.8%) in Egypt.[23] Lack of appropriate hand washing practices among food handlers can significantly boost the transmission of foodborne diseases.[56] Dealing with question about handling raw foods (59.3%) of current study participants were reported fair practice. Poor practice with (47.8%) was recorded about wearing gloves during work. In Maldives only (31.0%) and in Morocco (62.1%) of participants wear gloves while working in restaurants.[14,18] Wearing gloves is thought to help prevent food from becoming contaminated by bacteria.[13]

Participants had excellent practice (86.0%) concerning cleaning and sanitizing cutting boards and knives. Similar result (77.9%) found in Maldives[18] but low practice level was reported in Morocco with (46.5%)[14]. Regarding leftovers handling, poor practice (38.0%) was reported. Study in India fair score (52.6%) and in Morrocco (51.4%) of correct answer were recorded.[14,57] Meanwhile, good practice finding documented in Maldives (77.9%).[18] Poor practice in the current study concerning leftovers handling may be due to that the participant doesn't realize that leftovers food is a source of food poisoning and they don't have awareness about safe handling of leftovers. Also, fair practice was fond regarding handling garbage (58%) and measures against pests (58.7%). Poor practice score revealed about situation of wearing and changing gloves in the current study with (28.0%) correct answer. In Morrocco (37.9%) reported.[14] Wearing gloves significantly lowers the risk of bacterial cross-contamination of food.[18,58]

A significant association was found between knowledge and practice ($P = < 0.001$). (38.3%) of the participants who recorded an excellent level of practice were among those who had good knowledge. This finding was supported by study carried out in Malaysia, Saudi Arabia and Bangladesh.[59,3,60] According to the association, employees who are more aware of food safety are also more likely to handle and maintain food properly. Regular training, adherence to hygienic guidelines, and frequent monitoring should be put in place to increase compliance and guarantee safe food practices.

Critical insights regarding food safety KAP among food handlers were revealed by the current study. It draws attention to a numerous knowledge and practice gap, especially with regard to personal hygiene, cross-contamination, handling raw meat, the causes of foodborne illnesses, and restaurant pest control measures. This highlights the necessity of focused educational program and ongoing training.

Conclusion

The food handlers at restaurants in Sulaimani Governorate have an unacceptable level of knowledge and practice regarding food safety and hygiene. In the meantime, a positive attitude towards food safety has been identified. A significant association was found between knowledge and practice, which suggests that workers with higher knowledge had better practices. Moreover, food handlers' education level and previous training had a significant impact on the level of KAPs.

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Conflict of Interest

None.

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