

**FOOD SAFETY KNOWLEDGE, ATTITUDES AND PRACTICES AMONG
RESTAURANTS' FOOD HANDLERS IN NORTH LEBANON: EVALUATION OF
THE FOOD SAFETY TRAINING**

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ABSTRACT

This study was conducted to assess food safety knowledge, attitudes and practices among restaurant food handlers in North Lebanon and to determine what impact the food safety intervention had on the performance of workers. A structured questionnaire of 35 questions has been used to collect information on socio-demographic characteristics, knowledge, attitudes and practices for 110 food handlers randomly working in 38 food service establishments via face-to-face questioning interviews during three months. The intervention was made to a subgroup of 13 participants followed by a reassessment. The average percentage scores of all food handlers for knowledge, attitudes, and practices were 63.78%, 83.63% and 81%, respectively. For the 13 participants who received the intervention, a significant improvement was observed in their performance after the training ($p < 0.001$).

Keywords: Food safety; foodborne diseases; food handlers; KAP; Lebanon.

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1. INTRODUCTION

Food safety remains a major concern and poses a threat to the public health worldwide and to the economic development. Each year, millions of people around the globe are hospitalized and even die due to the consumption of contaminated food [1].

Food safety and security issues in Lebanon have been on the rise with several cases of spoiled and expired food, fraud, and outbreaks that have received national attention [2]. Foremost, in Lebanon, as in many developing countries, the food safety regulatory framework through the food supply chain is not adequately developed. One reason for this is the ignored laws responsible for food safety that are not consistent with the international approach that adopts hazard-based and risk-based systems, and overlapping responsibilities of governmental departments and agencies [3].

Consequently, in Lebanon, food safety is an important issue in light of a major ongoing campaign led by the Ministry of Public Health (MoPH) as of November 2014; a surprise inspection of several categories of food establishments have been including in this campaign. More than 1,000 establishments names with unsatisfactory food sampling or inspection results have been announced. One important output of the campaign as well was the agreement of the food safety law, which ensures synchronization and consistent application of rules through all points of the food chain from farm to fork, and enhances ministerial coordination on food safety [4].

Even though food contamination can occur at any point of the production chain, food handler's seem to be a major source of food contamination [5]. They can also be vehicles that carry organisms associated with foodborne diseases (FBDs), such as enteropathogenic *E. coli*, *Salmonella* Typhimurium and *Staphylococcus aureus* [6]. Moreover, inappropriate food handling might have been involved in 97% of all FBDs cases associated with the food service sector [7].

Having poor and inappropriate food safety knowledge by workers poses a critical threat to food safety [8]. In contrast, being armed with good knowledge can lead to better practice and behaviors [9]. Since the employees are the first line of defense in ensuring food safety, they must possess sufficient food safety knowledge, bear a positive attitude, and practice

professionally. Also, the World Health Organization (WHO) cited training of food workers should be provided at a regular interval of time to prevent FBDs [1].

In sum, the food safety should be a major concern for Lebanese government especially in this critical period where the country face the biggest economical and health crisis [10].

The present study was conducted to assess the knowledge, attitudes, and practices (KAP) of food handlers in North Lebanon, that worked in some restaurants, regarding food safety in North Lebanon, and to evaluate the impact of the food safety training program on the KAP improvement.

2. METHODS

2.1. Sample Size (Target population) / Duration of Fieldwork

A cross-sectional study was carried out in Tripoli the capital of North governorate. This study was conducted randomly on 110 workers in the field of food services working in 38 different food establishments. Then, the intervention was performed to a subgroup from the total participants (n = 13) during three months (September, October and November 2021).

2.2. Inclusion and Exclusion Criteria

All food handlers that gave consent after receiving explanation about the aim of the research and accepted to take part in the study were included. Food handlers who were unwilling to interact and participate in the study have been excluded.

2.3. Application of the KAP questionnaire

During the field survey, the information was collected through questionnaire via face-to-face questioning interviews to ensure the accuracy of responses and to avoid external influences. It took about 5 minutes to complete each questionnaire.

2.4. Questionnaire Design

The questionnaire consisted of 35 questions divided into four parts:

- Part one was designed to obtain food handlers' socio-demographic information using 9 questions.
- Part two involved 14 knowledge questions; five multiple choice questions and 9 questions consisted of three optional answers: "yes", "no" and "I don't know"; these questions

specifically dealt with respondents' knowledge by four categories: personal hygiene (2 statements), cross contamination and sanitation (one statement), time and temperature control (7 statements) and foodborne pathogens (4 statements).

- The third part concerned five (yes / no) attitude questions regarding safe food handling and food sanitation.
- The last part includes 7 practice questions about personal hygiene, cross contamination and sanitation; the responses to the practice questions have been graded as follows: Always – Sometimes – Never.

2.5. Intervention Strategy

The intervention was made for 13 participants, through a PowerPoint presentation, it took one hour, concentrated on food safety, personal hygiene, basic food microbiology, cross contamination, causes, prevention and control of FBDs.

After the execution of the pre questionnaire, the same survey was used directly after the intervention session as comparison. But unfortunately, this intervention was not made for the rest of participants because of the lockdowns due to coronavirus disease 2019 (COVID-19) outbreak.

2.6. Statistical Analysis

Statistical analysis was performed using GraphPad Prism 6 software (version 6.00) and Statistical Package for Social Sciences (SPSS). P-Value of less than 0.05 was considered to be statistically significant. The tests that are used to evaluate the correlation between socio-demographic variables and KAP responses are: "Independent-Samples t-Test" was used to compare variables such as gender and education on food safety (training) with KAP scores. "Spearman's rho Test" was used to determine the association between KAP responses with age, level of education and years of work experience. "Paired-Samples t-Test" was used for the result of the intervention session.

2.7. Ethical Considerations and Informed Consent

Before starting to fill out the form, a verbal consent was taken from each respondent who agrees to participate in the study and we assured their confidentiality and anonymity during the study.

3. RESULTS

Table 1 represents the socio-demographic characteristics of participants (n = 110). Most of the respondents were males (83.63%). The 26-35 age group account for the largest proportion of the sample (43.63%). Lebanese nationality represented more than half of the participants (53.63%). The majority of food handlers (41.81%) had attained complementary level education; less than quarter of them (20.91%) had completed the primary education and (2.72%) are uneducated. Moreover, less than half of them (40%) had been working in the food service for over than 10 years. Of the 110 food handlers, 43.64% indicated that they had undergone food safety training. Regarding the monthly average income, only 21.82% of them earned the minimum wages.

Table 1. Socio-demographic characteristics of food handlers (N = 110)

VARIABLES	DEMOGRAPHIC CHARACTERISTIC	ANSWERS N (%)
Gender	Male	92 (83.63%)
	Female	18 (16.37%)
Age group	> less than 18 years	2 (1.81%)
	18-25 years	33 (30%)
	26-35 years	48 (43.63%)
	36-45 years	21 (19.10%)
	46-55 years	3 (2.73%)
	56-65 years	3 (2.73%)
Nationality	Lebanese	59 (53.63%)
	Syrian	51 (46.37%)
Level of education	No schooling (uneducated)	3 (2.72%)
	Primary (grade 1 - grade 6)	23 (20.91%)
	Complementary (grade 7 - brevet)	46 (41.81%)
	Secondary	22 (20%)
	Professional (Technical education)	8 (7.28%)
	University	8 (7.28%)

Job responsibility	Preparing foods; cooking	81 (73.63%)
	Executive Chef	5 (4.55%)
	Assistant Chef	2 (1.82%)
	Others (Manager / Cashier / Delivery)	22 (20%)
Years of work experience	< less than one year	5 (4.55%)
	1-5 years	38 (34.55%)
	6-10 years	23 (20.90%)
	> more than 10 years	44 (40%)
Education on food safety (Training)	Yes	48 (43.64%)
	No	62 (56.36%)
Periodic controls	Yes	89 (80.90%)
	No	21 (19.10%)
Monthly net income	The minimum wage	24 (21.82%)
	Less than the minimum wage	86 (78.18%)

Table 2 demonstrates knowledge responses of food handlers; findings show that 47.28% of participants answered that wearing gloves is a substitute for hand cleansing. Moreover, 88.18% of them responded correctly to the question regarding that cooked and uncooked foods should be prepared with separate equipment and should be stored separately. A high correct score of 92.72% is seen for the question about harmful bacteria multiplying very quickly in the foods that are kept at room temperature more than 6 hours. Approximately, quarter of the participants believed that typhoid fever is an important digestive system disease. Another item where low number of respondents answered accurately is related to diseases transmitted by ingestion of contaminated foods for which 5.45% opted for hepatitis A.

Regarding knowledge categories, respondents were found to have the least knowledge (47.56%) about time and temperature control category. The majority of workers (55.22%) did not have the adequate information about foodborne pathogens. The maximum knowledge category is for cross contamination and sanitation (88%), and (84.59%) accounts for personal hygiene.

Table 2. Participants' Knowledge about different categories of food safety (N = 110)

CATEGORY	KNOWLEDGE QUESTIONS	ANSWERS	
		Correct N (%)	Incorrect N (%)
Personal hygiene	1- Wearing gloves is a substitute for hand cleansing (No)	58 (52.72%)	52 (47.28%)
	2- During work, food handlers can:		
	Smoke (No)	107 (97.27%)	3 (2.73%)
	Eat (No)	99 (90%)	11 (10%)
	Cough (No)	99 (90%)	11 (10%)
	Sneeze (No)	100 (90.90%)	10 (9.10%)
	Handle money (No)	94 (85.45%)	16 (14.55%)
Cross contamination and sanitation	3- Cooked and uncooked (raw) foods should be prepared with separate equipment and should be stored separately (Yes)	97 (88.18%)	13 (11.82%)
Time and temperature control	4- Which is the optimum temperature for bacterial growth? < 0°C, from 0°C to +3°C, from + 4°C to + 50°C , > +50°C.	13 (11.81%)	97 (88.19%)
	5- Harmful bacteria multiply very quickly in the foods that are kept at room temperature > 6 hours (Yes)	102 (92.72%)	8 (7.28%)
	6- The correct method for thawing frozen foods it to keep them at room temperature for an overnight (No)	56 (50.90%)	54 (49.1%)
	7- Vegetables must be placed on a higher rack inside the refrigerator than meat (Yes)	61 (55.45%)	49 (44.55%)
	8- In refrigerator temperature, bacteria: multiply, die, grow very slowly, do not grow .	18 (16.36%)	92 (83.64%)
	9- The correct temperature for a refrigerator	52 (47.27%)	58 (52.73%)

	is: < 1°C, 6–10 °C, 11–15 °C, 16–20 °C.		
	10- Which condition kills bacteria? cooking , cooling, freezing, cooking and freezing.	64 (58.18%)	46 (41.82%)
Foodborne pathogens	11- Typhoid fever is an important digestive system disease and may infect people by consuming chicken, milk, eggs (Yes)	29 (26.36%)	81 (73.64%)
	12- Which of the following diseases can be transmitted by ingestion of contaminated foods? Hepatitis A , Hepatitis B, Pneumonia, Flu.	6 (5.45%)	104 (94.55%)
	13- Open wounds and abscess can be sources for bacteria causing food poisoning (Yes)	105 (95.45%)	5 (4.55%)
	14- Insect such as cockroaches and flies might transmit foodborne pathogens (Yes)	103 (93.63%)	7 (6.37%)

* the write answers are written in bold.

Concerning attitude responses, the question which relates to the idea that food handlers should change gloves after they handle raw food and before they handle ready to eat food, had the highest score level of 99.10%. Furthermore, three quarter of them admit that they should remove accessories, rings, watches and bracelets before starting work (Table 3).

Table 3. Percentage distribution of participants according food safety attitudes (N = 110)

ATTITUDE QUESTIONS	ANSWERS	
	Correct N (%)	Incorrect N (%)
1- Food handlers should change gloves after they handle raw food and before they handle ready to eat foods (Yes)	109 (99.10%)	1 (0.90%)
2- Food handlers should wash hands before & after putting their gloves (Yes)	97 (88.18%)	13 (11.82%)
3- Food handlers should be medically examined every six	92 (83.63%)	18 (16.37%)

months (Yes)		
4- Food handlers suffering from FBDs should not be allowed to go to work (Yes)	79 (71.81%)	31 (28.19%)
5- Should workers remove accessories, rings, watches and bracelets before starting work? (Yes)	83 (75.45%)	27 (24.55%)

Regarding practice responses, maximum number of responses in favor of good practice “always” are found in two of the seven items; washing hands before and after touching unwrapped raw food and washing hands after a break from work. Moreover, those who always keep the hair completely covered with a cap while handling food represented 56.36%. More than three quarters of them confirmed that it is always necessary to change the knife after cutting raw vegetables and before starting to cut meat (Table 4).

Table 4. Food safety practices of participants toward food handling (N = 110)

PRACTICE QUESTIONS	ANSWERS		
	Always N (%)	Sometimes N (%)	Never N (%)
1- Do you wash your hands before and after touching unwrapped raw food?	103 (93.63%)	7 (6.37%)	0 (0%)
2- Do you wash your hand after a break from work?	103 (93.63%)	7 (6.37%)	0 (0%)
3- Do you keep your hair completely covered with a cap while handling food?	62 (56.36%)	6 (5.45%)	42 (38.19%)
4- Do you clean food contacting surfaces before and after processing?	96 (87.27%)	14 (12.73%)	0 (0%)
5- Is it necessary to change the knife after cutting raw vegetables and before starting to cut meat?	93 (84.54%)	12 (10.91%)	5 (4.55%)
6- Do you check the refrigerator and freezers temperature at regular intervals of time?	80 (72.72%)	18 (16.37%)	12 (10.91%)

7- Do check the expiration date of ingredients before using them in food preparation	89 (80.90%)	15 (13.64%)	6 (5.46%)
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The average percentage scores of all food handlers (n = 110) for KAP were 63.78%, 83.63% and 81%, respectively and 76.23% for the overall KAP score (mean of KAP scores). The score was calculated by the summation of the correct answers in the tested aspects. The average knowledge score was low in comparison with the levels of attitudes and practices that were satisfactory.

Table 5 represents the level of association between socio-demographic characteristics and KAP responses. There is no significant correlation between KAP scores of food handlers and their gender, age and years of work experience. On the other hand, KAP scores were significantly higher among food handlers that have a higher educational background ($p < 0.001$, $0 < r < 0.4$, weak positive correlation). Furthermore, participants who attended a training course have better knowledge ($p < 0.001$) than those who did not take any training course.

Table 5. Association between socio-demographic characteristics, knowledge, attitudes and practices scores of food handlers

Socio-demographic variables	Total	Knowledge		Attitudes		Practices		Overall KAP	
		%	p-Value	%	p-Value	%	p-Value	%	p-Value
Gender									
Male	92	63.34	0.307	83.9	0.737	80.74	0.461	76	0.593
Female	18	66.66		82.2		84.12		77.67	
Age									
> less than 18	2	63.88	0.676	80	0.085	85.71	0.063	76.53	0.050
18-25	33	65.15		78.2		75.32		72.88	
26-35	48	63.31		85.4		83.03		77.25	
36-45	21	62.16		85.7		84.33		77.41	
46-55	3	70.37		100		95.23		88.53	

56-65	3	64.81		86.7		80.95		77.47	
Level of Education									
No schooling (uneducated)	3	51.85		53.3		66.66		57.28	
Primary (grade 1 - grade 6)	23	58.45		80.9		78.88		72.73	
Complementary (grade 7 - brevet)	46	63.28	< 0.001*	80.4	0.001*	79.19	0.020*	74.30	< 0.001*
Secondary	22	66.91		90		86.36		81.09	
Professional (Technical education)	8	69.44		87.5		85.71		80.88	
University	8	73.61		100		87.50		87.03	
Years of work experience									
< less than one year	5	71.11		88		80		79.70	
1-5 years	38	62.67	0.369	81.5	0.396	78.02	0.193	74.07	0.313
6-10 years	23	67.92		79.1		81.81		76.27	
> more than 10 years	44	62.12		87.3		84.09		77.82	
Education on food safety (training)			< 0.001*		0.292		0.170		0.005*
Yes	48	69.90		85.8		83.92		79.88	
No	62	59.22		81.9		79.26		73.47	

*Statistically significant

Regarding the socio-demographic characteristics of food workers who participated in the intervention session ($n = 13$); most of the respondents were males (76.92%). The 26-35 age group account for the largest proportion of the sample. In addition, more than half of the participants were Syrian. The majority of workers (46.15%) had attained complementary level education, and 7.70% are uneducated. All food handlers were staff involved in food preparation. Moreover, 30.77% of them had been working in the food service between 6-10 years. Of the 13 food handlers 76.92% indicated that they had undergone food safety training. Regarding the monthly average income, only 30.76% of them earned the minimum wages.

Figure 1 shows the percentage of KAP pre and post intervention. The percentage of knowledge increased to 94.87% after the intervention was done, compared to 69.65% before the session. In addition, the attitude score was 72.30% in pre-test which in turn increased to 95.38% after the training. Furthermore, the practice percentage marked a noticeable rise from 71.42% to 95.60%.

A significant improvement was detected in their KAP level post-intervention compared to their pre- intervention level ($p < 0.001$), which reflects satisfactory level of KAP as a result of the effect of the intervention session.

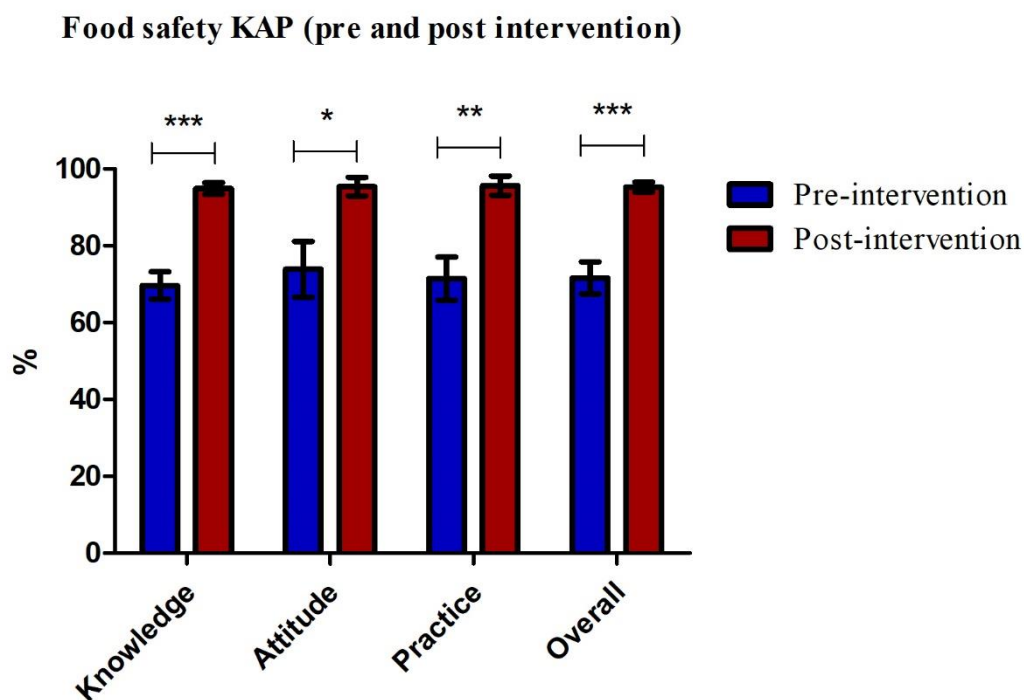


Fig.1. Food handler's average of knowledge, attitudes and practices before and after intervention. The data represent the mean values of each group ($n = 13$) \pm SEM. *refer to the comparison of food handler's average of knowledge, attitude and practices before and after intervention. * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

4. DISCUSSION

FBDs account for a high percentage of deaths and morbidities worldwide [11]. Mishandling food and poor hygiene during food preparation enhance the transmission of FBDs [12,13].

Our study shows that the average KAP percentage of all food handlers ($n = 110$) were 63.78%, 83.63% and 81%, respectively and 76.23% on the overall KAP score. This result is consistent with a study in Beirut, Lebanon by Bou-Mitri et al. [14], in which it was noticed that an average level of KAP of 59.2%, 83.7% and 83.2%, respectively. However, the findings of a study in Malaysia by Rohin et al. [15] concerning knowledge score is contrary with our results, which found a good knowledge level of 83%; and approximately in accordance with our findings regarding attitude and practice score of 87.2% and 90.7%, respectively.

Regarding food safety knowledge, the present study indicates that 88.18% of respondents agreed that cooked and uncooked foods should be prepared with separate equipment and

should be stored separately; compared to 57.5% in a study in Istanbul, Turkey by Ulusoy & Çolakoğlu [16]. Moreover, results of previous work in Indonesia by Lestantyo et al. [17] shows that 80% of them know that frozen foods can't be defrosted at room temperature for an overnight; which is more than our result which is 50.90%. The present study indicates that 16.36% of respondents correctly identified that in refrigerator temperature, bacteria do not grow which is approximately similar with the findings of a study in Beirut, Lebanon by Faour-Klingbeil et al. [3] where 20% of food handlers answered correctly. More than half (58.18%) responded correctly that cooking is a condition to kills bacteria; which is approximately in accordance with a study by Faour-Klingbeil et al. [3] which was 55%.

Concerning food safety attitudes, the highest score of 99.10% is for the question which relates to food handlers should change gloves after they handle raw food and before they handle ready to eat foods; which is more than 75% compared to a study in Malaysia by Asmawi et al. [18]. As well, our results show that three quarters of food workers (75.45%) admit that it should remove accessories, rings, watches and bracelets before starting work; in contrast to Ulusoy & Çolakoğlu [16] which was 48.8%.

Regarding food safety practices, 93.63% of respondent always wash their hands before and after touching unwrapped raw food; these findings are consistent with a study in Beirut, Lebanon by Bou-Mitri et al. [14] that reported 99%. Finally, 72.72% of workers stated that they always they check the refrigerator and freezers temperature at regular intervals of time; which is lower than the results of Bou-Mitri et al. [14] which was 96.5%.

The findings of the present study have reported no significant association between gender, age and KAP scores which is in consist with a study by Ncube et al. [5]. Other studies [14,21] show that gender significantly influenced KAP levels. In addition, our study shows that there is a significant difference in KAP scores and the educational background of food handlers which is similar to the findings of other studies [16,19,20]. Unlike Ncube et al. [5], and Teffo & Tabit [21] which demonstrate that the level of education do not influence KAP levels. Also, studies by Bou-Mitri et al. [14], and Ulusoy & Çolakoğlu [16] showed that KAP scores was significantly different according to years of work experience which do not go in line with our findings. Moreover, knowledge responses are significantly higher among food handlers who

attended a training course which is similar to other studies [5,14,20].

Regarding the results of the average of KAP before the intervention session (n = 13) are 69.65%, 72.30% and 71.42%, respectively. After the intervention, the average of KAP of food handlers (n = 13) are 94.87%, 95.38% and 95.60%, respectively. A significant improvement was observed in the KAP level post-intervention compared to their pre- intervention level. This supports the hypothesis which is “Food handlers who received an intervention session will exhibit a more positive KAP toward food safety compared to their pre-intervention level”. These results are in line with several studies [22-26] that revealed that food safety training was associated with improved KAP and behaviors among foodservice establishments' workers. In contrast, many studies by Chang et al. [27] and, Kuo et al. [28] have documented that training alone does not improve food safety practices.

5. CONCLUSION

FBDs remain a fundamental endemic health issue, in spite of Lebanon has undertaken several measures in food safety. To sum up, this study has considerable potential for the food sector; since food handlers are a ubiquitous figure in the food market worldwide, and are the first line of defense in ensuring food safety; identifying the potential gaps in their KAP is imperative to building upon interventional strategies to promote food safety and prevent the occurrence of FBDs.

In conclusion, there are several critical gaps in KAP in some points, so food handlers should undergo a periodic food safety training program in order to enhance the sustainability use of safe food handling practices, contributes to an overall improved social and quality of life and reduce burden on national health care.

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