

Effect of training program on food safety knowledge, behaviour and practices among female students of Qassim University, KSA

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Abstract

The study aimed to assess the effect of the training program in the level of concerns knowledge and various practices related to food safety among female students of the Food Science and Human Nutrition Department, College of Agriculture and Veterinary Medicine, Qassim University, Saudi Arabia. The number of participants in the study is 265 female students, with a response rate of 94.35% and an average age of 21 years. The questionnaire used in this study was divided into five sections: 1: demographic information, sections 2 to 5 measuring the students' concerns about: the risks affecting food safety, the correct behaviours of food preparation and their relationship to food poisoning, the methods of food circulation and the practices during the preparation of foods, respectively. The main concerns of the participants were: food taste, food temperature, methods of foods are served and the cooking degree of food. They also focused on the cleanliness of the area of preparation and the overall appearance of food handlers. The participants showed good knowledge regarding food safety, and they were more familiar with the cleanliness of kitchen surfaces and utensils, ways to prevent contamination and the importance of hand hygiene, but they showed weak knowledge about the appropriate temperatures of cooking and holding food after it is cooked. According to the results of this study, it was noticed that there is a significant effect of the training program on food safety knowledge and practices among students. As it was noticed that after the training program, the student's behaviour and knowledge of the principles and factors affecting food safety increased, including the method of handling, preparing and serving food, especially the cleanliness of food working surfaces and food cooking temperatures. As well as the personal hygiene of food handlers and its impact on the safety of the food product provided for consumption. At the same time, it could be recommended that there is a need for educational programs aimed at encouraging students to adhere to the practice of food safety measures, and not only to enhance their knowledge.

1. Introduction

Foodborne illnesses are a burden globally to public health and a nation's economy (Young and Waddell, 2016). Research has shown that the increase in foodborne illnesses could be related to improper food safety practices in homes, as home environments can harbour an array of foodborne pathogens (Langiano *et al.*, 2012; Mountjoy, 2014; Young and Waddell, 2016), such as bacteria, viruses and fungi (Byrd-Bredbenner *et al.*, 2013). Food safety knowledge also appears to be inadequate among university students outside of the U.S. for example, both female students in Jordan (37.39 out of

81 (Osaili *et al.*, 2011) and Greek students (6 out of 13) (Lazou *et al.*, 2012) averaged 46% correct answers to food safety knowledge questions, while Lebanese students averaged 54% correct answers (Hassan and Dimassi, 2014), and students in Turkey averaged 57% (11.97 out of 21) (Sanlier and Konaklioglu, 2012). Students in Saudi Arabia averaged 75% correct answers to 15 knowledge questions (Sharif and Al-Malki, 2010). A study of Spanish health sciences students, that did not report overall knowledge, found 50% of students knew to wash utensils used for raw materials before cutting cooked products, and that 85% knew to wash hands before, during, and after food handling and processing

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(Garayoa *et al.*, 2005). Most of the students have adequate knowledge of food safety and good behaviour and practices. However, because these items are assessed based on questions through a questionnaire, many students do not apply perceived knowledge of food safety in their daily practices. It is important for the correct implementation of food safety measures on an ongoing basis, which preserves the safety of the consumer (Nivethitha *et al.*, 2019; Sayuti *et al.*, 2020). At least 30% of consumers suffer from foodborne diseases in various countries of the world, and this may be due to the consumer's lack of knowledge about the safety and quality of the food provided to them. At the same time, there is a relationship and correlation between knowledge of food safety practices and their food handling and eating of food. Several studies have shown that consumers between the ages of 18-19 years have poor food handling practices even with education above high school level compared to others. Also, most food handlers may not have the experience and information regarding food safety (Sayuti *et al.*, 2020). The media is one of the tools that can be used to educate consumers about food safety. However, this method is considered insufficient and impractical in educating consumers and preserving their safety. Therefore, it is important to raise awareness of food safety practices and maintain consumer safety (Luo *et al.*, 2019; Odeyemi *et al.*, 2019). Cruz (2019) reported that the outbreak of foodborne diseases is due to many factors, the most important of which is insufficient training on food safety procedures. Ellinda-Patra *et al.* (2020) indicated the need to improve knowledge of food safety in order to improve the behaviour and safety of local communities. However, it is important to recognize that transforming knowledge into behaviour requires other factors such as training in applying food safety principles and practices.

Therefore, this study aimed to assess the effect of the training program at the level of concerns knowledge and various types of practices related to food safety among female students of Qassim University, KSA.

2. Materials and methods

2.1 Participants

The study started during the academic year 2019/2020. The targets of the study are students of the Department of Food Science and Human Nutrition, Faculty of Agriculture and Veterinary Medicine, Qassim University, Kingdom of Saudi Arabia. The socio-economic situation was not considered variable in the research and thus all income groups were involved.

The study sample number was calculated according to (Singh and Masuku, 2014) method using the formula

for determining the minimum sample size for a population greater than 10,000

$$n = \frac{Z^2 p(1-p)}{d^2}$$

Where n is the calculated number of participants (sample size), Z is the abscissa of the normal curve that cuts off an area of the tails and p is the approximate prevalence rate for which the survey is to be conducted.

The number of female students participating in the study was 265 female students with an average age of 21 years and an academic stage of study levels in the program from the second level to the seventh level.

The closed question method was used in preparing the questionnaire to create quantitative analysis data. Each questionnaire consists of 60 questions, through which the impact of training on food safety practices among students is assessed and assessment of knowledge, awareness and practices related to their food safety without identifying the participants. The participants' identification data included the following: age and social status.

All the participants were informed that the collected data will be used only for research purposes, and the posts were also informed that participation in the questionnaire will not have any effect on their grades as it is Participants had the option not to submit the completed form if they did not wish to do so, and thus by answering the questions, the participants indicated that they agreed to be part of the research, and the confidentiality of the posts was guaranteed by not asking them about their identity.

2.2 Data collection and questionnaire design

A questionnaire was designed according to Ovca *et al.* (2014) and Al-Shabib *et al.* (2016). The questionnaire was divided into five sections. The first part included demographic data namely participants age, the study was carried out on the female students only, nationality and college of study. The second part focused on the food safety concerns of students. The participants were asked to list their food safety concerns related to the food they buy on campus. The third part comprising six statements evaluated the personal understanding of participants towards food preparation and related risks. Knowledge regarding food safety was evaluated in the fourth part of the questionnaire on the basis of 15 questions. The questions were grouped under six categories, and one question was uncategorized as it was related to food safety responsibility after purchase. Food safety practices were investigated in the fifth part. Using a 3-point scale (never, always and sometimes) the participants reported

how often they performed the described action and scored from 0 to 2 with higher scores for better practices. The level of practice was classified into the poor level (Less than 59%), average level (60 to 80%) and good level (80 to 100%) as described by Gizaw *et al.* (2014).

2.3 Design of training program

The training program was prepared and designed according to Food Standards Australia New Zealand (2002) and Abu Dhabi Food Control Authority (2010). The training program included the following principles: Food safety terminology, Factors affecting food safety, What is the meaning of food poisoning, Food poisoning and its risk to consumer health, Food poisoning and its related to the personal hygiene of the consumer, The most common places where food poisoning occurs, Foods that cause and outbreaks food poisoning and The methods of handling and handling food.

2.4 Statistical analysis

Data analysis was performed using SPSS software for Windows, version 20.0. Data is presented as replicates (%); the chi-square test of independence is used to test the association between gender and select variables. A p-value less than 0.05 was considered statistically significant.

3. Results and discussion

3.1 The personal and social characteristics of the sample members

The demographic profile of the student participants is shown in Table 1. The distribution of members of the sample of female university students by age group and marital status, as well as their distribution according to the different school years, are shown in Table 1. Given that the study sample is located at a similar age level, this was reflected in most of the studied personal

Table 1. Age group data, marital status and educational level of female students participating in the study

Participant properties (n = 250 students)	Category	Students number	%
Age group	18-19 year	64	25.6
	20-21 year	154	61.6
	22-23 year	29	11.6
	≤24	3	1.2
Social status	Married	14	5.6
	Unmarried	236	94.4
Nationality	Saudi	250	100
	Not Saudi	0	0
Academic level	second	94	37.6
	third	96	38.4
	Fourth	45	18
	Fifth	7	2.8
	Sixth	2	0.8
	Seventh	6	2.4

characteristics.

Table 1 indicates that most of the female participants in the research are from the 20-21 age group, with a percentage of 61.6%, and that an estimated 1.2% of the female students under study fall into the 24 and older age group while the average is the age for female students understudy is 21 years, with a percentage of 61.6% and a standard deviation value (SD 12,1). It is also clear that all female students were of Saudi nationality and the vast majority of them (94.4%) were not married. The distribution of the academic level of female students participating in the study is shown in Table 1, where it was found that the highest percentage of female students were from the third academic level of the program with a percentage estimated at 38.4%. It was followed by students at the second academic level with 37.6%, at the same time, the percentage of female students at the fourth academic level participating in the study was 18%. While it was noted that the participation of female students of the fifth and seventh academic levels was small and was estimated at percentages of 2.8 and 2.4%, respectively. It was also found that the lowest female students participating in the study were those who attended the sixth level and the women were 0.8%.

3.2 Measuring the students 'concerns about the risks affecting food safety (Food safety concerns)

Food safety concerns of the students are listed in Table 2. The respondents were investigated for nine food safety concerns that related to food, food handlers and the environment in which the food was being served. Each student was asked to answer which specifies one of the two options with either "Yes it has an effect" or "No that has no effect" on food safety. The measurement results of the students 'concerns about food safety before and after participating in the training program to clarify the extent of the impact of the training on correcting those concerns. It is also clear from the results in Table 2 that the highest percentage of female students before the training process had concerns about the cleanliness of the place of preparation and handling of food and the extent of its impact on food safety from diseases at a rate of 97.2%, at the same time there was no significant difference to the same concerns after a training process ($p = 0.201$).

On the contrary, the percentage of female students who expressed their concerns about the cleanliness of the tables on which food was eaten before the training process amounted to 95.6%, hence, it became clear their training process made a difference by correcting some beliefs, especially among some female students who had answered them before training with no effect. For the cleanliness of tables where food is eaten and food safety

Table 2. Results of measuring training on female students' concerns about the risks affecting food safety

The concerns are measured	Before training		After training		P-values
	No.	%	No.	%	
Clean eating tables					
It has an effect	239	95.6	247	98.8	0.030
It has no effect	11	4.4	3	1.2	
Food taste					
It has an effect	155	62.0	226	90.0	0.000
It has no effect	95	38.0	24	9.0	
Food Temperature					
It has an effect	189	75.6	245	98.0	0.000
It has no effect	61	24.4	24	2.0	
How to provide food					
It has an effect	127	50.8	215	86.0	0.000
It has no effect	123	49.2	35	14.0	
Well cooked					
It has an effect	228	91.2	244	97.6	0.002
It has no effect	22	8.8	6	2.4	
Freshness of food					
It has an effect	195	87.0	233	93.2	0.000
It has no effect	55	22.0	17	6.8	
Cleanliness of serving area					
It has an effect	232	92.8	241	96.4	0.075
It has no effect	18	7.2	9	3.6	
Cleanliness of food preparation, production of food					
It has an effect	243	97.2	247	98.8	0.201
It has no effect	7	2.8	3	1.2	
Appearance of food handlers					
It has an effect	155	62.0	225	90.0	0.000
It has no effect	95	38.0	25	10.0	

from epidemics where the correct answers increased to the rate of 98.8% ($p = 0.030$).

Another concern that was measured was the cleanliness of the food place provided and well cooked at high temperature as well (92.8 and 91.2%) respectively, while it was found that after the training of female students there was a positive effect to correct some of the concerns, especially with regard to the correlation between food cooking and safety ($p = 0.002$).

Clean and healthy dining tables are a key component of food safety and several reports have shown that healthy eating conditions are usually measured in the cleanness of a direct eating environment such as a dining table (Kidd, 2000; Grunert, 2005; Sanlier and Kanaklioghi, 2012; Adam *et al.*, 2014) similarly, A clean food environment is also a very important factor as it reveals the general conditions under which food is served. We had a high percentage of respondents who were concerned about the environment and its hygiene.

Students' concern on food temperature as a food safety issue correlated well with the literature on food safety. Mozaffarian and Rimm (2006) and Adam *et al.* (2014) demonstrated that consumers prefer hot food as the heating process eliminates vegetative forms of foodborne pathogens and thus the risk of foodborne

infection. Clean and hygienic eating tables are a key component of food safety and several reports have outlined that hygienic eating conditions are usually measured by the cleanliness of the immediate eating environment such as the dining table (Kidd, 2000; Grunert, 2005; Sanlier and Kanaklioghi, 2012; Adam *et al.*, 2014). Likewise, a clean eating environment is also very important as it projects the overall conditions under which the food is being served. A high percentage of our respondent were concerned about the eating environment and its cleanliness. The results of our investigation highlight the correlation between the appearances of food handlers and food safety. These findings indicate the fact that students also associate the appearance of the food handlers to their food safety practices. A neat, clean and well-dressed food handler is more likely to be following food safety practices than a shabbily dressed one (Rheinländer *et al.*, 2008).

3.3 Students' cognitive level of correct behaviours to prepare food and its relationship to food poisoning

The cognitive level (experiences with food preparation and food poisoning) of the students in question was measured using 10 phrases designed to measure knowledge of the correct behaviours of food preparation and their relationship to food poisoning. The

first phase was an exploratory question about the behaviour of female students in preparing food or participating in preparing it. Each student was given four choices that include: Not participating in preparing it, once a week, daily or sometimes. As for the rest of the phrases were to measure knowledge of the concept of food poisoning and its causes also contained Miscellaneous information on food poisoning and asked each of the students understudy to explain the correctness of the phrase in response to one of the following options: right, wrong, or I don't know. It is also evident from Figure 1 that 46.4% of respondents sometimes responded with regards to preparing or participating in food themselves. In addition, the equivalent of 29.6% of the students stated that they prepare or participate in food on a daily basis. As for those who participate in preparing it at a rate of 19.60%, it was for those who participate in preparing it more than once a week, and for the lowest rate, 4.40% was for those who never participate in preparing food.

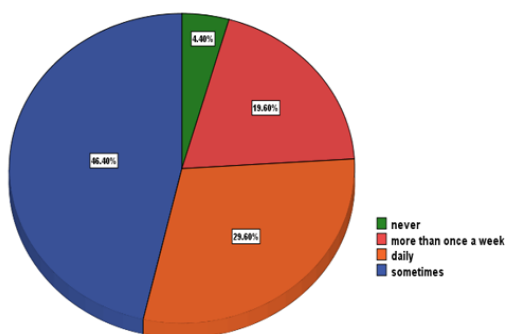


Figure 1. Knowledge of correct behaviours to prepare food and its relationship to food poisoning of the study sample

It is clear from Table 3, that the equivalent of 30.8% of the participants had previously been exposed to a state of food poisoning during the previous period of their lives. The results also showed that all the students participating in the research before training responded to all the phrases to varying degrees and it was found that the most phrases that were answered correctly, the concept of food poisoning was 92.8%, while the rates were equal to the two phrases, one of which questioned the seriousness of food poisoning on human health, while the other questioned whether there was a relationship between the validity and safety of the water used in preparing food and its safety from diseases, where the proportion was 92.4%.

The answers also varied from the statements that asked about the presence of (more common foods that cause the spread of food poisoning diseases, more prevalent places of food poisoning in them, desire to know about the healthy way to prepare food and the way it is circulated) where the students mentioned correct answers in the following proportions 63.6%, 71.2%,

85.2%, respectively. As for the phrase that was wondering about the degree of food poisoning, whether for food cooked at home or in restaurants, it was the least known statement before training, where the average of correct answers was 8.8% of the total answers.

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3.4 The students' knowledge of proper food handling

Table 4 shows the results before and after, in which the students' knowledge level was measured on how to deal with food. The same phrases were used before and after the training process. Each student participating in the research was asked to clarify the validity of the phrase by answering either yes or no. Also, the students were trained using a graphic presentation that contained various information on how to deal with food. In these section 15 questions were used, the answers to which were varied by the students. It also appears through the results in Table 4 that the students had a high level of awareness about some of the phrases that were wondering about how to deal with food. The highest rates for phrases whose correct answer was "yes" before training was for phrases that wonder as follows: "All utensils must be cleaned before eating, surfaces must be cleaned, and dirt and food and microbial residues should be washed, hands should be washed to reduce the risk of contamination, wash the cutting board with detergent and water. Warm-up before using it to cut vegetables if it was previously used to cut raw meat, defects in food containers may cause food damage.". The following percentages are respectively (99.2%, 98.8%, 97.6%, 93.2%, 90.4%). As for the phrases that have been answered correctly ended, "none" before the training process for the following phrases (that cooked and uncooked food is placed in the same container in the refrigerator, use one piece of cloth while preparing food to dry hands and wipe dishes and seats) was high (96.0%, 92.4%), respectively. However, after training provided to the students, an improvement was observed in the level of correct answers to the two phrases (food with a bad smell or bad appearance is not suitable for eating, defects in food containers may cause food

Table 3. Results of measuring the impact of training at the cognitive level, female students, with the correct behaviours to prepare food and its relationship to food poisoning

Question	Before Training		After training		P-values
	No.	%	No.	%	
Have you experienced food poisoning before?					
Yes	77	30.8	69	27.6	0.000
No	147	58.8	150	60.0	
Don't Know	26	10.4	31	12.4	
Do you know what is food poisoning?					
Yes	232	92.8	240	96.0	0.271
No	13	5.2	8	3.2	
Don't Know	5	2.0	2	0.8	
Is food poisoning a risk to human health?					
Yes	231	92.4	245	98.0	0.011
No	4	1.4	2	0.8	
Don't Know	15	6.0	3	1.2	
Is a person affected by food poisoning linked to his personal behaviour?					
Yes	74	29.0	184	73.6	0.000
No	126	50.4	52	20.8	
Don't Know	50	20.0	14	5.6	
Does food cooked at home or in restaurants cause food poisoning to the same degree?					
Yes	22	8.8	13	5.2	0.143
No	199	79.6	215	86.0	
Don't Know	29	11.6	22	8.8	
Is there a relationship between the viability and safety of water used in food preparation and safety?					
Yes	231	92.4	245	98.0	0.011
No	4	1.6	2	0.8	
Don't Know	5	6.0	3	1.2	
Are there more common foods that cause food poisoning?					
Yes	159	63.6	225	90.0	0.000
No	18	7.2	4	1.6	
Don't Know	73	29.2	21	8.4	
Are there more prevalent places for food poisoning?					
Yes	178	71.2	235	94.0	0.000
No	15	6.0	1	0.4	
Don't Know	57	22.8	14	5.6	
Do you want to know more about the healthy way to prepare food and how it is handled?					
Yes	213	85.2	259	83.6	0.001
No	23	9.2	39	15.6	
Don't Know	14	5.6	2	0.8	

damage) (95.2%, 96.4%), respectively. In which the students showed increased knowledge about how to deal with food to where training has played a role in bringing about this enhancement in their awareness aspect. The results also show an increase in the level of awareness of the phrase that asked whether the person is responsible for food safety after purchase, where the correct rate was 74.8%, as well as training was related to changing some wrong with a rate of 94.0% In the same context, the training also had a clear impact by increasing female students' knowledge of the effect of high temperature when heating food, as the rate of correct answers after the training process rose to 65.2% after it was only 42.8%. The findings of the present survey showed an average level of food safety knowledge among students as reported by various workers (Garayoa *et al.*, 2005; Byrd-Bredbenner *et al.*, 2007; Sanlier, 2009; Sharif and Al-Malki, 2010).

3.5 Evaluation of food handling practices

There were 15 questions designed to assess the level of female students' behaviour in dealing with food. Each female student participating in the research was asked to clarify the behaviour followed during her handling of any foodstuffs by responding to one of the following options: Always, never, sometimes, which bear the values of 1,2, 3. The results in Table 5 indicate the extent to which students use any type or form of packages to preserve food, so the response rate "sometimes" was the highest 62.8%, followed by the answer "always" where it was 28.8%, While a small number of respondents answered "Never" 8.4%, and since the training had a correlation with raising the level of correct practices among them, the rate of correct answers for them after training increased ($p = 0.000$). As for practices that state that "no" using an unwashed knife or cutting board where the average of correct answers before training was 94.4% high and training did not have a correlation where the high level of correct answers after training was very simple 98.0% ($p = 0.094$). With regard to the

Table 4. Results of measuring the impact of training at the female students' knowledge level using food handling methods

Question	Before training		After training		P-values
	No.	%	No.	%	
The person is responsible for food safety after purchase?					
Yes	187	74.8	235	94.0	0.000
No	63	25.2	15	6.0	
All pots must be clean before preparing food?					
Yes	248	99.2	249	99.6	0.563
No	2	0.8	1	0.4	
Should you clean utensils and surfaces, remove dirt, food residues and microbes?					
Yes	247	98.8	250	100.0	0.082
No	3	1.2	0	0	
Cooked and uncooked food is placed in the same container in the refrigerator?					
Yes	10	4.0	6	2.4	0.309
No	240	96.0	244	97.6	
If you prepared vegetables on the cutting board and had previously cut raw meat with the same knife, then you must first wash them with detergent and warm water?					
Yes	233	93.2	240	96.0	0.166
No	17	6.8	10	4.0	
Do you only use one piece of cloth while preparing food to dry hands and wipe food plates and benches?					
Yes	19	7.6	13	5.2	0.273
No	231	92.4	137	94.8	
Are you heating food quickly?					
Yes	143	57.2	87	34.8	0.000
No	107	42.8	163	65.2	
Is tasting the best way to know if food has been cooked adequately?					
Yes	161	64.4	69	27.6	0.000
No	89	35.6	181	72.4	
Do you put fresh meat and vegetables in the refrigerator before use?					
Yes	221	88.4	238	95.2	0.006
No	29	11.6	12	4.8	
Is the appropriate temperature for the growth of microorganisms is between 30°C to 40°C?					
Yes	192	76.8	222	88.8	0.000
No	58	23.2	28	11.2	
Defects of food cans cause food damage?					
Yes	226	90.4	241	96.4	0.007
No	24	9.6	9	3.6	
Bad-smelled or bad-looking food not suitable for eating					
Yes	220	88.0	238	95.2	0.004
No	30	12.0	12	4.8	
Does washing hands before eating reduces the risk of contamination?					
Yes	244	97.6	248	99.2	0.154
No	6	2.4	2	0.8	
Using watches, earrings, and rings may contaminate food?					
Yes	158	63.2	222	88.8	0.000
No	92	36.8	28	11.2	
Do you handle food when you have cuts, bruises, or injuries on your hands?					
Yes	60	24.0	44	17.6	0.078
No	190	76.0	206	82.4	

temperature of the refrigerator, 46% of female students mentioned before training that they “sometimes” check the temperature of the refrigerator before opening it, while the wrong response rate increased to “never” 46.6%, that is, they do not do, while the answer to “sometimes” remained the highest 64% among female students 'correct response rates after training is due to the influence and correlation of female students training process ($p = 0.000$). Also found in the data of Table 5 were that more than half of the students 52% answered

correctly the phrase that asks that they prepared food if their hands were injured or had bruises with "never" while the data also shows the presence of an effect and a correlation between training and a high rate correct answers 91.2% ($p = 0.000$).

The results also indicate that female students practised keeping food residues in the refrigerator before training respondents were "sometimes" 41.6% while the rest 55.2% responded with "always" and the lowest rate was "never" 3.2%. After training, the response rate

Table 5. Results of measuring the impact of training on female students' practices during food preparation and eating

Question	Before training		After training		P-values
	No.	%	No.	%	
Do you use any type or form of container to store food?					
always	72	28.8	40	16.0	0.000
never	21	8.4	129	51.6	
sometimes	157	62.8	81	32.4	
Do you use a washed knife or chopping board?					
always	1	0.4	0	0	0.094
never	236	94.4	245	98.0	
sometimes	13	5.2	5	2.0	
Do you check the refrigerator temperature before opening it?					
always	19	7.6	25	10.0	0.000
never	116	46.4	64	25.6	
sometimes	115	46.0	161	64.4	
Do you prepare food if your hands are injured or have bruises?					
always	14	5.6	0	0	0.000
never	130	52.0	228	91.2	
sometimes	106	42.4	22	8.8	
Do you keep food leftovers in the refrigerator?					
always	138	55.21	61	24.4	0.000
never	8	3.2	36	14.4	
sometimes	104	41.6	153	61.2	
Do you clean food serving utensils and utensils with warm water?					
always	137	54.8	201	80.4	0.000
never	12	4.8	12	4.8	
sometimes	151	40.4	37	14.8	
Do you clean kitchen surfaces and utensils after preparing food?					
always	224	89.6	238	95.2	0.061
never	2	0.8	1	.4	
sometimes	24	9.5	11	4.4	
Do you check the cleanliness of the utensils before cooking?					
always	235	94.0	244	97.6	0.016
never	1	0.4	3	1.2	
sometimes	14	5.6	3	1.2	
Do you remove watches, jewelry and rings before cooking?					
always	135	54.0	145	58.0	0.663
never	17	6.8	15	6.0	
sometimes	98	39.2	90	36.0	
Do you use expired food?					
always	6	2.4	0	0	0.048
never	228	91.2	234	93.6	
sometimes	16	6.4	16	6.4	
Do you wash your hands before cooking?					
always	237	94.8	244	97.6	0.261
never	2	0.8	1	0.4	
sometimes	11	4.4	5	2.0	
Are you instructing your parents or others about food safety practices?					
always	132	52.8	133	53.21	0.156
never	8	3.2	2	0.8	
sometimes	110	44.0	115	46.0	
Do you store cooked and raw food separately?					
always	225	90.0	245	98.0	0.001
never	7	2.8	2	0.8	
sometimes	18	7.2	3	1.2	
Do you use cracked eggs in preparing food?					
always	12	4.8	10	4.0	0.006
never	199	79.6	223	89.2	
sometimes	39	15.6	17	6.8	
Are you using raw unpasteurized milk to prepare food?					
always	8	3.2	8	3.2	0.000
never	191	76.4	230	92.0	
sometimes	51	20.4	12	4.8	

sometimes increased to 61.2% ($p = 0.000$). While it was found that more than half of the students had "always" correct practices before the training, as well as the training process that was presented contributed to changing some wrong practices, especially about terms that question the extent of (cleaning utensils and tools for providing food with warm water, cleaning kitchen surfaces and utensils after preparing food, checking the cleanliness of utensils before cooking, removing watches, jewellery and rings before cooking, washing hands before cooking, instructing your parents or others regarding food safety practices, storing cooked and raw food separately (with the following proportions) (80.4%, 95.2%, 97.6%, 58.0%, 53.2%, 97.6%, 98%), respectively. As for the statements that asked about not doing some wrong practices and that their correct answer was "never" such as using (expired foodstuffs, cracked eggs in preparing food, raw unpasteurized raw milk in preparing food), a correlation was found between their high response rates to the correct answer in doing the training in the following proportions (93.6%, 89.2%, 92%), respectively. The findings of the present survey showed an average level of food safety knowledge among students as reported by various workers (Garayoa *et al.*, 2005; Byrd-Bredbenner *et al.*, 2007; Sanlier, 2009; Sharif and Al-Malki, 2010). Student's demonstrated good knowledge regarding practices related to the cleanliness of kitchen utensils and kitchen surfaces, prevention of cross-contamination, hand hygiene and checking of food before use. Students displayed poor knowledge regarding heat treatment and temperature control. Our findings are in agreement with those of Sharif and Al-Malki (2010) who showed good food poisoning knowledge score of 75% among students of Taif University but had limited knowledge on some critical topics related to food safety. Osaili *et al.* (2011) reported that female college students were most knowledgeable about prevention of cross-contamination and disinfection procedures. Studies have shown that 50.87% reports of foodborne diseases are associated with domestic kitchen (Redmond and Griffith, 2009). Our results showed good knowledge about preparation, cooking, cooling and storing of food indicating lower risk of occurrence of food-related diseases.

4. Conclusion

According to the results of this study, it could be concluded that there is a significant effect of the training program on food safety knowledge and practices among students. It is important that the students have good knowledge and practices related to food safety as they should take care of their food consumption's conditions and handling in regards to creating a healthy individual or even community. At the same time, it could be

recommended that there is a necessity to design training programs and interactive educational materials for the community, in general, to enhance the food and health culture through the adoption of this initiative by government agencies, scientific and voluntary societies. Preparing various and intensive awareness and extension campaigns to educate university students in general and women, in particular ways to prevent food poisoning and epidemics that spread through food to achieve safe and sound means of food and health dealings.

References

- Abu Dhabi Food Control Authority. (2010). Essential food safety: A Guide for food handler. Retrieved from website: <https://www.adfca.ae/Arabic/PolicyAndLegislations/Documents/EFST-en.pdf>
- Adam, I., Hiamey, S.E. and Afenyo, E.A. (2014). Students' food safety concerns and choice of eating place in Ghana. *Food Control*, 43, 135-141. <https://doi.org/10.1016/j.foodcont.2014.03.005>
- Al-Shabib, N.A., Mosilhey, S.H. and Husain, F.M. (2016). Cross-sectional study on food safety knowledge, attitude and practices of male food handlers employed in restaurants of King Saud University, Saudi Arabia. *Food Control*, 59, 212-217. <https://doi.org/10.1016/j.foodcont.2015.05.002>
- Byrd-Bredbenner C., Berning, J., Martin-Biggers, J. and Quick, V. (2013). Food Safety in Home Kitchens: A Synthesis of the Literature. *International Journal of Environmental Research and Public Health*, 10(9), 4060-4085. <https://doi.org/10.3390/ijerph10094060>
- Byrd-Bredbenner, C., Maurer, J., Wheatley, V., Schaffner, D., Bruhn, C. and Blalock, L. (2007). Food safety self-reported behaviours and cognitions of young adults: Results of a national study. *Journal of Food Protection*, 70, 1917-1926. <https://doi.org/10.4315/0362-028X-70.8.1917>
- Cruz, C. (2019). Regulatory Disclosure Policies and Potential Induced Changes in Behaviour: An Outcome Evaluation of Sant Clara County's Enhanced Food Safety Program Elements. San Jose State University, USA: MSc. Dissertation.
- Ellinda-Patra, M.W., Dewanti-Hariyadi, R. and Nurtama, B. (2020). Modeling of food safety knowledge, attitude, and behaviour characteristics. *Food Research*, 4(4), 1045 – 1052. [https://doi.org/10.26656/fr.2017.4\(4\).375](https://doi.org/10.26656/fr.2017.4(4).375)
- Food Standards Australia New Zealand. (2002). Standard 3.2.2 Food Safety Practices and General Requirements. Retrieved from website: <https://www.foodstandards.gov.au/industry/safetystandards/safetypractices/Pages/default.aspx>
- Garayoa, R., Cordoba, M., García-Jalon, I., Sanchez-Villegas, A. and Vitas, A.I. (2005). Relationship

- between consumer food safety knowledge and reported behaviour among students from health sciences in one region of Spain. *Journal of Food Protection*, 68(12), 2631-2636. <https://doi.org/10.4315/0362-028X-68.12.2631>
- Gizaw, Z., Gebrehiwot, M. and Teka, Z. (2014). Food Safety Practice and Associated Factors of Food Handlers Working in Substandard Food Establishments in Gondar Town, Northwest Ethiopia, 2013/14. *International Journal of Food Sciences and Nutrition*, 3(7), 138-146. <https://doi.org/10.19070/2326-3350-1400027>
- Grunert, K.G. (2005). Food quality and safety: Consumer perception and demand. *European Review of Agricultural Economics*, 32(3), 369-391. <https://doi.org/10.1093/eurrag/jbi011>
- Hassan, F.H. and Dimassi H. (2016). Food safety and handling knowledge and practices of Lebanese university students. *Food Control*, 40, 127-133. <https://doi.org/10.1016/j.foodcont.2013.11.040>
- Kidd, M. (2000). Food safety- consumer concerns. *Nutrition and Food Science*, 30(2), 53-55. <https://doi.org/10.1108/00346650010314250>
- Langiano, E., Ferrara, M., Lanni, L., Viscardi, V., Abbatecola, A.M. and De Vito, E. (2012). Food safety at home: knowledge and practices of consumers. *Journal of Public Health*, 20(1), 47-57. <https://doi.org/10.1007/s10389-011-0437-z>
- Luo, X., Xu, X., Chen, H., Bai, R., Zhang, Y., Hou, X., Zhang, F., Zhang, Y., Sharma, M., Zeng, H. and Zhao, Y. (2019). Food safety related knowledge, attitudes, and practices (KAP) among the students from nursing, education and medical college in Chongqing, China. *Food Control*, 95, 181-188. <https://doi.org/10.1016/j.foodcont.2018.07.042>
- Mountjoy, M. (2014). *Handbook of Sports Medicine and Science, the Female Athlete*. USA: John Wiley and Sons. <https://doi.org/10.1002/9781118862254>
- Mozaffarian, D. and Rimm, E.B. (2006). Fish intake, contaminants, and human health: Evaluating the risk and the benefits. *Journal of the American Medical Association*, 296(15), 1885-1899. <https://doi.org/10.1001/jama.296.15.1885>
- Nivethitha R., Vishnupriya, V. and Gayathri, R. (2019). Awareness on food safety knowledge among college students – A survey. *Drug Invention Today*, 11(9), 2306-2308.
- Odeyemi, O.A., Sani, N.A., Obadina, A.O., Saba, C.K.S., Bamidele, F.A., Abughoush, M. and Aberoumand, A. (2019). Food safety knowledge, attitudes and practices among consumers in developing countries: an international survey. *Food Research International*, 116, 1386-1390. <https://doi.org/10.1016/j.foodres.2018.10.030>
- Osaili, T.M., Obeidat, B.A., Abu Jamous, D.O.A. and Bawadi, H.A. (2011). Food safety knowledge and practices among college female students in north of Jordan. *Food Control*, 22(2), 269-276. <https://doi.org/10.1016/j.foodcont.2010.07.009>
- Ovca, A., Jevšnik, M. and Raspor, P. (2014). Food safety awareness, knowledge and practices among students in Slovenia. *Food Control*, 42, 144-151. <https://doi.org/10.1016/j.foodcont.2014.01.036>
- Redmond, E. and Grjifith, C. (2009). Good practice for food handlers and consumers, in *Foodborne Pathogens, Hazards, Risk Analysis and Control*. 2nd ed., p. 518-543. USA: Woodhead Publishing Series in Food Science, Technology and Nutrition. <https://doi.org/10.1533/9781845696337.1.518>
- Rheinländer, T., Olsen, M., Abubakar, J., Takyi, H.B., Konradsen, F. and Samuelsen, H. (2008). Keeping up appearances: Perceptions of street food safety in urban Kumasi, Ghana. *Journal of Urban Health*, 85(6), 952e964. <https://doi.org/10.1007/s11524-008-9318-3>
- Sanlier, N. (2009). The knowledge and practice of food safety by young and adult consumers. *Food Control*, 20(6), 538-542. <https://doi.org/10.1016/j.foodcont.2008.08.006>
- Sanlier, N. and Konaklioglu, E. (2012). Food safety knowledge, attitude and food handling practices of students. *British Food Journal*, 114(4), 469-480. <https://doi.org/10.1108/00070701211219504>
- Sayuti, Y.A., Albattat, A., Ariffin, A.Z., Nazrin, N.S. and Silahudeen, T.N.A.T. (2020). Food safety knowledge, attitude and practices among management and science university students, Shah Alam. *Management Science Letters*, 10, 929–936. <https://doi.org/10.5267/j.msl.2019.10.002>
- Sharif, L. and Al-Malki, T. (2010). Knowledge, attitude and practice of Taif University students on food poisoning. *Food Control*, 21(1), 55- 60. <https://doi.org/10.1016/j.foodcont.2009.03.015>
- Singh, A. and Masuku, M. (2014). Sampling Techniques and Determination of Sample Size in Applied Statistics Research: an Overview. *International Journal of Commerce and Management*, 2(11), 1-22.
- Tirado, M.C. and Schmidt, K. (2001). WHO Surveillance Programme for Control of Foodborne Infections and Intoxications: Preliminary Results and Trends Across Greater Europe. *Journal of Infection*, 43(1), 80-84. [https://doi.org/10.1016/S0163-4453\(01\)90861-8](https://doi.org/10.1016/S0163-4453(01)90861-8)
- Young, I. and Waddel, L. (2016). Barriers and Facilitators to Safe Food Handling among Consumers: A Systematic Review and Thematic Synthesis of Qualitative Research Studies *PLOS ONE*, 11(12), e0167695. <https://doi.org/10.1371/journal.pone.0167695>