

***Interventional Program about Food Safety Knowledge and Handling Practices among Medical Students***

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***Abstract***

Gastrointestinal infections caused by food or drink contaminated with harmful bacteria, viruses and parasites are known as foodborne illnesses. Raising awareness can be accomplished most effectively through health education. The purpose of this study was to evaluate the effect of health education program on the level of food safety knowledge and practice. From September 2022 to the end of August 2023, an interventional study was conducted at Faculty of Medicine, Zagazig University, Egypt. Sixty two medical students of both sexes were included in the study and divided into two equal groups (intervention and control). The researcher applied two interviewing questionnaires for all participants; the first one focused on socio demographic characteristics, while the second one (pre/post intervention) assessed the food safety knowledge and food-handling practices. The result showed no statistically significant difference between the intervention and control groups pre-intervention regarding total knowledge and practice scores where only (6.5%, 9.7%) and (16.1%, 9.7%) of them had satisfactory knowledge and competent practice respectively. Post-intervention, a highly statistically significant difference was found between the two groups where (80.6%, 16.1%) and (90.3%, 12.9%) of them had satisfactory and competent practices respectively with the percent of improvement among intervention group was (91.27%) for knowledge and (90.95%) for practice. The study concluded that a major state of insufficient levels of food safety knowledge and practice among the Zagazig medical students and the application of an interventional program leads to highly statistical significant improvement among them.

**Key words:** Intervention Program, Food Safety, Knowledge, Practices, Medical Students

## ***Introduction***

Foodborne diseases represent an avoidable public health issue, by applying the food handling guidelines. There are several foodborne illnesses that can result from eating contaminated food that contains microorganisms or their toxins, such as viral hepatitis, typhoid, dysentery, salmonellosis, and amoebiasis (**Ahmed & Amin, 2021**). Food safety is an important practice. Food is considered safe if it does not sicken the consumer. Although it is a fundamental requirement, there is a chance that food safety may be disregarded in the creation of successful and productive procedures (**Kamboj et al., 2020**).

Health education facilitates the development of change-making environments and the capacity of individuals and groups to take autonomous health-related actions at various social life organization levels (**Assefa et al., 2015**). In certain consumer groups, food handling errors are more frequent than in others. Particularly, men, young adults (ages 18 to 29), and those with higher education than a high school diploma are more prone than others to handle food in a dangerous manner (**Aung, et al., 2019**). It is not clear from reported morbidity how hazardously this consumer group handles food, and young adults are often not regarded as "at risk" for foodborne disease. However, the consequences of such unsanitary eating habits become even more severe when they are responsible for the care of other household members who are more vulnerable, such small children and elderly parents (**Wahdan, et al., 2019**).

Young adults' self-reported food safety knowledge and food handling practices were evaluated by **Lazou et al. (2012)**. They demonstrated that university students who were part of the study generally lacked understanding about food safety and regularly handled food in an unsafe manner. There is lack of educational programs regarding food safety knowledge and practice among Egyptian medical population, as most of the studies focus on food handlers in spite of being a community issue. This study was conducted to evaluate the effect of health education program on the level of food safety knowledge and practice among medical students.

## ***Volunteers and methods***

### **Methods**

#### **Study Design and Setting:**

The study was done through a period of one year from the beginning of September 2022 to the end of August 2023 at Faculty of Medicine- Zagazig University, Egypt.

#### **Study participants:**

Medical students of both sex who aged equal and more than 18 years old and of both sex at Faculty of Medicine, Zagazig University were included in this study.

#### **Sampling:**

A simple random technique was used to choose the sample size included in the study. Sixty two medical students were divided into two groups (31 students in the intervention group and 31 students in the control group), based on comparing total knowledge score pre and post intervention (**Ahmed & Amin, 2021**). Power of the test was 80%, confidence interval (CI) 95%, drop out 10% by using Open Epi program version 3.

### Study tools:

#### A) Questionnaires:

##### First interviewing questionnaire:

Socio-demographic characteristics were guided by *Fahmy et al. (2015)* and included: name, telephone number, age, sex, academic year, mother and father education, mother and father occupation. Social class was divided into three levels: low (<19.2), medium (19.2- <33.6), and high (33.6-48) depending on the total score calculated was (48).

##### Second interviewing questionnaire:

A questionnaire was created by *Byrd-Bredbenner et al.(2007)* to evaluate students' understanding of food safety and their methods for handling food. It is valid and trust worthy used. This survey was split into two sections: 16 questions asked about knowledge of food safety, and 16 questions regarding food handling procedures. Four content-discrete subsections were created out of these questions: cleaning/hygiene, cooking/preparation, chilling/storage, and food microbiology/cross-contamination. All of the items were statements or multiple-choice questions such as true or false and yes/no options.

The practice part had a score of (16), and the total score for all knowledge items was (16), based on the scoring system of (Incorrect= 0, Correct = 1). According to prior research, a cutoff value of 60% was used to determine whether knowledge and practice were adequate. Less than 60% was deemed to represent inadequate knowledge or incompetent practice, while equal to or greater than 60% represented suitable knowledge or competent practice. The formula (after intervention score - before intervention score)/pre intervention score x 100 was used to determine the percent of changes in knowledge and practice. The same cut off was applied for categorizing changes to unsatisfactory and satisfactory.

#### B) Interventional program:

It was designed to assess knowledge and practices of students regarding food safety and impact of change in knowledge after intervention based on reviewing the related literature and included the following parts: nature of food borne illness and methods of its prevention through hygienic measures, proper storage and cooking (*Scallan et al., 2011; Havelaar et al., 2015; Aljamali et al. 2021*).

#### Operational Design:

Prior to beginning the final data collection, a pilot study including 10% of the sample size was carried out to assess the study's viability, the tool's clarity, and the amount of time needed for questionnaire completion. The results of the pilot study demonstrated that there was no need for revisions because the questionnaires were understandable and pertinent. The primary sample comprised the students that were chosen for the pilot study.

The activities started with building the initial rapport with all chosen students and obtaining each student's informed written permission. Then, all participants were interviewed and the questionnaires were filled for both groups by the researcher. Time was taken to fill the questionnaires about 30 minutes.

Application of an interventional program by the researcher was done for each student in the intervention group only. Each educational session lasted for 15 minutes. The educational session was

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conducted through in-person interviews and one-on-one conversations by using the message and educational materials. The delivered message contained information about nature of food borne illness and methods of its prevention through hygienic measures, proper storage and cooking. Educational materials (brochures and booklets) were used during the sessions and delivered to every student in the group receiving intervention only to remind them with the needed information. During the following three months, each student in the intervention group only received a phone call every two weeks to remind his/her with the needed information.

After three months, reassessment of knowledge and practice of each student in both groups through filling the post test questionnaire that was the same as pre-test questionnaire. Filling the post test was done by the researcher and taken about 15 minute.

### **Administrative & Ethical Design:**

The Institutional Review Board (IRB) at Zagazig University's Faculty of Medicine accepted the study protocol (ZU-IRB#9630-17-8-2022). The Zagazig University Faculty of Medicine's Family Medicine department provided the official consent. To get their assistance, the goals of the study were communicated to them. All enrolled students provided written informed consent, and they were free to leave the study at any time without having an adverse effect on their medical care. The participant's identity would be kept completely confidential, but the study's findings might be published in a scientific journal.

### **Statistical analysis:**

The data was analyzed using the Statistical Package for Social Science (SPSS) (Version 23.0. Armonk, NY: IBM Corp). Number & (percentage) was used to convey qualitative data, and mean  $\pm$  SD & (range) was used to describe quantitative data. The Student t test was employed to perform comparisons among various quantitative variables. To determine group differences and the association between different qualitative characteristics, the Fisher Exact test or the Chi square ( $\chi^2$ ) test were employed. The MC Nemar test (MN) was used to compare the same group's pre- and post-intervention differences. When the significant probability was  $\leq 0.05^*$  and  $\leq 0.001^{**}$ , respectively, the results were deemed statistically significant and extremely statistically significant.

After this study was finished and following a preliminary review of the data, we distributed pamphlets and booklets and provided educational messages to the control group. This was deemed ethically necessary due to the low pre intervention knowledge and practice among the control group and the demonstrated effect of the intervention on improving them.

## Results and Discussion

A total of 62 medical students from both sex were included in this study and split into two equal groups (31 students in intervention group and 31 students in control group) with no significant difference between them as regard all socio demographic characteristics; ensuring comparability of both groups (Table 1).

**Table 1**  
Socio-demographic characteristics of the studied medical students (n=62)

Characteristics	Intervention (n=31)		Control (n=31)		$\chi^2$	P value
	No	%	No	%		
Age (years)	22.26±0.73		21.93±0.99		t=1.45	0.151
Mean ±SD	21-23		21-23			
Range						
Sex					0.58	0.440
Male	13	41.9	16	51.6		
Female	18	58.1	15	48.4		
Academic years					0.272	0.602
Pre-clinical(first& second grades)	13	41.9	11	35.4		
Clinical(third, fourth & fifth grades)	18	58.1	20	64.6		
Mother's education					1.64	0.430
Secondary	5	16.1	7	22.6		
University	21	67.7	22	71.0		
Post graduate	5	16.1	2	6.5		
Father's education					1.073	0.59
Secondary	2	6.5	3	9.7		
University	20	64.5	16	51.6		
Post graduate	9	29.0	12	38.7		
Mother's work					1.033	0.31
No	13	41.9	17	54.8		
Yes	18	58.1	14	45.2		
Father's work					-	-
Yes	31	100	31	100		
Social class					0.34	0.56
High	24	77.4	22	71.0		
Medium	7	22.6	9	29.0		

$\chi^2$ : Chi square test, t: student't test, statistically significant ( $P \leq 0.05^*$ ), Highly statistical significant ( $P \leq 0.001^{**}$ )

On studying knowledge and practice regarding food safety among intervention and control groups pre intervention, there was no significant difference between both groups toward all items of knowledge and practice. In addition, no statistically significant difference was found between the two groups regarding the preintervention total knowledge and total practice scores where only (6.5%, 9.7%) and (16.1%, 9.7%) of them had satisfactory and competent total scores respectively (Tables 2, 5).

After intervention, the studying of food safety knowledge and food-handling practices among the studied groups showed that there was highly statistical significant difference between both groups

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toward all items as well as toward the total knowledge and total practice scores post intervention where (80.6%, 16.1%) and (90.3%, 12.9%) of them had satisfactory and competent total scores respectively (Tables 3, 5)

**Table 2**

Knowledge level regard food safety among the studied groups pre intervention (n= 62)

Variables	Intervention (n=31)		Control (n=31)		f P value
	No	%	No	%	
Food microbiology / cross-contamination					0.238
Satisfactory	3	9.7	0.0	0.0	
Unsatisfactory	28	90.3	31	100	
Food preparation (cooking)					0.99
Satisfactory	1	3.2	2	6.5	
Unsatisfactory	30	96.8	29	93.5	
Food storage (chilling)					0.99
Satisfactory	3	9.7	2	6.5	
Unsatisfactory	28	90.3	29	93.5	
Cleaning/hygiene					0.99
Satisfactory	4	12.9	3	9.7	
Unsatisfactory	27	87.1	28	90.3	
Knowledge food safety					0.99
Satisfactory	2	6.5	3	9.7	
Unsatisfactory	29	93.5	28	90.3	

<sup>f</sup>Fisher exact test, statistically significant (P≤0.05\*), Highly statistical significant (P≤0.001\*\*)

**Table 3**

Knowledge level regard food safety among the studied groups post intervention (n= 62)

Variables	Intervention (n=31)		Control (n=31)		$\chi^2$	P value
	No	%	No	%		
Food microbiology / cross-contamination						
Satisfactory	20	64.5	1	3.2	25.9	≤0.001**
Unsatisfactory	11	35.5	30	96.8		
Food preparation (cooking)						
Satisfactory	29	93.5	3	9.7	43.6	≤0.001**
Unsatisfactory	2	6.5	28	90.3		
Food storage (chilling)						
Satisfactory	28	90.3	5	16.1	34.3	≤0.001**
Unsatisfactory	3	9.7	26	83.9		
Cleaning/hygiene						
Satisfactory	29	93.5	4	12.9	40.5	≤0.001**
Unsatisfactory	2	6.5	27	87.1		
Knowledge food safety						
Satisfactory	25	80.6	5	16.1	25.8	≤0.001**
Unsatisfactory	6	19.4	26	83.9		

$\chi^2$ : Chi square test, statistically significant different ( $P \leq 0.05^*$ ), highly statistically significant different ( $P \leq 0.001^{**}$ )

Pre-post intervention comparisons among the intervention group showed that highly significant improvement was found regarding all items and the total scores of food safety knowledge and practice with the percent of improvement was (91.27%) and (90.95%) respectively. On the other hand, the control group did not show any statistically significant preference for any of the questions or the overall knowledge and practice scores pre/post intervention (Tables 4, 5).

**Table 4**

Knowledge level regard food safety within each group pre-post intervention (n= 62)

Variables	Intervention (n=31)				Control (n=31)			
	Pre		Post		Pre		Post	
	No	%	No	%	No	%	No	%
Food microbiology / cross-contamination								
Satisfactory	3	9.7	20	64.5	0.0	0.0	1	3.2
Unsatisfactory	28	90.3	11	35.5	31	100	30	96.8
<sup>MN</sup> P value	≤0.001**				0.99			
% of improvement	190.92%				41.67%			
Food preparation (cooking)								
Satisfactory	1	3.2	29	93.5	2	6.5	3	9.7
Unsatisfactory	30	96.8	2	6.5	29	93.5	28	90.3
<sup>MN</sup> P value	≤0.001**				0.99			
% of improvement	134.05%				5.0%			
Food storage (chilling)								
Satisfactory	3	9.7	28	90.3	2	6.5	5	16.1
Unsatisfactory	28	90.3	3	9.7	29	93.5	26	83.9
<sup>MN</sup> P value	≤0.001**				0.375			
% of improvement	62.68%				6.25%			
Cleaning/hygiene								
Satisfactory	4	12.9	29	93.5	3	9.7	4	12.9
Unsatisfactory	27	87.1	2	6.5	28	90.3	27	87.1
<sup>MN</sup> P value	≤0.001**				0.99			
% of improvement	70.49%				1.58%			
Knowledge food safety								
Satisfactory	2	6.5	25	80.6	3	9.7	5	16.1
Unsatisfactory	29	93.5	6	19.4	28	90.3	26	83.9
<sup>MN</sup> P value	≤0.001**				0.625			
% of improvement	91.27%				3.86%			

MN: MC Nemar test, statistically significant different (P≤0.05\*), Highly statistical significant different (P≤0.001\*\*)



**Table 5**

Food safety handling practice among the studied groups and within each group pre-post intervention (n= 62)

Variables	Intervention (n=31)				Control (n=31)				fP value	Post	
	Pre		Post		Pre		Post			χ 2	P value
	No	%	No	%	No	%	No	%			
Food safety handling practice											
Competent	5	16.1	28	90.3	3	9.7	4	12.9	0.707	37	≤0.001**
Incompetent	26	83.9	3	9.7	28	90.3	27	87.1			
<sup>MN</sup> P value	≤0.001**				0.99						
% of improvement	90.95%				11.57%						

<sup>f</sup>Fisher exact test,  $\chi^2$ : Chi square test, MN: MC Nemar test, statistically significant different (P≤0.05\*), Highly statistical significant different (P≤0.001\*\*)

As regard the percent of improvement in the total scores of knowledge and practice among the intervention group, the majority (83.9%) and (80.6%) of them had satisfactory changes respectively. The relationship between personal characteristics and the percent of improvement in food safety knowledge and handling practice among the intervention group showed that there was no statistically significant association between them, which indicates that the health education was the only significant factor for raising the awareness of medical students about food safety (Table 6).

**Table 6**

Relation between Sociodemographic data and percent of improvement in food safety knowledge & handling practice among intervention group (n=31).

Variables	Percent of improvement in food safety knowledge				T	Percent of improvement in food safety handling practice				t
	≥60% (n=26)		<60% (n=5)			≥60% (n=25)		<60% (n=6)		
Age per years	22.15±0.73		22.8± 0.45		1.89 P=0.069	22.24±0.66		22.33±1.03		0.28 P=0.78
Mean ±SD	21-23		21-23			21-23		21-23		
Range	21-23		21-23		21-23		21-23		21-23	
Gender	No.	%	No.	%	fP	No.	%	No.	%	fP
Males	12	46.2	1	20.0	0.37	10	40.0	3	50.0	0.676
Females	14	53.8	4	80.0		15	60.0	3	50.0	
Academic years					0.058					0.99
First three academic years	13	50.0	5	100.0		11	44.0	2	33.3	
second three academic years	13	50.0	0	0.0		14	66.0	4	66.7	
Social class level					fP					fP
High	19	73.1	5	100.0		0.56	18	72.0	6	
Middle	7	26.9	0	0.0						

t: student't test, <sup>f</sup>Fisher exact test, statistically significant (P≤0.05\*), Highly statistical significant (P≤0.001\*\*)

Health education has significant impact on food safety knowledge and practice and proved to be an independent factor for raising the awareness of medical students whatever their age, social class, parents' education or any other factor (**Alghafari&Arfaoui, 2022**).

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In certain consumer groups, food handling errors are more frequent than in others. Particularly, men, young adults (ages 18 to 29), and those with higher education than a high school diploma are more prone than others to handle food in a dangerous manner (**Aung et al., 2019**).

Hence, the study was conducted to evaluate the effect of health education program on the level of food safety knowledge and practice among medical students at Faculty of Medicine- Zagazig University, Egypt.

The current study defined that (93.5%) of the medical students in the intervention group had unsatisfactory knowledge level at the pre-intervention phase. There were upturn at the post-intervention phase, where (80.6%) of them had satisfactory food safety knowledge level. Additionally, the percent of improvement was (91.27%) which was highly statistical significant. On contrary, in the control group, there was statistically insignificant difference between food safety knowledge level pre/post-assessment.

In line with the research conducted by **Yarrow et al. (2009)** which discovered that an educational intervention on food safety has a favorable impact on college students' attitudes, beliefs, knowledge, and self-reported practices about food safety. Before beginning the educational intervention, which consisted of three interactive modules, subjects filled out a food safety questionnaire (FSQ). Students' FSQ belief and knowledge ratings improved dramatically from 86 to 98 and from 11 to 13, respectively, and their FSQ attitude levels climbed significantly from 114 to 122.

The findings of another study, conducted by **Nik Husain et al. (2016)** were consistent with those previously described. After the food safety intervention, there was a considerable improvement in the participants' understanding of personal hygiene and food preparation. In comparison to the baseline, the intervention group's self-reported food safety and hygiene practice score was significantly higher.<sup>14</sup>

The study conducted by Safari et al. sought to ascertain how educational intervention affected the food hygiene knowledge and attitudes of rural homemakers in Bisotun. They demonstrated how the educational intervention greatly improved the knowledge and attitudes of rural home makers, which was consistent with the current findings (**Safari et al., 2017**).

Additionally, **Ahmed and Sayedin (2021)** reported that once the instructional guidelines were implemented, food handlers' knowledge scores related safety food measures improved. Specifically, 3.8 percent of them had strong understanding prior to education, and that number rose to 32.5% post-education.

When we evaluated the food safety handling practices of the medical students in this study, we discovered that, while there was a highly statistically significant difference between both groups at the post-program, there were not statistically significant differences between the intervention and control groups at the pre-intervention phase. Approximately (83.9%) of medical students in the intervention group had incompetent practice level at the pre-intervention phase. During the post-intervention period, 90.3 percent of them demonstrated competent food safety handling practices. Furthermore, there was a 90.95 percent improvement, and this gain was extremely statistically significant. On the other hand, the control group demonstrated that the differences between the pre- and post-assessment food safety handling practices were statistically insignificant.

Similarly, prior to receiving food safety education, there was no appreciable difference in knowledge, attitude, or practice between the control and intervention groups, according to *Riyanto et al. (2017)* study. Following a six-month food safety education program, the intervention group's knowledge, attitude, and practice increased much more than those of the control group. Additionally, knowledge increased from (5.4%) to (91.1%) in the intervention group, attitude climbed from (69.6%) to (97.3%), and practice increased from (21.4%) to (59.8%). There was statistical significance to all of these changes.

*Mohamed et al. (2020)* assessed the impact of an educational programme on reducing food-borne illnesses at Suez Canal University eateries. They discovered that food handlers' procedures had improved between the pre- and post-test comparisons.

In line with the current findings, Ahmed and Sayed also reported that the application of educational guidelines was highly successful in enhancing the food handlers' practices regarding safety food measures. Specifically, 8.8% of them had satisfactory practices prior to education, which improved to reach (48.8%) after education (*Ahmed & Amin, 2021*).

The medical staff and team, who are thought to be the primary source of knowledge to influence their practices, are responsible for educating medical students. However, due to their shortage and increased work load, they may not have enough time to provide the students with the necessary knowledge. This could explain the inadequate levels of knowledge and practice regarding food safety prior to intervention. Post intervention, the above mentioned results and the all matched studies with them can be explained by the food safety is a very important for prevention of disease and community health. Physicians play an important part in educating the public including the medical students about how to eat a balanced and healthy diet and, most importantly, how to prepare food safely to avoid the risk of foodborne illnesses.

### Limitations

The study at hand had some limitations including the results were more representative for specific population as the study included medical students only and it is subjective assessment for knowledge without assessment of the actual practice in the real world.

### Conclusion & Recommendations

This study revealed a major state of insufficient levels of food safety knowledge and practice among the Zagazig medical students and the application of an interventional program leads to highly statistical significant improvement among them pointing to there is an urgent need to raise the interest in food safety and the importance of repetition of such program on wider scale and on other population.

**Conflict of interest:** The authors declare that they have no conflict of interest.

**Financial disclosures:** The authors declare that they have no funding support.

All authors have participated in the concept and design, analysis and interpretation of data, drafting or revising of the manuscript, and that they have approved the manuscript as submitted.

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### الملخص العربي

#### الخلفية والهدف:

تُعرف التهابات الجهاز الهضمي والتهيج الناجم عن الطعام أو الشراب الملوث بالبكتيريا الضارة أو الفيروسات أو الطفيليات أو المواد الكيميائية بالأمراض المنقولة بالغذاء. يمكن تحقيق رفع مستوى الوعي بشكل أكثر فعالية من خلال التثقيف الصحي. لذا كان الغرض من هذه الدراسة هو تقييم أثر برنامج التثقيف الصحي على مستوى المعرفة والممارسة في مجال سلامة الغذاء.

#### الطرق:

خلال الفترة من سبتمبر 2022 إلى نهاية أغسطس 2023، أجريت دراسة تدخلية في كلية الطب جامعة الزقازيق، مصر. تم تضمين اثنين وستين طالب طب في الدراسة وتم تقسيمهم إلى مجموعتين متساويتين (التدخل والضابطة). قام الباحث بتطبيق استبيانين للمقابلة على جميع المشاركين؛ ركز الأول على الخصائص الديموغرافية الاجتماعية، في حين قام الثاني (قبل/بعد التدخل) بتقييم المعرفة المتعلقة بسلامة الأغذية وممارسات التعامل مع الأغذية.

#### النتائج:

لم يكن هناك فروق ذات دلالة إحصائية بين مجموعات التدخل والمجموعات الضابطة قبل التدخل فيما يتعلق بمجموع درجات المعرفة والممارسة حيث فقط (6.5%، 9.7%) و (16.1%، 9.7%) منهم لديهم معرفة مرضية وممارسة مختصة على التوالي. وبعد التدخل، وجد فرق ذو دلالة إحصائية عالية بين المجموعتين حيث (80.6%، 16.1%) و (90.3%، 12.9%) منهم لديهم ممارسات مرضية وكفوة على التوالي حيث بلغت نسبة التحسن بين مجموعة التدخل (91.27%). (90.95%) للمعرفة و (90.95%) للممارسة.

#### الاستنتاجات:

هناك حالة كبيرة من عدم كفاية مستويات المعرفة والممارسة في مجال سلامة الأغذية بين طلاب الطب في الزقازيق، وتطبيق برنامج تدخلي يؤدي إلى تحسن كبير إحصائياً بينهم.

الكلمات المفتاحية: برنامج التدخل، سلامة الغذاء، المعرفة، الممارسات، طلاب الطب.