

## Original Article

# Effect of an Educational Program on Food Safety Practices in Food Preparation and Handling Procedures in Governmental Hospitals of an Egyptian Governorate

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## Abstract

**Background & Objective(s):** In hospitals, food borne diseases could be prevented if appropriate food safety measures are applied during food handling. The study aims to assess the food safety practices of food handlers in governmental hospitals of Gharbia Governorate and to design, implement and evaluate the effect of an intervention program on these practices.

**Methods:** The study was conducted in all Ministry of Health and Population hospitals of Gharbia Governorate (n=17) among all food handlers (n=161) using a one group pre-test post-test intervention approach. Data were collected using an interviewing questionnaire and an observation checklist. A health education program was designed and implemented then practices of food handlers were reassessed using the same study tools.

**Results:** Food handlers with scientific background related to nutrition and those working in general hospitals had higher significant odds of food handler practice score than relevant categories. Multivariate logistic regression analysis shows that hospital type and scientific background were significant predictors for food hygiene practices score. Food handlers had more good and fair levels of practices post-intervention compared to pre-intervention. There were significant differences between both pre and post intervention practice scores.

**Conclusion:** There is a significant effect of the intervention program on food safety practices of food handlers.

**Keywords:** Food safety; infection control; food preparation; food handling

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## INTRODUCTION

In hospitals, appropriate food handling procedures by food handlers, together with proper hygienic conditions in the kitchen are basic for prevention of food borne diseases (FBDs) among patients, their companions and hospital staff. Food is produced in large quantities and if not properly handled can cause outbreaks and result in disruption of the services provided by the hospital.<sup>(1)</sup> In addition, ensuring good sources of food, proper inspection and storage, the most important practices that must be followed by food handlers during preparation and handling of food are: hand hygiene, use of personal protective equipment (PPE) [clean coats, head covers, gloves and masks], sanitary practices during handling food

and environmental measures including cleaning of equipment.<sup>(2-4)</sup> Food safety education and training for food handlers is crucial in impacting their practices in food handling process and hence being fundamental in preventing FBDs.<sup>(5)</sup>

The study aimed at assessing food safety practices of food handlers in the 17 governmental hospitals of Gharbia Governorate and to design, implement and assess the effect of an intervention program on these practices.

## METHODS

An intervention approach (one group pre-test post-test design) was conducted among all food handlers (n=161) in all Ministry of Health and Population hospitals (n=17) of

Gharbia Governorate, Egypt.

The sample size was calculated using Sample Size calculators, Sample size for before-after study (Paired T-test).<sup>(6)</sup> Based on 0.01 Type I error rate, 0.05 Type II error rate, effect size of 0.35, 5 standard deviation of the change in the outcome of 1 and a 10% dropout, the sample size was 160.

For assessment of practices of food handlers, the sample size of the observations of food safety practices was determined using Med calc, version 11.1.1.0 on the assumption that the prevalence of poor food safety practice is 50%, the precision is 5% and power is 90%, the minimum required sample size at 95% confidence level was 450 observations. Each food handler was observed three times taking into consideration representation of different shifts. The total number of observations was 483. A predesigned structured interviewing questionnaire prepared by the researchers was used to collect data from all food handlers about their personal characteristics (age, sex, level of education, training on food safety, and years of experience). An observation checklist was also prepared to collect data from food handlers about hand hygiene (timing of hand washing whether before handling ready to eat food, after handling raw food, after touching hair, nose and ears; technique of hand washing including removing jewelry and watches, washing frequently missed areas, turning tap without touching it; and method of drying hands). The checklist also included using different types of PPE [coats, gloves, head covers, masks and footwear]. In addition, it included following hygienic practices during food purchase (source, and inspection), storage (labeling, temperature, and thawing) and preparation (proper trimming, cooking temperature, and separation of raw from cooked food); cleaning contaminated surfaces; and cleaning used equipment and utensils. The checklist was prepared and created by the researchers after literature review and was validated by two experts in the related field.

A health education intervention program was designed according to the results of the pre-test and was tailored to the needs of food handlers. Health education sessions were conducted for all food handlers in each hospital using different educational methods including demonstrations and group discussions. The contents of the program included food borne diseases, their modes of transmission and prevention and control, the importance of adherence to food safety practices in food preparation and handling, and detailed information on these practices. Three months after the end of the program, the practices of food handlers were reassessed using the same data collection tools.

Pre and post intervention data were collected, revised and entered to the computer using the SPSS program version 21. Descriptive and analytical statistics were done. Continuous variables were represented as means  $\pm$  standard deviation, while categorical variables were represented as frequencies and percentages. Chi-square

McNemar-Bowker test ( $X^2_{MN}$ ) was used. Differences at p-value were considered statistically significant ( $p < 0.05$ ). Differences in practice before and after the intervention were tested using the paired t-test.

A scoring system was done for the observations made on IC practices. Correct answers were given a score of one and incorrect answers were given a score of zero. The maximum score was 43 points: 14 points for hand hygiene, 5 points for PPE, 13 points for hygienic practices during food purchase, storage and preparation, 5 points for cleaning of contaminated surfaces, and 6 points for cleaning of used equipment and utensils. The scores were changed into percentages by dividing the score for each individual by the total score and multiplying it by 100. The level of practice was then categorized into: poor (<50% of total score), fair (50% - <75% of total score), and good ( $\geq$  75% of total score) observations.

### **Ethical considerations**

The study was approved by the Institutional Review Board and the Ethics Committee of the High Institute of Public Health. The researchers complied with the International Guidelines for Research Ethics. Verbal consent was taken from the study participants after explanation of the purpose and benefits of the study. Anonymity and confidentiality were assured and maintained.

## **RESULTS**

### **Personal characteristics of food handlers**

The mean age of food handlers was 40.63 $\pm$ 8.8 years. Those aged less than 40 years constituted 65.8% while those aged 40 years and more constituted 34.2%. More than half (54.7%) of the food handlers were females. More than three quarters (77.0%) of them had below university education. Most food handlers (83.2%) had a scientific background not related to nutrition. The years of experience of food handlers ranged between 1 year and 35 years with a mean of 12.44  $\pm$  8.95 years. Almost three quarters (74.5%) had 5 or more years of experience. Only half of food handlers (50.3%) had previous training courses on food safety. Food handlers working in specialized hospitals amounted to 72.0% while those working in general hospitals were 28.0% (Table 1).

### **Observations of food hygiene practices of food handlers**

Table 2 shows the results of food safety practices of food handlers before and after the intervention. Observations on hand hygiene practices of food handlers revealed that hands were not washed before handling ready to eat food in 62.1% of the observations. The same was seen with respect to washing hands after handling raw food where hands were not washed in 58.4% of the observations. Also, hands were not washed after touching hair, nose and ears in 99.4% of observations. Jewelry and watches were not

removed before washing hands in 96.9% of the observations.

**Table 1: Distribution of food handlers by their personal characteristics (Gharbia, 2016)**

Personal characteristics	Food handlers (n=161)	
	No.	%
<b>Age (years)</b>		
<40	106	65.8
40+	55	34.2
<b>Sex</b>		
Males	73	45.3
Females	88	54.7
<b>Marital status</b>		
Single	14	8.7
Ever married	147	91.3
<b>Level of education</b>		
Below university	124	77.0
University and above	37	23.0
<b>Scientific background</b>		
Not related to nutrition	134	83.2
Related to nutrition	27	16.8
<b>Years of experience</b>		
< 5 years	41	25.5
5+ years	120	74.5
<b>Previous training on food safety</b>		
No	80	49.7
Yes	81	50.3
<b>Type of hospital</b>		
General	45	28.0
Specialized	116	72.0

The most commonly missed areas during hand washing were the webs between the fingers and the finger nails in 93.2% and 93.8% of observations respectively. Tab was turned without touching it in only 1.2% of the observations. Regarding drying hands, there were no dryers in any hospital. Kitchen paper towels and cloth were used for drying hands in 60.9% and 36.6% of the observations respectively. The total mean score of hand hygiene was 32.6. Observations made on use of personal protective equipment showed that most of the food handlers were wearing clean coats in 83.9% of the observations, 15.5% were using disposable gloves when handling ready to eat food and 78.3% were using head covers. Masks and footwear (safety non-slip shoes or boots) were rarely used during handling food. Masks were used in 0.6% and footwear in 7.5% of the observations. The total mean score of use of personal protective equipment was 37.1.

Concerning hygienic practices in food purchase, storage and preparation, it was found that in all the studied hospitals, food was purchased from approved sources, inspected by specialist, stored labeled and dated. Also, meat was under veterinary inspection. Refrigerated food was stored at or below 40C in 93.8% of the observations and frozen food was stored at or below -180C in all observations. High risk food was checked daily in 88.8%

of the observations. Frozen meat was thawed in a refrigerator in 98.8% of the observations while thawed food was not refrozen in any observations. Regarding food preparation, fruits and vegetables were trimmed and washed properly in all observations. Raw food was separated from cooked food in 50.3% of the observations. Trash containers were present for disposal of food remnants in 96.3% of the observations. The total mean score of hygienic practices was 81.3.

The observations made on cleaning contaminated surfaces showed that the kitchen and food preparation areas were cleaned using soap and hot water in 19.9% of the observations. Appropriate detergents were used for cleaning in 45.3% of the observations. The total mean score of cleaning contaminated surfaces was 30.0.

The observations made on cleaning of used equipment and utensils revealed that the stoves, grills and refrigerators were cleaned in 14.3%, 14.9% and 95.7% of the observations respectively. Tables, sinks and utensils were cleaned using hot water and soap in 15.5% 8.1%, and 29.2% of the observations respectively. The total mean score of cleaning of used equipment and utensils was 30.1.

It appears from table 2 that all food safety practices of food handlers improved after the intervention. The degree of improvement varied between individual practices except for the method of drying hands which did not show any change.

Table 3 shows that food handlers with scientific background related to nutrition and those working in general hospitals had higher significant odds of food handler practice score than relevant categories .

Multivariate logistic regression analysis shows that hospital type and scientific background were significant predictors for food hygiene practices score (Table 4).

The ROC curve of probability of good score calculated from binary logistic regression model among food handlers shows that the area under the curve (AUC) was 0.782 (CI: 0.695, 869 and  $p < 0.001$ ) (Figure 1).

Table 5 illustrates the differences in the food safety practice mean score among food handlers pre and post-intervention. There were significant differences between pre and post-intervention scores of food handlers concerning the mean score of all practices. Concerning hand hygiene, the score increased from 32.6 to 36.5. As for PPE, the score increased from 37.1 to 39.6. The score of safety practices in food preparation increased from 81.3 to 88.3. As for cleaning contaminated surfaces, the score increased from 30.0 to 78.1. The same was observed for cleaning of used equipment where the score increased from 30.1 to 72.5.

As regards the total score of observations of food safety practices before and after intervention, it appears from table 6 that food handlers post-intervention had more good and fair levels of practices compared to food handlers pre-intervention. There were significant differences between both pre and post intervention practice scores ( $\chi^2_{MN} = 111.00, p = 0.000$ ).

**Table 2: Observations of food safety practices of food handlers before and after the intervention (Gharbia, 2016)**

<b>Item</b>	<b>Pre-intervention No. (%)</b>	<b>Post-intervention No. (%)</b>
<b>Hand hygiene</b>		
Timing		
Hand washing before handling ready to eat food	183 (37.9)	468 (96.9)
Hand washing after handling raw food	201 (41.6)	447 (92.5)
Hand washing after touching hair, nose and ears	3 (0.6)	36 (7.5)
Technique		
Removing jewelry and watches before hand washing	15(3.1)	447 (92.5)
Washing hands using hot water, soap for 30 seconds	63 (13.0)	450 (3.2)
Missed areas when hand washing		
Webs between fingers	450 (93.2)	72 (14.9)
Finger nails	453 (93.8)	63 (13.0)
Dorsum of finger	21 (4.3)	3 (0.6)
Thumbs	15 (3.1)	3 (0.6)
Turning tab without touching it	6 (1.2)	384 (79.5)
Drying hands using		
Dryer	0 (0.0)	0 (0.0)
Single use towels ( tissue paper)	0 (0.0)	0 (0.0)
Single use kitchen paper towels	294 (60.9)	306 (63.4)
Clothing	177 (36.6)	177 (36.6)
<b>PPE using</b>		
Clean coat	405 (3.9)	477 (92.5)
Gloves	75 (15.5)	468 (96.9)
Head cover	378 (78.3)	411 (85.1)
Mask	3 (0.6)	24 (5.0)
Footwear	36 (7.5)	180 (37.3)
<b>Hygienic practices</b>		
Food purchase		
Food purchased from approved sources	483 (100.0)	483 (100.0)
Food inspected by specialist	483 (100.0)	483 (100.0)
Meat under veterinary inspection	483 (100.0)	483 (100.0)
Food storage		
Stored labeled and dated	483 (100.0)	483 (100.0)
Refrigerated food stored at 4°C	453 (93.8)	483 (100.0)
Frozen food stored at -18°C	483 (100.0)	483 (100.0)
High risk food checked daily	429 (88.8)	483 (100.0)
Frozen meat thawed in a refrigerator	477 (98.8)	480 (99.4)
No refreezing of thawed food	483 (100.0)	483 (100.0)
Food preparation		
Fruits, vegetables trimmed and washed properly	483 (100.0)	483 (100.0)
Cooking temperature >73°C	480 (99.4)	483 (100.0)
Separation of ready-to eat food from cooked	243 (50.3)	483 (100.0)
Protected prepared food	18 (3.7)	474 (98.1)
<b>Cleaning of contaminated surfaces</b>		
Clean kitchen	96 (19.9)	483 (100.0)
Smooth contact surface	96 (19.9)	483 (100.0)
Intact and clean food preparation area	96 (19.9)	483 (100.0)
Using appropriate chemicals for cleaning	219 (45.3)	483 (100.0)
Washing clothes regularly	219 (45.3)	480 (99.4)
<b>Cleaning of used equipment and utensils</b>		
Stoves	69 (14.3)	339 (70.2)
Grills	70 (14.5)	371 (76.9)
Refrigerators	462 (95.7)	483 (0.0)
Tables	75 (15.5)	399 (82.6)
Sinks	39 (8.1)	402 (83.2)
Utensils	141 (29.2)	429 (88.8)

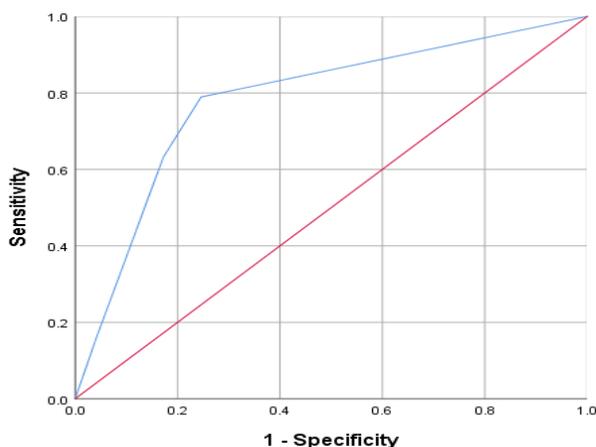
**Table 3: Crude odds ratio of factors affecting practice score of food handlers (Gharbia, 2016)**

Variable	cOR	95% CI	$\chi^2_{MH}$
Age (<40 versus 40+ years)	1.566	.742- 3.308	.965, $p= .326$
Sex (Males versus females)	1.032	.497, 2.145	.010, $p= .920$
Marital status (Single versus ever married)	1.146	.302, 4.340	.017, $p= .898$
Level of education (Below university versus university and above)	1.809	.803, 4.079	1.481, $p= .224$
Scientific background (Not related to nutrition versus related)	3.323	1.390, 7.944	6.448, $p= .011$
Years of experience (< 5 years versus 5+)	1.133	.485, 2.650	.006, $p= .940$
Previous training (No versus yes)	.857	.414, 1.776	.052, $p= .819$
Hospital (General versus others)	.120	.053- .270	28.195, $p = 0.00$

cOR, crude odds ratio; CI, confidence interval

**Table 4: Multivariate logistic regression of factors affecting practice of food handlers (Gharbia, 2016)**

Variable	B	Sig.	Exp ( $\beta$ )	95% CI for EXP( $\beta$ )	
				Lower	Upper
Hospital type	2.060	.000	.127	.056	.292
Scientific background	1.147	.023	3.150	1.168	8.495
Constant	.785	.898	.764	1	

**Figure 1: ROC of practice score calculated from binary logistic regression model****Table 5: Distribution of observations of food handlers by their mean practice scores regarding food safety pre and post intervention (Gharbia, 2016)**

Scores of practices	Pre Mean $\pm$ SD	Post Mean $\pm$ SD	Paired samples t-test	$p$
Hand hygiene	32.6 $\pm$ 5.4	36.5 $\pm$ 6.8	-8.445	0.000*
Personal protective equipment	37.1 $\pm$ 17.2	39.6 $\pm$ 17.8	- 3.947	0.000*
Hygienic practices in food preparation	63.3 $\pm$ 14.5	88.3 $\pm$ 3.3	-14.468	0.000*
Cleaning of contaminated surfaces	30.0 $\pm$ 38.7	78.1 $\pm$ 33.0	12.063	0.000*
Cleaning of used equipment and utensils	30.1 $\pm$ 29.4	72.5 $\pm$ 34.9	-13.969	0.000*
Total percentage score	47.6 $\pm$ 10.6	63.4 $\pm$ 11.0	-18.948	0.000*

\*Significant ( $p < 0.05$ )**Table 6: Distribution of overall general practice scores of food handlers before and after intervention (Gharbia, 2016)**

Overall general practice score	Pre No. (%)	Post No. (%)	$\chi^2_{(MN)}$	$p$
Good (<50% of total score)	4 (2.5)	18 (11.2)		
Fair (50%- <75% of total score)	34 (21.1)	125 (77.6)	111.00	0.000*
Poor ( $\geq$ 75% of total score)	123 (76.4)	18 (11.2)		

MN: McNemar-Bowker test

\*Significant ( $p < 0.05$ )

## DISCUSSION

The results of the study with respect to food handlers' practices showed that hands were not washed before handling ready to eat food in 62.1% of the observations of the current study. This finding shows that food washing was worse than findings of Pengetahuan *et al.*,<sup>(7)</sup> in Malaysia (2011) who found that, hands were not washed before handling ready to eat food in 40% of observations. A study conducted by Meleko *et al.*,<sup>(8)</sup> in Ethiopia (2015) found that in 47.7% of observations, hands were not washed before starting any activity, while in a study conducted by Singh *et al.*,<sup>(9)</sup> in Italy (2015), it was found that hands were not washed before handling ready to eat food in only 17.1% of the observations. In the present study, hands were not washed after handling raw food in 58.4% of the observations. The study by Buccheri *et al.*,<sup>(10)</sup> in Italy (2007) revealed that in only 16.4% of the observations, hands were not washed after handling raw food. Findings of the other studies showed better hand washing practices than findings of the present study and this might be attributed to the fact that about half of food handlers were not trained.

The present study showed that almost all food handlers (99.4%) did not wash their hands after touching their hair, nose and ears. The study conducted by Jong, *et al.*,<sup>(11)</sup> in Korea (2010) found that only 25% of food handlers did not wash their hand after touching their hair, nose and ears. In the present study, hands, jewelry, and watches were not removed before washing hands in 96.9% of the observations. A study by Mobolaji *et al.*,<sup>(12)</sup> in Nigeria (2014) found that jewelry was not removed during food handling in 77.4% of the observations. This very deficient practice among food handlers in the current study than in other studies could be explained by a defect in training.

It was observed in the current study that during washing hands, most of food handlers (93.2%) missed the webs between the fingers and 93.8% missed their finger nails and only 7% did not miss any area. A study by Manning, *et al.*,<sup>(13)</sup> in USA (1993) reported better hand washing practices as in only 2% of observations, hands were washed without missing any area. This highlights the need for strengthening training about the technique of hand washing and the importance of avoiding missing areas during hand washing.

For drying hands, kitchen paper towels were used by food handlers in 60.9% and 36.6% used cloth towels and no dryers were available. The study conducted by Jong, *et al.*,<sup>(11)</sup> in Korea (2010) found that in 37.9%, 27.6%, 3.5% of the observations, single use paper towels, dryers and cloth were used when drying hands respectively. Differences are due to the type of equipment provided by the hospital for drying hands.

Regarding PPE, clean coats were worn in 83.9% and head covers were used in 78.3% of the observations. Almeida *et al.*,<sup>(14)</sup> in Brazil (2014) found that proper

uniforms and hair covers were worn in 18.1%, 91.7% of observations respectively.

Gloves were not used in 84.5% of the observations in this study. Singh *et al.*,<sup>(9)</sup> in Italy (2015) found that gloves were not used in 65.2% of the observations, while Mobolaji, *et al.*,<sup>(12)</sup> in Nigeria (2014) found that gloves were not used in 90.1% of the observations.

Masks were used during handling food in only 0.6% of the observations. A study conducted by Anuradha, *et al.*,<sup>(15)</sup> in India (2013) found that masks were used in 66.7% of the observations. Differences in use of personal protective equipment are partly due to the availability of these equipment in the various setting and rules and regulations concerning them in different countries.

Concerning hygienic practices of food handlers in all steps of food preparation, in all observations of the present study, it was found that food was purchased from approved sources, inspected by specialist, stored labeled and dated, and meat was under veterinary inspection. Studies from other countries showed less strict procedures than in the present study. Almeida, *et al.*,<sup>(14)</sup> in Brazil (2014) found that food temperature receipt, or expiry date and package integrity were not checked in 37.2% of the observations. Meleko *et al.*,<sup>(8)</sup> in Ethiopia (2015) found that ingredients, food expiry date were not checked before use in half of their observations. Findings of the current study revealed that there was strict supervision of sources of food and its storage by qualified personnel.

According to the current study, refrigerated food was stored at or below 4°C in 93.8% of the observations. A study conducted by Almeida, *et al.*,<sup>(14)</sup> in Brazil (2014) found that there was inappropriate storage of food that required refrigeration in 19.6% of the observations. Raw food was separated from cooked food in half of the observations. Cheraghi *et al.*,<sup>(16)</sup> in Iran (2014) found that raw foods were separated from cooked in 70% of the observations.

As regards wiping clothes, they were washed daily in 45.3% of the observations of the present study. A higher percentage was reported by Modiwala *et al.*,<sup>(17)</sup> in India (2015) who found that wiping clothes were washed and dried daily in 89.4% of the observations.

The present study showed that there was a significant improvement of all food hygiene practices following the intervention. The mean scores of all practices (hand hygiene, PPE, hygienic practices, cleaning of used equipment and utensils) showed a significant increase in the post intervention score. Similar observations were reported in different studies. A study conducted by Ngivu<sup>(5)</sup> in East Africa (2016) revealed that there was a 35% increase in food safety compliance audit score especially hand hygiene compliance which improved from 50% before to 100% after the intervention.

This highlights the importance of training on the improvement of food safety practices.

One of the major difficulties in the present study was that the food handlers were sometimes busy and did not

have time to answer the interviewing questionnaire, so the researcher had to make more than one visit to be able to fill the questionnaire.

Among the strengths of this study is that the practice of the food handlers was observed rather than being self-reported. As well this study highlights the role of food hygienic practice in hospitals where nosocomial infections can occur through unsafe food hygiene practices and have detrimental effects on patients' health outcomes.

### CONCLUSION & RECOMMENDATIONS

It could be concluded that there is a significant effect of the intervention program on food safety practices among food handlers.

It is recommended therefore to conduct regular training courses to all food handlers as part of their continuous education. It is also recommended to ensure the regular supply of required equipment to ensure the ability to perform the required duties for food safety. There is also a need to ensure effective supervision of food handlers.

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**Conflict of Interest:** The authors declare that there was no conflict of interest.

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