



Hand Contamination among Food Handlers

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Authors' contributions

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ABSTRACT

Introduction: Food handlers act as a vehicle for microorganisms causing a potential risk to the public health. Hands contamination of food handlers can be used as an indicator of their behavior regarding food-related practice and personal hygiene.

Aim of the Study: To assess hand contamination among food handlers working in Menoufia University and Shebin Al-Kom Educational hospital kitchens and the effect of a health education session over them.

Subjects and Methods: A seventy two food handlers were the target group of this study. A pre-structured questionnaire was filled including socio-demographic data beside questions regarding risk factors for contamination and personal hygiene practices during dealing with food. Hand rinse sample was taken from each participant to detect the contaminants. A brief and simple health education session was held regarding personal hygiene practices. Three months later, the same kitchen was revisited to appraise the participants' hygiene compliance where another hand sample rinses were taken.

Results: Both *Staphylococcus Epidermidis* and *Escherichia coli* (41.7%) followed by *Staphylococcus aureus* (29.2%) were the prevalent organisms. A significant reduction in hand

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contamination was achieved after the interventional health education session. Being illiterate, ignoring hand wash after toilet or touching dirty materials and having long fingernails were the significant risk factors for hand contamination.

Recommendations: periodic interventions on food safety, proper hand washing procedures and good hygiene practices beside regular medical checkup are necessary to improve food handlers' hygiene practices.

Keywords: Hand contamination; food handlers; prevalence.

1. INTRODUCTION

Food handler is a person who works for a food business and handles food, regardless whether he prepares or serves it. They could transmit microorganisms to the food from their skin, nasal secretions, and bowel, also from the contaminated food prepared or served by them [1]. Food-borne illnesses have a dramatic impact in both developing and developed countries. The health status of the food handlers, their personal hygiene, knowledge and practice of food hygiene play an important role of food contamination [2].

The hands of food handlers are a major vehicle of food cross-contamination so that improved personal hygiene and hand washing would lead to the basic control of faeces-to-hand to-mouth spread of potentially pathogenic transient microorganisms [3].

Staphylococcus aureus, *Escherichia coli* survive on hands and surfaces for hours or even days after initial contact with the microorganisms. These microbes have been associated with food-borne illness for decades and they cause illness and even death to many people each year, an immeasurable economic cost and human suffering [4].

Many food-borne disease outbreaks are reported every year in Egypt. Numerous factors, contribute to this high number of incidents. However, it is important to note that most cases of food-borne disease are not reported, so the true extent of the problem is unknown [5]. In most countries of the region, the surveillance infrastructure for food-borne diseases of both microbiological and chemical etiology is weak or non-existent. This absence of reliable data on the burden of food-borne disease impedes understanding about its public health importance and prevents the development of risk based solutions to its management [6].

Medical and paramedical staffs, patients and their relatives were consuming food from the

hospital kitchen, so we should be aware of health status of hospital kitchen food handlers in order to prevent food borne diseases [7].

Studying the hand contamination among the food handlers could have great importance to understand the hygienic practices of food handlers. Hands contamination of food handlers can be used as an indicator of their behavior regarding food-related practice and personal hygiene. However this issue is not well studied in Egypt. So, this study aimed to assess hand contamination among food handlers working in Menoufia University and Shebin Al-Kom Educational hospital kitchens and the effect of a health education session over them.

2. SUBJECTS AND METHODS

An interventional study was carried out between June to December 2015, among 72 food handlers working in both Menoufia University and Shebin Al-Kom Educational hospital kitchens. Exclusion criteria were food handlers having skin inflammation, eczema or irritation. Response rate was 91% of all working food handlers. During the first visit, a face to face personal interview was done using a pre-structured questionnaire. The questionnaire contains data about socio-demographic characteristics of the studied group, questions regarding risk factors for contamination and personal hygiene practices during dealing with food (processing and/or serving). Before starting any meal preparation activity including hand washing (if any), participant's hands were sampled for microbial testing. Notification was not given in advance, and extra hand hygiene was not allowed during the hand rinse sample collection. A sterile polyethylene plastic bag technique (Stomacher@400 Classic; Seward, Worthing, UK) was employed to collect the hand rinse samples. Participants were asked to dip their hands into sterile polyethylene plastic bag containing 100 milliliter of buffered peptone water (0.1% BPW) (Difco/Becton Dickinson, Franklin Lakes, and NJ). The bag was grasped tightly around the participant's wrist and the Peptone

buffer was massaged through the wall of the bag by the investigator for one minute, over all surfaces of the participant's hand, particularly around the nails and palm. The bag was immediately sealed and transported to the educational hospital medical microbiology laboratory for examination; all media used in this study were from Oxoid Ltd [8].

Staphylococcus aureus, *Escherichia coli* and other pathogenic bacteria not usually found in skin flora were searched by using standard microbiological procedures. Briefly, *Staphylococcus aureus* was identified by colony morphology, hemolytic patterns on blood agar, Gram-staining characteristics, mannitol fermentation and slide and tube coagulase test. The various genera of enteric bacilli were differentiated and identified by colony morphology, Gram-staining characteristics, oxidase, and biochemical reactions on MacConkey agar [9].

Culture Medias were prepared based on the manufactures instruction. Then the sterility of culture media was checked by incubating 5% of the batch at 35 – 37°C overnight and observed for bacterial growth. Those Media which showed growth were discarded.

At the end of the same visit, a health education session for the food handler participants was held. This session emphasized on raising the awareness of food handlers towards most common food borne diseases, ways by which the microorganisms can be transmitted to food, proper hand washing techniques, personal hygiene practices and importance of both wearing gloves and nail trimming. The session was done by the help of a power point lecture, short video for proper hand washing technique and a poster for mode of microorganism transmission to food. Three months later, unexpectedly without prior notification, the kitchen was revisited. Another hand sampling rinses were taken by the same previous procedure to the previously examined workers. The aim of this second visit was to appraise the hygiene compliance of the same participants.

2.1 Ethical Consideration

The respective approvals of the review board and the ethics committee of the Menoufia Faculty of medicine were obtained before commencing the study. Agreement letters were taken from the

managers of Menoufia University and Shebin Al-Kom Educational hospitals. Study protocol and its benefits were explained to all participants, and a consent form was signed by each subject. All personal information about the study participants were kept confidential.

2.2 Data Management

Student's t-test for continuous quantitative parametric variables was used. Mann-Whitney test was used for continuous quantitative non parametric variables. Chi-squared test (χ^2) was used for categorical variables. Fisher exact test was used for categorical variables when the expected value was less than 5. Odds ratio (OR) together with the exact 95% confidence interval (95% CI) were used to study the crude relationship between hand contamination rate and associated risk factors. Comparisons of data were made with overall α error set at 0.05 (2-tailed). Analyses were conducted with SPSS v. 20 software (SPSS Inc, Chic ago, Ill).

3. RESULTS

Regarding socio-demographic characteristics of the food handlers, it was observed that male workers were the most prevalent (70.8%). More than half of the food handlers were illiterate (54.2%). The majority of the participants were rural dwellers (79.2%). Only 25% were cooks, another 25% were servers and the rest (50%) were cleaners (Table 1).

By observing the personal hygiene practices of the participants, it was observed that most of them were practicing incorrect personal hygiene. Only 16.7% of the studied food handlers were exposed to informal food hygiene training. One fifth of the responders were using hand gloves during working. Moreover, 27.8% were using their apron/hair ties. Studied participants were not paying a great attention to untrimmed fingernails (only 34.7% did). Those who wash their hands after toilet or after touching dirty materials represented 58.3% and 47.2%; respectively (Table 2).

Hand rinse samples of the studied food handlers at the first visit pre-intervention were positive for one or more food born bacterial hand contaminants, fungal contamination and/or enteric pathogens. Both *Staphylococcus Epidermidis* and *Escherichia coli* (41.7%) followed by *Staphylococcus aureus* (29.2%) were the prevalent organisms (Table 3).

Table 1. Socio-demographic characteristics of the studied food handlers (No=72)

Parameters	Frequency
Age (Mean± SD)	40.2±6.3
Years of work (Mean± SD)	7.3±4.0
Gender (No, %)	
*Male	51 (70.8)
*Female	21 (29.2)
Education (No, %)	
*Illiterate	33 (45.8)
*Basic & secondary education	39 (54.2)
Residence (No, %)	
*Rural	57 (79.2)
*Urban	15 (20.8)
Occupation (No, %)	
*Cookers	18 (25)
*Servers	18 (25)
*Cleaners	36 (50)

Table 2. Personal hygiene practices (N0=72)

Personal hygiene practices (correct)	No	%
Hand wash after toilet	42	58.3
Hand wash after touching dirty materials	34	47.2
Use of apron/hair tie	20	27.8
Use of hand gloves	15	20.8
Informal food hygiene training	12	16.7
Untrimmed fingernails	25	34.7

Table 3. Prevalence of organisms appeared in hand rinse sample pre-intervention (No=72)

Hand rinse results	No	%
<i>Staphylococcus aureus</i>	21	29.2
<i>Staphylococcus epidermidis</i>	30	41.7
<i>Staphylococcus citrus</i>	9	12.5
<i>Escherichia coli</i>	30	41.7
<i>Proteus</i>	3	4.2
<i>Klebsiella</i>	9	12.5
<i>Anthracooid</i>	9	12.5
<i>Candida</i>	15	20.8
Other fungal contamination	9	12.5

A significant reduction in the prevalence of organisms in hand rinse samples of the same workers was achieved after a simple interventional health education session on strict hand-washing after toilet and before food handling, nail trimming and wearing gloves during work (Fig. 1).

Regarding job position of food handlers, cleaners showed the highest prevalence of almost all

types of hand contaminants reaching a significant level for all except *Klebsiella* and *Anthracooid* (Table 4).

Being illiterate, ignoring hand wash after toilet or touching dirty materials and having long fingernails were significant risk factors for hand contamination with different pathogens (P value <0.05) (Table 5).

4. DISCUSSION

Food borne disease outbreaks continue to happen, despite the progress achieved in food quality and safety, the restricted research on food handlers and food handling practices in food establishments indicates that food handling problems need to be highlighted. Food handlers act as a vehicle for microorganisms causing a potential risk to the public health [10].

In this study 51(70.8%) of the studied food handlers were males. In contrast, Musa and Akande [11] showed that 98% of the food handlers were women. This is because food handling in Egypt is mainly a men occupation.

Almost all of the studied food handlers were of low educational levels (45.8% illiterate and 54.2% basic and secondary education) which made them unaware of food safety guidelines. Consequently, Prabhu and Shah [12], reported that food handlers could pose a potential risk to food safety due to their low educational background and hence, may have little or no understanding of the risks of microbial or chemical contamination of food or how to avoid them. In addition to low educational level, only 16.7% had attended informal food hygiene training courses, this means that the majority of the studied food handlers would not be aware of the practices to be followed during food processing.

In this study, 50% of the participants' hands were contaminated with one or more potentially food borne contaminants before the intervention. The most prevalent contaminants were both *Escherichia coli* and *Staphylococcus epidermidis* (41.7%, for each), followed by *Staphylococcus aureus* (29.2%), then *candida* (20.8%) and *Klebsiella* (12.5%). The same type of contaminants was identified by Fawzi et al. [5], in Alexandria, Egypt (31% *Staphylococcus aureus* and 13.8% *Escherichia coli*) and Zagloul et al. [13], in Makkah, Saudi Arabia (17.5% *Staphylococcus aureus*).

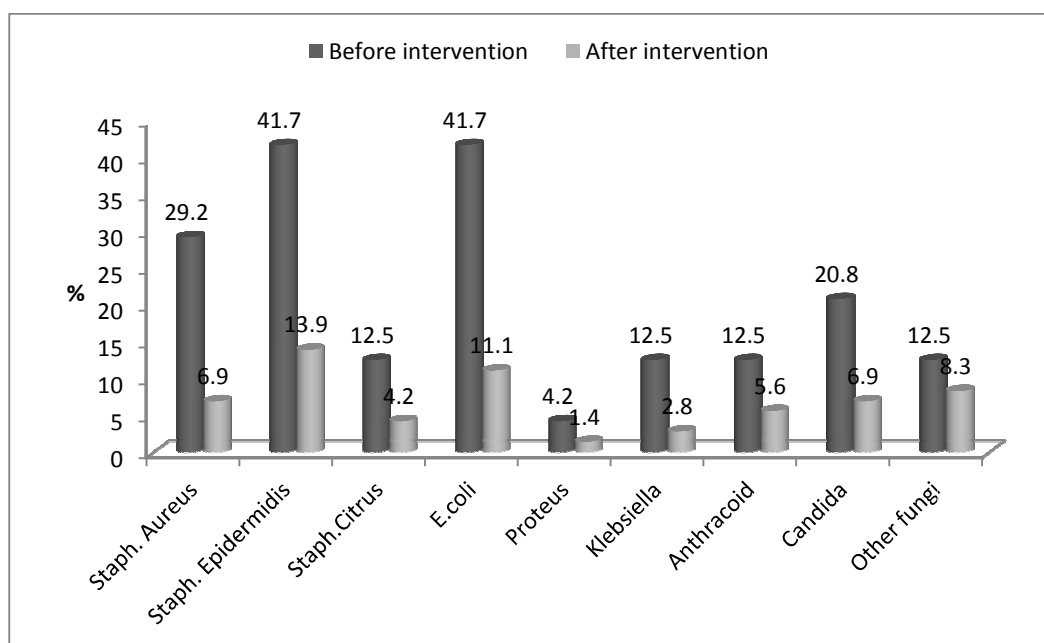


Fig. 1. Comparison between hand rinse results before and after intervention education session

Table 4. Comparison between food handlers regarding hand rinse contaminant results

Hand rinse results	Cookers no =18	Servers no =18	Cleaners no =24	P value
<i>Staphylococcus aureus</i> (n=21)	0 (0)	9 (42.9)	12 (57.1)	<0.01
<i>Staphylococcus epidermidis</i> (n=30)	3 (10)	6 (20)	21 (70)	<0.01
<i>Staphylococcus citrus</i> (n=9)	0	0	9 (100)	<0.01
<i>Escherichia coli</i> (n=30)	9 (30)	3 (10)	18 (60)	<0.05
<i>Proteus</i> (n=9)	0	0	3 (100)	<0.01
<i>Klebsiella</i> (n=9)	3 (33.3)	3 (33.3)	3 (33.3)	>0.05
<i>Anthracoid</i> (n=9)	3 (33.3)	3 (33.3)	3 (33.3)	>0.05
<i>Candida</i> (n=15)	0	3 (20)	12 (80)	<0.01
Other fungi (n=12)	0	3 (25)	9 (75)	<0.01

Staphylococcus epidermidis is a commensal inhabitant of human skin that rarely causes disease in healthy persons. In recent years, *Staphylococcus epidermidis* has emerged as a major nosocomial pathogen [14].

In the present study *Staphylococcus aureus* were isolated from 29.2% of the studied food handlers' hands. This figure is comparable to that mentioned by Assefa et al. [15], in Ethiopia which was 23.5% and Bustan et al. [16], in Kuwait city of being 26.6%. However, it is higher than that found by Shojaei et al. [17], in Iran of being 13.3%. The discrepancy in socioeconomic status, type of food establishment and lack of personal hygiene between the studied group in this study and others may be the explanation. Toxine-producing strains of *Staphylococcus aureus* are the leading cause of gastroenteritis

following handling of food by persons who carry and transmit them to food during improper hygiene practices like poking fingers into nose [18].

Escherichia coli is considered one of the enteric pathogens that are believed to be capable of being transmitted by food workers. The most prevalent contaminant isolated from the studied group was *Escherichia coli* (41.7%). This prevalence is much higher than the reported prevalence by Assefa et al. [15], in Ethiopia and Shojaei et al. [17], in Iran (10.9% and 22%; respectively). This result which reflects hand contamination with fecal matter pointed to inadequate and poor hand washing habits among those Egyptian studied group than other nationality as well as the different used methods of contaminant detection.

Table 5. Hand contamination and associated risk factors among the studied food handlers

Risk factors	Hand contamination		P-value	Odd's ratio
	Present no=36	Absent no=36		
Gender				
Male	27 (52.9)	24 (47.1)	0.61	1.5 (0.54-4.18)
Female	9 (42.9)	12 (57.1)		
Education				
Illiterate	21 (63.7)	12 (36.3)	0.05	2.8 (1.07-7.30)
Basic & secondary education	15 (38.5)	24 (61.5)		
Residence				
Rural	30 (52.6)	27 (47.4)	0.56	1.67 (0.52-5.29)
Urban	6 (40.0)	9 (60.0)		
Hand wash after toilet				
Yes	8 (19.1)	34 (80.9)	<0.001	0.02 (0-0.09)
No	28 (93.3)	2 (6.7)		
Hand wash after touching dirty materials				
Yes	10 (29.4)	24 (70.6)	<0.001	0.19 (0.07-0.53)
No	26 (68.4)	12 (31.6)		
Use of apron/hair tie				
Yes	9 (45.0)	11 (55.0)	0.59	0.76 (0.27-2.13)
No	27 (51.9)	25 (48.1)		
Use of hand gloves				
Yes	5 (33.3)	10 (66.7)	0.15	0.42 (0.13-1.38)
No	31 (54.4)	26 (45.6)		
Informal food hygiene training				
Yes	4 (33.3)	8 (66.7)	0.13	0.38 (0.10-1.39)
No	32 (57.1)	24 (42.9)		
Untrimmed fingernails				
Yes	20 (80.0)	5 (20.0)	<0.001	7.75 (2.45-24.5)
No	16 (34.0)	31 (66.0)		

The frequency of *Escherichia coli* isolated from workers hands significantly decreased after interventional health education session to 11.1% after training them simply the practice of proper hand washing after toilet and/or touching dirty materials. This demonstrates that this organism is easily controlled by proper hand washing which emphasis the real need to continuous training over personal hygiene and related practices.

There was significant association between hand contamination rate and low educational level ($P < 0.05$, $OR = 2.8$). This could be attributed to ignorance of safety instructions and noncompliance to hygienic practice. A protective factor for hand contamination was found to be hand washing after toilet and touching dirty

materials (P value < 0.05 , $OR = 0.2$, 0.19 ; respectively).

5. CONCLUSION

The findings of this study emphasized the role of food handlers' hands as potential vector of food borne bacterial pathogens transmission that could constitute a potential risk of food borne disease outbreaks.

6. LIMITATION OF THE STUDY

One potential limitation of our study includes small sample size of food handlers working in the kitchens of Educational and University hospitals. Although the hygiene of the studied food handlers in both hospitals is a representative sample of the hygiene hospital's food handlers,

but increasing the sample size in further studies could clarify more data. Another limitation is the lack of sufficient funding to include viral and parasitic pathogenic isolation from the hands of food handlers.

7. RECOMMENDATIONS

It is recommended that local health authorities should implement continuous interventions such as food handler's training courses on food safety and good hygiene practices periodically beside regular medical checkup. Proper hand washing procedures as well as healthy environment in the form of availability of posters for this procedure and antiseptic solution in the kitchen for food handlers is necessary to improve hygiene practices.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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