



Food safety knowledge and practices among Saudi women



Mohamed F. Farahat ^{a,*}, Mona M. El-Shafie ^a, Mostafa I. Waly ^b

^a Department of Community Health Sciences, College of Applied Medical Sciences, King Saud University, Riyadh, Kingdom of Saudi Arabia

^b Department of Food Science and Nutrition, College of Agricultural and Marine Sciences, Sultan Qaboos University, Oman

ARTICLE INFO

Article history:

Received 23 April 2014

Received in revised form

16 July 2014

Accepted 23 July 2014

Available online 1 August 2014

Keywords:

Food safety knowledge

Food safety practices

Food handling

Food poisoning

ABSTRACT

The present cross sectional study was conducted on 811 Saudi women to evaluate their food safety knowledge and practices and explore factors affecting them. They reported better food safety practices than knowledge in overall food safety and all parameters except cooking. Personal hygiene was the parameter where they reported higher mean knowledge and practice (63.4% and 73.8%; respectively) with the lowest mean knowledge score in utensils and equipment (49.8%) whereas the lowest mean practice (60.2%) was in cooking. Saudi women with higher studies and those with 60 years and more showed higher mean knowledge and practice score in overall food safety and most parameters than those in other educational levels or age groups with significant variations ($P < 0.05$) among different educational levels except in practicing personal hygiene. Working women showed higher mean knowledge and practice than non working in all parameters with significant variation between their mean knowledge scores except in personal hygiene. Launching a food safety education program and repeating it at specific intervals is recommended.

© 2014 Published by Elsevier Ltd.

1. Introduction

In the developing world, foodborne illness causes an estimated 2.2 million deaths each year, of which 1.9 million are children (WHO/FAO, 2005). About 40% of foodborne illness occurred in home so cases are less likely to be reported (WHO/FAO, 2002). Most cases of foodborne illness are preventable if food protection principles are followed from production to consumption. Given that it is currently impossible for food producers to ensure a pathogen free food supply, the home food preparer is a critical link in the chain to prevent foodborne illness. Several studies in various countries have revealed that consumers have inadequate food safety knowledge and/or practices and most of them reported gaps between their food safety knowledge and practices. (Albrecht, 1995; Bruhn & Schutz, 1999; Fawzi & Shama, 2009; Jay, Comar, & Govenlock, 1999; Mederios, Hillers, Kendall, & Mason, 2001; Redmond & Griffith, 2003; Unusan, 2007).

Although the public is increasingly concerned about food-related risks, the rise in food poisoning cases suggests that people still make decisions of food consumption, food storage and food preparation that are less ideal from a health and safety perspective (McCarthy et al., 2007). Studies have estimated that between 50 and 87% of reported foodborne disease outbreaks have been associated with

the home (Fawzi, 1999; Fawzi & Shama, 2009; Raspor, Jevšnik, & Hlebec, 2006; Redmond & Griffith, 2003; Scott, 1996). These studies have uncovered a lack of food safety knowledge and the need to promote food safety behaviors (Jevšnik, Hoyer, & Raspor, 2008).

Most of the work during the last few years has centred on hazard control in the production sector, but an equal effort was not dedicated to improving the food safety education of consumers (Garayoa, Cordoba, Garcia-Jalon, Sanchez-Villegas, & Vitas, 2005). The need for enhanced food safety education started to be recognized in developed countries with the launch of national initiatives to find ways to educate consumers effectively (Haapala & Probart, 2004).

To the best of our information, there is no national education program in Kingdom of Saudi Arabia to enhance food safety knowledge and practices among home food preparers. Obtaining information on food safety knowledge and practices is essential for the development of effective health education programs in an attempt to reduce the risks associated with improper food handling at home. So, the aim of this study was to evaluate food safety knowledge and practices among Saudi women and explore factors affecting them.

2. Materials and methods

2.1. Subjects selection and recruitments

The present cross sectional study was conducted from October 2011 till June 2012 on 811 Saudi women responsible for food

* Corresponding author. Tel.: +966 55 6218488; fax: +966 114693502.

E-mail addresses: mohamedfawzi_high@yahoo.com, mffarahat@ksu.edu.sa (M.F. Farahat).

preparation for 4625 family members in four provinces of the Kingdom of Saudi Arabia (East, Middle, South and West province).

2.2. Data collection

The research data was collected using a food safety questionnaire of [Fawzi and Shama \(2009\)](#) after its pilot testing and modification to be compatible with the Saudi Community. The questionnaire included questions on demographic characteristics and questions on food safety knowledge and practices that were included under five parameters as follow:-

2.2.1. Questions on food safety knowledge

2.2.1.1. Purchasing and storage

- Raw food of animal origin should be displayed in chillers (**True/False/don't know**)
- Frozen food should be displayed in freezers (**True/False/don't know**)
- Fresh fish should be displayed in ice (**True/False/don't know**)
- Grossly unspoiled food can cause food poisoning (**True/False/don't know**)
- Firstly purchased food should be consumed first (**True/False/don't know**)
- Hot food should not be stored hot in chillers (**True/False/don't know**)
- Opened long life milk should be stored in chillers (**True/False/don't know**)
- Duplication time of food poisoning microorganisms under optimum condition is 10–30 min (**True/False/don't know**)
- Microbial growth is faster in summer than winter (**True/False/don't know**)
- Microbial growth is faster at room temperature than in refrigerators (**True/False/don't know**)
- Microorganisms can not be destroyed in chillers (**True/False/don't know**)
- Microorganisms can not be destroyed in freezers (**True/False/don't know**)

2.2.1.2. Food preparation

- Causes of food poisoning:
 - Keeping prepared salad at room temperature (**True/False/don't know**)
 - Thawing frozen food at room temperature (**True/False/don't know**)
 - Thawing and refreezing of frozen food (**True/False/don't know**)
 - Using the same cutting boards for raw and cooked food (**True/False/don't know**)

2.2.1.3. Food cooking

- It is safer to cook food quantities sufficient for one day (**True/False/don't know**)
- Prepared food should not be kept for >4 h outside the chillers (**True/False/don't know**)
- Causes of food poisoning:
 - Inadequately boiled milk (**True/False/don't know**)
 - Raw or half cooked food of animal origin (**True/False/don't know**)
 - Inadequately reheated cooked food (**True/False/don't know**)

2.2.1.4. Personal hygiene

- Food handling should be avoided during illness (**True/False/don't know**)
- Cooked food should not be tasted by fingers or unclean spoons (**True/False/don't know**)
- To prepare safe food, hands should be:
 - Properly cleaned (**True/False/don't know**)
 - Free of wounds (**True/False/don't know**)
 - With short and clean nails (**True/False/don't know**)
 - Unvarnished (**True/False/don't know**)
- Sources of food contamination with food poisoning microorganisms:
 - Diseased persons (**True/False/don't know**)
 - Apparently health persons (**True/False/don't know**)

2.2.1.5. Utensils and equipment

- Inadequately cleaned and sanitized utensils and equipment can be a source of food poisoning microorganisms (**True/False/don't know**)
- Stainless steel is among the safest food contact surfaces (**True/False/don't know**)

2.2.2. Questions on food safety practices

2.2.2.1. Purchasing and storage

- Reading expiry date before purchasing (**Often/sometimes/no**)
- Purchasing food of animal origin displayed refrigerated (**Often/sometimes/no**)
- Firstly purchased food are consumed first (**Often/sometimes/no**)
- Avoiding storage of cooked food while still hot in chillers (**Often/sometimes/no**)

2.2.2.2. Food preparation

- Washing of salad vegetables (under running water/soaking in water/soaking in water with lemon or vinegar/soaking in water with potassium permanganate)

- Thawing of frozen food of animal origin (**Oftentimes/sometimes/no**)
- Thawing frozen food of animal origin is usually done (In the chiller/Over the kitchen counter/under running water/by soaking in water/during cooking of small pieces)
- Not refreezing of thawed frozen food (**Oftentimes/sometimes/no**)
- Using separate or the same but properly cleaned cutting boards between raw and cooked food (**Oftentimes/sometimes/no**)

2.2.2.3. Food cooking

- Not consuming raw food of animal origin (**Oftentimes/sometimes/no**)
- Not consuming half cooked food of animal origin (**Oftentimes/sometimes/no**)
- Checking adequacy of food cooking by (examining the texture by a fork/tasting/examining internal and external color changes/using thermometer)
- Not leaving cooked food in the kitchen till eating for more than four hrs (**Oftentimes/sometimes/no**)
- Cooking of food in quantities sufficient for less than three days (**Oftentimes/sometimes/no**)
- Avoiding storing of cooked and leftover foods in the chillers for more than three days (**Oftentimes/sometimes/no**)
- Adequate reheating of foods (**Oftentimes/sometimes/no**)
- Reheating of a portion sufficient for a meal (**Oftentimes/sometimes/no**)

2.2.2.4. Personal hygiene

- Avoiding food preparation while ill (**Oftentimes/sometimes/no**)
- Washing of hands using warm water and soap (**Oftentimes/sometimes/no**)
- Rubbing of fingers' tips, between fingers and the wrist during hand washing (**Oftentimes/sometimes/no**)
- Hand washing before food preparation (**Oftentimes/sometimes/no**)
- Hand washing after using the WC (**Oftentimes/sometimes/no**)
- Hand drying using (**special towels/disposable tissues**)
- Avoiding tasting of cooked food by fingers or unclean spoons (**Oftentimes/sometimes/no**)
- Avoiding tasting of cooked food by inserting the same spoon several times (**Oftentimes/sometimes/no**)

2.2.2.5. Utensils and equipment

- Cleaning of food utensils and equipment using (**tap water/tap water and detergent/warm water and detergent**)
- Sterilizing food utensils and equipment (**Oftentimes/sometimes/no**)
- Sterilizing food utensils and equipment using (**chlorine/steam/others**)
- Drying food utensils and equipment (**Oftentimes/sometimes/no**)
- Drying food utensils and equipment by (**special towel/disposable tissue/inverting them**)

Each knowledge question has only one right answer and scored one if the answer was correct otherwise zero. Questions on food safety practices had either 3 or 4 responses and scored from 0 to either 2 or 3 respectively with higher scores for better practices. The total score of the overall food safety knowledge and practice was calculated by summing the scores of its five parameters. Cronbach alpha coefficient of internal consistency was used to estimate the reliability of the questionnaire. Alpha coefficient was =0.758.

2.3. Statistical analysis

Data was statistically analyzed using SPSS program version 14.0. The cutoff point for statistical significance was P value < 0.05 and all tests were two-sided. One way ANOVA was used to test significant variations in the mean scores of food safety knowledge and practices and their parameters among different educational levels, age groups, locations, working status. Tukey's test was used in conjunction with an ANOVA to find means that are significantly different from each other. Mann Whitney was used to test significant variations between knowledge and practice mean scores (Streiner & Norman, 1995, pp. 104–143).

3. Results

A total of 811 Saudi women with a mean age of 25.1 years \pm 9.6 were interviewed during the present study who were responsible for preparing the foods for 4625 family members with a mean age of 22.3 years \pm 14.9. The educational level of about 80% of the interviewed women was secondary and Bachelor, moreover, 72.6% of them were from the middle province and 72.4% not working. Exploring food safety knowledge and practices of these 811 women revealed that their practices were better than their knowledge concerning overall food safety and all parameters except cooking where more or less similar means were reported. Personal hygiene was the parameter where they reported higher mean knowledge and practice (63.4% and 73.8%; respectively) while the lowest mean knowledge was in utensils and equipment (49.8%) and cooking had the lowest mean practice (60.2%) (Table 1).

3.1. Food safety and age

The mean knowledge and practice scores showed insignificant variations ($P > 0.05$) among different age groups in all parameters except in overall food safety practice. Women with 60 years and more showed higher mean knowledge and practice score in the overall food safety and most parameters (Table 1). There were significant positive correlations ($P < 0.05$) between overall food

Table 1
Food safety Knowledge and practices scores (Mean \pm SD) among Saudi women with different ages.

Age (years)	NO (%)	Food safety Knowledge (practices)					
		Purchasing and storage	Preparation	Cooking	Utensils and equipment	Personal hygiene	Overall
10–	14 (1.7)	62.1 \pm 11.1 (75.7 \pm 10.2)	64.3 \pm 30.6 (62.6 \pm 17.0)	62.5 \pm 27.3 (59.2 \pm 11.9)	50.0 \pm 51.9 (75.0 \pm 13.1)	62.7 \pm 18.8 (70.5 \pm 18.4)	62.2 \pm 9.7 (67.0 \pm 7.4)
<i>P</i> value*		0.000	0.610	0.852	1.000	0.310	0.153
20–	257 (31.7)	61.5 \pm 16.0 (68.7 \pm 14.5)	55.2 \pm 31.1 (61.4 \pm 15.4) ^a	59.5 \pm 26.0 (60.0 \pm 9.5)	48.2 \pm 50.1 (71.9 \pm 19.1)	63.0 \pm 15.9 (72.7 \pm 14.4)	60.4 \pm 12.7 (66.0 \pm 7.9) ^a
<i>P</i> value*		0.000	0.000	0.832	0.042	0.000	0.000
30–	5.3 (30.3)	63.1 \pm 17.4 (69.4 \pm 14.4)	57.5 \pm 32.8 (64.9 \pm 15.7) ^a	59.8 \pm 29.2 (61.0 \pm 9.4)	48.8 \pm 50.1 (74.7 \pm 18.4)	63.6 \pm 15.8 (75.6 \pm 13.1)	61.6 \pm 14.8 (68.1 \pm 7.8) ^a
<i>P</i> value*		0.000	0.000	0.832	0.042	0.000	0.000
40–	225 (27.7)	62.3 \pm 17.4 (68.5 \pm 15.0)	57.6 \pm 33.4 (63.9 \pm 15.1)	62.6 \pm 27.5 (59.4 \pm 9.2)	51.1 \pm 50.1 (73.3 \pm 18.8)	63.2 \pm 16.2 (73.2 \pm 15.2)	61.6 \pm 14.4 (66.6 \pm 8.3)
<i>P</i> value*		0.000	0.106	0.017	0.806	0.000	0.000
50–	63 (7.8)	63.1 \pm 15.0 (72.1 \pm 13.6)	59.9 \pm 32.5 (65.3 \pm 18.6)	58.3 \pm 29.1 (61.0 \pm 10.0)	54.0 \pm 50.2 (72.4 \pm 18.9)	64.7 \pm 15.7 (72.8 \pm 16.8)	62.3 \pm 12.4 (67.6 \pm 8.7)
<i>P</i> value*		0.000	0.439	0.939	0.484	0.003	0.003
60+	6 (0.7)	64.1 \pm 14.3 (75.0 \pm 8.4)	66.7 \pm 25.8 (65.4 \pm 19.9)	70.8 \pm 29.2 (64.6 \pm 12.3)	66.7 \pm 51.6 (79.2 \pm 18.1)	63.0 \pm 20.7 (84.4 \pm 11.0)	65.1 \pm 14.2 (72.7 \pm 8.7)
<i>P</i> value*		0.142	0.747	0.505	0.505	0.036	0.334
Total	811 (100.0)	62.4 \pm 16.6 (69.3 \pm 14.5)	57.2 \pm 32.3 (63.5 \pm 15.8)	60.5 \pm 27.7 (60.2 \pm 9.5)	49.8 \pm 50.0 (73.3 \pm 18.7)	63.4 \pm 16.0 (73.8 \pm 14.6)	61.3 \pm 13.8 (67.0 \pm 8.1)
<i>P</i> value*		0.000	0.000	0.088	0.471	0.000	0.000
<i>P</i> value**	Knowledge	0.929	0.745	0.696	0.899	0.985	0.840
	Practices	0.214	0.187	0.381	0.601	0.079	0.030

* Mann Whitney *P* value (in italics).

** ANOVA *P* value.

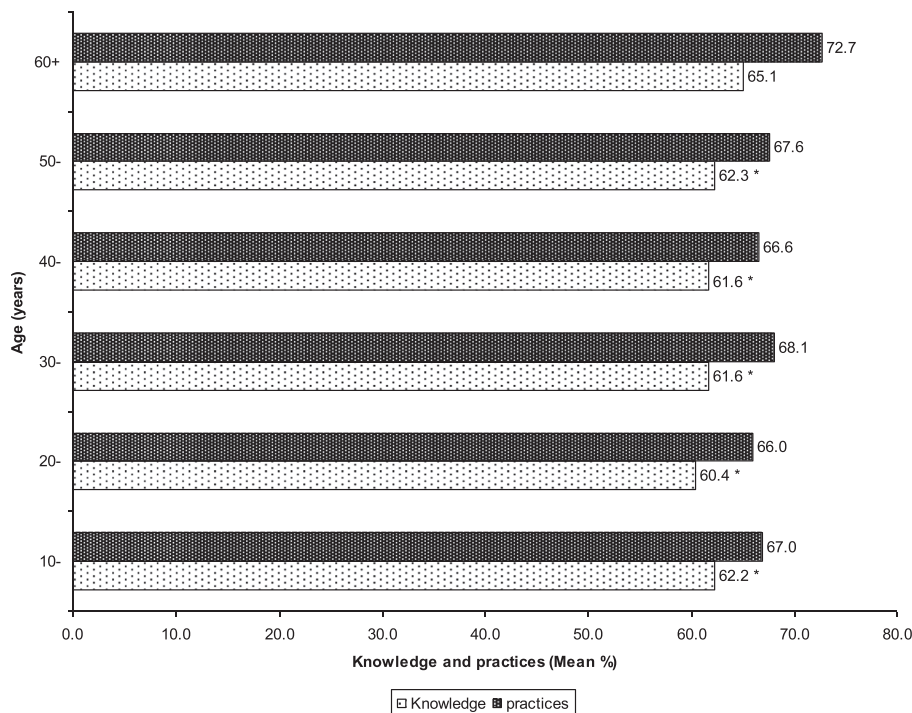
The difference between cells with the same letter within the same column is significant.

safety knowledge and practices in age groups except in 10–19 years and 60 years and over age groups (Fig. 1).

3.2. Food safety and educational level

Saudi women with higher studies had the highest mean food safety knowledge and practices in all parameters except the practice of purchasing and storage where those with primary and

preparatory education showed insignificantly higher mean (70.8 \pm 13.8). There were significant variations ($P < 0.05$) among different educational levels in both knowledge and practices of food preparation and overall food safety but only in practicing personal hygiene. Women in all educational levels showed higher mean practices than knowledge in all parameters except cooking in most educational levels, preparation and overall food safety in women with higher studies; and personal hygiene in illiterate/read and



* Significant positive correlations between knowledge and practices ($P < 0.05$)

Fig. 1. Overall Food safety Knowledge and practices (Mean %) among Saudi women with different ages.

Table 2
Food safety Knowledge and practices scores (Mean \pm SD) among Saudi women with different educational levels.

Education	NO (%)	Food safety Knowledge (practices)					
		Purchasing and storage	Preparation	Cooking	Utensils and equipment	Personal hygiene	Overall
Illiterate/read and write	22 (2.7)	58.7 \pm 22.9 (65.5 \pm 15.3)	45.5 \pm 35.9 a (55.2 \pm 14.8) ^{ef}	60.2 \pm 25.2 (58.9 \pm 8.0)	40.9 \pm 50.3 (67.0 \pm 21.6)	66.2 \pm 13.0 (63.9 \pm 17.6) ^{abc}	58.8 \pm 15.9 (61.5 \pm 9.4) ^{abc}
<i>P value*</i>		0.423	0.210	0.739	0.292	0.777	0.541
Primary & preparatory	134 (16.5)	62.0 \pm 16.0 (70.8 \pm 13.8)	57.1 \pm 33.0 b (62.5 \pm 17.7)	58.6 \pm 29.4 (58.5 \pm 10.6)	53.0 \pm 50.1 (72.3 \pm 19.3)	61.9 \pm 17.8 (72.9 \pm 14.2)	60.6 \pm 14.0 (66.1 \pm 8.5)
<i>P value*</i>		0.000	0.193	0.984	0.527	0.000	0.000
Secondary	331 (40.8)	61.8 \pm 16.2 (69.7 \pm 15.2)	55.8 \pm 32.6 ^c (63.5 \pm 14.5)	59.7 \pm 27.1 (60.6 \pm 9.2)	48.0 \pm 50.0 (73.7 \pm 18.5)	62.2 \pm 16.3 (73.9 \pm 14.7) ^a	60.4 \pm 13.4 (67.2 \pm 7.7) ^a
<i>P value*</i>		0.000	0.002	0.828	0.198	0.000	0.000
Bachelor	312 (38.5)	63.2 \pm 17.0 (68.5 \pm 13.8)	58.3 \pm 31.3 ^d (64.3 \pm 16.0) ^f	61.7 \pm 27.5 (60.5 \pm 9.4)	50.6 \pm 50.1 (73.5 \pm 18.2)	64.8 \pm 15.1 (74.6 \pm 14.1) ^b	62.4 \pm 13.9 (67.3 \pm 8.0) ^b
<i>P value*</i>		0.000	0.010	0.032	0.997	0.000	0.000
Higher studies	12 (1.5)	67.9 \pm 10.3 (68.3 \pm 18.0)	87.5 \pm 16.9 ^{abcd} (71.8 \pm 17.5) ^e	72.9 \pm 32.8 (63.5 \pm 8.5)	58.3 \pm 51.5 (79.2 \pm 22.0)	69.4 \pm 9.6 (78.1 \pm 15.7) ^c	71.2 \pm 9.8 (71.2 \pm 9.9) ^c
<i>P value*</i>		0.449	0.074	0.078	0.928	0.115	0.954
<i>P value**</i>		Knowledge 0.466 Practices 0.367	0.006 0.028	0.082 0.139	0.721 0.373	0.082 0.013	0.028 0.003

* Mann Whitney *P* value (in italics).

** ANOVA *P* value.

The difference between cells with the same letter within the same column is significant.

write women (Table 2). There were significant positive correlations ($P < 0.05$) between overall food safety knowledge and practices in all educational levels except in women with higher studies where there were similar means (71.2) with insignificant correlation (Fig. 2).

3.3. Food safety and location

The mean knowledge scores of overall food safety and all parameters showed significant variations ($P < 0.05$) among women from different locations except in utensils and equipment

parameter whereas their mean practice score showed insignificant variations among locations except in personal hygiene parameter (Table 3). There were significant positive correlations ($P < 0.05$) between overall food safety knowledge and practices in all locations except in south province (Fig. 3).

3.4. Food safety and working status

Working Saudi women showed higher mean knowledge and practice than non working in overall food safety and all

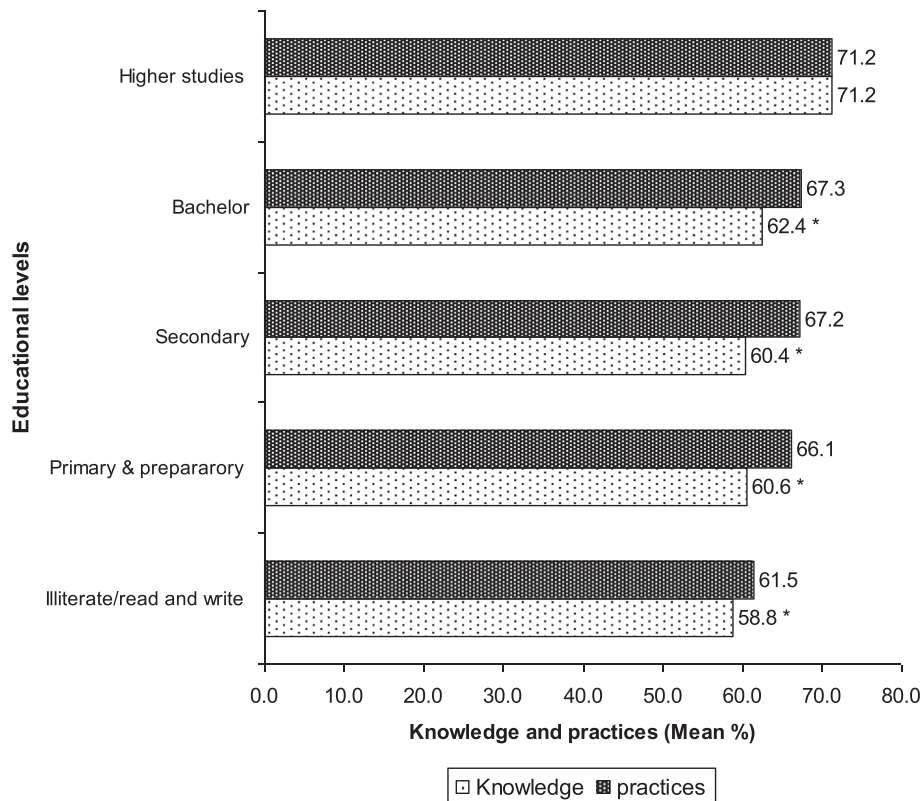


Fig. 2. Overall Food safety Knowledge and practices (Mean %) among Saudi women with different educational levels.

Table 3
Food safety Knowledge and practices scores (Mean \pm SD) among Saudi women in different provinces.

Provinces	NO (%)	Food safety Knowledge (practices)					Overall
		Purchasing and storage	Preparation	Cooking	Utensils and equipment	Personal hygiene	
East	100 (12.3)	59.5 \pm 16.3 ^{ab} (69.2 \pm 13.9)	63.0 \pm 29.0 (65.8 \pm 15.8)	58.3 \pm 26.6 ^{cd} (59.2 \pm 9.1)	59.0 \pm 49.4 ^a (72.2 \pm 19.5)	66.7 \pm 16.6 ^a (73.5 \pm 13.7)	61.9 \pm 12.9 (66.8 \pm 8.1)
<i>P value*</i>		<i>0.000</i>	<i>0.588</i>	<i>0.676</i>	<i>0.036</i>	<i>0.000</i>	<i>0.002</i>
Middle	589 (72.6)	61.9 \pm 16.5 (69.1 \pm 14.3)	55.0 \pm 32.9 (63.2 \pm 15.7)	58.8 \pm 27.8 ^{ab} (60.2 \pm 9.5)	49.2 \pm 50.0 (73.4 \pm 18.5)	62.2 \pm 15.9 ^a (74.6 \pm 14.1) ^b	60.3 \pm 13.8 ^{ab} (67.1 \pm 7.8)
<i>P value*</i>		<i>0.000</i>	<i>0.000</i>	<i>0.813</i>	<i>0.320</i>	<i>0.000</i>	<i>0.000</i>
South	29 (3.6)	69.0 \pm 18.4 ^b (73.1 \pm 11.7)	68.1 \pm 28.3 (61.5 \pm 17.6)	75.9 \pm 20.6 ^{bd} (60.5 \pm 8.8)	31.0 \pm 47.1 ^a (73.3 \pm 17.9)	67.0 \pm 12.1 (72.4 \pm 15.8)	68.0 \pm 14.4 ^a (66.9 \pm 9.4)
<i>P value*</i>		<i>0.545</i>	<i>0.288</i>	<i>0.000</i>	<i>0.011</i>	<i>0.119</i>	<i>0.085</i>
West	93 (11.5)	66.6 \pm 16.6 ^a (69.4 \pm 17.0)	61.0 \pm 31.4 (64.0 \pm 15.3)	68.5 \pm 27.6 ^{ac} (61.2 \pm 10.3)	49.5 \pm 50.3 (73.9 \pm 19.2)	65.9 \pm 16.4 (69.4 \pm 16.9) ^b	65.4 \pm 13.5 ^b (66.6 \pm 9.1)
<i>P value*</i>		<i>0.142</i>	<i>0.715</i>	<i>0.009</i>	<i>0.700</i>	<i>0.062</i>	<i>0.523</i>
<i>P value**</i>	Knowledge	0.003	0.014	0.000	0.056	0.011	0.000
	Practices	0.549	0.389	0.543	0.924	0.012	0.939

* Mann Whitney *P* value (in italics).

** ANOVA *P* value.

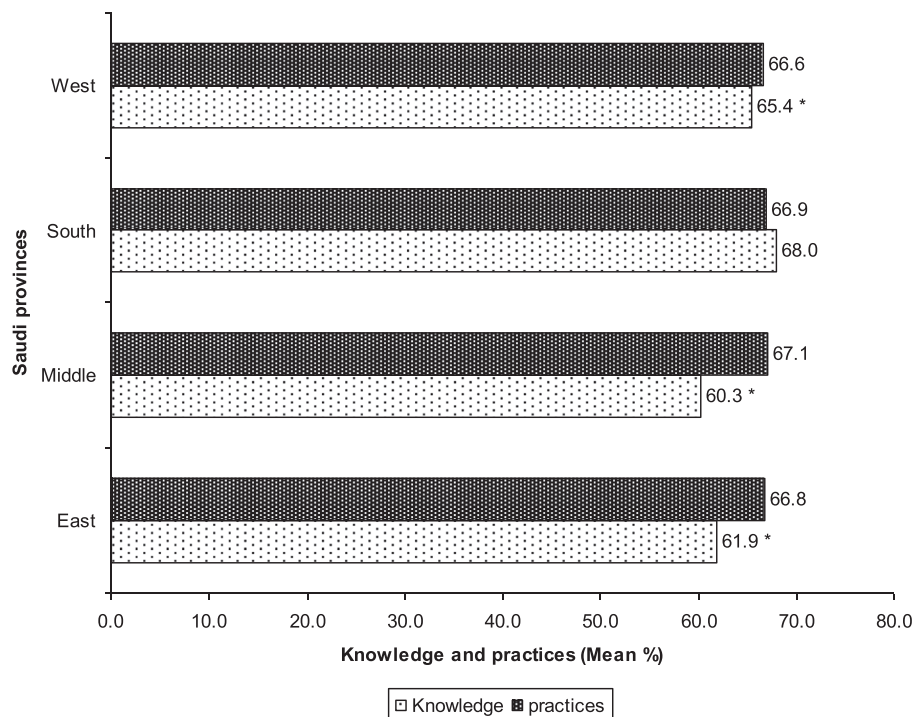
The difference between cells with the same letter within the same column is significant.

parameters. The variations between their mean knowledge scores were significant ($P < 0.05$) except in personal hygiene while variations in the practice scores were insignificant ($P > 0.05$) except in overall food safety (Table 4). There were significant positive correlations ($P < 0.05$) between overall food safety knowledge and practices in both working and non working women (Fig. 4).

4. Discussion

Food handlers seem to think that they know how to handle food safely, but their self-reported food handling behaviors do not support this confidence (Fawzi & Shama, 2009; Gettings & Kiernan, 2001; Redmond & Griffith, 2003). The present study revealed gaps

between food safety knowledge and practices that were significant in most parameters among Saudi women with secondary and bachelor education, from East and Middle provinces, in the age groups 20-, 30- and 40-years as well as among both working and non working women. Better food safety practices indicating that some women used to do the right practices although their knowledge was deficient. Even the personal hygiene where the interviewed women reported better knowledge and practice, its score needs further improvements. This necessitates launching a food safety training program from the responsible authorities emphasizing all studied food safety parameters. Motivation for proper food handling practices requires that the consumer view the mishandling of food as a direct threat to their health (Schafer, Schafer, Bultena, & Hoiberg, 1993).



* Significant positive correlations between knowledge and practices ($P < 0.05$)

Fig. 3. Overall Food safety Knowledge and practices (Mean %) among Saudi women in different provinces.

Table 4Food safety Knowledge and practices scores (Mean \pm SD) among working and non working Saudi women.

Working	NO (%)	Food safety Knowledge (practices)					
		Purchasing and storage	Preparation	Cooking	Utensils and equipment	Personal hygiene	Overall
Yes	224 (27.6)	64.7 \pm 14.1 (70.2 \pm 13.2)	61.9 \pm 29.8 (64.8 \pm 15.9)	65.4 \pm 25.4 (61.1 \pm 8.9)	55.8 \pm 49.8 (74.2 \pm 18.8)	64.0 \pm 14.8 (74.6 \pm 13.8)	64.0 \pm 11.9 (67.9 \pm 7.8)
<i>P value*</i>		<i>0.000</i>	<i>0.351</i>	<i>0.000</i>	<i>0.053</i>	<i>0.000</i>	<i>0.000</i>
No	587 (72.4)	61.5 \pm 17.5 (68.9 \pm 14.9)	55.3 \pm 33.0 (63.1 \pm 15.7)	58.6 \pm 28.3 (59.9 \pm 9.7)	47.5 \pm 50.0 (72.9 \pm 18.6)	63.1 \pm 16.4 (73.5 \pm 14.8)	60.4 \pm 14.3 (66.6 \pm 8.1)
<i>P value*</i>		<i>0.000</i>	<i>0.000</i>	<i>0.832</i>	<i>0.042</i>	<i>0.000</i>	<i>0.000</i>
<i>P value**</i>	Knowledge	0.014	0.009	0.002	0.035	0.469	0.001
	Practices	0.254	0.159	0.104	0.373	0.344	0.040

* Mann Whitney *P* value (in italics).** ANOVA *P* value.

4.1. Food safety knowledge and practices concerning purchasing and storage

Practicing of the interviewed women to food safety during their purchasing and storage was better than their knowledge in most educational levels, age groups, locations, working and non working women with significant variations ($P < 0.05$) only in their knowledge among different locations and working status. This indicates that some women used to do the right practices although their knowledge was deficient which may be attributed to the safety measures installed in the majority of hypermarkets where most of the Saudi families usually purchase their food that is displayed under safe conditions.

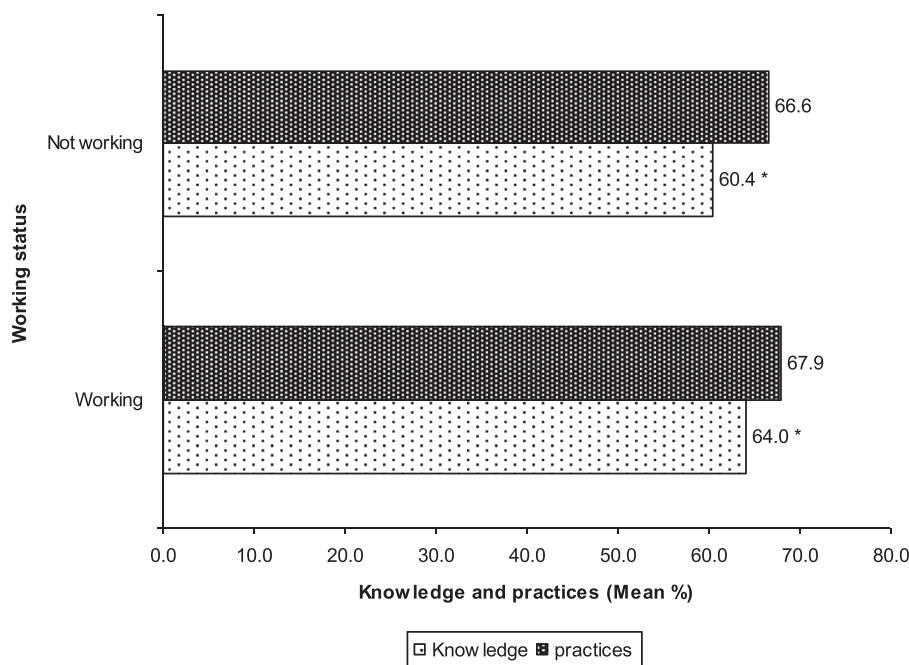
The highest mean knowledge was reported by those with higher studies, and 60 years and more, whereas the highest mean practice was among those with primary and preparatory education, in the age groups (10-years) and (60 years and more). Working women and those in the South province reported insignificantly higher mean knowledge and practice than non working and those in other provinces except East province. It was reported that food safety knowledge tends to increase with age, and younger respondents

show the greatest need for additional food safety education (Osaili, Obeidat, Abu Jamous, & Bawadi, 2011).

Although, the majority of the interviewed Saudi women reported reading expiry dates and purchasing food of animal origin displayed in refrigerators, some of them reported that they did not know that bacteria can grow faster outside the fridge, food poisoning can result from consumption of grossly unspoiled foods, foods of animal origin or salads displayed outside refrigerators. Most of the interviewed women believed that bacteria can be destroyed in the fridge or in the freezers.

4.2. Food safety knowledge and practices concerning preparation

The interviewed women reported better food safety practice concerning food preparation than knowledge and this was observed in all educational levels except higher studies, age groups except (10-years), locations except South province, working and non working women with significant variations ($P < 0.05$) in their knowledge and practices among educational levels but only in their knowledge among different locations and working status. Another

* Significant positive correlations between knowledge and practices ($P < 0.05$)**Fig. 4.** Overall Food safety Knowledge and practices (Mean %) among working and non working Saudi women.

study of [Fawzi and Shama \(2009\)](#) reported better food preparation practices than knowledge score (69 and 59.8; respectively).

The present study revealed that working women, those in the age group (60+ years) and with higher studies reported higher mean knowledge and practice than non working and those in other age groups and educational levels. Women from the East province reported better knowledge while those from the South province reported better practice than women from other Saudi provinces. Better educated consumers often recognize the importance of food safety and younger respondents have shown the greatest need for additional education on food safety ([Sudershan, SubbaRao, Rao, VardhanaRao, & Polasa, 2008](#)).

Food should never be thawed or stored on the counter, since food poisoning microorganisms grow faster in the middle of the temperature danger zone (21–52 °C) than at any other point ([Badrie, Gobin, Dookeran, & Duncan, 2006](#)). Although, the majority of the interviewed Saudi women reported proper thawing of frozen foods, some of them reported that they do not know that thawing frozen foods outside the fridge or thawing and refreezing them can lead to food poisoning.

The use of the same cutting boards for raw and cooked food of animal and vegetable origin without proper washing can be one of the causes of food poisoning ([Jevšnik et al., 2008](#)). Although, the majority of the interviewed Saudi women reported using separate cutting boards for raw and cooked foods or using the same after proper cleaning, some of them reported that they do not know that using the same improperly cleaned cutting boards can lead to food poisoning.

4.3. Food safety knowledge and practices concerning cooking

Inadequate cooking of meat and cross-contamination due to poor hand hygiene in food handling practices are responsible for many foodborne illnesses ([Clayton & Griffith, 2008](#); [Medeiros et al., 2001](#)). The present study revealed that there were non significant variations ($P > 0.05$) in food safety knowledge or practices concerning cooking of the interviewed women except in their knowledge among different locations and between working and non working. Another study of [Fawzi and Shama \(2009\)](#) revealed that the mean score of food safety practices cooking was higher than their corresponding knowledge (77.5% and 70.0%; respectively).

Working women, those in the age group (60+ years) and with higher studies reported higher mean knowledge and practice than non working and those in other age groups and educational levels. Although, the majority of the interviewed Saudi women reported avoiding consumption of raw or half cooked foods of animal origin, some of them reported that they did not know that eating raw or half cooked foods could lead to food poisoning. Another study showed that over 50% of the Saudi college students consumed raw eggs and raw white cheese and 34% believed that there is no risk of disease from eating cooked food kept at room temperature for one day if covered ([Sharif & Al-Malki, 2010](#)).

Leaving cooked food for longer periods in the kitchen constitutes a hazardous practice since food poisoning microorganisms can grow to produce large number and/or toxins sufficient to induce food poisoning ([Fawzi & Shama, 2009](#)). Although, the majority of the interviewed Saudi women reported cooking of foods in quantities sufficient for a meal, eating within 4 h after cooking, and avoiding leaving the cooked foods outside the refrigerator for more than 4 h, some of them failed to specify the period where cooked foods can be kept safely outside the fridge. A typhoid foodborne outbreak caused by eating cake in a children potluck caused 19 cases of typhoid fever in Saudi Arabia ([Al-Zubaidy, El Bushra, & Mawlawi, 1995](#)).

4.4. Food safety knowledge and practices concerning utensils and equipment

Food should be handled with equipment and utensils that has been thoroughly cleaned and sanitized. Thorough washing and disinfecting of utensils are needed to prevent contamination and to maintain a hygienic condition ([Marriott & Gravani, 2006](#), pp. 374–391). The interviewed women in all educational levels, age groups, locations, those working and non working reported better food safety practice concerning food utensils and equipment than their corresponding knowledge with non significant variations ($P > 0.05$) except in the knowledge between working and non working women. Working women, those in the age group (60+ years) and with higher studies reported higher mean knowledge and practice than non working and those in other age groups and educational levels. Women from the East province reported better knowledge while those from the West province reported better practice than women from other Saudi provinces. Although, the majority of the interviewed Saudi women reported using stainless steel, Teflon and Pyrex; proper washing, disinfection and drying of their food preparation utensils, some of them reported that they did not know that stainless is considered safe for food handling.

4.5. Food safety knowledge and practices concerning personal hygiene

Practicing personal hygiene was ranked as the first set of behaviors in maintaining the safety of food and reducing number of foodborne illnesses with washing hands before handling food received the highest rank ([Medeiros, Kendal, Hillers, Chen, & Schroeder, 2001](#)). The interviewed women reported better food safety practice concerning personal hygiene than knowledge and this was observed in all educational levels except Illiterate/read and write, age groups, locations, and between working and non working women with significant variations ($P < 0.05$) in their knowledge and practices among different locations but only in their practice among educational levels. Working women and those with higher studies reported higher mean knowledge and practice than non working and those in other educational levels, whereas women in the age group (50-years) and those from the South province reported better knowledge while those in the age group (60+ years) and from the Middle province reported better practice than women from other age groups and Saudi provinces.

A meta analysis carried out by [Curtis and Cairncross \(2003\)](#) using seven intervention studies indicated that washing hands with soap can reduce the risk of diarrheal diseases by 42–47% and that interventions to promote hand washing might save a million lives. Although most of the interviewed Saudi women reported proper washing and drying of their hands, avoiding tasting of foods by fingers or using the same spoon several times, some of them reported that they did not know if it is safe to taste foods by fingers or by using the same spoons several times. Another study reported that the vast majority of consumers were engaged in less than ideal hygiene practices due to lack of knowledge or failure to implement known food safety procedures ([Griffith, Worsfold, & Mitchell, 1998](#)).

Not only persons suffering from food poisoning can contaminate the food, but also healthy carriers who carry normally a lot of food poisoning microorganisms ([Trickett, 2001](#), pp. 18–24). Although most of the interviewed Saudi women reported that diseased person can contaminate foods and foods should not handled by ill persons, some of them reported preparing foods during their illness. Also, most of the interviewed women reported that they did not know if apparently healthy persons can contaminate foods.

It can be concluded that there was a gap between food safety knowledge and practices with better practices than knowledge in the overall food safety and all parameters except cooking. Personal hygiene showed higher mean knowledge and practice scores with the lowest knowledge score in utensils and equipment while the lowest practice in cooking.

5. Recommendations

Food safety education program should be launched to Saudi women and repeated at specific intervals to ensure that learnt information is put into the daily life practices. The information gained by this study can be used to formulate essential messages for such educational programs.

6. Limitation of the study

The limitations of this study included interviewing Saudi women who were easily accessible by the students; therefore the results should not be generalized to all Saudi women. Also, food safety practices were assessed through self reporting that may overestimate the actual practices.

Acknowledgements

The authors would like to thank the students of both the college of Applied Medical Sciences and College of nursing at King Saud University who have exerted their efforts to collect the study data, and to the Saudi women who shared in the study and answered the questions honestly. The authors also extend their appreciation to the Research Center of the College of Applied Medical Sciences and the Deanship of Scientific Research at King Saud University for funding this research.

References

- Albrecht, J. A. (1995). Food safety knowledge and practices of consumers in the U.S.A. *Journal of Consumer Studies and Home Economics*, 19, 119–134.
- Al-Zubaidy, A. A., El-Bushra, H. E., & Mawlawi, M. Y. (1995). An outbreak of typhoid fever among children who attended a potluck dinner at Al-Mudhnab, Saudi Arabia. *East African Medical Journal*, 72, 373–375.
- Badrie, N., Gobin, A., Dookeran, S., & Duncan, R. (2006). Consumer awareness and perception to food safety hazards in Trinidad, West Indies. *Food Control*, 17, 370–377.
- Bruhn, C. M., & Schutz, H. G. (1999). Consumer food safety knowledge and practices. *Journal of Food Safety*, 19, 73–87.
- Clayton, D. A., & Griffith, C. J. (2008). Efficacy of an extended theory of planned behavior model for predicting caterers' hand hygiene practices. *International Journal of Environmental Health Research*, 18(2), 83–98.
- Curtis, V., & Cairncross, S. (2003). Effect of washing hands with soap on diarrhoea risk in the community: a systematic review. *The Lancet Infectious Diseases*, 3(5), 275–281.
- Fawzi, M. (1999). *Investigation of bacterial food poisoning outbreaks in Alexandria*. Thesis, DrPHSc. Alexandria University, High Institute of Public Health.
- Fawzi, M., & Shama, M. E. (2009). Food safety knowledge and practices among women working in Alexandria University. *Journal of the Egyptian Public Health Association*, 85(1–2), 95–117.
- Garayoa, R., Cordoba, M., Garcia-Jalon, I., Sanchez-Villegas, A., & Vitas, A. I. (2005). Relationship between consumer food safety knowledge and reported behavior among students from health sciences in one region of Spain. *Journal of Food Protection*, 68(12), 2631–2636.
- Gettings, M. A., & Kiernan, N. E. (2001). Practices and perceptions of food safety among seniors who prepare meals at home. *Journal of Nutritional Education*, 33, 148–154.
- Griffith, C. J., Worsfold, D., & Mitchell, R. (1998). Food preparation, risk communication and the consumer. *Food Control*, 9(4), 225–232.
- Haapala, I., & Probart, C. (2004). Food safety knowledge perceptions and behaviors among middle school students. *Journal of Nutrition Education and Behavior*, 36, 71–76.
- Jay, S. L., Comar, D., & Govenlock, L. D. (1999). A national Australian food safety telephone survey. *Journal of Food Protection*, 62, 921–928.
- Jevšnik, M., Hoyer, S., & Raspor, P. (2008). Food safety knowledge and practices among pregnant and non-pregnant women in Slovenia. *Food Control*, 19, 526–534.
- Marriott, N. G., & Gravani, R. B. (2006). *Principles of food sanitation* (5th ed.). USA: Springer.
- McCarthy, M., Brennan, M., Kelly, A. L., Ritson, C., de Boer, M., & Thompson, N. (2007). Who is at risk and what do they know? Segmenting a population on their food safety knowledge. *Food Quality and Preference*, 18(2), 205–217.
- Medeiros, L. C., Kendal, I. P., Hillers, V. N., Chen, G., & Schroeder, M. (2001). Identification and classification of consumers food handling behaviors for food safety education. *Journal of the American Dietetic Association*, 101(11), 1326–1339.
- Medeiros, L. C., Hillers, V. N., Kendal, I. P., & Mason, A. (2001). Evaluation of food safety education for consumers. *Journal of Nutrition Education and Behavior*, 33(51), S27–S34.
- Osaili, T. M., Obeidat, B. A., Abu Jamous, D. O., & Bawadi, H. A. (2011). Food safety knowledge and practices among college female students in north of Jordan. *Food Control*, 22, 269–276.
- Raspor, P., Jevšnik, M., & Hlebec, V. (2006). Consumers' awareness of food safety from shopping to eating. In D. Báná ti (Ed.), *Nutrition and food safety* (p. 112). Brussels: Consortium International Congress on Food Safety.
- Redmond, E. C., & Griffith, C. J. (2003). Consumer food handling in the home: a review of food safety studies. *Journal of Food Protection*, 66, 130–161.
- Schafer, R. B., Schafer, E., Bultena, G. L., & Hoiberg, E. O. (1993). Food safety: an application of the health belief model. *Journal of Nutrition Education*, 25, 17–23.
- Scott, E. (1996). Foodborne disease and other hygiene issues in the home. *Journal of Applied Bacteriology*, 80, 5–9.
- Sharif, L., & Al-Malki, T. (2010). Knowledge, attitude and practice of Taif University students on food poisoning. *Food Control*, 21, 55–60.
- Streiner, D. L., & Norman, G. R. (1995). *Health measurement scales* (2nd ed.). Oxford: Oxford University Press.
- Sudershan, R. V., SubbaRao, G. M., Rao, P., VardhanaRao, M. V., & Polasa, K. (2008). Food safety related perceptions and practices of mothers – a case study in Hyderabad, India. *Food Control*, 19(5), 506–513.
- Trickett, J. (2001). *Prevention of food poisoning* (4th ed.). UK: Nelson Thrones.
- Unusan, N. (2007). Consumer food safety knowledge and practices in the home in Turkey. *Food Control*, 18, 45–51.
- WHO/FAO. (2002). *Assuring food safety and quality: Guidelines for strengthening national food control systems*. World Health Organization.
- WHO/FAO. (2005). Major issues and challenges in food safety. In *FAO/WHO regional meeting on food safety for the Near East*. Jordan: WHO/FAO.