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ORIGINAL ARTICLE

Food Safety and Handling Practice among Medical Students at Zagazig University

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ABSTRACT

Background: Foodborne diseases are gastrointestinal tract infections caused by the consumption of beverages or foods that are contaminated with pathogenic viruses, bacteria, parasites, or chemical compounds. Medical students are exposed to foodborne infection as they are spending a lot of time outdoors. **Objective:** to assess food safety knowledge and practice among medical students as well as the risk variables that may be associated with inadequate food safety knowledge and practice. **Methods:** This Cross-sectional study included 345 medical students at faculty of medicine Zagazig University for 3 months duration from September to December 2023. These students were assessed regarding food safety knowledge and practice via a questionnaire. Their sociodemographic characters were analyzed to assess the associations between their demographic data and their knowledge and handling practices. **Results:** There is insufficient knowledge in 89.6% of studied medical students. Incompetent food safety handling practice level was 77.4% of studied medical students. Increased age, higher practical academic years, higher fathers' education and social class were significant predictors for higher knowledge score, $p < 0.05$. Higher socioeconomic class and students' knowledge score were significant predictors for proper food safety handling practices score, $p < 0.05$. **Conclusion:** we conclude that there is insufficient food safety practice and knowledge among medical students at Zagazig university which illustrates the need to raise awareness among these students about food safety.

Keywords: food safety knowledge, practice, medical students.

INTRODUCTION

Food safety is a serious problem. Food is considered safe if it does not injure or sicken the customer. Although it is a fundamental requirement, there is a possibility that food safety may be disregarded in the development of successful and productive procedures [1]. It is possible to avoid foodborne illnesses in the public by having food workers adhere to food safety regulations. Several foodborne illnesses can result from eating contaminated food that contains microorganisms or toxins, such as dysentery, viral hepatitis, salmonellosis, typhoid, and amoebiasis [2].

Certain consumer groups are more likely to handle food improperly than others. Young people (ages 18-29), men, and those with education above high school are more susceptible to engaging in risky food handling than others [3]. The risky food-handling actions of these consumers does not remarkably show up in observed morbidity, and young adults are rarely regarded "at risk" for foodborne disease. Moreover, the effects of such unsanitary cooking

habits become even more significant when they are in the position of giving care to other family members who are at heightened risk, such as children and elderly parents [4].

Lazou et al. [5] investigated young individuals' self-reported food safety knowledge and practices. They demonstrated that the college students involved in the investigation had in general low food safety awareness and were regularly engaged in risky food-handling activities.

There is a scarcity of research on food safety knowledge and practice among Egyptian university students, especially medical students. So, the purpose of the current study was to assess food safety knowledge and practice among medical students as well as the risk factors that may be associated with inadequate food safety knowledge and practice.

METHODS

Study design and settings: This is a cross-sectional study that was conducted at Faculty of Medicine Zagazig University for 3 months duration from September to December 2023.

Sample size: The sample was evaluated to be 345 medical students as the total number of students at faculty of medicine Zagazig University is 7184 and the prevalence of proper food handling practices is 38% [5], power of the study 80%, CI 95% by using open epi program version 3.

Population: Medical students aged > 18, both sexes were included. Sample was collected by systematic random technique from Zagazig medical students. Exclusion Criteria: Students who refused to participate in the study were excluded.

Tools:

Two parts were included:

The sociodemographic factors including field of study, age, gender, study area, residence status, engagement in food buying and processing (cooking habit), likelihood of eating meals outside the home, experience with foodborne disease personally, and resources for FSK. [5]

Assessment of Food safety knowledge and practice (FSKP) was done via Food safety knowledge and practice (FSKP) questionnaire [5]. The questionnaire was structured to assess college students' FSK and behaviors. The questionnaire was created using items chosen from an updated, trustworthy, and valid tool developed by Byrd-Bredbenner et al. [5] to be used as an instrument for measuring FSKP. The questionnaire took approximately 15 minutes to be completed.

The section on food-handling practices consisted of 16 questions and the section on FSK consisted of 16 questions; in 4 content-discrete sections: food chilling, cooking, cleaning/hygiene, and microbiology/cross-contamination. All points were multiple-choice questions or statements with two to six alternative answers including true/false and yes/no options.

Correct answer was given 1 and wrong answer was given zero to estimate the total knowledge and practice. Proper knowledge and practice were considered at score more than 60% as per Byrd-Bredbenner et al. [5].

Ethical consideration and administrative design

The protocol was approved by Institutional Review Board (IRB) number 9630-17-8-2022. Informed consent was collected from all participants after an explanation of the procedure and medical research. The research was conducted under the World Medical Association’s Code of Ethics (Helsinki Declaration) for human research.

STATISTICAL ANALYSIS

All data were analyzed using SPSS Statistics for Windows, version 23.0. While qualitative data were expressed as numbers and percentages, quantitative data were expressed as mean ± SD and range. When appropriate, the Fisher exact test or the Chi-squared test were used to compare the percentage of categorical variables. The relationship between the several inquiry variables was assessed using Pearson's correlation coefficient; values close to 1 indicate strong correlation and values close to 0 indicate weak correlation. (+) indicates direct correlation and (-) indicates inverse correlation. Predictive analysis is one kind that includes stepwise linear regression. Data are described and the relationship between a single dependent variable and one or more independent variables is explained using stepwise linear regression. A p-value of less than 0.05 was deemed statistically significant in all two-sided tests.

RESULTS

Table (1) shows that 51% of the studied students were females, all students had aged from 17 to 23 years old with mean age 20.68±1.58. 42.6% of students in pre-clinical academic years. Moreover, most mothers and fathers had university, educational qualification, (85.5%, 75.9%) respectively. All fathers had work versus 70.4% of mothers. In conclusion, 91.3% of the studied sample had high social grade, only 8.7% had middle social grade.

In table (2), satisfactory level was distributed as follows; about dimensions of FSK is 3.2% in food microbiology/cross-contamination, 20.9% in cooking, 27.8% in chilling, finely safety knowledge is 25.2% in cleaning/hygiene of food.

Table (3) illuminated that mean food safety handling practices score was 8.11±1.85 and ranged from 3 to 13 for studied medical students with mean percent of 50.7%. Competent food safety handling practices level was 22.6% and 77.4% in competent food safety handling practices level.

Table (4) shows that there was substantial association between students' FSK level and students' academic years, father's education, mother's work, in favor of postgraduate educated fathers and working mothers ($p<0.05$). However, there were no relation between students' FSKP level and other students' characteristics ($p>0.05$).

Table (5) shows that there was remarkable relation between Students' Food Safety handling practice level and gender, Mother's education, Mother's work, social class in favor of females, post graduate educated mothers and working mothers, high social class, ($p<0.05$). However, there was no relation between Students' Food Safety handling practice level and other students' characteristics, $p>0.05$.

Table (6) shows that increased age, higher academic years, higher fathers' education and socioeconomic score were significant predictors for students' FSK score, $p < 0.05$.

Socioeconomic score and students' FSK score were significant predictors for students' food safety handling practices score, $p < 0.05$ (Table 7).

Supplementary Table (1) showing that there was significant, direct association between Food Safety Knowledge and Food Safety Handling Practices score, age per years and total socioeconomic score $p<0.05$. Also, there is a significant direct association between Food Safety Handling Practices score, age per years and total socioeconomic score, $p<0.05$.

Table (1): Frequency and Percentage Distribution of the Studied students According to Personal Characteristics (n = 345)

Variables		
Age (years) Mean ±SD Range	20.68±1.58 17-23	
Gender	n.	%
Males	169	49.0
Females	176	51.0
Academic years Pre-clinical (first &second grades) Clinical (third, fourth &fifth grades)	 147 198	 42.6% 57.4%
Mother's education		
Preparatory	11	3.2
Secondary	15	4.3
University	295	85.5
postgraduate	24	7.0
Father's education		
Secondary	12	3.5
University	262	75.9
Postgraduate	71	20.6

Mother's work		
Yes	243	70.4
Father's work		
Yes	345	100.0
Social class		
High	315	91.3
Middle	30	8.7

Table (2): Frequency Distribution of Food Safety Knowledge of studied medical Students (n = 345)

Variables	Satisfactory		Unsatisfactory	
	n.	%	n.	%
food microbiology / cross-contamination	11	3.2	334	96.8
food preparation (cooking)	72	20.9	273	79.1
food storage (chilling)	96	27.8	249	72.2
cleaning/hygiene	87	25.2	258	74.8
Total knowledge about food safety	36	10.4	309	89.6

Table (3): Food Safety Handling Practices of studied medical Students (n = 345)

Variable			Mean percent
Food Safety Handling Practices score (16) *	mean± SD (range)	8.11±1.85 3-13	50.7
	Competent	n.	%
Food Safety Handling Practices level		78	22.6
	Incompetent	267	77.4

()* :Maximum score

Table (4): Relation between personal characteristics of studied medical students and food safety knowledge level (n = 345)

Variables	Students' Food Safety Knowledge level				Number total	χ^2	p-value
	Satisfactory n.36		Unsatisfactory n.309				
Age per years Mean ±SD Range	22.11±1.35 18-23		20.51±1.52 17-23			6.04	0.0001
Gender	No.	%	No.	%			
Males	13	7.7	156	92.3	169	2.67	0.103
Females	23	13.1	153	86.9	176		
Academic years							
	4	2.7	143	97.3	147	16.31	0.0001
Pre-clinical (first &second grades) Clinical (third, fourth &fifth grades)	32	16.2	166	83.8	198		
Mother's education							
Preparatory	0	.0	11	100.0	11		

Secondary	3	20.0	12	80.0	15	5.72	0.13
University	33	11.2	262	88.8	295		
postgraduate	0	.0	24	100.0	24		
Father's education							
Secondary	0	.0	12	100.0	12	9.11	0.01*
University	22	8.4	240	91.6	262		
postgraduate	14	19.7	57	80.3	71		
Mother's work							
No	5	4.9	97	95.1	102	4.74	0.029*
Yes	31	12.8	212	87.2	243		
Father's work							
Yes	36	10.4	309	89.6	345		
class grade							
High	33	10.5	282	89.5		0.007	0.935
Middle	3	10.0	27	90.0	30		

Table (5): Relation Between Personal Characteristics of studied medical students and Food Safety Handling Practices Level (n = 345)

	Students' Food Safety Handling Practices Level				**Number total**	**χ^2**	**p-value**
	Competent n.78		**Incompetent n. 267**				
Age per years Mean ±SD Range	20.94±2.05 17-23		20.59±1.41 17-22			1.64	0.098
Gender	No.	%	No.	%			
Males	29	17.2	140	82.8	169	5.62	0.018*
Females	49	27.8	127	72.2	176		
Academic years							
First three academic years	29	19.7	118	80.3	147	1.21	0.27
second three academic years	49	24.7	149	75.3	198		
Mother's education							
Preparatory	0	.0	11	100.0	11		
Secondary	2	13.3	13	86.7	15	8.942	0.03*
University	66	22.4	229	77.6	295		
post graduate	10	41.7	14	58.3	24		
Father's education							
Secondary	1	8.3	11	91.7	12	2.761	0.251
University	57	21.8	205	78.2	262		
post graduate	20	28.2	51	71.8	71		
Mother's work							
No	14	13.7	88	86.3	102	6.531	0.011*
Yes	64	26.3	179	73.7	243		
Father's work							
Yes	78	22.6	267	77.4	345		
Social class							
High	78	24.8	237	75.2	315	9.599	0.002*
Middle	0	.0	30	100.0	30		

Table (6): Multiple linear regression model for predicting Students' Food Safety knowledge score and handling practices score (n = 345)

Predictors	Unstandardized Coefficients		t	Sig.	r	$R1^2/R2^2$
	β	SE				
Students' Food Safety knowledge score						
(Constant)	-2.94				0.45	$R1^2$ 0.21
Age per years	0.116	0.022	5.252	0.0001*		
Academic years	0.238	0.073	3.263	0.001*		
Father education	0.042	0.018	2.28	0.023*		
Mother work	-0.019	0.036	0.522	0.602		
Socioeconomic score	0.021	0.004	5.105	0.0001*		
Food practice cleaning/hygiene	0.002	0.022	0.101	0.920		

β = regression coefficients, SE: standard error, R1 square =21% of predictors, R2 square = 17.6% of predictors, f test=14.1*significant P=0.0001.

Table (7): Multiple linear regression for predicting Students' Food Safety Handling Practices score (n = 345)

Predictors	Unstandardized Coefficients		t	Sig.	r	R^2
	B	SE				
(Constant)	2.466	.435			0.42	0.176
gender	-.022	.072	0.307	.759		
Mother's education	-.006	.056	0.107	.915		
Mother work	.091	.083	1.094	.275		
Total socioeconomic score	0.042	.009	4.738	.0001*		
Food Safety Knowledge score	0.167	.435	7.823	.0001*		

β = regression coefficients, SE: standard error, R square = 17.6% of predictors, f test=14.4*significant P=0.0001.

Supplementary Table (1): Correlation matrix between Food Safety Knowledge, Food Safety Handling Practices score, age per years, and total socioeconomic score (n = 345)

Variables	Food Safety Knowledge score		Food Safety Handling Practices score	
	r	P	r	P
Food Safety Handling Practices score	0.248**	0.0001	1	
Age per years	0.410**	0.0001	0.160**	0.003
Total socioeconomic score	0.264**	0.0001	0.669**	0.0001

(r) correlation coefficient ** Correlation is significant at the 0.01 level (2-tailed).

* Correlation is significant at the 0.05 level (2-tailed).

DISCUSSION

Food improper handling occurs more frequently in certain consumer categories than others [6]. Young persons (ages 18-29), men, and those with education beyond high school are more susceptible to engaging in dangerous food handling than others [7].

The goals of this study are to analyze the degree of FSKP among medical students, as well as the risk factors linked with a lack of FSKP. This Cross-sectional investigation included 345 medical students at faculty of medicine Zagazig University. These students were assessed regarding FSKP via a questionnaire. Their sociodemographic characters were analyzed to assess the associations between their demographic data and their food safety knowledge and handling practices. Age, academic year, parents' education and work status were considered as possible risk factors for poor FSK and handling practices among medical students.

The study showed that 51% of the studied students were females. Their age ranged from 17 to 23 years old with mean age of 20.68±1.58, 42.6% of students were in the first three academic years. Moreover, most mothers and fathers had university, educational qualification (85.5% and 75.9%) respectively. All fathers had work versus 70.4% of mothers. About 91.3% of studied sample had high social grade, only 8.7% had middle social grade.

Regarding to FSK in our study, 10.4% was satisfactory and 89.6% was unsatisfactory in studied medical students. In agreement with this study, a study performed among individuals at family medicine outpatient clinic revealed lacks appropriate food safety knowledge and practice. Just 0.3% of the individuals in this survey had appropriate FSK, while 19.3% had adequate practice [8].

Also, a study carried out among college students in Athiopis in 2019 showed that approximately 35.7% of the individuals demonstrated good FSK [9]. Al-Makhroumi et al. [10] observed that most of the respondents had low FSK scores. Only 43% of responders could accurately answer the knowledge questions. A study conducted on FSKP among university students in Saudi Arabia differed with our findings since students demonstrated high FSK [11]. In addition, the research on hygiene and food safety conducted at Tehran University of Medical Sciences found that 68% had strong FSK and 31% had moderate FSK [12].

The good knowledge in the previous two studies may be attributed to different curriculum as there is lack of concentration on food safety and handling practices knowledge in the students' curriculum in Egypt.

In our study, satisfactory level was distributed as follow about dimensions of food safety know FSK is 3.2% in food microbiology cross-contamination, 20.9% in cooking, 27.8% in chilling, finally safety knowledge is 25.2% in cleaning/hygiene of food. Concerning food safety handling practice in our study, the percentage of food safety handling practice level was 22.6% competent and 77.4% incompetent in studied medical students. In agreement with our results, evaluation of FSKP and food handling practice in College of Basic Education Students in Kuwait have poor general awareness about food safety (35.5%) [13].

On the other hand, medical Students at Ain Shams University showed a significant high level of practice knowledge scoring (≥50%) [14]. Also, Al-Makhroumi et al. [10] disagreed with our study by recording that the mean percentage of responders with good attitudes and proper habits was 76.9% and 70%, respectively.

According to safety food knowledge, in food-contamination organisms, the highest correct answer regard food can be contaminated with Salmonella bacteria (25.8%), while all students answered incorrectly about food can contaminated with Listeria bacteria organism. In food preparation, all students answered correctly about eggs texture to be safe to eat, while 79.7% of students answered incorrectly about all foods are thought to be safe when cooked to an internal temperature. But Kunadu et al. [15] published that most of the respondents had no idea whether Staphylococcus, Salmonella, viruses, or hepatitis A and B caused foodborne illnesses.

In food storage, the highest correct answer regards storing fish, raw meat, or poultry in the refrigerator (93.9%), while 82.9% of students answer incorrectly about maximum temperature of refrigerators. In cleaning/hygiene, the highest correct answer regards kitchen counters cleaning (95.9%), while 75.1% of students answer incorrectly about kitchen counters cleaning.

In agreement with our study, Hamed and Mohammed [16] found that around a third of the individuals positively responded to the FSK points about the higher likelihood of food poisoning from medium-cooked or raw meat eating (32.7%), unwashed vegetables (35.9%), and leftover covered food stored in room temperature for < 6 hours (40.0%). 56.7% were not aware that insects can spread poisoning

diseases (56.7%) and that hazardous bacteria proliferate at room temperature (59.2%).

Lazou et al. [4] disagreed with our study as there was no substantial variance in the mean values of students of study respecting reported food storage and cleaning/hygiene habits. The mean cleaning/hygiene knowledge score among all individuals was 1.5 points (scores ranged from 0 to 4).

In safety food handler practice, the highest correct practice regard time of putting cream in shopping cart (98.8%), cleaning knife (95.4%), then kitchen sink drains sanitization (95.1%), while 84.1% of students practice incorrectly in case electricity went off and the seafood, chicken, and/or meat in freezer thawed and began to warm, then students practice incorrectly regard sufficient cooking of hamburger or poultry (80.9%)

Also, Hamed and Mohammed [16] found that 39.2% of their respondents had a good understanding of food safety, whereas 61.2% had good attitudes toward it. 56.3% reported proper food safety measures.

Our study reported that there was substantial relationship between students' FSK level and students' academic years, father's education, mother's work, in favor of postgraduate educated fathers and working mothers ($p < 0.05$). However, there were no relation between students' FSK level and other student characteristics ($p > 0.05$).

In addition, there was notable relationship between students' food safety handling practice level and gender, mother's education, mother's work, social class in favor of females, postgraduate educated mothers and working mothers, high social class ($p < 0.05$).

Our study reported that there was remarkable direct correlation between FSK and food safety handling practices score, age(years) and total socioeconomic score ($p < 0.05$). Also, there was substantial direct association between food safety handling practices score, age (years) and total socioeconomic score ($p < 0.05$)

Also, Hamed and Mohammed [16] found that higher education was correlated with considerably higher FSK scores ($P < 0.001$), but not with attitude or practice scores. Residence (rural/urban) had a significant effect on participants' FSK and attitude scores, with urban food handlers scoring higher. Job remarkably correlated with FSK scores, with kitchens having higher scores ($P < 0.001$). FSK scores were substantially correlated with participants' age and years of experience, with older and more experienced food handlers having higher knowledge scores.

Also, a study carried out among general population at family medicine outpatient found that there was a substantial variance in practice grade and education among the study individuals, with 78% of those with proper practice being moderately or highly educated. This is consistent with many research results that suggest that the more increased the individual's education, the more FSKP they have, and vice versa. [8].

On the other hand, Akabanda et al. [17] stated that institutional food handlers have adequate FSK, cleaning, general and personal hygiene, and sanitation processes. Moreover, this did not lead to rigorous food hygiene practices. Thus, continual food safety education and motivation for food handlers of diverse socioeconomic cultures, with special emphasis dedicated to those without high education levels, would complement other initiatives that seek to promote food safety systems.

Our study revealed that there was no association with gender unlike a study by Hamed and Mohammed [16] found Males had elevated attitude and knowledge than females ($P < 0.004$ and $P < 0.001$, respectively), but there was no remarkable variance in practice scores between genders.

In our study there was a remarkable direct relationship between FSK and Food Safety Handling Practices. Mohamed et al. [18] agreed with our study by finding a positive association between food handlers' knowledge with their practices. Also, Cempaka et al. [19] assessed the level of understanding, dispositions, and behaviors of food street vendors at an Indonesian public elementary school and found a strong correlation between the research participants' FSK and FSKP.

Ahmed and Sayed [2] demonstrated that before the educational plans were adopted, there was a favorable correlation between food handlers' overall knowledge and overall practices scores regarding food safety measures. Our findings were supported by the fact that food handlers' total knowledge and total practice ratings increased both before and after

the instructional recommendations were implemented. Al-Makhroumi et al. [10] showed that the correlation between participants' KAPs was determined to be poor.

Multiple linear regression model revealed that increased age, practical academic years, increase fathers' education score and socioeconomic score were significant predictors for students' FSK score ($p > 0.05$). Also, socioeconomic score and students' FSK score were significant predictors for students' food safety handling practices score ($p > 0.05$).

Woh et al. [20] found that age, sex and education remarkably affected FSK. Moreover, Abdul Mutalib et al. [21] reported that none of these variables had a substantial effect on food handlers' knowledge. Research in Malaysia additionally revealed that education was substantially linked to the attitude of food workers. However, Anuradha and Dandekar [22] showed that only age and sex had a substantial effect on individuals' attitudes.

Dun-Dery and Addo [23] reported that age, gender, and education had no impact on FSKP. Nevertheless, Afolaranmi et al. [24] revealed that education and age have a substantial impact on food vendors' practices. Pokhrel et al. [25] showed that education had a considerable impact on food handlers' attitudes and knowledge, but without effect on their practices.

Hamed and Mohammed [16] reported that age, male sex, urban location, higher education, and being a cook were all substantial predictors of good FSKP, while residence and education had a strong correlation with favorable food safety attitudes.

Limitations of the study include that the participants reported their food safety practices which was a limitation of our study as they may have been subjected to social desirability bias and reported that they followed correct practices when they may not have. Direct observation of the hygiene practices is needed to draw an accurate conclusion on the compliance of the participants with food safety practices.

CONCLUSION

There is insufficient FSKP and practice among Zagazig medical students. Therefore, there is an urgent need to raise awareness of medical students about food safety knowledge and practice.

CONFLICTS OF INEREST

No potential conflict of interest was reported by the authors.

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