

Socio-demographic determinants of good food safety practices for young, educated food handlers in Türkiye

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ABSTRACT

Food handlers' poor food safety practices increase the risk of foodborne diseases. In this study, food safety practices varied significantly according to gender, age, grade level (student or graduate), and internship status but did not differ according to marital status and income. Correct cutting board use received the highest score (92.6%) among student and graduate food handlers. Double tasting, hand cleaning before food contact, and expiration date/first in-first out rule were scored over 90% correctly. Neglecting hand washing during peak hours (43.9%) and not washing the vegetables to be cooked (45.7%) took the lowest scores. Gender, age, and grade level determine whether food safety practices are good or poor. Men were found to be 0.2 times less likely than women to perform good food safety practices. Food handlers aged 25-30 were 0.1 times less likely to prepare safe food than individuals aged 18-24. It has been determined that the probability of safe food preparation of graduates is 0.1 times lower than that of students.

Keywords: Food handler, Practice, Safe food, Poisoning, Cook, Student

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Introduction

Food safety is a global issue in terms of consumers and food handlers. Unsafe foods containing biological (pathogens) and chemical hazards cause more than 200 illnesses, ranging from diarrhoea to cancers (WHO, 2022). The World Health Organization reported that almost one in ten people fell ill after consuming contaminated food. This causes a loss of 33 million healthy life years (disability-adjusted life years [DALYs]) each year. Meanwhile, foodborne diseases strain health systems and harm countries' economies, especially in tourism and trade. For the health system, about 110 billion USD is lost yearly in productivity and medical expenses resulting from unsafe food in underdeveloped and developing countries (WHO, 2022). The situation is similar in developed countries. In 2021, 4,005 foodborne diseases were diagnosed in the European Union, 29.8% more cases than in 2020 (EFSA, 2023). According to PAHO (2023), foodborne diseases can be eliminated mainly if food handlers follow food hygiene and other safe food preparation guidelines because it is known that food handlers' practice causes 20% of foodborne diseases (Michaels et al., 2004). A previous study (Schwartz, 1975) suggested a relationship among food handlers' knowledge, attitude, and practice (KAP). Food safety practice has been demonstrated as a consequence of knowledge and attitude. This makes food handlers' practices the most influential determinant of food safety.

To the author's knowledge, the food safety practices of gastronomy and culinary arts students and recent graduates have not been studied so far. Limited studies investigate students' food safety practice levels (Ali et al., 2023; Giritlioglu et al., 2011; Hassan & Dimassi, 2014; Ovca et al., 2018). Giritlioglu et al. (2011) and Ovca et al. (2018) were conducted among undergraduates professionally engaged in food handling. However, neither of these studies examined what demographic characteristics determine the food safety behaviour of food handlers and to what extent. Internship status and grade level (student or recent graduate) might change the food handlers' behaviours and food safety practices in commercial food establishments. On a commercial scale, identifying risky demographic groups is essential for designing monitoring systems and targeted food safety training. Another point is that these findings will contribute to improving the food safety education curriculum at the university.

Therefore, this study focuses on the self-reported evaluation of food safety practices regarding the demographic profiles of young Turkish food handlers from culinary programs. The objectives are (1) to evaluate the proportion of correct re-

sponses among these educated young food handlers to questions about food safety practices; (2) to compare the levels of food safety practice according to socio-demographics; (3) to determine the socio-demographic predictors of food safety practice.

Materials and Methods

Survey

In this study, a 3-point Likert scale was used, with each statement scored as (1) incorrect, (2) not sure, and (3) correct. The survey comprised socio-demographics (6 questions) and self-reported food safety practices (19 statements). Gender, age, monthly income, marital status, grade level, and internship status were the questions determining the socio-demographic profile of the respondents. Çelen and Avcikurt (2017) provided the framework of the survey statements. For a pilot study, the survey form was sent to 30 young food handlers who did not participate in the main study. The form was corrected by the feedback of the handlers about typos and the intelligibility of the text. Then, the consistency of the final version of the survey was measured using Cronbach's Alpha as 0.8. This value is greater than the acceptable level (0.7) according to Cortina (1993), showing that the food safety practice survey has good internal consistency.

Sampling and Data Collection

Using G*power software (3.1.9.4 version, 2019, Heinrich-Heine-Universität Düsseldorf, Düsseldorf, Germany), the minimum sample size was calculated as 200 (Figure S1) at the alpha level of 0.05, power level of 0.80, and effect size 0.25. However, 403 randomly selected participants with experience in food handling were involved in the study.

The data were collected online from culinary program graduates and students using convenience sampling. As the survey was voluntary, each respondent signed a voluntary participation form before scoring. All procedures were carried out by the World Medical Association Declaration of Helsinki and the ethical standards of the Turkish National Research Committee.

Statistical Analysis

The statistical analysis was performed using SPSS 23 (IBM, New York, USA). A frequency test was used for incorrect, not sure, and correct scores, cross-tabulation to show good practice levels with rates according to the socio-demographics, and variance analyses (Independent-samples t-test and ANOVA) to compare the survey scores of the young

food handlers. Binary logistic regression was carried out to find the socio-demographic predictors of food safety practice, and the results were interpreted using odds ratio (OR). Microsoft Excel (version 365, Microsoft Corporation, Washington, US) was also used to determine the young food handlers' food safety practice levels as "good" if they had a correct score rate of 60% or more. The results were considered significant for $p < 0.05$ at the 95% confidence interval.

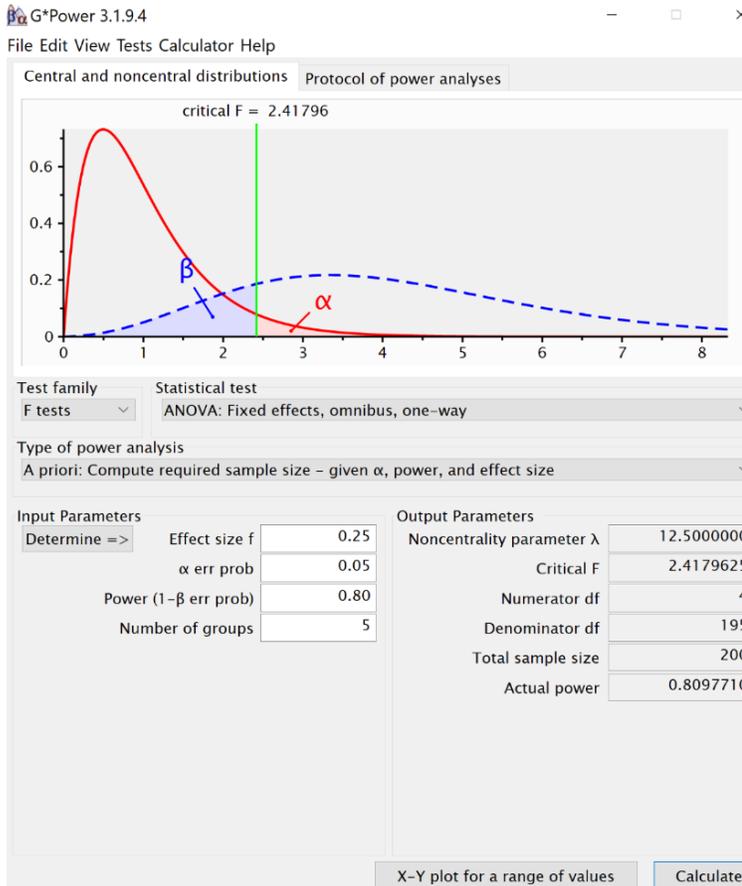


Figure S1. Sample size calculation in G*power

Results and Discussion

The socio-demographics of the young food handlers are presented in Table 1. 58.1% ($n = 234$) of the respondents were male; 56.3% ($n = 227$) were between 18-24 years old; 63.0% ($n = 254$) had an income of less than \$425; 69.7% ($n = 281$) were single; 55.3% ($n = 223$) were graduates and 74.9% ($n = 302$) had fulfilled their internship requirement.

The distribution of the practice scores is summarised in Table 2. The highest correct score (92.6%) was found in the statement, "It is enough to turn the same cutting board upside down to prepare raw and cooked foods in succession". Other

statements with a correct score rate higher than 90% were "Since the food is cooked, there is no harm in tasting it with a stirring spoon" with 90.8%; "I clean appliances after use" with 90.6%; "I wash my hands with hot water and soap before touching food" with 90.6%; and "I store food by the time of purchase, not the expiration date" with 90.1%.

Table 1. Socio-demographics of the young food handlers ($n = 403$)

Variables	Frequency	Percentage
Gender		
Female	169	41.9
Male	234	58.1
Age (years)		
18 - 24	227	56.3
25 - 30	176	43.7
Monthly income		
Less than \$ 425	254	63.0
\$ 425 - \$ 637	41	10.2
\$ 638 - \$ 850	62	15.4
More than \$ 850	46	11.4
Marital status		
Married	122	30.3
Single	281	69.7
Grade Level		
Student	180	44.7
Graduate	223	55.3
Internship status		
No	101	25.1
Yes	302	74.9

Similarly, in the Al-Kandari et al. (2019) study, food handlers strongly agreed with changing the cutting board (89.6%) after use for raw foods, and 93% of the food handlers avoided cross-contamination by using cutting boards correctly during food preparation. Another instance of high awareness about the use of kitchen utensils is that the stirring spoon is not used repeatedly to taste food. Double dipping, however, is widely observed in European TV cooking shows (Geppert et al., 2019). It is a disgusting habit and causes microorganisms to be transferred to food. This poor habit can be avoided mainly by having tasting spoons of a different shape from stirring spoons and keeping them readily available while cooking, as the food handlers of this study did. Therefore, the correct score may be high.

Considering awareness of appliance cleaning, it was reported that kitchen appliances were cleaned periodically (e.g., refrigerator cleaning at least once a month) by 58% of food handlers (Gilbert et al., 2007). Byrd-Bredbenner et al. (2007)

found that young food handlers scored less than 60% on appliance cleanliness, which was in line with their practice, as nearly half of the handlers were observed to have dirty kitchen appliances during the food safety audit. A double check at the end of the shift using a checklist can resolve these cleaning issues, and the participants of this study solved the problem with this control method.

From another aspect, cleaning appliances is necessary to prevent food from allergen contamination. The finding of the Galan-Malo et al. (2019) study is consistent with the effectiveness of cleaning on the removal of allergens, and it has been reported that cleaning with conventional detergents on food contact surfaces can remove 91% of remaining milk and 100% of egg and gluten residues.

As another cleaning practice, hand hygiene is an essential factor in controlling pathogens and cleaning the food preparation area. Still, hand washing with soap prevents food contamination (Codex Alimentarius, 2023). As in the present study, in the Moreb et al. (2017) study, most food handlers (85%) agreed that soap and warm water were necessary for proper hand washing, and likewise, Hassan and Dimassi (2014)

found that 87% of food handlers followed correct hand washing procedures.

As a high-scored food safety practice, the expiration date indicates freshness. Consumers feel safe consuming "fresh" products that do not contain microorganisms that degrade food quality or pathogens that cause foodborne disease (Fortin et al., 2009). Controlling expiration dates reduces the risk of purchasing a stale, degraded, or possibly spoiled product that may hurt the consumer's health. Some people, however, might deal with the sensory characteristics of foods rather than their expiration dates (Barone & Aschemann-Witzel, 2022). In some cases, since the expiration dates are not in the same place on every package, significantly visually impaired or elderly individuals cannot find or read the date on the label. According to Shiferaw et al. (2000), 50% of the individuals studied noticed food labels, and 87% were able to read them properly. However, the findings of this study do not coincide with these arguments; the food handlers note the opening date of the package next to the expiration date before using food-stuffs; thus, they are considered to have checked the expiration dates simultaneously. Therefore, the rate of correct scoring may have been unrealistically high.

Table 2. Score rates of food safety practice items

Statements	Correct (%)	Incorrect (%)	Not sure (%)
The food I prepare does not cause disease.	79.1	10.7	10.2
All the food I prepare is safe.	59.3	21.6	19.1
Nobody has ever become ill from the food I prepared.	67.0	9.4	23.6
I cook food at the right temperature.	87.6	2.2	10.2
I store food at the appropriate temperature.	87.1	2.2	10.7
I clean appliances after use.	90.6	1.7	7.7
I can explain with inner peace to the guests how I prepare the food.	77.2	9.6	13.2
I wash my hands with hot water and soap before touching food.	90.6	3.2	6.2
I wash my hands with hot water and soap after touching raw food.	85.9	3.2	10.9
Using expired food does not pose a risk. (-)	86.2	6.9	6.9
It is enough to turn the same cutting board upside down to prepare raw and cooked foods in succession.(-)	92.6	2.4	5.0
Vegetables to be cooked do not need to be washed.(-)	45.7	39.0	15.3
I wear gloves if I have cuts, wounds, or burns on my hand.	84.4	5.0	10.6
Since the food is cooked, there is no harm in tasting it with a stirring spoon.(-)	90.8	4.0	5.2
I store food by the time of purchase, not the expiration date. (-)	90.1	4.7	5.2
I can reduce the microorganism load by drying the utensils after washing them.	80.4	3.2	16.4
I do not keep raw meat at room temperature for over 2 hours.	85.1	3.2	11.7
If I am busy, I can skip washing my hands. (-)	43.9	49.4	6.7
I taste food with my finger. (-)	84.4	12.9	2.7

(-): Reverse-coded statements

On the other hand, the lowest correct score rates were calculated for the statements “If I am busy, I can skip washing my hands” (43.9%) and “Vegetables to be cooked do not need to be washed” (45.7%), respectively. The Clayton et al. (2015) study stated that the first food safety rule that some food workers skipped due to their workload was hand washing and changing gloves. In other words, the first rule food handlers bend when they are rushed has to do with personal hygiene. However, hand washing is critical to prevent 33% of gastrointestinal diseases (Food Safety, 2021) and many foodborne diseases caused by norovirus, *Campylobacter*, *Salmonella*, and *Escherichia coli* (CDC, 2022). For this reason, the awareness of food handlers should be increased by refresher hygiene training or by reminding handlers of the importance of handwashing while preparing food.

For the issue of washing raw materials, it was observed that the chefs in TV cooking shows also did not wash plant-based foods properly (Geppert et al., 2019). Physical (dust and soil), chemical (trace metals), and biological (spores of *Clostridium botulinum*, *Clostridium perfringens*, and *Bacillus cereus*) hazards can be eliminated via proper washing practice (Kaysner, 1999). Moreover, Badri et al. (2022), Dardona et al. (2021), and Dixon et al. (2013) reported a possible risk of infection by protozoan parasites (*Entamoeba histolytica*, *Cryptosporidium spp.*, *Giardia lamblia*, *Toxoplasma gondii*, *Plasmodium falciparum*) in improperly washed vegetables and fruits.

Another point to consider for washing is that accumulation of trace metals, such as lead (Pb) and chromium (Cr), in the body causes systemic severe health problems due to their cellular and neurological effects, in addition to oxidative stress induced by metal triggering free radical formation (Jaishankar et al., 2014; Martin & Griswold, 2009; Rai et al., 2019). The Nabulo et al. (2010) study also revealed a risk of trace metals in unwashed garden stuff. 90% of Pb traces are measured in edible portions of vegetables, and Pb is found 9 times more in unwashed vegetables than in washed ones. In addition, Nabulo et al. (2010) found that more than 30% of unwashed vegetables contained higher Pb concentration than the maximum limit (0.3 mg kg^{-1}), which is permitted in the EU (European Union, 2001). Like Pb, Cr concentration can be reduced by 21% by washing (Nabulo et al., 2010). Therefore, it is possible to reduce trace metal residues below the maximum permitted value by washing. This finding demonstrates that washing vegetables before preparation and consumption is critical for preventing physical, chemical, and biological hazards. Unfortunately, this process is not given enough attention by food handlers in this study. For overall assessment, all low-scoring practice statements are simple but

common mistakes in the commercial kitchen; however, it should be remembered that most foodborne diseases result from poor practice rather than poor food safety knowledge.

Levels of food safety good practice according to the socio-demographic profiles of the respondents are shown in Table 3. The rate of good practice of food safety among females (15.84 ± 1.98) is significantly higher than that of males (14.53 ± 3.40) at the conditions of $t(341.41) = 5.29$ and $p = 0.000$. In general, females prepare food more safely than males. This argument is in line with the research findings of the Sanlier (2010) study. This result may be because females perform more food preparation at home than males, making them more knowledgeable and experienced in safe food practices (Sanlier, 2010).

Considering the age groups, a significant difference was found between the respondents in the 18-24 (15.50 ± 2.23) age group and the 25-30 (14.53 ± 3.63) age group [$t(228.38) = 5.53$, $p = 0.000$]. Most (55.5%) of respondents in the 18-24 range are still students. These individuals are still taking applied food safety courses at university; this may explain this difference. Similar findings obtained in the Kang et al. (2010) study indicated that there was a negative correlation between age and food safety practice scores ($p < 0.05$). It was reported that food handlers aged 18-24 scored higher in the correct practice of food hygiene than individuals aged 25-35 (Islam et al., 2023).

In terms of grade level, the excellent practice levels of students (15.78 ± 1.96) were higher than those of graduates (14.51 ± 3.46), with values of $t(341.80) = 4.76$ at $p = 0.000$. It was an expected result that the correct food safety practice rates of students would be higher than those of graduates since the students had recently updated food safety knowledge and have been using this while preparing food at the university; education ameliorates the food safety practices of food handlers. Stein et al. (2010) also showed that the correct food safety practice level increased after individuals received training. In addition, these findings parallel the Nik Husain et al. (2016) study, which declares that safer food will be prepared through food safety training and that food handlers will be more competent in practice. When training is not carried out with practice, food safety rules are replaced by other priorities, such as the pressures of event, banquet or buffet meals, which should be prepared in food establishments with limited personnel, excessive workload, overtime, and extended working hours. For this reason, graduates' good food safety practice levels may be low. This context is also

revealed by Adesokan and Raji (2014), which show the negative relationship between working experience and food safety.

Another point to consider is that internship status significantly influences good practice levels. The levels of the respondents who did not fulfil an internship (15.43 ±2.08) were higher than the levels of those who had completed an internship (14.96 ±3.19) with values of $t(275.20) = 3.04$ at $p = 0.003$, although internship is the best way to turn theoretical knowledge into practice. Lema et al. (2020) showed that internship experience improves food safety practices. Astoundingly, this study determined that the internship negatively affected the food handlers' behaviour towards safe food preparation. When the places where the trainees had completed their internships were examined, it was seen that cafes and

restaurants were in the majority (60%). In addition, it was determined that some students (5%) were exempted from internships, while some (5%) did their internship in the cafeteria within the university. Accordingly, only 30% of these food handlers had internships in hotels and corporate catering companies. In other words, it can be said that the place of internship significantly affects the level of food workers' food safety practices. Jeinie et al. (2016) also emphasised the importance of the internship location and even the hotel type (business, resort, or boutique).

In contrast to these socio-demographic factors that change the levels of food safety practices of food handlers, food safety practice scores did not vary by income or marital status. Consequently, the best scores on safe food preparation in the current study were female students aged 18-24 who have not yet fulfilled their internship requirements.

Table 3. Comparison and logistic regression results for good practice level on food safety

Variables	Good practices of food handlers (%)	B	S.E.	OR (95% CI)	Significance
Gender					
Female	97.0 ^a			1.0	
Male	82.1 ^b	-1.6	0.5	0.2 (0.1, 0.6)	0.002***
Age (years)					
18 - 24	96.5 ^a			1.0	
25 - 30	77.8 ^b	-1.9	0.4	0.1 (0.1, 0.3)	0.000***
Monthly income					
Less than \$ 425	87.0			1.0	
\$ 425 - \$ 637	85.4	0.3	0.6	0.8 (0.3, 2.4)	0.649
\$ 638 - \$ 850	91.9	0.3	0.6	1.3 (0.4, 4.2)	0.618
More than \$ 850	93.5	1.2	0.7	3.3 (0.8, 13.2)	0.089
Marital status					
Married	86.1			1.0	
Single	89.3	0.6	0.4	1.8 (0.8, 3.8)	0.145
Grade Level					
Student	96.1 ^a			1.0	
Graduate	82.1 ^b	-2.1	0.8	0.1 (0.0, 0.6)	0.007***
Internship status					
No	95.0 ^a			1.0	
Yes	86.1 ^b	1.5	0.9	4.5 (0.8, 27.6)	0.100

***The values are significantly different at $p < 0.01$.

Omnibus Test of Model Coefficients: $\chi^2 = 70.9$, $df = 8$, $p = 0.0$.

Hosmer and Lemeshow Test: $\chi^2 = 14.4$ $df = 8$, $p = 0.1$.

Nagelkerke $R^2 = 0.3$

As shown in Table 3, the regression model for safe food preparation was utilised to find the influence of socio-demographic characteristics on the levels of good practice among young food handlers. The model was checked using Omnibus Tests of Model Coefficients ($\chi^2 = 70.9$, $df = 8$, $p = 0.0$). The Hosmer and Lemeshow Test ($\chi^2 = 14.4$, $df = 8$, $p = 0.1$) is the most reliable tool to test the goodness of model fit. The model could be accepted to predict sound practice effects because the p -value is more significant than 0.05 (Pallant, 2020). The model explains 31.4% (Nagelkerke R^2) of differences in young food handlers' good practices in safe food preparation. The model correctly predicted 88.1% (classification table value) of the observed poor or good practice levels. The results of binary regression showed that good practice levels for safe food preparation significantly varied according to gender, age, and grade level ($p < 0.01$). For gender groups, males were 0.2 times less likely than females to observe safe food practices. Likewise, Buccheri et al. (2007) predicted that females were more likely to behave safely while preparing foods because protective practices and risk perception are higher in females than in males (Shiferaw et al., 2000). For age groups, food handlers aged 25-30 were 0.1 times less likely to prepare food safely than those aged 18-24. Chuang et al. (2021) determined that young adults have more risky food practices due to inadequate cleaning habits and engaging in practices that cause cross-contamination. Older individuals' safer food preparation than younger ones was attributed to their exposure to more food safety education and practices over time in previous studies (Zorba & Kaptan, 2011). The results of this study follow the same rationale but in the opposite direction; since most individuals between the ages of 18-24 are students, continuing food safety education may have improved their level of safe food practice. On the other hand, these results suggested that food handlers aged 25-30 did not receive satisfactory food safety training in the food premises where they work. Similar to the results comparing age groups, the OR of 0.1 for the graduate level showed that the graduates were 0.1 times less likely to practice safe food preparation than the students. Moreover, income, marital status, and internship status were not predictors in the good practice model for food safety.

Conclusion

In the study, the safe food preparation levels of the students and graduates of the culinary programs who have taken theoretical and applied food safety courses at the university and who were at most 30 years old were evaluated by self-reported practice. The excellent practice rates of food handlers differed significantly according to gender, age, grade level

(student or graduate), and internship status. Still, no significant difference was found according to income or marital status. Gender, age, and grade level predicted the levels of food safety practice of the food handlers. In summary, it was determined that female students aged 18-24 were more likely to have good practice in food safety. These findings are essential in identifying risk groups of food handlers in the food sector and providing training on hazards. In further research, the sample can be divided into educated- and non-educated food handlers, and length of employment can be included in the demographics. Thus, the effect of experience on food safety practice will be examined. In addition, the results might be consolidated with one-on-one interview outputs using qualitative research methods.

Compliance with Ethical Standards

Conflict of interests: The author(s) declares that for this article, they have no actual, potential, or perceived conflict of interest.

Ethics committee approval: This study was approved by the Institutional Review Board of Amasya University (approval number is E-30640013-108.01-135629). Written informed consent was obtained from all study participants.

Data availability: The data and analysis steps of the study can be accessed at <https://data.mendeley.com/datasets/zf8wmrcc5v/1> (<https://doi.org/10.17632/zf8wmrcc5v.1>).

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