

Knowledge and practices of students receiving cooking education about food safety: The example of Istanbul province

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Abstract

Nutrition is the most basic need for a healthy life. Healthy food consumption depends on ensuring food safety. Food safety encompasses processes that protect food from physical, biological, and chemical hazards and prevent loss of nutritional value at all stages, from production to the table. In this cross-sectional study, a face-to-face survey was administered to 348 students (male: 183; female: 165) enrolled in three high schools of tourism and hotel management in Istanbul. The overall knowledge level about food safety was higher among female students (14.553.44) than among male students (13.57±3.55) ($p < 0.05$). The total food safety knowledge level scores for the classes were 13.37±3.50, 14.64±3.60, and 14.22±3.70 in the 10th, 11th, and 12th grades, respectively. A significant increase was detected from the 10th to the 11th grade, whereas the 12th-grade scores remained comparable to those of the 11th grade ($p < 0.05$). The results indicate the need to expand and sustain food safety education. In conclusion, the findings demonstrate that food safety education is a crucial tool for supporting access to healthy, safe food.

Keywords: Food safety, Food hygiene, Cooking, Food safety knowledge, public health, Culinary Education,

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Aşçılık eğitimi alan öğrencilerin gıda güvenliğine ilişkin bilgi ve uygulamaları: İstanbul ili örneği

Öz

Beslenme, sağlığın korunması ve geliştirilmesinde temel bir belirleyici olup sağlıklı beslenmenin sürdürülebilirliği gıda güvenliğinin etkin biçimde sağlanmasına bağlıdır. Gıda güvenliği (gıdaların fiziksel, biyolojik ve kimyasal tehlikelerden korunmasını, üretimden tüketime uzanan tüm aşamalarda besin değerinin muhafazasını ve güvenli tüketimin temin edilmesini amaçlayan uygulama ve süreçler bütünü) ifade eder. Bu kesitsel araştırmada, İstanbul'da bulunan üç farklı turizm ve otelcilik lisesinde aşçılık eğitimi alan toplam 348 öğrenci (183 erkek, 165 kadın) ile yüz yüze anket yöntemi kullanılarak veri toplanmıştır. Bulgular, genel gıda güvenliği bilgi düzeyi puanlarının kadın öğrencilerde ($14,55 \pm 3,44$) erkek öğrencilere ($13,57 \pm 3,55$) kıyasla anlamlı düzeyde daha yüksek olduğunu göstermiştir ($p < 0,05$). Sınıflara göre toplam gıda güvenliği bilgi düzeyi puanları 10., 11. ve 12. sınıflarda sırasıyla $13,37 \pm 3,50$, $14,64 \pm 3,60$ ve $14,22 \pm 3,70$ olarak belirlenmiştir. 10. sınıftan 11. sınıfa geçişte anlamlı bir artış saptanırken, 12. sınıf puanlarının 11. sınıf puanlarına benzer olduğu görülmüştür ($p < 0,05$). Elde edilen sonuçlar, gıda güvenliği eğitiminin yaygınlaştırılmasının ve sürekliliğinin sağlanmasının gerekliliğine işaret etmektedir. Sonuç olarak, elde edilen bulgular gıda güvenliği eğitiminin sağlıklı ve güvenli gıdaya erişimin desteklenmesinde potansiyel olarak önemli bir rol oynayabileceğine işaret etmektedir.

Anahtar Kelimeler: Besin güvenliği, besin hijyeni, aşçılık, gıda güvenliği bilgi düzeyi, halk sağlığı, aşçılık eğitimi,

Introduction

To sustain human life and protect health, it is essential to have access to safe and nutritious food and to consume sufficient, balanced amounts (WHO, 2006; FAO, 2022). Food safety is commonly defined as the assurance that food will not cause harm to consumers when prepared and/or consumed as intended (Codex Alimentarius Commission, 2020). Safe food preserves its nutritional value when prepared properly and does not contain physical, chemical, or microbiological contaminants (Akdoğan & Erol, 2023). Precautions should be taken to address biological, physical, and chemical hazards to ensure the availability of safe food (Pakdel et al., 2023; Michaels et al., 2024). These hazards cause foodborne diseases

and constitute a public health problem in many countries (Levy et al., 2022). Each year worldwide, unsafe food causes an estimated 600 million cases of foodborne diseases and 420,000 deaths, with a substantial share of deaths occurring among children under 5 years of age (WHO, 2015). Foodborne diseases are common in low- and middle-income countries due to inadequate food processing and sanitation practices, inadequate training of food personnel, limited food safety awareness, and deficiencies in regulatory systems (Desye et al., 2023). The WHO has emphasized five essential points in preventing foodborne diseases: keeping foods clean, separating raw and cooked foods, cooking thoroughly, storing foods at safe temperatures, and using safe water and raw materials (WHO, 2006). Food processors and consumers need to apply these key principles to ensure food is handled safely (WHO, 2006).

States and scientists have essential duties in ensuring and maintaining food safety. Legal regulations and research aim to ensure food safety from farm to table, thereby reducing food-related morbidity and mortality rates (Kocaman, 2015). In this context, food safety is supported through the Hazard Analysis and Critical Control Points (HACCP) system and ISO 22000-based food safety management approaches. In Türkiye, the legislative framework for food safety is primarily based on the Law on Veterinary Services, Plant Health, Food and Feed (Veteriner Hizmetleri, Bitki Sağlığı, Gıda ve Yem Kanunu [5996 SK], 2010: Madde 21) and related secondary regulations, including the Regulation on Food Hygiene (Gıda Hijyeni Yönetmeliği [GHY], 2011: Madde 11), which sets out hygiene requirements across the food chain and emphasizes risk-based controls aligned with HACCP principles. National studies conducted in Türkiye among culinary/gastronomy students and food service personnel also indicate that food safety knowledge levels may vary across groups and that specific knowledge gaps persist, highlighting the need for structured, continuous training (Tuncer & Akoğlu, 2020; Özcan, 2020; Terkuran, 2021).

Based on this, students who receive cooking education in Tourism and Hotel Management High Schools will soon become the most essential element in the tourism industry. Food safety education provided to these students will significantly enhance the quality and safety of food offered to customers visiting food and beverage businesses. The most critical area for providing food safety education is schools. It is one of the important issues

for students who will receive cooking education and work in the kitchen department or become food producers, offering safe food to consumers. Preventing students from spreading misinformation about food safety will be ensured through the training to be provided. Thus, kitchen students working in hotels and restaurants will be able to reduce risks to human health and prevent foodborne diseases. However, the literature provides relatively limited evidence on food safety knowledge levels among students receiving secondary-level culinary education in Türkiye, and the specific areas requiring further improvement are not always clearly described. This research aims to measure students' knowledge of food safety in secondary school cooking education. This study also aims to determine whether students receive food safety education and the extent of their knowledge in this area.

Materials and methods

This research was conducted in 2020 to determine students' knowledge levels in culinary education regarding food safety. The study was conducted in the city center of Istanbul at the secondary level of culinary education at Küçükçekmece IMKB Hotel Management Vocational High School, Zeytinburnu Hotel Management Vocational High School, and Tuzla Hotel Management Vocational High School. It consists of students in 10th, 11th, and 12th grade. The research universe comprised all 10th–12th-grade students enrolled in culinary programs in the participating schools during the study period. The study sample consists of students enrolled in culinary education programs at three vocational high schools, selected using simple random sampling. For this purpose, eligible student lists were obtained from the relevant school administrations, and students were selected by randomization. The sample consists of 348 students enrolled in a culinary education program. Ethical Permission was obtained from the Gedik University Ethics Committee (2020/03) before the research, and institutional permissions were obtained from the school administrations. Participation was voluntary, and students were informed that they could withdraw at any time without academic or administrative consequences. For students under 18 years of age, written parental/guardian consent was obtained in addition to the students' assent.

Data Collection- The research employed face-to-face interviews to assess the knowledge and practices of 10th-, 11th-, and 12th-grade students receiving training in tourism and hotel management in Istanbul,

specifically regarding food safety. The research data were collected using a questionnaire. This form was prepared to facilitate easy application and was compiled by the researcher from previously prepared similar sources (Erdem, 2014). Before administration, students were briefly informed about the purpose and scope of the study and data confidentiality; the questionnaire was completed anonymously and did not include personally identifiable information. The prepared questionnaire was administered to 348 students, and all completed questionnaires were collected. Accordingly, the questionnaire return rate was determined to be 100%.

Limitations and constraints of the study: This research is limited to secondary school students studying at Küçükçekmece Vocational High School, Zeytinburnu Vocational High School, and Tuzla Hotel Management and Tourism Vocational High School. The research is limited to evaluating questionnaire data on students' food safety knowledge and practices; therefore, the findings reflect self-reported data and cannot be interpreted as a direct observational assessment of behavior. The researcher's financial possibilities limit the research.

Analysis of data- The "SPSS (Statistical Package for Social Sciences) version 25" program was used to evaluate the data obtained in the study and create the tables. Frequency and percentage values were used to present categorical variables (demographic characteristics and question response distributions), and statistical analyses were performed using the Chi-Square (χ^2) test. Statistical significance was set at $p < 0.05$.

Results

In this part of the research, the distribution of 10th, 11th, and 12th-grade students is presented according to their gender, age, their status of following general information about food safety in visual and written media, and their perception of themselves as sufficient in this regard, as shown in Table 1. of the 348 students who participated in the research, 52.6% were male ($n=183$), 47.4% were female ($n=165$). Of the male students, 58.5% ($n=72$) were in the 10th grade, 42.9% ($n=42$) were in the 11th grade, and 54.3% ($n=69$) were in the 12th grade. of the female students, 41.5% ($n=51$) were in the 10th grade, 57.1% ($n=56$) were in the 11th grade, and 45.7% ($n=58$) were in the 12th grade. It was determined that 5.5% ($n=18$) of the participants were 15 years old, 47.4% ($n=124$) were 16 years old, 39.1% ($n=137$) were

17 years old, and 19.8% (n = 69) were between the ages of 18 and 19. While the rate of students who follow information about food safety in visual and written media is 10.3%, the rate of students who do not follow it is 89.7% (p < . While 41.4% of participants consider their knowledge of food safety sufficient, 58.6% do not (p > 0.05).

Table 1. Demographic information of participants

Variables	10th grade n (%)	11th grade n (%)	12th grade n (%)	Total n, %	χ^2 p
Gender					
Male (n-%)	72(58.5)	42(42.9)	69(54.3)	183(52.6)	p >0.05
Girl(n-%)	51(41.5)	56(57.1)	58(45.7)	165(47.4)	
Total(n-%)	123(100)	98(100)	127(100)	348(100)	
Age					
15(n-%)	18(14.6)	-	-	18(5.5)	* p<0.05
16(n-%)	85(69.1)	39(39.8)	-	124(47.4)	
17(n-%)	15(12.2)	50(51)	72(56.7)	137(39.1)	
18-19(n-%)	5(4.1)	9(9.2)	55(43.3)	69(19.8)	
Total(n-%)	123(100)	98(100)	127(100)	348(100)	
Status of the following general information on food safety in the visual and written media					
Following(n-%)	7(5.7)	16(16.3)	13(10.2)	36(10.3)	$\chi^2 = 0.655$ * p<0.05
Non-follower(n-%)	116(94.3)	82(83.7)	114(89.8)	312(89.7)	
Total(n-%)	123(100)	98(100)	127(100)	348(100)	
Distribution of food safety general information adequacy					
Yes(n-%)	47(38.2)	36(36.7)	61(48)	144(41.4)	$\chi^2 = 3.697$ p >0.05
No	76(61.8)	62(63.3)	66(52)	204(58.6)	
Total(n-%)	123(100)	98(100)	127(100)	348(100)	

Chi-Kare

Participants' general knowledge of food safety was assessed using the questions in Table 2. The participants' responses to food-safety questions, categorized by class level, are shown in Table 3. It was determined that participants' responses to the seventh and tenth questions were significant, resulting in a corresponding increase in

class level ($p < 0.05$). The understanding of cross-contamination related to chopping boards, clothing, and workbenches was assessed among students in the 10th, 11th, and 12th grades. Of the 10th graders, 55.3% responded "yes," 4% said "no," and 40.7% were unsure. Among 11th graders, 72.4% answered "yes," and 4.1% answered "no." In the 12th grade, 71.7% said "yes," while 4.7% said "no." Overall, 66.1% of all students confirmed awareness of cross-contamination.

Regarding damaged utensils, 80.5% of 10th graders responded "yes," 11.4% said "no," and 8.1% were unsure. Among 11th graders, 87.8% answered "yes," while 3.1% said "no." In the 12th grade, 70.9% responded "yes," and 18.9% said "no." Overall, 70.9% of all students recognized that damaged utensils should not be used.

Table 2. General information questions on food safety

Question 1: Food safety protects consumers from health risks.
Question 2: The most sought-after quality feature in food production is safety for health.
Question 3: Hands can be washed in dishwashing sinks in very urgent cases and when necessary.
Question 4: You can continue working after the wounds or cuts on your hand are taped.
Question 5: Some foods can be touched with bare hands if the hands are clean.
Question 6: Broken glass, hair, nails, etc., can be given as examples of biological pollution.
Question 7: Chopping boards, clothes, and workbenches are cross-contamination factors.
Question 8: If the can is bulging, dented, or damaged, it should never be used.
Question 9: Freezing food does not kill bacteria (it just stops their reproduction).
Question 10: Scratched, cracked utensils should not be used in food preparation and service.

Table 3. Distribution of participants' responses to general information questions on food safety

Answers to questions		10th grade (n:123) N(%)	11th grade (n:97) N(%)	12th grade (n:127) N(%)	Total (n:348) N(%)	χ^2	p
Question 1	Yes	94(76.4)	70(71.4)	95(74.8)	259(74.4)	8,307	0.81
	I do not know	28(22.8)	27(27.6)	25(19.7)	80(23)		
	No	1(0.8)	1(1)	7(5.5)	9(2.6)		
Question 2	Yes	116(94.3)	88(89.8)	113(89)	317(91.1)	4,131	0.389
	I do not know	6(4.9)	9(9.2)	10(7.9)	25(7.2)		
	No	1(0.8)	1(1)	4(3.1)	6(1.7)		
Question 3	Yes	64(52)	50(51)	62(48.8)	176(50.6)	3,548	0.471
	I do not know	23(18.7)	11(11.2)	23(18.1)	57(16.4)		
	No	36(29.3)	37(37.8)	42(33.1)	115(33)		
Question 4	Yes	78(63.4)	71(72.4)	76(59.8)	225(64.7)	4,394	0.355
	I do not know	15(12.2)	7(7.1)	15(11.8)	37(10.6)		
	No	30(24.4)	20(20.4)	36(28.3)	86(24.7)		
Question 5	Yes	84(68.3)	73(74.5)	78(61.4)	235(67.5)	8,695	0.069
	I do not know	10(8.1)	3(3.1)	5(3.9)	18(5.2)		
	No	29(23.6)	22(22.4)	44(34.6)	95(27.3)		
Question 6	Yes	115(74.7)	49(50)	66(52)	179(51.4)	0,311	0.989
	I do not know	34(22.1)	31(31.6)	41(32.3)	111(31.9)		
	No	5(3.2)	18(18.4)	20(15.7)	58(16.7)		
Question 7	Yes	68(55.3)	71(72.4)	91(71.7)	230(66.1)	11,299	0.023*
	I do not know	50(40.7)	23(23.5)	30(23.6)	103(29.6)		
	No	5(4)	4(4.1)	6(4.7)	15(4.3)		
Question 8	Yes	91(74)	79(80.6)	90(70.9)	260(74.7)	2,959	0.565
	I do not know	25(20.3)	14(14.3)	28(22)	67(19.3)		
	No	7(5.7)	5(5.1)	9(7.1)	21(6)		
Question 9	Yes	86(70)	77(78.6)	97(76.4)	260(74.7)	2,959	0.232
	I do not know	26(21.1)	17(17.3)	17(13.4)	60(17.2)		
	No	11(8.9)	4(4.1)	13(10.2)	28(8.1)		
Question 10	Yes	99(80.5)	86(87.8)	90(70.9)	275(79)	14,150	0.007*
	I do not know	10(8.1)	9(9.2)	13(10.2)	32(9.2)		
	No	14(11.4)	3(3.1)	24(18.9)	41(11.8)		

* Mann-Whitney U

The participants' responses to the food safety questions, categorized by gender, are presented in Table 4. Participants' responses to the third and eighth food safety questions, categorized by gender, were statistically significant ($p < 0.05$). In response to the statement, "Hands can be washed in dishwashing sinks in very urgent cases and when necessary," 51.4% of male students answered "yes," 26.8% answered "no," and 21.8% responded "I do not know." Among female students, 49.7% agreed with 'yes,' while 40% answered 'no,' and 10.3% said

‘I do not know.’ Overall, 50.6% of all students responded ‘yes,’ 33% answered ‘no,’ and 16.4% said ‘I do not know.’

Regarding the statement, "If the can is bent, it should not be used," 62.3% of male students agreed with "yes," 7.7% answered "no," and 30.1% responded "I do not know." For female students, 88.5% answered ‘yes,’ 4.2% said ‘no,’ and 7.3% responded ‘I do not know.’ In total, 74.7% of all students agreed with ‘yes,’ 6% answered ‘no,’ and 19.3% said ‘I do not know.’

Table 4. Distribution of participants' responses to general information questions about food safety by gender

Answers to questions		Male (n:183) N (%)	Women (n:165) N (%)	Total (n:348) N (%)	χ^2	p
Question 1	Yes	129(70.5)	130(78.8)	259(74.4)	3,243	0.198
	I do not know	49(26.8)	31(18.8)	80(23)		
	No	5(2.7)	4(2.4)	9(2.6)		
Question 2	Yes	168(91.8)	149(90.3)	317(91.1)	0.917	0.632
	I do not know	13(7.1)	12(7.3)	25(7.2)		
	No	2(1.1)	4(2.4)	6(1.7)		
Question 3	Yes	94(51.4)	82(49.7)	176(50.6)	11,712	0.003*
	I do not know	40(21.8)	17(10.3)	57(16.4)		
	No	49(26.8)	66(40)	115(33)		
Question 4	Yes	110(60.1)	115(69.7)	225(64.7)	3,490	0.175
	I do not know	22(12)	15(9.1)	37(10.6)		
	No	51(27.9)	35(21.2)	86(24.7)		
Question 5	Yes	125(68.3)	110(66.7)	235(67.5)	0.260	0.878
	I do not know	10(5.5)	8(4.8)	18(5.2)		
	No	33(21.4)	30(19.6)	63(20.5)		
Question 6	Yes	90(49.2)	89(53.9)	179(51.4)	4,682	0.096
	I do not know	55(30.1)	56(33.9)	111(31.9)		
	No	38(20.8)	20(12.1)	58(16.7)		
Question 7	Yes	119(65)	111(67.3)	230(66.1)	1,592	0.451
	I do not know	58(31.7)	45(27.3)	103(29.6)		
	No	6(3.3)	9(5.5)	15(4.3)		
Question 8	Yes	114(62.3)	146(88.5)	260(74.7)	33,026	0.001*
	I do not know	55(30.1)	12(7.3)	67(19.3)		
	No	14(7.7)	7(4.2)	21(6)		
Question 9	Yes	130(71)	130(78.8)	260(74.7)	3,717	0.156
	I do not know	34(18.6)	26(15.8)	60(17.2)		
	No	19(10.4)	9(5.5)	28(8)		
Question 10	Yes	138(75.4)	137(83)	275(79)	3,157	0.206
	I do not know	19(10.4)	13(7.9)	32(9.2)		
	No	26(14.2)	15(9.1)	41(11.8)		

*Chi-Kare

The total knowledge level scores for food safety are compared across demographic variables in Table 5. Grade-level differences in total knowledge score were significant (overall $p < 0.05$). Post hoc Bonferroni comparisons showed that 11th-grade students scored higher than 10th-grade students ($p < 0.05$), whereas 12th-grade scores did not differ from those of 11th-grade students ($p > 0.05$). Significant differences were found in participants' total knowledge scores on food safety, by gender, age, and perceived sufficiency ($p < 0.05$). As age and level of education increased, the total knowledge level score on food safety increased. The average score for female students was 14.55 ± 3.44 , while that for male students was 13.57 ± 3.55 . The average score of participants who consider their general knowledge of food safety to be sufficient is 13.64 ± 3.8 , and the average score of participants who do not believe their knowledge to be adequate is 14.31 ± 3.31 .

Table 5. Comparison results of total knowledge level scores on food safety according to demographic variables

Variables	n	$\bar{x}$	SS	Min	Max	Test	p
Gender							
Male	183	13.57	3.55	0	27	$f = 6.682$	0.01*
Girl	165	14.55	3.44				
Total	348	14.06	3.49				
Class							
10th Grade	123	13.37	3.5	0	27	$f = 3.841$	0.022*
11th Grade	98	14.64	3.66				
12th Grade	127	14.22	3.37				
Total	348	14.07	3.51				
Age							
15	19	11.42	4.1	0	27	$f = 3.865$	0.004*
16	124	13.73	3.44				
17	136	14.44	3.49				
18	65	14.6	3.36				
19	4	13.25	1.25				
Total	348	13.48	3.12				
Information on food safety in visual and written media							
Following	36	14.16	2.81	0	27	$f = 0.51$	0.821
Non-follower	312	14.02	3.6				
Total	348	14.09	3.2				
Distribution of food safety general information adequacy							
Yes	144	13.64	3.8	0	27	$f = 3.081$	0.08*
No	204	14.31	3.31				
Total	348	13.97	3.55				

Anova, Mann-Whitney U

Discussion

Retail and food service establishments are a common source of foodborne illness outbreaks (Angelo et al, 2013). From 2009 to 2015, 4,696 outbreaks were reported in the United States at a single establishment where food was prepared. Of these outbreaks, 87% were associated with retail or food service establishments, with the majority being restaurants (61%), catering services, or banquet facilities (14%) (Dewey-Mattia et al., 2018). Education of food handlers in retail and food service establishments is a crucial strategy for improving food safety. Many different types of education and training interventions, including training courses and workshops, informational posters, and other multifaceted approaches, have been developed and evaluated to improve food handlers' attitudes, beliefs, knowledge, and behaviors toward safe food handling (Soon et al, 2012) (Viator et al, 2015) (Zanin et al, 2017) (Clark et al, 2018). This study examined the level of food safety knowledge among students enrolled in culinary education programs to work or become managers in the food and beverage sector.

According to the research, in line with the literature, female students' food safety scores are higher than those of male students (Çakıroğlu & Uçar, 2008; Lazou et al., 2012; Sanlier et al., 2012). In addition, studies report that gender-related food safety knowledge scores are not statistically significant (Kocaman, 2015; Gözener & Büyükbay, 2009; Akbulut & Özkaya, 2016). In a similar study, it was found that consumers' food safety knowledge levels, categorized by gender, were not statistically significant (Özçelik et al., 2021). In this study, female students' total food safety knowledge level scores were higher than those of male students ($p<0.05$). The fact that the study results are in this direction does not mean that food safety knowledge scores will be interpreted differently according to gender.

In a study conducted among students of gastronomy and culinary arts, the food safety knowledge score was found to be significantly higher at higher grade levels (Akbulut & Özkaya, 2016). In a study comparing the knowledge levels of undergraduate students in food processing and food service with those of associate degree students, a statistically significant difference was found between the two groups (Uygun, 2017). In a similar study, food safety knowledge scores of food and beverage management students, by university level, were statistically significantly different from those of the control group (Kocaman, 2015). In another

study, it was observed that personnel hygiene knowledge scores, which play an essential role in food safety, were higher among participants with university education than among those with high school education ($p = <0.05$) (Ünlüönen & Cömert, 2013). According to the current study, the total knowledge score of students receiving culinary education regarding food safety was significantly associated with their grade level ($p < 0.05$). While the students' scores increased in line with the education they received, the 12th-grade students' scores decreased. This plateau/decrease in the final grade may indicate that food safety content is not sufficiently reinforced through periodic repetition and structured practical applications after a particular stage of the curriculum, and differences in internship/workplace exposure in the final year may also play a role. Therefore, it is possible that 12th-grade students may not retain theoretical knowledge to the same extent without continued reinforcement.

In the studies conducted, no relationship was found between food safety knowledge level scores and age (Gözener & Büyükbay, 2009; Ünlüönen & Cömert, 2013; Alintaş, 2021). In another study among university students, knowledge scores were higher among those aged ≤ 20 years than among those aged >20 years; however, this difference was not statistically significant (Sanlier et al., 2012). An attempt was made to determine the food safety knowledge and practices of cooks working in the hospital kitchen. When the scores of the cooks on food hygiene, personnel hygiene, kitchen equipment hygiene, and the total questions were compared across age groups, no significant difference was found (Bıyıklı, 2011). A study conducted with students at the School of Tourism Management and Hotel Management found a negative relationship between age and food safety knowledge ($p < 0.05$). It has been reported that this situation may be due to the closeness of the age distributions among university students (Kocaman, 2015). The current study found that the total knowledge level score regarding food safety increased with age ($p < 0.05$). However, the low total knowledge level score regarding food safety among 19-year-old students is due to the small number of students in that age group.

In risky situations concerning public health, communication among political authorities, industry, scientific institutions, civil society organizations, and society primarily occurs through the media (written, oral, and visual press) (Avşar et al., 2006). A study concluded that food safety knowledge increased when comprehensive coverage of food

safety was provided in both written and visual press publications (Meer & Misner, 2000). In Erdem's (2014) study, of the students who followed information about food safety from the media, 64.9% were in the 10th grade, and 69.3% were in the 12th grade, while of the students who did not follow, 35.1% were in the 10th grade, and 30.7% were in the 12th grade. It was observed that the rate of following information about food safety and nutrition from the media increased with grade level. In another similar study, 56.8% of students who followed food safety information in the press were high school students, and 53.8% were college students. The distribution of high school students who do not follow is 43.2%, and the distribution of college students is 46.2%. It is believed that the closeness of the rates of following and not following is not directly related to the culinary education received, but instead to the student's interest in this subject (Aratoğlu, 2015). Another study examining the extent to which individuals receiving culinary and pastry training followed food safety information in the media found that 86.08% of those who received education followed food safety information in the press, while 13.91% did not. It was determined that exposure to visual and written media on food safety and nutrition is directly proportional to educational level (Yılmaz & Nizamlioğlu, 2018). This study found that 5.7%, 16.3%, and 10.2% of 10th-, 11th-, and 12th-grade students, respectively, followed general food safety information in the visual and written media. In this context, it can be assumed that students were exposed to general information about food safety through various media, including visual and written materials, as well as the education they received. While 10.3% of the 348 students who participated in the study followed food safety information, 89.7% did not. As can be understood from this, the high rate of students who did not follow is unrelated to the culinary education they received. However, it may be related to the student's interest in this subject.

Erdem (2014) reported that among 10th-grade students who consider their knowledge of food safety sufficient, the rate is 18.8%, and among 12th-grade students, it is 28.1% (Erdem, 2014). In a similar study, 26.1% of high school students and 36.5% of college students reported proficiency in food safety (Aratoğlu, 2015). In this study, the rate of 10th-grade students who consider their general knowledge of food safety sufficient is 38.2%, 36.7% for 11th-grade students, and 48% for 12th-grade students ($p > 0.05$). When the total knowledge level scores on food safety are examined, the rate of students who

consider themselves sufficient is 13.64 ± 38 , while the rate of students who do not consider themselves sufficient is 14.3131 ($p < 0.05$). The increase in the proportion of students who consider their general knowledge of food safety sufficient across higher grades is consistent with the literature. However, no significant differences were observed in the general knowledge scores related to food safety and the overall knowledge level scores. In this case, the quality of education and practical studies, as well as students' perspectives on this topic, should be reviewed to help students feel more confident in their food safety knowledge.

Cross-contamination can occur from workers, surfaces that food comes into contact with, and other foods (Çetin, 2022). In a study conducted in this context, 73.9% of culinary education students responded 'yes', 20.2% 'sometimes', and 5.9% 'no' to the statement, 'Work clothes, benches, and tools used in chopping are contagion factors.' It has been observed that the number of students who answered 'yes' increased with grade level (Erdem, 2014). In a similar study, the same statement was asked of high school and college students. College and high school students responded 'yes' at 95.2% and 81.1%, respectively. Of the total students, 87.9% responded 'yes', 1.4% answered 'no', and 10.7% 'I do not know'. This study found that students were aware of cross-contamination ($p < 0.001$) (Aratoğlu, 2015). In another study, high school students in the food and beverage program were asked: 'I use the same knife and chopping board for vegetables I use for meat.' Of the students, 59.9% reported not using the same equipment, while 6.8% reported using it (Onur, 2018). In the current study, consistent with the literature, students' responses to the cross-contamination question were associated with a higher grade level ($p < 0.05$). In this context, it is believed that the students received the necessary training on cross-contamination.

In Aratoğlu's (2015) study, students receiving culinary training were asked about the statement, "Scratched and cracked kitchen utensils should not be used in food preparation and serving." College and high school students answered 'yes' at a rate of 80.8% and 100%, respectively. Of the total students, 80.9% answered 'yes', 14% answered 'no', and 5.1% answered 'I do not know' ($p > 0.05$) (Aratoğlu, 2015). In a similar study, the same statement was asked of students receiving

culinary education. Of the 11th-grade students, 75.3% answered 'yes,' and of the 12th-grade students, 76.5% answered 'yes.' Of the total students, 75.9% answered 'yes', 14.3% 'sometimes', and 9.8% 'no' ($p>0.05$) (Erdem, 2014). Similar results were found in this study. Of the 10th-grade students, 80.5%, of the 11th-grade students, 87.8%, and of the 12th-grade students, 70.9% answered 'yes' ($p = 0.05$). Thus, it was determined that the students were aware of the proper use of kitchen utensils for preparing, cooking, and serving food. Scratched and cracked utensils should not be used to prepare and serve food. If used, food items that accumulate in damaged areas can increase microorganism levels over time and pose a health risk (Kizen, 2018). Some mistakes in preparing and serving food and beverages include failing to use hand-washing and food-preparation sinks for their intended purposes (Sevim, 2015). Since handwashing sinks are used for hand cleaning during production, food, tools, and equipment should not be washed in these sinks (Sanlier & Sezgin, 2017). In this context, kitchen sinks and hand-washing sinks should be located in separate areas, and kitchen sinks should be used exclusively for cleaning food, tools, and equipment (Kizen, 2018). In a study, high school and college students were asked: 'Hands can be washed in dishwashing sinks in urgent cases and when necessary.' Among high school students, 33.3% answered 'yes', 35.1% answered 'no', and 31.5% answered 'I do not know'. Of the college students, 45.2% said 'yes', 45.2% said 'no', and 9.6% said 'I do not know'. Of the total students, 39.1% said 'yes', 40% said 'no', and 20.9% said 'I do not know' ($p < <0.05$) (Kizen, 2018). In a similar study, as grade level increased, 'yes' and 'sometimes' responses to this question decreased, while 'no' responses increased ($p < 0.05$) (Erdem, 2014). In this study, as the grade level increased, the 'yes' answer to the question decreased while the 'no' answer increased. The majority of students answered 'yes' ($p > 0.05$). Compared to females, males gave the 'yes' answer more often ($p < <0.05$). As a result, it was understood that hands should not be washed in sinks in case of an emergency, and this understanding increased with grade level ($p < 0.05$). It was determined that male students were less aware of this issue than female students ($p < 0.05$).

Canned foods are dangerous due to the microorganism *Clostridium botulinum*. Burst and bulging cans should not be used (Doğan, 2022). The hotel kitchen staff was asked: "If the can is bulging, it should

not be used.” Of the hotel kitchen staff, 82.7% answered ‘correct’, 7.3% answered ‘incorrect’ (Bayram & Ersoy, 2023). In another study, most participants responded to the same question with a ‘yes’ (Erdem, 2014). In another similar study, the question ‘Can bulging, dented, or damaged cans be used?’ was asked, and all employees answered ‘no’ (Sanlier & Tunc, 2008). In this study, when the statement ‘If it can bulge, it should not be used.’ was examined across all grade levels, the majority of students answered ‘yes.’ At the same time, when students’ gender was compared to this statement, it was found that female students were more aware of this issue, but the difference was not statistically significant ($p>0.05$). As this shows, products with curved cans pose a risk to human health and can cause food poisoning.

Conclusion

This study found a significant difference between the students’ food safety knowledge scores and the education they received (Tables 3 and 4). This may be related to the fact that food safety concepts are introduced relatively recently in the lower grades. Although higher scores might be expected in upper grades, the lack of marked improvement among 12th-grade students may suggest that the training is not sufficiently reinforced through periodic repetition and practical components. Although the number of students who follow food safety information through the media increases with grade level, the number who do not is considerable. Thus, students may not consider their general knowledge of food safety sufficient. This situation can be associated with the quality of their education and the students’ interests. Therefore, incorporating age-appropriate food safety content earlier in the curriculum and strengthening it across educational stages may be beneficial.

Additionally, it would be beneficial to reinforce food safety training regularly after high school and university. In-service training should also be supported by authorized institutions and individuals in working life. The knowledge and application behaviors of students working in the food and beverage sector regarding food safety, which can lead to health problems, should be monitored by expert educators, and their deficiencies should be addressed through active kitchen applications. In addition, visual and written materials should be emphasized in education at primary, secondary, and tertiary levels,

as well as in working life, and information should be translated into practical behavior. As a result, it is crucial to enhance the quality of the education provided, utilize general information about food safety more accurately, and take the necessary precautions to ensure food safety.

Conflict of interest statement

There is no conflict of interest between the authors.

Ethics committee statement

This study was approved by the Ethics Committee of Istanbul Gedik University (Decision Date: June 3, 2020; Decision No: 2020/03). Informed consent was obtained from all participants, and the research was conducted in accordance with the principles of the Declaration of Helsinki.

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