

Eurasian consumers' food safety beliefs and trust issues in the age of COVID-19: evidence from an online survey in 15 countries

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Abstract

BACKGROUND: This investigation provides an important insight into Eurasian consumers' food safety beliefs and trust issues influenced by the COVID-19 pandemic. An online survey was conducted in 15 European and Asian countries involving more than 4000 consumers.

RESULTS: It has confirmed that different socioeconomic characteristics, cultural aspects and education levels shape food safety perceptions within Eurasian countries. The COVID-19 pandemic influenced their beliefs and trust in food safety, which is relatively low on average. However, it is significantly higher for European consumers (especially European Union ones) compared to their Asian counterparts. Both Asian and European respondents agreed that food fraud and climate changes represent a food safety issue. However, European consumers were less concerned regarding the food safety of genetically modified foods and meat and dairy analogs/hybrids. Asian consumers were, to a greater extent, worried about the risk of getting COVID-19 from food, restaurants, food retail establishments and home food deliveries.

CONCLUSION: Eurasian consumers have put their greatest extent of trust, when food safety assurance is concerned, into food scientists and food producers holding a food safety certificate. Broadly, they are uncertain to what extent their federal governments and food inspectors are competent, able and efficient in ensuring food safety. Higher education of Eurasian consumers was followed by increased food safety confidence in all parts of the food chain.

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INTRODUCTION

Although generally avoidable, foodborne diseases are still a part of our lives and remain accountable for hundreds of millions of illnesses, hundreds of thousands of premature deaths and an overwhelming number of disability-adjusted life years annually.^{1–3} Without a doubt, food safety is still an important concern for public health worldwide.

Consumer trust is an essential element of the food market, without whom selling and purchasing existing or developing new

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types of food types would be almost impossible.⁴ We also already know that trust can vary widely between countries in the East and West^{5,6} and between European Union (EU) and non-EU countries. The sophistication of the contemporary food industry may also (negatively) affect trust,⁷ as well as the globalization of the food market that made consumers distanced from the food sources.⁸ Trust in food safety is a complex theory, including multiple dimensions that different factors can alter; for example, (inter)national food scandals and crises, such as mad cow disease in the UK, Japan, and Canada^{9–11} or dioxin in Belgium.¹² Although the COVID-19 pandemic did not compromise food safety in general,¹³ it most definitely had an impact on consumer purchasing and eating behavior,^{14,15} demands,¹⁶ shopping preferences,¹⁷ consumption expenditures¹⁸ and even quantities of food waste.¹⁹ However, evidence of how the COVID-19 pandemic affected consumer trust in food safety is scarce.

On the other hand, trust can also be explained as the personal and idiosyncratic response (based on feeling or intuition) to the objective notion of 'risk', which can be statistically calculated in an ideal scenario.⁹ Consumer risk awareness plays a crucial role in food safety because it indicates how they comprehend the presence of physical, chemical or biological contaminants and their association with certain types of foods or places of consumption. This strongly reflects an individual's belief regarding the amount of health risk, influencing consumers' choices and willingness to buy food.²⁰ A recent review on this important topic clarified that sociodemographic characteristics influence food safety risk perception²⁰ and that the latest food safety studies should focus more on understanding individuals' motivations and beliefs about food safety in specific cultural contexts.^{21,22} The latter review also noted that most food safety (consumer-related) studies originated from USA and UK. The premise was that the lack of studies from third-world and developing countries resulted from the absence of interest in this subject because of consumers' lack of education and training and therefore their modest impact on food safety.²³

With this survey, we aim to determine whether quite the opposite is true. The less educated and inadequately trained consumers have a more significant (negative) impact on food safety, making them highly relevant for scientific research. Therefore, this consumer survey targeted 15 Eurasian countries that have not been investigated intensely before, including the developing ones with low and middle incomes. We hypothesize that different socioeconomic characteristics, cultural aspects and education levels shape food safety perceptions within Eurasian countries. We also assume the COVID-19 pandemic influenced consumers' beliefs and trust in food safety.

MATERIALS AND METHODS

Survey and questionnaire

The survey was conducted through an online questionnaire, from March until September 2022, directed at 4500 consumers of 15 different Eurasian countries (Armenia, Bosnia & Herzegovina, China, Croatia, Germany, Greece, India, Italy, North Macedonia, Poland, Russia, Serbia, Slovakia, Spain and Turkey). Both countries and their consumers were collected by convenience along with probability sampling via social media and e-mail using an online platform (Slido; <https://www.slido.com>), by volunteers, aged over 18 years, not financially rewarded, and randomly recruited through networks of families, friends, relatives and their networks. Sex, age and education level, as demographic characteristics,

were not stratified because of resource restrictions with respect to interviewing 15 countries at the same time. Respondents were given a brief explanation of the aims of the research at the beginning of questionnaire. All study procedures were conducted in line with Codex of professional ethics of the University of Belgrade.²⁴ The questionnaire was initially developed in English language and then translated into local languages by professional translators, using the procedure of back-translation as explained in Maneesriwongul and Dixon.²⁵ Only the fully answered questionnaires ($n = 4129$) were considered for data analysis. The demographic characteristics of the sample are depicted in Table 1.

A questionnaire containing four parts has been developed to investigate consumers' food safety beliefs and trust issues in the age of COVID-19, as an addition to similar research and questionnaires that we have already used in our previously published investigations.^{13,22,26} The first part was about the participants' main demographic characteristics, including country, sex, age, education, size and type of household. The second consisted of six statements regarding their food safety beliefs about meat, dairy and their analogs, freshly sourced food, and different food safety topics, including food fraud, climate changes and genetically modified (GM) food. The third one was about consumer concerns directly related to COVID-19 and consisted of five questions. For the second and the third part of the questionnaire, respondents were given the choice to rate their degree of agreement according to a five-point Likert scale from 1 'strongly disagree', 2 'disagree', 3 'no opinion', 4 'agree' to 5 'strongly agree'. The fourth and final part (11 questions) investigated the extent of

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Table 1. Demographic characteristics of the sample (N = 4129)

	AM (n = 229)	BA (n = 207)	CN (n = 334)	HR (n = 213)	DE (n = 328)	GR (n = 268)	IN (n = 289)	IT (n = 255)	MK (n = 206)	PL (n = 305)	RU (n = 301)	RS (n = 301)	SK (n = 211)	ES (n = 369)	TR (n = 313)
Gender															
Male	1503 (36.4%)	50 (21.8%)	114 (34.1%)	61 (28.6%)	164 (50%)	101 (37.7%)	98 (33.9%)	106 (41.6%)	90 (43.7%)	105 (34.4%)	104 (34.6%)	116 (38.5%)	54 (25.6%)	169 (45.8%)	119 (38%)
Female	2626 (63.6%)	179 (78.2%)	220 (65.9%)	152 (71.4%)	164 (50%)	167 (62.3%)	191 (66.1%)	149 (58.4%)	116 (56.3%)	200 (65.6%)	197 (65.4%)	185 (61.5%)	157 (74.4%)	200 (54.2%)	194 (62%)
Age (years)															
Below 35	2099 (50.8%)	100 (43.7%)	302 (90.4%)	111 (52.1%)	85 (25.9%)	188 (70.1%)	278 (96.2%)	75 (29.4%)	94 (45.6%)	143 (46.9%)	101 (33.4%)	160 (53.2%)	76 (36.0%)	93 (25.2%)	235 (75.1%)
35–60	1626 (39.4%)	113 (49.3%)	31 (9.3%)	91 (42.7%)	151 (46%)	75 (28%)	7 (2.4%)	84 (32.9%)	102 (49.5%)	146 (47.9%)	142 (47%)	132 (43.9%)	95 (45.0%)	251 (68%)	74 (23.6%)
Above 60	404 (9.8%)	16 (7%)	1 (0.3%)	11 (5.2%)	92 (28%)	5 (1.9%)	4 (1.4%)	96 (37.6%)	10 (4.9%)	16 (5.2%)	58 (19.5%)	9 (3%)	40 (19.0%)	25 (6.8%)	4 (1.3%)
Household members															
1 person	485 (11.7%)	3 (1.3%)	20 (6%)	27 (12.7%)	71 (21.6%)	81 (30.2%)	21 (7.3%)	37 (14.5%)	3 (1.5%)	38 (12.5%)	50 (16.6%)	21 (7.0%)	26 (12.3%)	43 (11.7%)	26 (8.3%)
2 persons	899 (21.8%)	25 (10.9%)	33 (9.9%)	52 (24.4%)	146 (44.5%)	59 (22%)	27 (9.3%)	85 (33.3%)	20 (9.7%)	68 (22.3%)	92 (30.6%)	60 (19.9%)	60 (28.4%)	83 (22.5%)	50 (16%)
3 persons	842 (20.4%)	40 (17.5%)	89 (26.6%)	57 (26.8%)	57 (17.4%)	41 (15.3%)	38 (13.1%)	41 (16.1%)	50 (24.3%)	63 (20.7%)	72 (23.9%)	64 (21.3%)	40 (19.0%)	87 (23.6%)	52 (16.6%)
4 persons	1229 (29.8%)	77 (33.6%)	99 (29.6%)	50 (23.5%)	35 (10.7%)	63 (23.5%)	87 (30.1%)	73 (28.6%)	91 (44.2%)	84 (27.5%)	49 (16.3%)	85 (28.2%)	62 (29.4%)	113 (30.6%)	185 (59.1%)
More than 4	674 (16.3%)	84 (36.7%)	23 (7.1%)	27 (12.7%)	19 (5.8%)	24 (9%)	116 (40.1%)	19 (7.5%)	42 (20.4%)	52 (17%)	38 (12.6%)	71 (23.6%)	23 (10.9%)	43 (11.7%)	0 (0%)
With children?															
Yes	1838 (44.5%)	140 (61.1%)	119 (35.6%)	103 (48.4%)	96 (29.3%)	90 (33.6%)	139 (48.1%)	44 (17.3%)	133 (64.6%)	170 (55.7%)	144 (47.8%)	159 (52.8%)	97 (46%)	152 (41.2%)	131 (41.9%)
No	2291 (55.5%)	89 (38.9%)	215 (64.4%)	110 (51.6%)	232 (70.7%)	178 (66.4%)	150 (51.9%)	211 (82.7%)	73 (35.4%)	135 (44.3%)	157 (52.2%)	142 (47.2%)	114 (54%)	217 (58.8%)	182 (58.1%)
Education															
High school and lower	545 (13.2%)	41 (17.9%)	26 (7.8%)	39 (18.3%)	30 (9.1%)	20 (7.5%)	7 (2.4%)	77 (30.2%)	23 (11.2%)	52 (17%)	17 (5.6%)	73 (24.3%)	49 (23.2%)	18 (4.9%)	51 (16.3%)
Student	624 (15.1%)	0 (0%)	29 (8.7%)	21 (9.9%)	191 (58.2%)	73 (27.2%)	41 (14.2%)	8 (3.1%)	44 (21.4%)	53 (17.4%)	27 (9.0%)	37 (12.3%)	29 (13.7%)	16 (4.3%)	34 (10.9%)
Bachelor and higher	2960 (71.7%)	188 (82.1%)	283 (84.7%)	153 (71.8%)	107 (32.6%)	175 (65.3%)	241 (83.4%)	170 (66.7%)	139 (67.5%)	200 (65.6%)	257 (85.4%)	191 (63.5%)	133 (63.0%)	335 (90.8%)	228 (72.8%)

Note: n represents the number of interviewees; (%) represents their share in the sample.

Abbreviations: AM, Armenia; BA, Bosnia and Herzegovina; CN, China; HR, Croatia; DE, Germany; GR, Greece; IN, India; IT, Italy; MK, North Macedonia; PL, Poland; RU, Russia; RS, Serbia; SK, Slovakia; ES, Spain; TR, Turkey.

Table 2. Differences in food safety beliefs per country ($N = 4129$)

	Total	AM	BA	CN	HR	DE	GR	IN	IT	MK	PL	RU	RS	SK	ES	TR
S1. I believe the food I eat is safe	3.2 ± 1.1	2.7 ± 1.3 a	2.7 ± 1.1 a	3.2 ± 0.7	3.4 ± 1.0	3.9 ± 1.3 d	3.2 ± 1.0	3.5 ± 1.1 d	3.3 ± 1.0 c	3.0 ± 1.1	3.1 ± 1.1	3.3 ± 1.0 c	3.0 ± 1.0	3.0 ± 1.1 b	3.9 ± 1.0 d	2.7 ± 1.2 a
S2. I believe climate changes represent a food safety issue	3.9 ± 1.0	3.8 ± 1.0	3.8 ± 1.1	4.1 ± 0.7 d	3.9 ± 0.8	4.1 ± 1.1 d	4.0 ± 0.8	4.0 ± 0.8	4.1 ± 0.9 d	3.7 ± 1.0 b	4.0 ± 0.9	3.2 ± 1.0 a	3.6 ± 0.9 b	3.7 ± 1.0 b	3.9 ± 1.0	3.8 ± 1.0
S3. I believe food fraud (untruthful description of the origin of food, its composition and how it has been obtained and/or prepared) represents a food safety issue	4.2 ± 0.9	4.1 ± 0.9	4.3 ± 0.9	4.2 ± 0.7 b	4.4 ± 0.7	4.1 ± 1.1 a	4.3 ± 0.9	4.1 ± 0.8 a	4.4 ± 0.8 c	4.2 ± 0.8 b	4.4 ± 0.7	4.0 ± 1.0 a	4.2 ± 0.9 b	4.3 ± 0.8	4.2 ± 0.9	3.9 ± 1.0 a
S4. I believe eating freshly sourced foods represents a food safety issue	3.0 ± 1.2	3.2 ± 1.2 c	3.2 ± 1.1 c	4.0 ± 0.8 d	2.6 ± 1.0 b	2.5 ± 1.3 b	4.1 ± 0.8 d	3.1 ± 1.1 c	2.0 ± 0.9 a	3.3 ± 1.2	2.4 ± 0.9 b	3.5 ± 1.0	3.6 ± 1.0	2.3 ± 0.9 b	2.0 ± 0.9 a	3.1 ± 1.1 c
S5. I believe eating meat and dairy products represents a food safety issue	2.9 ± 1.2	3.1 ± 1.3	3.4 ± 1.1 e	3.4 ± 1.1	2.6 ± 1.0	3.0 ± 1.4 c	3.8 ± 0.9 e	3.1 ± 1.1	2.2 ± 1.0 b	3.2 ± 1.1 d	2.4 ± 1.1 b	3.4 ± 1.2 e	3.2 ± 1.1 d	2.4 ± 1.0 b	1.9 ± 0.9 a	2.8 ± 1.2 c
S6. I believe eating meat and dairy analogs/hybrids represents a food safety issue	3.2 ± 1.1	3.8 ± 1.1 d	3.3 ± 1.0	3.7 ± 1.0	2.7 ± 0.9 a	3.0 ± 1.5 a	3.9 ± 0.8 d	3.3 ± 1.0	2.8 ± 1.1 a	3.2 ± 1.1	3.0 ± 1.0	3.3 ± 1.2	3.6 ± 1.0 c	3.3 ± 0.9 c	2.8 ± 1.1 a	3.1 ± 1.0 b
S7. I believe genetically modified food represents a food safety issue	3.6 ± 1.2	3.8 ± 1.0 c	4.1 ± 1.1 c	3.8 ± 1.0	3.3 ± 1.3	3.8 ± 1.2	4.0 ± 0.9 c	3.4 ± 1.0 b	3.1 ± 1.1 a	3.5 ± 1.1 b	3.1 ± 1.2 a	3.4 ± 1.2 b	3.9 ± 1.0 c	3.6 ± 1.1 b	2.9 ± 1.2 a	3.9 ± 1.1 c
S8. I am concerned about a risk of getting COVID-19 from food in general	2.4 ± 1.2	3.0 ± 1.5 d	2.4 ± 1.0 c	3.3 ± 1.0 d	2.0 ± 0.9 a	2.3 ± 1.0	2.5 ± 1.1 c	3.1 ± 1.1 d	1.7 ± 0.8 a	2.0 ± 1.0 a	2.1 ± 0.9	2.2 ± 1.1 b	2.2 ± 1.0 b	2.1 ± 0.9	1.7 ± 0.9 a	2.8 ± 1.2 c
S9. I am concerned about a risk of getting COVID-19 from food served in restaurants	2.6 ± 1.2	3.1 ± 1.4 c	2.6 ± 1.1	3.3 ± 1.0	2.1 ± 1.0 a	2.3 ± 1.1 b	2.9 ± 1.2	3.6 ± 0.9 d	2.0 ± 1.0 a	2.4 ± 1.1 b	2.4 ± 1.0 b	2.3 ± 1.2	2.4 ± 1.0 b	2.2 ± 0.9	1.8 ± 1.0 a	3.1 ± 1.2 c
S10. I am concerned about a risk of getting COVID-19 from food delivered to my home	2.6 ± 1.2	3.2 ± 1.4 c	2.7 ± 1.1 b	3.8 ± 0.8 d	2.1 ± 0.9 a	2.3 ± 1.0	2.7 ± 1.1 b	3.5 ± 1.0 d	2.0 ± 1.0 a	2.4 ± 1.1	2.4 ± 1.0	2.4 ± 1.2	2.3 ± 1.0	2.2 ± 0.9 a	1.9 ± 1.0 a	3.1 ± 1.2 c
S11. I am concerned about a risk of getting COVID-19 from food bought in a store/supermarket	2.5 ± 1.2	3.0 ± 1.3 c	2.4 ± 1.1 b	3.4 ± 1.0 d	2.0 ± 0.8 a	2.4 ± 1.1 b	2.6 ± 1.1	3.4 ± 1.0 d	1.8 ± 0.9 a	2.2 ± 1.0	2.3 ± 1.0 b	2.3 ± 1.2 b	2.2 ± 0.9	2.1 ± 1.0	1.8 ± 0.9 a	3.1 ± 1.2 c

Note: The mean ± SD values were obtained from the raw data. Items denoted with different letters are significantly different at the level of 5%. Likert scale: (1) 'strongly disagree', (2) 'disagree', (3) 'no opinion', (4) 'agree', (5) 'strongly agree'.

Abbreviations: AM, Armenia; BA, Bosnia and Herzegovina; CN, China; HR, Croatia; DE, Germany; GR, Greece; IN, India; IT, Italy; MK, North Macedonia; PL, Poland; RU, Russia; RS, Serbia; SK, Slovakia; ES, Spain; TR, Turkey.

Table 3. Description of the (food safety beliefs) clusters in terms of country, gender, age, and education

		Cluster 1 (n = 1817)	Cluster 2 (n = 2312)	Total (N = 4129)
Country	Armenia	139 (60.7%)	90 (39.3%)	229 (100%)
	Bosnia and Herzegovina	94 (45.4%)	113 (54.6%)	207 (100%)
	China	301 (90.1%)	33 (9.9%)	334 (100%)
	Croatia	54 (25.4%)	159 (74.6%)	213 (100%)
	Germany	90 (27.4%)	238 (72.6%)	328 (100%)
	Greece	150 (56%)	118 (44%)	268 (100%)
	India	236 (81.7%)	53 (18.3%)	289 (100%)
	Italy	35 (13.7%)	220 (86.3%)	255 (100%)
	North Macedonia	78 (37.9%)	128 (62.1%)	206 (100%)
	Poland	106 (34.8%)	199 (65.2%)	305 (100%)
	Russia	126 (41.9%)	175 (58.1%)	301 (100%)
	Serbia	116 (38.5%)	185 (61.5%)	301 (100%)
	Slovakia	42 (19.9%)	169 (80.1%)	211 (100%)
	Spain	51 (13.8%)	318 (86.2%)	369 (100%)
	Turkiye	199 (63.6%)	114 (36.4%)	313 (100%)
Gender	Male	597 (39.7%)	906 (60.3%)	1503 (100%)
	Female	1220 (46.5%)	1406 (53.5%)	2626 (100%)
Age (years)	Below 35 years of age	1105 (52.6%)	994 (47.4%)	2099 (100%)
	Between 35 and 60 years of age	561 (34.5%)	1065 (65.5%)	1626 (100%)
	Over 60 years of age	151 (37.4%)	253 (62.6%)	404 (100%)
Education	High school or lower	277 (50.8%)	268 (49.2%)	545 (100%)
	Student	254 (40.7%)	370 (59.3%)	624 (100%)
	Bachelor and above	1286 (43.4%)	1674 (56.6%)	2960 (100%)
Food safety beliefs statements		Mean $\pm$ SD ¹	Mean $\pm$ SD ¹	Mean $\pm$ SD ¹ Mode ²
S1. I believe the food I eat is safe		3.07 $\pm$ 1.09 a	3.37 $\pm$ 1.14 b	3.24 $\pm$ 1.13 4.00
S2. I believe climate changes represent a food safety issue		3.93 $\pm$ 0.87	3.80 $\pm$ 1.05	3.85 $\pm$ 0.98 4.00
S3. I believe food fraud (untruthful description of the origin of food, its composition and how it has been obtained and/or prepared) represents a food safety issue		4.14 $\pm$ 0.85	4.23 $\pm$ 0.90	4.19 $\pm$ 0.88 4.00
S4. I believe eating freshly sourced foods represents a food safety issue		3.43 $\pm$ 1.10 a	2.66 $\pm$ 1.19 b	3.01 $\pm$ 1.22 4.00
S5. I believe eating meat and dairy products represents a food safety issue		3.28 $\pm$ 1.13 a	2.62 $\pm$ 1.22 b	2.91 $\pm$ 1.23 2.00
S6. I believe eating meat and dairy analogs/hybrids represents a food safety issue		3.53 $\pm$ 1.02 a	3.01 $\pm$ 1.15 b	3.24 $\pm$ 1.13 4.00
S7. I believe genetically modified food represents a food safety issue		3.83 $\pm$ 0.99 a	3.37 $\pm$ 1.25 b	3.57 $\pm$ 1.17 4.00
S8. I am concerned about a risk of getting COVID-19 from food in general		3.28 $\pm$ 1.01 a	1.65 $\pm$ 0.63 b	2.37 $\pm$ 1.15 2.00
S9. I am concerned about a risk of getting COVID-19 from food served in restaurants		3.62 $\pm$ 0.83 a	1.75 $\pm$ 0.65 b	2.57 $\pm$ 1.19 2.00
S10. I am concerned about a risk of getting COVID-19 from food delivered to my home		3.67 $\pm$ 0.80 a	1.77 $\pm$ 0.65 b	2.61 $\pm$ 1.19 2.00
S11. I am concerned about a risk of getting COVID-19 from food bought in a store/supermarket		3.47 $\pm$ 0.89 a	1.72 $\pm$ 0.63 b	2.49 $\pm$ 1.15 2.00

Note: The mean $\pm$ SD values¹ and modes² were obtained from the raw data. Items denoted with different letters are significantly different at the level of 5%. Likert scale: (1) 'strongly disagree', (2) 'disagree', (3) 'no opinion', (4) 'agree', (5) 'strongly agree'.

consumers' trust in food safety inspection, the federal government, Food and Agriculture Organization of the United Nations (FAO), World Health Organization (WHO), farmers, food producers, certified food companies, retailers, restaurants, food scientists and other consumers to ensure food safety. For the fourth part of the questionnaire, respondents were given the choice to rate their extent of trust according to a five-point Likert scale from 1 'completely distrust', 2 'somewhat distrust', 3 'neither trust nor distrust', 4 'somewhat trust' to 5 'completely trust'.

Data processing and statistical methods

Likert scale data from the questionnaires were processed using non-parametric statistical tests. A two-step cluster analysis was employed to categorize the statements deployed by various

demographic parameters (country, gender, age and education) as categorical variables. The Mann-Whitney *U*-test was used to understand whether statements reveal statistically significant ($P < 0.05$) differences between the clusters (Tables 3 and 5). In parallel, The Kruskal-Wallis *H*-test was used to determine if there are statistically significant differences ($P < 0.05$) between countries (Tables 2 and 4).

RESULTS AND DISCUSSION

Demography and size of the sample

Applying survey-based methods to acquire evidence on consumer food safety perceptions is useful because such methods can give a snapshot of characteristics across a large sample.²⁷

Table 4. Differences in food safety trust per country (N = 4129)

	Total	AM	BA	CN	HR	DE	GR	IN	IT	MK	PL	RU	RS	SK	ES	TR
Q1. To what extent do you trust the food safety inspectors to ensure food safety	3.2 ± 1.1	2.9 ± 1.2 a	2.9 ± 1.1 a	3.5 ± 0.9 c	3.2 ± 0.9 b	3.2 ± 1.1 b	3.2 ± 1.0 b	3.4 ± 1.0 b,c	3.6 ± 0.8 c	2.5 ± 1.0 a	3.3 ± 1.1 b	3.3 ± 1.1 b	2.8 ± 1.1 a	3.4 ± 1.2 b,c	3.7 ± 0.9 c	2.9 ± 1.2 a
Q2. To what extent do you trust the federal government to ensure food safety	2.9 ± 1.2	2.8 ± 1.2 b	2.4 ± 1.2 a	3.5 ± 1.0 d	2.9 ± 1.1 b	3.0 ± 1.2	3.1 ± 1.0	3.4 ± 1.0	3.2 ± 1.0	2.3 ± 1.0 a	2.3 ± 1.2 a	3.2 ± 1.1 b,c	2.5 ± 1.2	2.6 ± 1.2	3.4 ± 1.1	2.5 ± 1.2
Q3. To what extent do you trust the farmers to ensure food safety	3.2 ± 1.1	2.8 ± 1.1 a	3.1 ± 1.0 b	3.0 ± 0.9	3.1 ± 1.0 b	3.5 ± 1.1 c	3.0 ± 1.0	3.8 ± 1.0 c	3.3 ± 0.8	2.9 ± 0.9 a	3.1 ± 1.1 b	2.9 ± 1.1 a	2.8 ± 1.0 a	3.6 ± 1.1 c	3.6 ± 0.9	2.9 ± 1.1 a
Q4. To what extent do you trust the retailers/grocery/stores to ensure food safety	2.9 ± 1.0	2.6 ± 1.2 a	2.7 ± 1.1 a	3.2 ± 0.8	2.7 ± 1.0 a	3.1 ± 1.0 b	2.9 ± 1.0	3.1 ± 1.0 b	3.2 ± 0.9	2.6 ± 0.9 a	2.9 ± 1.0 a	3.1 ± 1.1 b	2.6 ± 1.0 a	2.8 ± 1.1 a	3.4 ± 1.0	2.6 ± 1.0 a
Q5. To what extent do you trust the restaurants to ensure food safety	3.0 ± 1.0	3.0 ± 1.1 b	3.0 ± 1.0 b	3.0 ± 0.9 b	3.1 ± 0.9 b	3.2 ± 1.0	2.8 ± 1.0 a	2.9 ± 1.0	3.2 ± 0.8	2.6 ± 0.9 a	3.1 ± 1.0 b	3.1 ± 1.0 b	2.7 ± 1.1 a	3.0 ± 1.1 b	3.3 ± 0.9	2.6 ± 1.1 a
Q6. To what extent do you trust the food producers to ensure food safety	3.2 ± 1.0	3.0 ± 1.1	3.2 ± 1.0 b	3.0 ± 0.8	3.2 ± 0.9 b	3.1 ± 1.1 b	3.0 ± 1.0	3.3 ± 1.0 b	3.4 ± 0.9	3.0 ± 0.9 a,b	3.2 ± 1.1 b	3.3 ± 1.1 b	2.9 ± 1.1 a	3.3 ± 1.1 b	3.7 ± 0.9	2.7 ± 1.1 a
Q7. To what extent do you trust the consumers to ensure food safety	3.1 ± 0.9	2.9 ± 1.0	3.1 ± 0.9 b	3.3 ± 0.8 c	3.0 ± 0.8	3.2 ± 0.9 b	2.9 ± 1.0	3.5 ± 0.9 c	2.9 ± 0.7	2.8 ± 0.9 a	3.0 ± 1.0 a,b	3.1 ± 0.8 b	2.7 ± 0.9 a	3.2 ± 0.9 b	3.2 ± 0.9	2.9 ± 1.0
Q8. To what extent do you trust a food company holding a food safety certificate (ISO 22000, BRC, IFS, Global GAP, other) to ensure food safety	3.6 ± 1.0	3.3 ± 1.2 a	3.6 ± 0.9 b	3.7 ± 0.8	3.5 ± 0.9 b	3.2 ± 1.1 a	3.7 ± 1.0	3.7 ± 0.9	3.6 ± 0.8 b	3.3 ± 0.9 a	3.8 ± 1.0 c	3.5 ± 1.0 b	3.3 ± 1.0 a	3.8 ± 1.0 c	3.9 ± 0.9	3.2 ± 1.1 b
Q9. To what extent do you trust the Food and Agricultural Organization (FAO) to ensure food safety	3.4 ± 1.0	3.2 ± 1.1 a	3.6 ± 1.0	3.6 ± 0.8	3.4 ± 1.0	3.2 ± 1.0 a	3.6 ± 1.0	3.9 ± 1.0 c	3.3 ± 0.9 a	3.3 ± 0.9 a	3.3 ± 1.1 a	3.5 ± 0.9 b	3.2 ± 1.0 a	3.7 ± 1.0 c	3.7 ± 1.0	3.1 ± 1.2 a
Q10. To what extent do you trust the World Health Organization (WHO) to ensure food safety	3.4 ± 1.1	3.3 ± 1.2 b	3.4 ± 1.1	3.6 ± 0.8 c	3.2 ± 1.1 b	3.2 ± 1.1 b	3.6 ± 1.1	4.0 ± 0.9 d	3.4 ± 1.0	3.1 ± 1.0 a,b	3.3 ± 1.1 b	3.2 ± 1.0 b	2.9 ± 1.2 a	3.4 ± 1.2	3.5 ± 1.0	3.1 ± 1.2
Q11. To what extent do you trust food scientists to ensure food safety	3.7 ± 1.0	3.3 ± 1.1 a	3.8 ± 1.0 b	3.5 ± 0.9	3.7 ± 0.9 b	3.4 ± 1.0 a	3.8 ± 1.0 b	4.0 ± 0.9 c	3.8 ± 0.9 b	3.5 ± 1.0 a	3.6 ± 0.9 a,b	3.6 ± 1.1	3.5 ± 1.0 a	3.8 ± 1.0 b	4.2 ± 0.9	3.3 ± 1.2 a

Note: The mean ± SD values were obtained from the raw data. Items denoted with different letters are significantly different at the level of 5%.

Abbreviations: AM, Armenia; BA, Bosnia and Herzegovina; CN, China; HR, Croatia; DE, Germany; GR, Greece; IN, India; IT, Italy; MK, North Macedonia; PL, Poland; RU, Russia; RS, Serbia; SK, Slovakia; ES, Spain; TR, Turkey. (1) 'completely distrust', (2) 'somewhat distrust', (3) 'neither trust nor distrust', (4) 'somewhat trust', (5) 'completely trust'.

Table 5. Description of the (food safety trust) clusters in terms of country, gender, age, and education

		Cluster 1 (n = 2349)	Cluster 2 (n = 1780)	Total (N = 4129)
Country	Armenia	104 (45.4%)	125 (54.6%)	229 (100%)
	Bosnia and Herzegovina	106 (51.2%)	101 (48.8%)	207 (100%)
	China	230 (68.9%)	104 (31.1%)	334 (100%)
	Croatia	117 (54.9%)	96 (45.1%)	213 (100%)
	Germany	169 (51.5%)	159 (48.5%)	328 (100%)
	Greece	155 (57.8%)	113 (42.2%)	268 (100%)
	India	208 (72.0%)	81 (28.0%)	289 (100%)
	Italy	175 (68.6%)	80 (31.4%)	255 (100%)
	Poland	163 (53.4%)	142 (46.6%)	305 (100%)
	North Macedonia	75 (36.4%)	131 (63.6%)	206 (100%)
	Russia	173 (57.5%)	128 (42.5%)	301 (100%)
	Serbia	124 (41.2%)	177 (58.8%)	301 (100%)
	Slovakia	129 (61.1%)	82 (38.9%)	211 (100%)
	Spain	297 (80.5%)	72 (19.5%)	369 (100%)
	Turkiye	124 (39.6%)	189 (60.4%)	313 (100%)
Gender	Male	840 (55.9%)	663 (44.1%)	1503 (100%)
	Female	1509 (57.5%)	1117 (42.5%)	2626 (100%)
Age (years)	Below 35 years of age	1230 (58.6%)	869 (41.4%)	2099 (100%)
	Between 35 and 60 years of age	892 (54.9%)	734 (45.1%)	1626 (100%)
	Over 60 years of age	227 (56.2%)	177 (43.8%)	404 (100%)
Education	High school or lower	199 (36.5%)	346 (63.5%)	545 (100%)
	Student	388 (62.2%)	236 (37.8%)	624 (100%)
	Bachelor and above	2002 (67.6%)	958 (32.4%)	2960 (100%)
Food safety trust statements		Mean $\pm$ SD ¹	Mean $\pm$ SD ¹	Mean $\pm$ SD ¹ Mode ²
Q1. To what extent do you trust the food safety inspectors to ensure food safety		3.76 $\pm$ 0.80 a	2.47 $\pm$ 0.97 b	3.21 $\pm$ 1.09 4.00
Q2. To what extent do you trust the federal government to ensure food safety		3.51 $\pm$ 0.98 a	2.11 $\pm$ 0.96 b	2.91 $\pm$ 1.19 4.00
Q3. To what extent do you trust the farmers to ensure food safety		3.61 $\pm$ 0.87 a	2.57 $\pm$ 1.00 b	3.16 $\pm$ 1.06 4.00
Q4. To what extent do you trust the retailers/grocery/stores to ensure food safety		3.43 $\pm$ 0.86 a	2.29 $\pm$ 0.87 b	2.94 $\pm$ 1.03 4.00
Q5. To what extent do you trust the restaurants to ensure food safety		3.44 $\pm$ 0.83 a	2.37 $\pm$ 0.89 b	2.98 $\pm$ 1.01 4.00
Q6. To what extent do you trust the food producers to ensure food safety		3.70 $\pm$ 0.76 a	2.44 $\pm$ 0.90 b	3.16 $\pm$ 1.03 4.00
Q7. To what extent do you trust the consumers to ensure food safety		3.42 $\pm$ 0.81 a	2.60 $\pm$ 0.86 b	3.06 $\pm$ 0.93 3.00
Q8. To what extent do you trust a food company holding a food safety certificate (ISO 22000, BRC, IFS, Global GAP, other) to ensure food safety		4.08 $\pm$ 0.68 a	2.87 $\pm$ 0.96 b	3.56 $\pm$ 1.01 4.00
Q9. To what extent do you trust the Food and Agricultural Organization (FAO) to ensure food safety		3.97 $\pm$ 0.69 a	2.72 $\pm$ 0.94 b	3.43 $\pm$ 1.02 4.00
Q10. To what extent do you trust the World Health Organization (WHO) to ensure food safety		3.92 $\pm$ 0.79 a	2.60 $\pm$ 1.02 b	3.35 $\pm$ 1.11 4.00
Q11. To what extent do you trust food scientists to ensure food safety		4.14 $\pm$ 0.70 a	3.05 $\pm$ 1.03 b	3.67 $\pm$ 1.02 4.00

Note: The mean $\pm$ SD values¹ and modes² were obtained from the raw data. Items denoted with different letters are significantly different at the level of 5%. (1) 'completely distrust', (2) 'somewhat distrust', (3) 'neither trust nor distrust', (4) 'somewhat trust', (5) 'completely trust'.

Eurasia is the largest continental area on Earth, comprising all of Europe and Asia, with an estimated population of 5, 3 billion in 2019.²⁸ To calculate the number of respondents needed in a consumer survey to get obtain significant results ($P < 0.05$) for a Eurasian population, we have applied the sample size methodology as explained in Hamburg²⁹ and Rosner³⁰ using the 2% margin of error and 99% confidence level. The required (representative) estimated sample size was 4147 consumers, which only marginally exceeds the respondents rate we have achieved.

Out of the 4129 fully answered questionnaires, only one-third of the respondents (36.4%) were men (Table 1), although this should not be considered as bias in our sample because family grocery shopping is the accepted domain of women.^{31,32} The age distribution reveals that half of the respondents were younger, whereas

the other half was older than 35 years, with close to one-tenth of the consumers (9.8%) older than 60 years (Table 1). However, if we look at figures per individual country, we will find out that (in most cases) they make a representative sample in terms of demographic aging. For example, the observed 37.6% of the older Italian and 28% of the older German population in our investigation (Table 1) coincides almost perfectly with the official EU demographic statistical data (37.5% for Italy and 32% for Germany).³³ Also, the finding that the majority of Chinese (90.4%), Indian (96.2%) and Turkish (75.1%) consumers in our investigation were below the age of 35 years (Table 1) is in agreement with an actual, globally below-average, median age of the population in these countries.³⁴ The only significant demographic bias in our survey was the share of consumers with tertiary education (71.7%)

(Table 1), which was significantly higher than the official average for Europe (29.5%)³⁵ and even more so for Asia (11.5%).³⁶

Eurasian consumers' food safety beliefs

On average, Eurasian consumers do not have an opinion (3.2) (Table 2) regarding food safety. The exceptions are the German and Spanish (3.9) consumers who do agree (although not strongly), whereas Armenian, Bosnian and Turkish consumers (2.7) incline to disagree, that the food they eat is safe. Climate changes represent a food safety issue for all, and most clearly for Chinese, German and Italian (4.1) consumers, whereas Russia was the only country where consumers had no opinion (3.2) regarding this issue (Table 2). Universally, Eurasian consumers believe (4.2) that food fraud represents a food safety issue. This signifies a shift, at least for European consumers, who (until recently) have not viewed food fraud as a risk to food safety.³⁷ EU legislation does not provide a definition of 'fraud' in the agri-food chain. Instead, fraud notifications are made when fraud is suspected of non-compliance, implying an intentional action by businesses or individuals for the purpose of making an economic gain. Therefore, not all fraudulent food practices are necessarily harmful to humans or represent a risk to public health. However, European suspicions of fraud are growing by more than 15% in 2021, compared to 2020, with problems including undeclared added water in frozen pangasius fillets and shrimp and honey adulterated with sugar.³⁸ Based on our results, it appears that a significant number of media reports about food fraud incidents across Europe³⁷ have raised the awareness of its consumers regarding this issue and changed their minds into believing that food fraud represents a food safety issue, as well. This is especially so because our findings suggest that Italian and Polish consumers agreed with such a statement the most (4.4) (Table 2), whereas we already know that these countries are at the forefront of European food fraud reporting cases^{38,39} and appears to have the most media reported incidents.³⁷

Broadly, the Eurasian consumer does not have an opinion (3.0) (Table 2) on whether eating freshly sourced foods represents a food safety issue. However, the differences may be observed if we compare the EU and the rest of Eurasian countries, included in our survey. Altogether, EU consumers believe in the safety of their freshly sourced food (2.0) (data not shown), except for Greece, where consumers believe (4.1) that it represents a food safety issue and can be compared only to the situation we have observed in China (4.0) (Table 2). This agrees with the findings of Djekic *et al.*,²⁶ where European consumers also perceived that fresh food is associated with low levels of food safety risks. When it comes to meat and dairy products, EU consumers disagreed (2.6) that they represent a food safety issue, whereas non-EU (3.3) and Asian (3.2) (data not shown) consumers were uncertain about it. Tradition, quality, taste and EU regionality are well-defined key characteristics of any food with a Protected Designation of Origin (PDO). Out of 638 food products labeled as PDO, 30.1% are cheeses, and 12.6% are meat and meat products. Both locally and on the regional scale, Italy and Spain are identified as PDO animal-origin food product 'hotspots'.⁴⁰ Spanish (1.9) and Italian (2.2) consumers (Table 2) disagreed the most with the statement that food of animal origin is unsafe to eat, which can be explained by the fact that the production, processing, packaging and consumption of the food of animal origin are a part of their everyday life, tradition and cultural identity.

It appears that in countries such as Italy, Germany and Spain, which are witnessing a rise in the popularity of flexitarian diets

and are therefore prominent markets for meat and dairy analogs/hybrids,⁴¹ consumers are also less likely to agree that they represent a food safety issue (Table 2). Although much attention is focused on meat analogs/hybrids, the market value of plant-based milk alternatives in the EU is approximately 700 million euros larger than the market value of their meat counterparts. The share of Italian consumers who consume dairy substitutes regularly is 23%.⁴² In Eastern Europe, the meat and dairy analogs market is 13 times smaller than in Western Europe.⁴³ This could explain why the consumers from Greece (3.9) and Serbia (3.6) (Table 2) were more likely to agree that meat and dairy analogs/hybrids might represent a food safety issue.

Our results confirm the already acknowledged skepticism of Greek^{44,45} and Chinese⁴⁶ consumers toward GM food. Because the answers about GM food from the Polish consumers in our survey were almost right in the middle of the scale provided to them (3.1) (Table 2), we might assume that their beliefs about it had not changed since 2017, when an almost equal number of respondents showed intention for purchasing GM food products, an intention to act otherwise or were not decided.⁴⁷ Furthermore, it was already established that of all European countries, only Spain may have a potential market niche for GM foods,^{48,49} and so perhaps we should not be surprised that of all countries included in our survey, Spanish consumers were the only one that could (even slightly) disagree (2.9) that GM food represent a food safety risk.

Segmentation analysis of Eurasian consumers according to their food safety beliefs

If numerous countries are involved in the survey, consumer segments could be revealed, taking into account all the participants, to achieve a cross-country segmentation analysis.⁵⁰ The present study defined two clusters of Eurasian consumers according to their food safety beliefs. The first cluster was smaller in size and contained 1817 (44%) respondents. It was composed of 90.1% Chinese, 81.7% Indian, 63.6% Turkish and 60.7% Armenian consumers (Table 3). Because only 3% of Turkish territory lies in Europe, we could name this cluster as 'Asian consumers'. Two-thirds of the consumers in this cluster were females ($n = 1220$) and below the age of 35 years ($n = 1105$). The second cluster comprised 56% of the consumers involved in this research ($n = 2312$). Its important demographic characteristic was that it included more than 80% of Italian, Spanish, and Slovakian, more than 70% of Croatian and German, more than 60% of Polish, Serbian and North Macedonian, and more than half of Bosnian consumers (Table 3). Therefore, the consumers from the second cluster could be named 'European consumers'. Of all the European countries, the only exception was Greece, with most consumers (56%) belonging to the first cluster.

Consumers from the European cluster agreed slightly more strongly than those from the Asian cluster that the food they eat is safe. Asian and European consumers were equally confident that climate changes and food frauds represent a food safety issue. Eating freshly sourced food represented more of a food safety issue to Asian consumers (3.43) compared to their European counterparts (2.66) (Table 3). Similar observations are apparent when it comes to eating meat and dairy products. Although the European consumers were without an opinion about the statement that eating meat and dairy analogs/hybrids represents a food safety risk (3.01), the Asian consumers were more willing to agree with it (3.53). Respondents from the Asian cluster believed significantly more (3.83) than those from the

European cluster (3.37) that GM food may be associated with health issues. This result confirms the findings of Frewer *et al.*⁵¹ that European consumers are generally reluctant to accept GM food based on their perceived risks, but contradicts their conclusion that they hold more negative attitudes compared to Asian consumers.

There is still no evidence that food is a possible cause or path of transmission for severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2).⁵² However, consumers may (still) believe the opposite is true because the original COVID-19 viral spread was linked to a food marketplace in China.⁵³ Also, in-person restaurant dining was prohibited worldwide because of the pandemic, which could have led consumers to erroneously relate the virus to the food itself. According to our results, this had a greater effect on Asian consumers who were uncertain (3.28) compared to European consumers who were not concerned (1.65) (Table 3) about the risk of getting COVID-19 from food, in general.

Although restaurants have improved their hygiene before,⁵⁴ and they continued to develop a safer and healthier operating environment during the pandemic,^{55,56} their hygiene attributes still cause consumers' fear of COVID-19.⁵⁷ This was more valid for the consumers from the Asian cluster, who were significantly more concerned (3.62) about the risk of getting COVID-19 from food served in restaurants compared to consumers from the European cluster (1.75) in our investigation. This is in agreement with the conclusions of Byrd *et al.*⁵⁸ that COVID-19 concerns about restaurant foods vary with consumers' sociodemographics.

COVID-19 has boosted food home delivery services in Europe⁵⁹ and introduced innovations such as contactless delivery and curbside pickup.⁵⁶ However, European consumers from our survey disagreed (1.77) that they are concerned about the risk of getting COVID-19 from food delivered to their homes, unlike the Asian consumers who agreed (3.67) (Table 3) with such a statement. This perhaps can explain the fact that China was one of the few countries in the World where food home deliveries decreased significantly during the lockdown period and appeared to bounce back only after reopening.⁶⁰

Finally, even when the general hygiene of food retailing establishments is significantly improved using different prerequisite programs,⁶¹ the infected hands of their clients could be a potential source of SARS-CoV-2 transmission.⁶² This fact represented a much more significant concern to the Asian (3.47) than to the European (1.72) consumers in our survey (Table 3) who disagreed about the risk of getting COVID-19 from food bought in a store/supermarket.

Eurasian consumers' trust in food safety

Average Eurasian consumer neither trust nor distrust (3.2) the food safety inspectors to ensure food safety. Only Spanish (3.7), Italian (3.6) and Chinese (3.5) (Table 4) consumers were the exception, somewhat trusting that their local food safety officers were successful in their professional duties. We already know that consumers from Bosnia and Herzegovina, Croatia, Serbia and India believe that inspection is essential to the food chain regarding food safety assurance.²⁶ However, the results of our survey imply that the extent of trust in food safety inspection for Serbian (2.8) and Bosnian (2.9) consumers is below, for Croatian (3.2) consumers equal to, and only for Indian (3.4) consumers above, the average (3.2) extent of trust of a typical Eurasian consumer (Table 4).

Broadly, Eurasian consumers are uncertain (2.9) as to what extent their federal governments are competent, able and

efficient in ensuring food safety. However, respondents from Poland (2.3), North Macedonia (2.3), and Bosnia and Herzegovina (2.4) in our survey (Table 4) expressed their partial distrust of their national food authorities. By contrast, Chinese respondents were the only ones who exhibited a certain extent of trust (3.5). This is in sharp contrast to the study by Lee *et al.*²⁷ concluding that the credibility of Chinese government food regulators is exceptionally weakened and that local consumers do not trust they have the power anymore to regulate food safety adequately. Also, other researchers suggested that there is consumer skepticism and distrust in the Russian food regulatory apparatus.⁶³ However, our results reveal that the trust of Russian consumers in the federal government to ensure food safety (3.2) is higher than that of consumers in 11 other countries included in our survey (Table 4).

When it comes to the farmers, it appears that Indian ones were the most trustworthy (3.8) when their consumers were asked about it, followed by their Spanish (3.6), Slovakian (3.6) and German (3.5) counterparts (Table 4). This agrees with the latest data from the European Food Safety Authority (EFSA),⁶⁴ suggesting that almost three-quarters of EU consumers (74%) trust farmers and primary producers regarding food safety matters. Our results disagree with the study by Wu *et al.*⁶⁵ concluding that 'Consumers from developed countries with fewer experiences of food incidents tend to put more trust in local farmers'. In our case, the extent of trust put into farmers by Indian consumers (3.8) was significantly higher than the extent of trust put into farmers by Polish and Croatian (3.1) consumers. Furthermore, it was not statistically different from the consumer's trust in Spanish, Slovakian (3.6) or German (3.5) farmers (Table 4).

In traditional markets, foods are susceptible to the transmission of foodborne pathogens because of several factors, including poor market infrastructure,⁶⁶ imperfect hygienic conditions⁶⁷ and inadequate storage practices by vendors.⁶⁸ Therefore, at least partially, governmental policies are moving toward closing traditional markets in favor of modern supermarkets to improve food safety.²⁷ Our investigation discovers that consumers from Armenia, North Macedonia, Serbia and Turkey expressed the lowest extent of trust in food retailers and grocery stores and their food safety practices (2.6). By contrast, the average Eurasian consumer (2.9) did not have an opinion about it (Table 4). They broadly expressed almost the same extent of food safety trust uncertainty (3.0) when we asked them about the restaurants in their countries. This confirms the findings of Dedeoğlu and Boğan⁶⁹ indicating that, when trust in the government is lacking, consumers fail to trust restaurants even when motivated to do so.

It is interesting to note that Eurasian consumers somewhat trusted (3.6) food companies holding a food safety certificate (ISO 22000, BRC, IFS, Global GAP, amongst others). In comparison, they neither trusted nor distrusted (3.2) food companies without one. Countries and their consumers whose trust in companies' food safety assurance was most enhanced by certification were Spain (3.9), Slovakia (3.8), Poland (3.8), India (3.7) and China (3.7) (Table 4). Our results confirm that certification labels support consumers' confidence in food quality/safety.^{70,71}

Regarding food safety risks, European and Asian consumers believe that they are the least important food actor in the chain,²⁶ and they associate a low personal risk of food poisoning from home-produced food.^{72,73} The general vagueness regarding the food safety trust that the Eurasian consumers in our survey put in almost all food chain actors has been extended to the extent of trust that they put in themselves (3.1). The only

exception was the Indian consumers who exhibited at least partial self-confidence (3.5) regarding this matter (Table 4). Regarding international organizations, Eurasian consumers are equally inclined to trust somewhat the FAO (3.4) and the WHO (3.4) to ensure food safety (Table 4). Indian consumers were most confident about it of all countries included in our survey.

Finally, of all the food chain actors they were asked about, Eurasian consumers trusted food scientists the most (3.7) regarding food safety. This was especially emphasized in Spain (4.2), India (4.0) and Italy (3.8) (Table 4). Similar findings were recently observed by the EFSA⁶⁴ when 82% of the EU consumers trusted scientists working at a university or publicly-funded research organizations. Our results concur with the previous observations that developing countries also tend to trust food scientists more than any other food supply chain operator.⁶⁵

Segmentation analysis of Eurasian consumers according to their trust in food safety

According to their trust in food safety, two clusters of Eurasian consumers were defined. The first cluster was more significant in size and contained 2349 (57%) respondents. The second cluster comprised 43% of the consumers involved in this research (1780). The most crucial demographic difference between the clusters was their consumers' education level. The larger cluster comprised 36.5% of all Eurasian consumers with only higher school education or less, 62.2% of students and 67.6% of consumers with a Bachelor's degree or above. The smaller cluster comprised almost two-thirds of Eurasian consumers with the lowest level of education and included only one-third of students and respondents with at least a university degree. Therefore, we could name the consumers from the first cluster as 'the more educated' and from the second 'the less educated' ones. The more educated consumers expressed a statistically significant ($P < 0.05$) more considerable extent of trust in all actors of the food chain compared to the less educated consumers (Table 5). Our results confirm that knowledge strongly impacts people's food safety risk perceptions,⁷³ making it more precise and resulting in greater trust in food safety in general.²⁰ Similar to the conclusions of Bozic⁷⁴ we have also observed that consumers with higher levels of trust do not exuberate more considerable trust differences between different food chain actors.

CONCLUSIONS

This survey has confirmed that different socioeconomic characteristics, cultural aspects and education levels shape food safety perceptions within Eurasian countries. The COVID-19 pandemic influenced their beliefs and trust in food safety, which is relatively low on average. However, it is significantly higher for European consumers (especially EU ones) compared to their Asian counterparts. Both Asian and European respondents agreed that food fraud and climate changes represent a food safety issue. However, European consumers were less concerned regarding the food safety of GM foods and meat and dairy analogs/hybrids. Asian consumers were, to a greater extent, worried about the risk of getting COVID-19 from food, restaurants, retail food establishments and home food deliveries. Eurasian consumers have put their greatest extent of trust, when food safety assurance is concerned, into food scientists and food producers holding a food safety certificate. Higher education of Eurasian consumers was followed by increased food safety confidence in all parts of the food chain.

A limitation of the present study is that convenience sampling was used partially, which includes several drawbacks that can reduce the reliability and validity of research findings. When participants are not chosen completely at random from a larger population, this might result in sampling bias. This indicates that the sample may not be typical of the greater population, and the findings may not apply to other groups. However, this is why we have used probability sampling alongside, aiming to keep this sampling bias under check. Furthermore, a follow-up study should be conducted in other countries and continents. Because COVID-19 comprises a pandemic, it would provide a better insight into consumers' food safety beliefs and trust issues in the age of COVID-19 in other world regions and allow a comparison with the results obtained for Eurasia.

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REFERENCES

- 1 Tilashalski FP, Sillence EM, Newton AE and Biggerstaff GK, Enhancing response to foodborne disease outbreaks: findings of the foodborne diseases centers for outbreak response enhancement (FoodCORE), 2010–2019. *J Public Health Manag Pract* **28**:E702–E710 (2022).
- 2 Sarno E, Pezzutto D, Rossi M, Liebana E and Rizzi V, A review of significant European foodborne outbreaks in the last decade. *J Food Prot* **84**:2059–2070 (2021).
- 3 Chen L, Sun L, Zhang R, Liao N, Qi X and Chen J, Surveillance for foodborne disease outbreaks in Zhejiang Province, China, 2015–2020. *BMC Public Health* **22**:135 (2022).
- 4 Nuttavuthisit K and Thøgersen J, The importance of consumer Trust for the Emergence of a market for green products: the case of organic food. *J Bus Ethics* **140**:323–337 (2017).
- 5 Krockow EM, Takezawa M, Pulford BD, Colman AM and Kita T, Cooperation and Trust in Japanese and British Samples: evidence from incomplete information games. *Int Perspect Psychol* **6**:227–245 (2017).
- 6 Yamagishi T and Yamagishi M, Trust and commitment in the United States and Japan. *Motiv Emot* **18**:129–166 (1994).
- 7 Giampietri E, Verneau F, Del Giudice T, Carfora V and Finco A, A theory of planned behaviour perspective for investigating the role of trust in consumer purchasing decision related to short food supply chains. *Food Quality Preference* **64**:160–166 (2018).
- 8 Wilson AM, Withall E, Coveney J, Meyer SB, Henderson J, McCullum D *et al.*, A model for (re)building consumer trust in the food system. *Health Promot Int* **32**:988–1000 (2017).
- 9 Berg L, Trust in food in the age of mad cow disease: a comparative study of consumers' evaluation of food safety in Belgium, Britain and Norway. *Appetite* **42**:21–32 (2004).
- 10 Walravens T, Food safety and regulatory change since the 'mad cow' in Japan: science, self-responsibility, and trust. *Contemporary Jpn* **29**: 67–88 (2017).
- 11 Muringai V and Goddard E, Long-term impacts of bovine spongiform encephalopathy on beef risk perceptions and risk attitudes in Canada. *J Toxicol Environ Health A* **79**:746–761 (2016).
- 12 Motarjemi Y, Crisis Management, in *Food Safety Management: A Practical Guide for the Food Industry*, Elsevier, London, pp. 1037–1063 (2014).
- 13 Djekic I, Nikolic A, Uzunovic M, Marijke A, Liu A, Han J *et al.*, Covid-19 pandemic effects on food safety-multi-country survey study. *Food Control* **122**:107800 (2021).
- 14 Azzam Z, The moderator effect of COVID pandemic on the relationship between online shopping services and online consumer purchasing behavior. A case of Jordan, in *Studies in Systems, Decision and Control*, Springer Nature, pp. 25–35 (2022).
- 15 Ben Hassen T, El Bilali H, Allahyari MS, Berjan S and Fotina O, Food purchase and eating behavior during the COVID-19 pandemic: a cross-sectional survey of Russian adults. *Appetite* **165**:105309 (2021).
- 16 Lim A, Xu J and Yu Y eds, Consumer Food Demand Shifts in the COVID-19 Pandemic: An Empirical Study Based on Retail Sales Data. Lecture

- Notes in Networks and Systems; 2023, Consumer Food Demand Shifts in the COVID-19 Pandemic: An Empirical Study Based on Retail Sales Data.
- 17 Harantová V, Kalašová A, Kubíková SS, Mazanec J and Jordová R, The impact of mobility on shopping preferences during the COVID-19 pandemic: the evidence from the Slovak Republic. *Mathematics* **10**:1394 (2022).
 - 18 Kaicker N, Gupta A and Gaiha R, Food consumption expenditures and the COVID-19 pandemic in India. *Econ Pol Wkly* **57**:16–21 (2022).
 - 19 Masotti M, van der Haar S, Janssen A, Iori E, Zeinstra G, Bos-Brouwers H et al., Food waste in time of COVID-19: the heterogeneous effects on consumer groups in Italy and The Netherlands. *Appetite* **180**:106313 (2023).
 - 20 Machado Nardi VA, Teixeira R, Ladeira WJ and de Oliveira SF, A meta-analytic review of food safety risk perception. *Food Control*. **112**: 107089 (2020).
 - 21 Zanetta LD, Dardaqui Mucinhato RM, Hakim MP, Stedefeldt E and Da Cunha DT, What motivates consumer food safety perceptions and beliefs? A scoping review in BRICS countries. *Foods*. **11**:1–16 (2022).
 - 22 Tomasevic I, Kovačević DB, Jambrak AR, Zsolt S, Dalle Zotte A, Martinović A et al., Comprehensive insight into the food safety climate in central and Eastern Europe. *Food Control* **114**:107238 (2020).
 - 23 Wilcock A, Pun M, Khanona J and Aung M, Consumer attitudes, knowledge and behaviour: a review of food safety issues. *Trends Food Sci Technol* **15**:56–66 (2004).
 - 24 Serbia, *Kodeks profesionalne etike Univerziteta u Beogradu*. University of Belgrade, Belgrade, p. 193 (2016).
 - 25 Maneesriwongul W and Dixon JK, Instrument translation process: a methods review. *J Adv Nurs* **48**:175–186 (2004).
 - 26 Djekic I, Nikolic A, Mujcinovic A, Blazic M, Herljevic D, Goel G et al., How do consumers perceive food safety risks? – results from a multi-country survey. *Food Control*. **142**:109216 (2022).
 - 27 Lee J, Pelto GH and Nordhagen S, Beliefs, values, and sociocultural patterns related to food safety in low- and middle-income countries: a synthesis of the descriptive ethnographic literature. *Appetite* **178**: 106265 (2022).
 - 28 Tripathi AD, Mishra R, Maurya KK, Singh RB and Wilson DW, Estimates for world population and global food availability for global health, in *The Role of Functional Food Security in Global Health*. Elsevier, London, pp. 3–24 (2019).
 - 29 Hamburg M, *Basic statistics: a modern approach*. Harcourt Brace Jovanovich, New York, p. 548 (1985).
 - 30 Rosner B, *Fundamentals of Biostatistics*. Brooks/Cole, Boston (2011).
 - 31 Mortimer G and Clarke P, Supermarket consumers and gender differences relating to their perceived importance levels of store characteristics. *J Retail Consumer Serv* **18**:575–585 (2011).
 - 32 Beardsworth A, Bryman A, Keil T, Goode J, Haslam C and Lancashire E, Women, men and food: the significance of gender for nutritional attitudes and choices. *Br Food J* **104**:470–491 (2002).
 - 33 Eurostat, in *Ageing Europe: looking at the lives of older people in the EU: 2020th edition*, ed. by Corsetti-Nordblad L and Strandell H. European Commission, Brussels (2020).
 - 34 CIA, Median Age-The World Factbook: Central Intelligence Agency (2022). Available from: <https://www.cia.gov/the-world-factbook/fold/median-age/country-comparison>.
 - 35 Dragomirescu-Gaina C, Elia L and Weber A, A fast-forward look at tertiary education attainment in Europe 2020. *J Policy Model* **37**:804–819 (2015).
 - 36 ADB, *Higher education across asia: an overview of issues and strategies*. <http://hdl.handle.net/11540/932>. Asian Development Bank, Manila, Philippines, p. 66 (2011).
 - 37 Kendall H, Clark B, Rhymer C, Kuznesof S, Hajslova J, Tomaniova M et al., A systematic review of consumer perceptions of food fraud and authenticity: a European perspective. *Trends Food Sci Technol* **94**: 79–90 (2019).
 - 38 RASFF, *Rapid alert system for food and feed-alert and cooperation network: 2021 annual report*. Publications Office of the European Union, Brussels (2021).
 - 39 Marvin HJP, Bouzembrak Y, Janssen EM, van der Fels-Klerx HJ, van Asselt ED and Kleter GA, A holistic approach to food safety risks: food fraud as an example. *Food Res Int* **89**:463–470 (2016).
 - 40 Flinzberger L, Zinngrebe Y, Bugalho MN and Plieninger T, EU-wide mapping of 'protected designations of origin' food products (PDOs) reveals correlations with social-ecological landscape values. *Agron Sustain Dev* **42**:43 (2022).
 - 41 Bhavana T and Roshan D, Europe meat substitute market by product type, source, and category: regional opportunity analysis and industry forecast, 2021–2027 allied market research (2021).
 - 42 Nils-Gerrit W, Plant-based milk and dairy alternatives in Europe-statistics & facts: Statista (2022). Available from: <https://www.statista.com/topics/10162/milk-and-dairy-alternatives-in-europe/#topicOverview>.
 - 43 Nils-Gerrit W, Retail sales value of milk and milk alternatives worldwide in 2020, by region: Statista (2021). Available from: <https://www.statista.com/topics/10162/milk-and-dairy-alternatives-in-europe/#topicOverview>.
 - 44 Tsourgiannis L, Karasavvoglou A and Florou G, Consumers' attitudes towards GM free products in a European region. The case of the prefecture of Drama-Kavala-Xanthi in Greece. *Appetite* **57**:448–458 (2011).
 - 45 Tsourgiannis L, Markopoulos T and Zoumpoulidis V, An examination of consumers' attitudes towards genetically modified-food: the greek case, in *Strategic innovative marketing and tourism*. Springer, Berlin, pp. 469–477 (2019).
 - 46 Xu R, Wu Y and Luan J, Analysis of farmers' willingness to adopt genetically modified insect-resistant rice in China. *China Agric Econ Rev* **8**: 368–382 (2016).
 - 47 Popek S and Halagarda M, Genetically modified foods: consumer awareness, opinions and attitudes in selected EU countries. *Int J Consumer Stud* **41**:325–332 (2017).
 - 48 Delwaide AC, Nalley LL, Dixon BL, Danforth DM, Nayga RM Jr, van Loo EJ et al., Revisiting GMOs: are there differences in European Consumers' acceptance and valuation for Cisgenically vs Transgenically bred Rice? *PLoS One* **10**:e0126060 (2015).
 - 49 Rodríguez-Entrena M and Sayadi S, Analyzing consumers' preferences towards GM food in southern Spain. *New Genet Soc* **32**:18–36 (2013).
 - 50 Tomasevic I, Bahelka I, Čandek-Potokar M, Čitek J, Djekić I, Djurkin Kušec I et al., Attitudes and beliefs of eastern European consumers towards piglet castration and meat from castrated pigs. *Meat Sci* **160**:107965 (2020).
 - 51 Frewer LJ, van der Lans IA, Fischer ARH, Reinders MJ, Menozzi D, Zhang X et al., Public perceptions of Agri-food applications of genetic modification-a systematic review and meta-analysis. *Trends Food Sci Technol* **30**:142–152 (2013).
 - 52 EFSA, *Coronavirus: no Evidence that Food Is a Source or Transmission Route*. Publications Office of the European Union, Rome, Italy (2020).
 - 53 Chen N, Zhou M, Dong X, Qu J, Gong F, Han Y et al., Epidemiological and clinical characteristics of 99 cases of 2019 novel coronavirus pneumonia in Wuhan, China: a descriptive study. *Lancet* **395**:507–513 (2020).
 - 54 Djekic I, Kuzmanović J, Anđelković A, Saračević M, Stojanović MM and Tomašević I, Effects of HACCP on process hygiene in different types of Serbian food establishments. *Food Control*. **60**:131–137 (2016).
 - 55 Neise T, Verfürth P and Franz M, Rapid responding to the COVID-19 crisis: assessing the resilience in the German restaurant and bar industry. *Int J Hosp Manag* **96**:102960 (2021).
 - 56 Sanabria-Díaz JM, Aguiar-Quintana T and Araujo-Cabrera Y, Public strategies to rescue the hospitality industry following the impact of COVID-19: a case study of the European Union. *Int J Hosp Manag* **97**:102988 (2021).
 - 57 Siddiqi UI, Akhtar N and Islam T, Restaurant hygiene attributes and consumers' fear of COVID-19: does psychological distress matter? *J Retail Consum Serv* **67**:102972 (2022).
 - 58 Byrd K, Her E, Fan A, Almanza B, Liu Y and Leitch S, Restaurants and COVID-19: what are consumers' risk perceptions about restaurant food and its packaging during the pandemic? *Int J Hosp Manag* **94**:102821 (2021).
 - 59 Gavilan D, Balderas-Cejudo A, Fernández-Lores S and Martínez-Navarro G, Innovation in online food delivery: learnings from COVID-19. *Int J Gastron Food Sci* **24**:100330 (2021).
 - 60 Wang X, Zhao F, Tian X, Min S, von Cramon-Taubadel S, Huang J et al., How online food delivery platforms contributed to the resilience of the urban food system in China during the COVID-19 pandemic. *Glob Food Sec* **35**:100658 (2022).
 - 61 Tomasevic I, Kuzmanović J, Anđelković A, Saračević M, Stojanović MM and Djekic I, The effects of mandatory HACCP implementation on microbiological indicators of process hygiene in meat processing and retail establishments in Serbia. *Meat Sci* **114**:54–57 (2016).
 - 62 Duda-Chodak A, Lukasiewicz M, Zięć G, Florkiewicz A and Filipiak-Florkiewicz A, Covid-19 pandemic and food: present knowledge,

- risks, consumers fears and safety. *Trends Food Sci Technol* **105**:145–160 (2020).
- 63 Dolgoplova I, Teuber R and Bruschi V, Consumers' perceptions of functional foods: trust and food-neophobia in a cross-cultural context. *Int J Consum Stud* **39**:708–715 (2015).
 - 64 EFSA, Food Safety in the EU: report (2022).
 - 65 Wu W, Zhang A, van Klinken RD, Schrobback P and Muller JM, Consumer trust in food and the food system: a critical review. *Foods* **10**:2490 (2021).
 - 66 Moloi M, Lenetha GG and Malebo NJ, Microbial levels on street foods and food preparation surfaces in Mangaung metropolitan municipality. *Health SA Gesondheid* **26**:1–7 (2021).
 - 67 Pilamala Rosales A, Linnemann AR and Luning PA, Food safety knowledge, self-reported hygiene practices, and street food vendors' perceptions of current hygiene facilities and services-an Ecuadorean case. *Food Control*. **144**:109377 (2023).
 - 68 Alves da Silva S, Cardoso RCV, Góes JAW, Santos JN, Ramos FP, Bispo de Jesus R et al., Street food on the coast of Salvador, Bahia, Brazil: a study from the socioeconomic and food safety perspectives. *Food Control*. **40**:78–84 (2014).
 - 69 Dedeoğlu BB and Boğan E, The motivations of visiting upscale restaurants during the COVID-19 pandemic: the role of risk perception and trust in government. *Int J Hosp Manag* **95**:102905 (2021).
 - 70 Bruschi V, Shershneva K, Dolgoplova I, Canavari M and Teuber R, Consumer perception of organic food in emerging markets: evidence from Saint Petersburg. *Russia Agribusiness* **31**:414–432 (2015).
 - 71 Rupprecht CDD, Fujiyoshi L, McGreevy SR and Tayasu I, Trust me? Consumer trust in expert information on food product labels. *Food Chem Toxicol* **137**:111170 (2020).
 - 72 Redmond EC and Griffith CJ, Consumer perceptions of food safety risk, control and responsibility. *Appetite* **43**:309–313 (2004).
 - 73 Bailey C, Garg V, Kapoor D, Wasser H, Prabhakaran D and Jaacks LM, Food choice drivers in the context of the nutrition transition in Delhi, India. *J Nutr Educ Behav* **50**:675–686 (2018).
 - 74 Bozic B, Consumer trust repair: a critical literature review. *European Manag J* **35**:538–547 (2017).