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## Research Paper

# A study into food safety knowledge among restaurant and cafe workers in Kazakhstan

Mehmet Tas<sup>a,b</sup>, Sanar Muhyaddin<sup>c,\*</sup>, Sandra Nelly Leyva-Hernández<sup>d</sup>,  
Isabella Nyambayo<sup>e</sup>, Nurettin Can<sup>e</sup>, Selman Tetik<sup>f</sup>, Maha D. Abbas<sup>g</sup>

<sup>a</sup> Faculty of Law and Social Sciences at SDU University, Kazakhstan

<sup>b</sup> Eurasian Technological University

<sup>c</sup> Faculty of Social and Life Science, Wrexham University, Wrexham, UK

<sup>d</sup> Tecnológico Nacional de México, Instituto Tecnológico del Valle de Etla, Abasolo S/N, Barrio del Agua Buena, Santiago Suchilquitongo, CP. 68030, Oaxaca, Mexico

<sup>e</sup> Vistula University, Poland

<sup>f</sup> School of Business and Creative Industries, University of the West of Scotland, UK

<sup>g</sup> Department of Medical Laboratory Techniques, Institute of Medical Technology- Al Mansour, Middle Technical University (MTU), Baghdad, Iraq

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## ABSTRACT

Food safety is the primary concern in the hospitality sector, especially in Kazakhstan, wherein the demand for fine dining experiences has increased due to the country's resilient tourism expansion. This study evaluated restaurant and café employees' knowledge of food safety, emphasizing important aspects including cross contamination, personal hygiene, temperature control, and foodborne illnesses. The primary objective of the study was to assess knowledge gaps and provide insights for improving food safety practices. A standardized questionnaire was given to restaurant and café employees in several regions as part of a quantitative research strategy, generating 428 valid responses. Multiple-choice questions measuring employees' knowledge of food safety elements were included in the survey. The significance of the observed knowledge patterns was assessed using chi-square tests. The results showed significant gaps in knowledge about food safety, especially with relation temperature control, cross-contamination prevention, and personal hygiene practices. Restaurant and café employees lacked awareness of proper food handling temperatures, bacterial growth conditions, and sanitation measures. Although, some demonstrated a rudimentary understanding of basic hygiene practices, yet, there was inconsistent adherence to critical practices such as handwashing, handling raw and cooked food separately, and recognizing symptoms of foodborne illnesses. These deficiencies posed potential risks to public health because of poor food safety standards in the hospitality industry. The study implies that there is an urgent need for targeted food safety training programs in Kazakhstan's hospitality sector.

## 1. Introduction

Culinary attractions appeal to both locals and foreign tourists [1]. Also, it influences destination loyalty [2]. However, food safety in the hospitality industry remains a challenge. This has become increasingly important due to the growing need for authentic and exquisite dining experiences [3,4]. As tourists look for gastronomic experiences, food safety issues threaten Kazakhstan's tourism industry [5].

Kazakhstan presents itself as the gastronomic centre of Central Asia. This country relies on the quality and safety of its cuisine to drive growth in its tourism industry. Nonetheless, the literature on food safety

practices among restaurant and cafe employees remains limited [6]. The primary constraints for the restaurant business in Kazakhstan are regulatory, human resource, macroeconomic, and infrastructural [7]. This study identified essential food safety knowledge for employees to support consumer health and public confidence.

In contemporary tourism, food safety is not only a health requirement but also an essential dimension of sustainable gastronomy and rural development [8]. For Kazakhstan, improving the technical knowledge of its workers is not only a public health measure but also a strategic necessity to protect its culinary heritage and ensure the economic viability of its hospitality sector. Furthermore, it has been noted

\* Corresponding author.

E-mail addresses: [mehmet.tas@sdu.edu.kz](mailto:mehmet.tas@sdu.edu.kz) (M. Tas), [sanar.muhyaddin@wrexham.ac.uk](mailto:sanar.muhyaddin@wrexham.ac.uk) (S. Muhyaddin), [sandra.nlh@itvalletla.edu.mx](mailto:sandra.nlh@itvalletla.edu.mx) (S.N. Leyva-Hernández), [Isabella.Nyambayo@wrexham.ac.uk](mailto:Isabella.Nyambayo@wrexham.ac.uk) (I. Nyambayo), [N.can@vistula.edu.pl](mailto:N.can@vistula.edu.pl) (N. Can), [selman.tetik@uws.ac.uk](mailto:selman.tetik@uws.ac.uk) (S. Tetik), [maha-diekan@mtu.edu.iq](mailto:maha-diekan@mtu.edu.iq) (M.D. Abbas).

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that while good food generates positive memories, poor hygiene and food poisoning serve as deterrents, creating powerful negative memories [9]. These incidents lead to undesirable behaviours, such as negative word of mouth and a loss of loyalty to the destination.

To improve food safety procedures, research recommends customised training [10,11]. The expansion of Kazakhstan's tourism industry fails to address persistent food safety issues, particularly in worker training and in inadequate infrastructure and regulatory systems [12, 13]. Foodborne diseases remain a public concern that disproportionately impacts rapidly developing tourist hotspots such as Nur-Sultan and Almaty. For example, the number of salmonellosis outbreaks in these cities increased markedly from two in 2021 to twenty-three in 2022 [14]. A wedding in 2022 caused 76% of guests to contract salmonellosis, leading to hospitalisation [15]. Improving food safety rules in restaurants in Kazakhstan is important for public health and for boosting the country's reputation in food tourism.

Past studies by Kramer and Scott [16], Baş et al. [17], and Jevšnik et al. [18] investigated food handlers' safety knowledge. Even though they grasped fundamental hygiene practices and the dangers of contamination, their understanding of temperature management and of raw versus cooked food handling remained incomplete, and they were careless about cross-contamination prevention. Individuals' knowledge and attitudes did not lead to proper hand sanitation, nor did they keep raw and cooked foods separate or maintain appropriate storage temperatures. Even with food safety knowledge at their disposal, food handlers struggled to apply it consistently, underscoring the need for enhanced training and reinforcement to maintain safe food-handling practices in kitchens.

Researchers have documented significant discrepancies between food safety knowledge and its application [19]. Research demonstrates that individuals with professional culinary training are more likely to adhere to established food safety protocols. In the same vein, a study by Brannon et al. [20] in the US documented that experience in the food-service industry enhances understanding of food safety and practice by linking staff tenure to compliance standards. Most new staff members frequently demonstrate a lack of awareness, leading them to adopt dangerous practices. Food safety knowledge varies across roles, with culinary workers demonstrating superior understanding compared to front-line staff due to their direct involvement in food preparation, underscoring the need for position-specific training programs.

Studies have also examined how deficient food safety practices contribute to increased foodborne disease risk in food service venues [21,22]. Food safety standards encounter breaches in critical areas such as food poisoning, knowledge, personal hygiene, temperature control, and cross-contamination. Although food handlers understand the importance of personal cleanliness, studies highlight a gap in practice. Abdul-Mutalib et al. [23] found that handwashing and hygiene procedures, especially after handling raw foods or using restrooms, were often neglected. Ansari-Lari et al. [24] observed that while Iranian employees acknowledged the need for clean clothes and handwashing, they frequently failed to follow through. In Jordanian dining establishments in 2013, employees frequently failed to wash their hands after handling raw meat and before cooking, despite understanding the critical importance of this step, thereby increasing the risk of infection. Temperature control represents an additional fundamental problem [25]. The 2012 study showed that workers had insufficient knowledge of proper food temperatures, which are critical for inhibiting bacterial proliferation [23]. The study conducted in 2010 revealed that workers in meat processing plants frequently failed to maintain required temperature conditions, leading to potential bacterial growth [24]. The 2013 study revealed that café employees understood the need for temperature control yet failed to regularly use thermometers or verify food temperatures, resulting in hazardous practices [25]. The issue of cross-contamination presented additional worries. Research conducted in 2012 demonstrated an increased probability of cross-contamination when food handlers failed to use distinct equipment for raw and

cooked foods [23]. The study conducted in 2010 revealed that workers in Iranian meat production plants failed to maintain separation between raw and cooked foods, thereby heightening the risk of contamination by pathogens such as *Salmonella* or *Escherichia coli* [24]. A 2013 study reported that raw and prepared foods were often placed together in Jordanian restaurants, increasing the risk of cross-contamination [25].

Recent studies over the past ten years reveal a notable disconnect between food safety knowledge and actual practices, particularly regarding temperature control, cross-contamination, hand hygiene, and sanitation. Asim et al. [26] found that food sector supervisors in Doha had a solid theoretical understanding of food hygiene but struggled to apply proper hygiene practices, thereby heightening the risk of food poisoning. Poor temperature management in food establishments contributed to microbial growth, leading to foodborne illnesses. Taha et al. [27] found that food workers in the UAE did not regularly check food temperatures, allowing harmful bacteria to flourish. Likewise, Ncube et al. [28] reported that restaurant staff faced challenges with temperature management, resulting in unsafe handling of perishable items. Al-Nasraween et al. [29] reported that food handlers in Amman, Jordan, lacked the necessary skills to prevent cross-contamination, particularly between raw meats and ready-to-eat foods, thereby increasing the risk of foodborne illness. Mwove et al. [30] identified risky behaviours among Kenyan food vendors, stemming from limited awareness of foodborne infections. Likewise, Samapundo et al. [31] noted that Vietnamese street vendors often used the same utensils for both raw and cooked food, raising contamination risks.

Ma'moun et al. [32] investigated how restaurant workers in Jordan managed food handling practices by assessing their knowledge of and compliance with food safety protocols. The mixed-methods research investigation exposed significant deficiencies in food safety practices, including insufficient handwashing, improper storage, and failure to use protective equipment. People possessed minimal understanding of foodborne diseases and cross-contamination. The combination of inadequate training programs, low awareness, and weak regulatory enforcement led to the emergence of these substandard practices. The research underscored the need for enhanced training initiatives, rigorous food safety enforcement, and periodic inspections to establish safety standards in the hospitality sector. The study failed to determine the exact factors contributing to non-compliance. Baser et al. [33] examined the relationship between food safety knowledge and the attitudes and behaviours of hotel foodservice personnel in Turkey. Their study revealed that enhanced knowledge directly affected attitudes and behaviours, while attitudes partially mediated the relationship between knowledge and behaviour. The study failed to take into account the cultural influences. The study by Lee and Liu [34] examined university campuses and found substantial knowledge deficits that led to varied food safety practices. The investigation found that training facility deficiencies remained confined to university contexts, rendering their relevance to diverse foodservice operations unclear.

Researchers conducted multiple studies in various countries on the hospitality industry's food safety, yet Kazakhstan remains an exception, despite possessing vast agricultural resources, a distinctive culinary heritage, and an expanding tourism sector. Studies from the US, Turkey, Slovenia, and Jordan identify problems such as temperature mismanagement and cross-contamination, but these findings may not be directly applicable to Kazakhstan due to differing cultural practices, food safety standards, and economic conditions [35]. Kazakhstan adheres to Eurasian Economic Union (EAEU) food safety regulations, which set it apart from nations such as Turkey [36]. Kazakh food handlers' behaviours emerge more from cultural customs, mythical beliefs, and risk perception than from their food safety knowledge. The examination of regional influences remains vital to advancing food safety standards and reducing foodborne disease cases in Kazakhstan's hospitality sector. Effective policy creation and training program development for food safety standard compliance would benefit from specialised research [37]. Analysing Kazakhstan's knowledge-practice gap helps develop a

broader international understanding of food safety standards across diverse cultural and economic contexts.

This study in Kazakhstan addresses a critical knowledge gap within a context of global challenges, where the increase in local salmonellosis outbreaks reflects the worldwide need to identify gaps in scientific evidence regarding emerging pathogens and the impacts of climate change [38,14,1]. Contemporary international research underscores that individual technical knowledge alone is insufficient; it is imperative to develop a robust food safety culture that integrates leadership, commitment, and organisational adaptability to ensure that knowledge is effectively translated into safe practices [39]. This disconnect between knowing and doing, identified among Kazakh food handlers, manifests globally as the motivation-behaviour gap, which demonstrates that concern for food safety only generates real change when there is trust in certification systems and transparent knowledge of the entire supply chain [40]. Finally, the trend towards circular food systems and the use of by-products adds a layer of technical complexity, introducing risks of re-emergence of chemical and biological hazards that require regulatory frameworks, such as those of the EAEU, to adopt safe design approaches to protect both public health and the reputation of gastronomic tourism [41].

Unlike studies in other countries, this analysis assumes that Kazakhstan operates under the EAEU's food safety standards, which differ from those of other regions previously studied. Furthermore, the study highlights that the behaviour of food handlers in Kazakhstan is influenced by cultural customs, mythic beliefs, and local risk-perception factors that are not typically captured in studies conducted in Western or Middle Eastern contexts. It provides quantitative evidence that Kazakh workers rely excessively on sensory inspection rather than microbiological principles, revealing a fragmented and disconnected knowledge structure characteristic of this group. By analysing the gap between knowledge and practice in Kazakhstan, the study contributes to a broader international understanding of food safety standards in diverse cultural and economic contexts.

## 2. Methodology

The positivist philosophy, which underpins the present research, emphasises an unbiased and rigorous approach to determining the extent of knowledge among Kazakhstani restaurant and café employees about food safety. Since the goal of this study is to quantify and evaluate knowledge of food safety using objective, realistic data devoid of prejudice, positivism seems a suitable approach [42]. Assuming that truth is external, observable, and interpretable through data analysis, this perspective supports the research's aim of measurement of knowledge levels, free from personal judgments [43]. This research used a deductive approach, which takes general concepts or current information, such as food safety knowledge, as a starting point and then constructs assumptions for practical observational testing [44]. The assumptions thus formed are tested through the analysis of collected data, which either validates or refines preexisting beliefs [45]. Deductive reasoning emphasises impartial assessment and the testing of hypotheses; it lends support to positivism.

In order to measure the level of food safety awareness among a broad sample of restaurant and café employees, the study employed a quantitative research method, a survey, which made it possible to gather numerical data in a methodical manner. Ethical approval EC172 (3/10/2023) for this survey was considered by Eurasian Technological University's Ethics Framework. Investigations which gauge variables, examine hypotheses, and find associations are all good fits for quantitative research [46]. Food safety knowledge of restaurant and café employees was evaluated using a structured questionnaire, treating the former as a quantitative concept. This method minimised individual misinterpretation by ensuring an impartial and objective assessment of knowledge levels [43]. Identifying knowledge gaps and generating practical insights to enhance food safety procedures and training were

two additional benefits of using a quantitative approach in this study. To effectively collect information from a large, diverse sample of participants, a survey strategy was employed. Surveys are considered perfect for quantitative research to gather data on understanding behaviours, beliefs, and actions [47]. Furthermore, by employing a standardised questionnaire, the survey minimised variability and facilitated comparison of results across participants, ensuring consistency in data collection [48]. This strategy, which emphasises factual measurement and hypothesis testing while offering an account of respondents' current knowledge, was also consistent with the study's positivist, quantitative nature.

A structured questionnaire with multiple-choice questions (MCQs) intended to gauge knowledge of food safety served as the data gathering tool. Transparency, neutrality, and uniformity in data collection were ensured by the predetermined options and a single correct answer for each multiple-choice question. Researchers computed knowledge scores and examined patterns using descriptive statistics (such as frequency distributions) and inferential methods (such as chi-square tests), given the MCQ format, which facilitated statistical analysis. This framework of multiple-choice questions facilitated trustworthy data analysis and upheld the study's objectivity [49]. The questionnaire items were adapted from the study by Muhyaddin and Sabir [22].

A pilot test is conducted with a group of higher education students to evaluate the questionnaire's clarity and comprehensibility. During this process, students are asked to provide feedback on various aspects of the questionnaire, such as the wording of the questions, the overall structure, and any potential ambiguities. This preliminary assessment aims to ensure that the questions are easy to understand and that the intended information can be accurately gathered. The insights gained from this pilot test will be instrumental in refining the questionnaire before it is distributed on a larger scale. The reliability values of Food Poisoning Knowledge ( $\alpha=0.445$ ), Personal hygiene awareness ( $\alpha=0.386$ ), temperature control knowledge ( $\alpha=0.180$ ), cross contamination and cleaning ( $\alpha=0.505$ ) were calculated.

### 2.1. Sampling

Convenience sampling and judgment sampling, two non-probability sampling techniques, were used to choose the participants. While judgment sampling aimed to include employees with pertinent roles in food service organisations, convenience sampling chose participants who were readily available. The inclusion criteria were 1) that the participants participated of their own free will, 2) that they were over 18 years old, 3) that they worked in the food and beverage industry, and 4) that their work involved contact with food. In this context, obtaining information is difficult because not all food handlers have the time or willingness to participate in a study. That is why these two sampling methods proved convenient for the study, but it was ensured that a statistically representative sample was obtained. Studies of nature in which the exact population size and distribution remain unknown usually use a 95% confidence level (with a corresponding Z-score of 1.96), a 50% population proportion representing the maximum variability, and a precision level of  $\pm 5\%$  [50]. This study also considered the same and determined that a minimum of 384 samples is needed to make the sample truly representative of the population. Given that the usual response rate for online surveys lies between 20–30% [51], the questionnaire was sent to 1500 people via online distribution. We obtained 470 responses; after removing incomplete responses, 428 were considered suitable for the study.

The sample size of 428 was justified because it ensured that the results were representative of the target population by providing sufficient statistical power, validity, and reliability [48]. Greater sample numbers improve the precision of the findings and lower the margin of error [52]. Additionally, the sample size was sufficient to capture a range of demographic characteristics that could affect food safety awareness, such as age, education, and job experience [53]. Lastly, the sample size of 428

fell within the typical sample size range for similar studies [54].

2.2. Statistics

SPSS software (version 23.0) was used for data analysis. The chi-square goodness-of-fit test was used to assess whether the observed distribution of responses deviated significantly from a uniform distribution across response categories. Given the use of non-probability sampling, the test is not intended to support population-level inferences but rather to identify statistically significant response patterns within the sample studied. The use of the chi-square goodness-of-fit test rather than bivariate association tests is fully justified by the research's univariate design and the specifics of the adopted non-probability sampling design [42]. Because the central purpose was to diagnose each item of the multiple-choice questionnaire (MCQ) in isolation and independently to assess the level of knowledge about food safety, the statistical tool was applied to determine whether the empirical response frequencies differed significantly from a theoretical uniform distribution, which would represent chance or simple guessing by the workers [49]. By rejecting the equiprobability hypothesis with highly significant p-values ( $p < 0.05$  and  $p < 0.001$ ), the results demonstrate systematic behavioural patterns and structured knowledge gaps in the sample. Furthermore, since the study was based on convenience and judgment sampling, dispensing with bivariate association tests avoids the fallacy of overgeneralising to the active population and focuses on a methodologically rigorous inferential analysis to identify the specific vulnerabilities of the evaluated group [48]. While descriptive statistics, such as frequency tables, were employed to compile demographic data and knowledge levels regarding food safety, this approach helped address knowledge gaps [49].

3. Results

The results obtained from the data analysis are displayed here. This section has been divided into several subsections. The first displays the demographic details of the study's participants. The next section details the respondents' employment. The preceding section provides details on the respondents' food safety knowledge.

3.1. Demographic details of the respondents

Table 1 of the study presents a demographic profile of workers in Kazakhstan's catering sector, characterised by marked gender parity and a predominantly young workforce. The data reveal an equitable distribution between men and women, with each group representing 48% of the sample. It is particularly noteworthy that 77% of respondents are in the 18–24 age range, suggesting that the hospitality sector is a key source of employment for young people, although this may also imply less accumulated work experience. In terms of education, 73% of participants hold a high school diploma or a university degree, reflecting a considerable level of basic academic training in the industry. Geographically, the sample is concentrated in the country's main urban and tourist centres, with 50% of workers located in Almaty and 23% in Astana. Finally, the ethnic profile is predominantly Kazakh (78%), with a Russian minority (12%), underscoring the importance of considering local cultural contexts when designing food security training programs.

3.2. Employment details of the respondents

This research aimed to assess the food safety knowledge of food handlers in Kazakhstan. Table 2 of the study reveals a hospitality sector in Kazakhstan characterised by the prevalence of small businesses and a workforce with a strong academic background. The data show that 58% of workers are students, 37% of whom are studying food-related fields, indicating that the industry serves as a platform for temporary employment or practical training for young people still acquiring their

**Table 1**  
Respondents' demographic profile.

Variable	Categories	Respondents (%)
Gender <sup>a</sup>	Male	48
	Female	48
	Other	2
	Prefer not to say	2
Age	18–24 Years	77
	25–49 Years	18
	50–60 Years	4
	Above 60 Years	1
	High school or equivalent Bachelor's degree	73
Education	Master's degree	10
	Ph.D. or other advanced degree	3
	Prefer not to say	14
	Almaty	50
Location	Uralsk	4
	Atyrau	1
	Aktau	2
	Astana	23
	Taraz	5
	Saryagash	3
	Shymkent	7
	Oral	1
	Taldykorgan	5
	Others	4
	Ethnic or Racial Group	Kazakh
Russian		12
Uzbek		3
Ukrainian		1
Tatar		2
Other		4

<sup>a</sup> In this article we used Gender and gave volunteers option to indicate anything outside of female and male, Other' or 'prefer not to say' if not willing to disclose.

**Table 2**  
Employment details of the respondents.

Variable	Categories	Respondents (%)
Employment Status	Employed full-time	26
	Employed part-time	11
	Self - employed	4
	Student	58
	Retired	2
Profession	Food industry professional	8
	Food safety inspector/regulator	4
	Chef/ Cook	13
	Food service worker (waiter/waitress, bartender, etc.)	19
	Educator/ Trainer in food related field	3
	Student (Studying food-related field)	37
	Other	15
	Fast food restaurants	19
Type of Restaurant	Traditional Kazakh restaurants	32
	Ethnic cuisine restaurants	7
	Buffet-style restaurants	8
	Casual dining restaurants	6
	Fine dining restaurants	5
	Cafés and coffee shops	9
	International chain restaurants	3
	Street food vendors	2
	Others	14
	Number of Workers	01–10
11–20		22
21–30		16
31–40		8
41–50		5
Above 50		15

theoretical foundations. Regarding market structure, traditional Kazakh restaurants (32%) and small-scale establishments predominate, with 57% employing fewer than 20 people. This labour configuration underscores the strategic challenge, particularly the transition from training to practical experience, in traditional settings where local customs and beliefs often exert greater influence than technical microbiological protocols.

### 3.3. Knowledge of food poisoning

One aspect of assessing food safety knowledge was evaluating respondents' understanding of food poisoning. Questions related to the behaviour of bacteria, the typical temperature that facilitates bacterial growth, symptoms and sources of food poisoning, and ways to examine food contaminated with food-poisoning bacteria were asked, with 5 options to choose from, of which 1 was the correct answer. Based upon the existing literature, the study hypothesised that:

*H01: Restaurants and cafe workers in Kazakhstan lacked food safety knowledge.*

Table 3 shows the respondents' responses regarding knowledge of food poisoning; the option in bold is the correct answer. The respondents exhibited limited conceptual understanding of foodborne pathogens, particularly regarding conditions conducive to bacterial growth and methods for detecting contamination. While there was a relatively high recognition of common symptoms, such as diarrhoea, prevalent misconceptions about bacterial behaviour at body temperature, and an undue reliance on sensory inspection—via smell, sight, and taste—indicate a superficial grasp of microbiological risk. These patterns suggest that knowledge regarding food poisoning is fragmented and disconnected, mainly from established scientific principles of food safety.

To assess the significance of the results, the chi-square goodness-of-

fit test was applied. The chi-square test was applied to the categorical data used in this study. Table 3 shows the test results, which revealed significant values ( $p < 0.001$ ) for questions 1 through 4. The results for question 5 were also significant ( $p < 0.05$ ). This, in turn, is evidenced by the effect size: only question 5 showed a small effect, while the others showed moderate effects. These significant results indicated that food handlers in Kazakhstan had low to moderate knowledge of food poisoning, with rates ranging from 18% to 49%. 63% of respondents mistakenly rely on their senses to detect contaminated food. Specifically, they lacked knowledge of bacterial behaviour, the typical temperatures that facilitate bacterial growth, the symptoms and sources of foodborne bacteria, and methods for examining food contaminated with foodborne bacteria. This led to the acceptance of the null hypothesis (H01). This implies training regarding food poisoning.

### 3.4. Personal hygiene awareness

The second aspect of food safety knowledge concerned awareness of personal hygiene. Respondents were asked about personal hygiene habits, such as handwashing and handling cuts, desired kitchen wear, and sources of Salmonella contamination. The study hypothesised that:

*H02: Restaurant and cafe workers in Kazakhstan lacked awareness of personal hygiene.*

Table 4 presents the respondents' responses regarding personal hygiene awareness. Knowledge related to personal hygiene showed a moderate understanding of general practices, such as handwashing, but little technical precision in specific situations, including wound management, appropriate protective clothing, and routes of contamination, such as Salmonella sources. This combination reflects a familiarity with procedures that lacks a microbiological foundation, which is expected since not everyone has technical expertise, but in food service, it hinders the ability to ensure food safety.

**Table 3**  
Food poisoning knowledge.

Question	Categories	Respondents (%)	Test Statistics		
			Chi square ( $X^2$ )	P value	Cramer's V
At body heat (37° C), what will food poisoning bacteria do?	Die	18	62.771	< 0.001	0.191
	Do not grow	14			
	Grow quickly*	29			
	Grow slowly	11			
	I do not know	29			
What is the typical temperature food-borne pathogenic bacteria begin to grow?	0 °C	9	89.570	< 0.001	0.229
	4 °C*	18			
	25 °C.	32			
	65 °C	12			
	I do not know	30			
Which of the following is a common symptom of food poisoning?	Headache	9	231.463	< 0.001	0.368
	Diarrhoea*	49			
	Rash	10			
	Constipation.	15			
	I do not know.	17			
Which of the following bring food poisoning bacteria into the food preparing area?	Insects.	11	114.336	< 0.001	0.258
	Food handlers.	12			
	Raw food.	20			
	All of the above*	40			
	I do not know	18			
Which is the most effective way to examine any food item against contamination with food poisoning bacteria:	Tasting it.	16	14.079	< 0.05	0.091
	Looking at it	21			
	Smelling it	26			
	None of the above	19			
	*				
	I do not know	18			

\* The option that is asterisked indicates the correct choice.

**Table 4**  
Personal hygiene awareness.

Question	Categories	Respondents (%)	Test Statistic		
			Chi square ( $\chi^2$ )	P value	Cramer's V
We should wash our hands after:	Going to the toilet	17	404.547	< 0.001	0.486
	Touching raw food	10			
	Touching our hair	8			
	All the above*	58			
	I do not know	7			
The most common products associated with salmonella contamination are:	Chicken and meat*	22	3.425	0.489	0.045
	Eggs.	19			
	Fishes	22			
	Dairy products.	17			
	I do not know.	20			
When a finger cut happens in food preparing area or setting, we:	Can't enter the kitchen at all	14	117.771	< 0.001	0.262
	Can touch raw food only.	7			
	Can't touch food at all	32			
	Can cover cuts with easily detectable plaster and touch food*	33			
	I do not know	15			
Which of the following should be avoided during food handling in food preparing area or setting:	Putting Make-up.	10	150.154	< 0.001	0.296
	Wearing finger rings.	22			
	Wearing earrings.	9			
	All of the above*	42			
	I do not know.	17			
When we are in the kitchen e.g. (Catering kitchen):	A special jacket e.g. (Protective Jacket or Clothing) is needed*	11	97.678	< 0.001	0.239
	Special shoes are needed e.g. (Safety boots' or 'Safety shoes)	14			
	A special pair of gloves are needed e.g. (Cut resistant gloves or oven gloves)	27			
	All of the above.	35			
	I do not know.	13			
If we are suffering from sickness and diarrhoea (i.e. typical food poisoning symptoms), we:	Can't enter the kitchen at all*	41	133.589	< 0.001	0.279
	Can enter the kitchen without handling any food.	17			
	Can touch raw food only.	9			
	Can cover our mouth and nose before handling food.	13			
	I do not know.	20			

\* The option that is asterisked indicates the correct choice.

Table 4 presents the results of the Chi-square test, which show that all questions related to personal hygiene awareness were significant ( $p < 0.001$ ), except Q2, which concerned Salmonella contamination. Significant results indicated that low to moderate personal hygiene awareness, i.e. ranging from 11% to 58%. However, concrete results could not be obtained regarding the food handlers' knowledge about the sources of Salmonella infection. Although there is a moderate understanding of handwashing (chi-square=404.547), the lack of technical precision regarding issues such as handling cuts and the use of protective clothing indicates that the knowledge is superficial and lacks a microbiological basis. This led to partial rejection of hypothesis H02.

### 3.5. Temperature control

The third aspect of food safety focused on assessing respondents' knowledge of temperature control by asking questions about the ideal refrigerator temperature, the effect of temperature on bacteria, and the ideal temperature for hot food. It was hypothesised that:

*H03: Restaurant and cafe workers in Kazakhstan lacked knowledge related to temperature control.*

The respondents' responses are presented in Table 5. Temperature control emerged as the most critical area of deficiency. Across all indicators (refrigeration, freezing effects, and hot-holding temperatures), accuracy was consistently low. This suggests a structural weakness in

understanding temperature control as a preventive barrier against bacterial growth. Given the central role of temperature control in food safety systems, these findings indicate increased vulnerability.

This is evident in Table 5, which shows that respondents lacked knowledge of temperature control, with correct answers ranging from 16% to 35%. Only 16% correctly identified the hot food serving temperature, demonstrating a structural weakness in the use of temperature as a preventative barrier. The significance of the results was assessed using the chi-square test (Table 5). Based on the results, food handlers in Kazakhstan had very limited knowledge of temperature control. This led to the acceptance of hypothesis H03.

### 3.6. Cross-contamination and cleaning

The fourth aspect of food safety knowledge concerns cross-contamination and cleaning. Questions related to the segregation of cooked and uncooked food, as well as the cleaning of kitchen and cutting surfaces, were posed to respondents, and their responses were recorded. The study hypothesised that:

*H04: Restaurant and cafe workers in Kazakhstan lacked knowledge of how to handle cross-contamination and cleaning.*

Table 6 of the study delves into the complexities of understanding cross-contamination and cleaning practices among workers in the sector. The findings reveal a concerning picture, with alarmingly low

**Table 5**  
Temperature control knowledge.

Question	Categories	Respondents (%)	Test Statistic		
			Chi square ( $X^2$ )	P value	Cramer's V
The temperature inside a refrigerator should be at or below:	5 °C*	31	101.065	< 0.001	0.217
	8 °C	8			
	10 °C	14			
	(-) 18 °C	23			
	(-) 25 °C	8			
	I do not know	17			
By freezing foods, what will bacteria do?	Die	17	64.126	< 0.001	0.194
	Do not grow*	35			
	Grow quickly	12			
	Grow slowly	17			
	I do not know	19			
Hot food must be kept above which temperature?	73 °C	14	19.921	< 0.05	0.108
	63 °C*	16			
	47 °C	22			
	22 °C	21			
	I do not know	26			

\* The option that is asterisked indicates the correct choice.

accuracy rates ranging from 12% to 39%. One of the most striking results is the widespread confusion regarding appropriate materials for cutting surfaces. Only a mere 12% of participants correctly identified plastic as the ideal choice; in contrast, a significantly larger segment mistakenly selected stainless steel (31%) or wood (22%) as suitable alternatives.

When it comes to sanitising methods, 39% of respondents recognised disinfectants as the most effective means of eradicating bacteria. Yet, a notable 26% still resort to boiling water, a method that has proven ineffective. The statistical analysis, employing a Chi-square test ( $p < 0.001$ ), underscores that these knowledge gaps are not mere coincidences; rather, they highlight a significant, systemic deficiency in understanding how bacterial transfer occurs.

These findings bolster the hypothesis that workers in Kazakhstan's sector lack the critical technical knowledge necessary to prevent cross-contamination and implement efficient cleaning protocols. Such insights not only point to the need for improved training and education but also underscore the potential health risks stemming from these misunderstandings.

**4. Discussion**

The investigation focused on assessing the food safety knowledge of food handlers in Kazakhstan. It is important to note that this study only measured cognitive knowledge and did not assess observed practices or adherence to established behaviours. Consequently, interpretations are limited to vulnerabilities related to knowledge rather than to observed food-handling behaviour. The survey's findings indicate that respondents' knowledge about food safety remained at moderate to low

levels across multiple areas, including cross-contamination, temperature control, personal hygiene, food poisoning, and cleaning procedures. Kazakh food handlers lacked an understanding of essential food safety principles, including the behaviour of pathogenic bacteria, temperature control methods, and indicators of food poisoning. The incorrect information about food poisoning symptoms and bacterial growth temperatures underscores the relevance of improved educational methods in these areas. The findings indicate a disturbing lack of awareness among respondents about the essential conditions for bacterial proliferation, which are vital to foodborne illness prevention [55]. Food handlers unintentionally increase the risk of foodborne illness due to insufficient knowledge to detect food contamination [56]. The knowledge of the typical temperature at which foodborne pathogenic bacteria begin to grow was also insufficient. This knowledge gap is alarming, as proper temperature control is vital to preventing the growth of harmful bacteria in food establishments. The results of the present study align perfectly with findings of studies conducted by Rogers and Taylor [57], Behnke and O'Rourke [58], Osaili et al. [25], Abdul-Mutalib et al. [23] and Brannon et al. [20].

Participants exhibited an intermediate level of awareness of the need to wash their hands after using the toilet, when handling raw food, or when touching their hair. The research indicates that despite some respondents showing proficiency in personal hygiene knowledge, a substantial number of workers still require education on essential hygiene practices to prevent foodborne illnesses [59]. Understanding of the sources of Salmonella contamination remained inadequate. The lack of understanding of typical contamination pathways poses significant food safety risks in workplace environments because Salmonella-induced foodborne illnesses can be extremely severe [60]. The survey found that only 33% of participants understood the correct cut-handling procedures in food prep zones, while 32% mistakenly believed they were prohibited from touching food at all during cutting. The findings reveal a significant gap in employees' understanding of workplace personal injury management. Therefore, this research suggests a comprehensive food safety training program with special emphasis on knowledge of temperature control to address these problems effectively. The findings presented in this study are consistent with international research indicating that food handlers frequently exhibit an inadequate understanding of food safety protocols [61,62]. Studies conducted in Saudi Arabia found that many food handlers lacked knowledge of safe food-handling techniques to prevent contamination or bacterial growth within temperature thresholds [56]. Food handlers in India demonstrated a lack of knowledge about personal hygiene practices, including proper handwashing methods and the appropriate treatment of cuts and injuries in food preparation zones [63].

The respondents' understanding of temperature control systems proved severely deficient. A scant 31% of survey participants knew the correct refrigeration temperature settings. A mere 35% of participants correctly identified that freezing stops bacterial growth, demonstrating widespread ignorance about freezing's effects on bacteria. A mere sixteen per cent of survey participants correctly identified the appropriate temperature for serving hot meals. The necessity of consistent training emerges from these findings, as it supports proper temperature-control practices essential to preventing bacterial growth in Kazakhstan's restaurant and cafe sector. The research outcomes of this study align with the work of Fawaz and Saeed [61], who found that food handlers in Kuwait also demonstrated insufficient knowledge of essential food safety practices, including cross-contamination prevention and temperature control. The research conducted by Lal and Dinesh [63] demonstrates that Indian food handlers exhibit substandard hygiene practices due to their lack of knowledge, which aligns with this study's findings about the absence of information on essential practices such as handwashing, wound care, and wearing proper clothing in food preparation areas.

The results also highlighted significant knowledge gaps on cross-contamination and cleaning techniques. Just 37% of respondents

**Table 6**  
Cross contamination and cleaning.

Question	Categories	Respondents (%)	Test Statistic		
			Chi square (X <sup>2</sup> )	P value	Cramer's V
Why cooked and uncooked foods should be kept separately?	Food will go off quicker.	23	103.192	< 0.001	0.246
	To stop bacteria transfer*	37			
	The flavour will be affected.	12			
	The smell will be affected.	10			
	I do not know.	18			
Which of the following is best at killing bacteria that can be found on kitchen surfaces?	Disinfectant*	39	138.860	< 0.001	0.285
	Boiled water	26			
	Detergent	12			
	Scrubbing brush	6			
	I do not know	17			
It is recommended to use cutting surfaces that is made of:	Wood	22	60.061	< 0.001	0.187
	Plastic*	12			
	Stainless steel	31			
	Glass.	11			
	I do not know	23			
After cutting raw meats and raw chicken, if we need to cut any other food, the cutting surface should be:	Replaced.	23	4.079	0.395	0.049
	Mobbed with disinfectant napkins or wipes	20			
	Washed with soap and hot water	18			
	Washed with soap, hot water and disinfectant*	21			
	I do not know.	19			
After cutting raw meats and chicken, if we need to cut fresh vegetables, the cutting knife should be:	Replaced*	27	24.664	< 0.001	0.120
	Washed with soap and cold water.	13			
	Washed with soap and hot water.	22			
	Washed with water and detergent.	18			
	I do not know.	19			
After cooked food handling, hands should be:	Mopped with disinfectant napkins or wipes	17	14.079	< 0.001	0.091
	Washed with soap and cold water	15			
	Washed with soap and hot water	23			
	Washed with soap, hot water and disinfectant*	25			
	I do not know.	19			

\* The option that is asterisked indicates the correct choice.

accurately identified the rationale for separating cooked and uncooked food, and many more were either unsure or perplexed by the idea. In line with this, only 39% of respondents knew that using disinfectants is the best way to kill germs on kitchen surfaces; the majority opted for less effective solutions, such as boiling water. Only 12% of respondents accurately identified plastic as the best material, demonstrating a notably low level of knowledge on suitable cutting surfaces. Additionally, just 21% of those surveyed were aware of the proper way to clean cutting surfaces after handling raw meat. These findings point to significant ignorance about cross-contamination avoidance, a key cause of foodborne illness outbreaks [64]. The study by Jovanović and Mihajlović [62] reported similar deficiencies in Serbia, as many participants had trouble identifying signs of food poisoning and adhering to proper food-handling practices related to cross-contamination and food-item separation. The findings of this study revealed food handlers' failure to know to safety protocols, especially concerning foodborne diseases and cross-contamination, while Siani and D'Amico [65,66] stressed the importance of food safety attitudes and practices across European countries. The present research supports the views of WHO [67] alongside Scallan et al. [68] on food safety knowledge as a crucial factor in mitigating foodborne illnesses.

The results of this study reveal a critical and systematic gap in workers' technical knowledge, with alarmingly low success rates in areas such as temperature control and cross-contamination prevention. These findings are closely related to those presented by Hassan et al. [69] in

their research in Lebanon, where it was identified that, despite a moderate level of knowledge, adherence to safe food handling practices is poor, confirming that a lack of awareness of microbiological risks is a persistent problem that transcends borders.

This disconnect between knowledge and action has direct implications for consumer perception. As Serhan et al. [70] point out, food safety is not just an internal protocol, but a critical attribute of service quality that directly influences customer satisfaction in hospitality settings. Consequently, the fragmented knowledge structure identified among Kazakh employees, who rely dangerously on sensory inspection rather than scientific principles, not only poses a risk to public health but, from the perspective of Serhan et al. (2022), constitutes a strategic threat to Kazakhstan's reputation and competitiveness as an emerging gastronomic destination.

## 5. Conclusion

The findings of this study highlight the inadequate knowledge of food safety among food handlers in Kazakhstan, mirroring trends observed in similar international research. The results indicate that food safety knowledge gaps exist across crucial areas such as temperature control, cross-contamination, personal hygiene, food poisoning symptoms, and cleaning procedures. Deficiencies in food safety knowledge pose immediate threats to both public health and Kazakhstan's culinary tourism industry. The lack of a comprehensive understanding of

bacterial behaviour, contamination routes, and proper food-handling methods leads to a higher incidence of foodborne diseases among consumers in cafes and restaurants. In line with previous work highlighting the impact of food service attributes on consumer satisfaction in university food environments, ensuring food safety remains a critical component of overall service quality [70].

### Implication

The study found that food handlers in Kazakhstan lacked knowledge of proper temperature control for storing and serving food. Training programs should focus on educating food handlers about the importance of maintaining proper refrigeration, cooking temperatures, and hot food storage. The study indicated that food handlers in Kazakhstan lacked knowledge of preventing cross-contamination and cleaning practices. To mitigate this, establishments should provide training on correct cleaning procedures for kitchen surfaces and utensils, emphasising the importance of using disinfectants and sanitisers. In addition, food handlers should be taught the correct methods for segregating raw and cooked foods to prevent cross-contamination. The use of colour-coded cutting boards and utensils should be encouraged, as it helps to avoid cross-contact between raw and cooked foods. Regular audits and hygiene checks could help reinforce these practices.

Beyond formal training programs, fostering a food safety culture within Kazakhstan's food establishments is crucial. Establishments should encourage managers and owners to take a proactive role in reinforcing food safety standards. This can include offering incentives to staff who demonstrate exemplary food safety practices, conducting periodic reviews of food safety protocols, and involving employees in decision-making on food safety improvements.

The study's policy implications suggest that Kazakhstan's regulatory system, aligned with EAEU standards, must transition to a more rigorous inspection and monitoring model to ensure practical compliance with regulations in the hospitality sector. It is proposed that policymakers collaborate with industry associations and experts to develop national food-handling guidelines that serve as a framework for technical training, thereby mitigating the influence of myths and cultural customs that currently shape worker behaviour more than technical knowledge. Furthermore, it is crucial that regulations be modernised by integrating digital technologies, such as platforms for tracking health records and real-time temperature logs, thereby enabling more transparent and efficient oversight by the authorities. Finally, strengthening the legal framework should include mandatory, personalised, practical training programmes that not only address microbiological theory but also standardise the use of critical preventive measures to reduce foodborne illness outbreaks in the country's tourist centres.

Educational institutions in Kazakhstan can play a crucial role in improving food safety knowledge and practices, especially in the hospitality and food service industries. Educational institutions, particularly vocational and technical schools, can integrate comprehensive food safety training into their curricula. These programs should cover essential topics such as personal hygiene, temperature control, cross-contamination, and foodborne illnesses. Vocational institutes could collaborate with local restaurants and cafes to develop real-world, hands-on training opportunities, ensuring food safety knowledge is not only theoretical but also practical. Universities and other educational institutions should partner with restaurants, food service providers, and regulatory agencies to design relevant, up-to-date training programs. In Kazakhstan, public awareness campaigns can be launched by educational institutions in partnership with health and food safety authorities.

### Limitations and future research directions

The study only examined the awareness status of restaurant and café employees in Kazakhstan using a quantitative approach. The study offers results that can be statistically relevant but fails to offer insights

highlighting the root cause of such non-compliance. It remains yet to be seen whether there are organizational or cultural reasons responsible for the non-compliance of the food-safety standards. Future researchers can explore these factors while studying food safety knowledge. They might also look at how local laws, cultural perspectives on food safety, and the financial constraints restaurant employees face could make it more difficult to comply with food safety standards. The results of the study are based upon the survey findings, which are known to suffer from self-reporting bias. Other researchers are recommended to corroborate survey-based study findings with other methods, such as microbial testing or statutory audits. The sample composition presents a significant limitation in representativeness: students comprised approximately 58% of respondents, which may not accurately reflect the demographic and experiential profile of active food service workers. Students may have greater exposure to theoretical training but lack sustained operational experience, which could inflate their perceived knowledge relative to practical experience. Furthermore, the use of nonprobability sampling limits the generalizability of the findings beyond the studied sample. While the sample size was statistically adequate for exploratory analysis, the results should be interpreted as indicative rather than representative of the population. Future research should address these limitations through stratified sampling designs that distinguish between students, frontline workers, chefs, and management staff. A mixed methods approach that integrates surveys with direct observation, hygiene audits, or microbiological testing would allow for triangulation between knowledge and actual practices. Qualitative research could also shed light on the organisational, cultural, and regulatory factors that influence food safety compliance. Given Kazakhstan's growing tourism sector, future studies should also examine consumer perceptions of food safety and their influence on destination image and dining behaviour, thereby explicitly linking food safety knowledge to service quality and tourism sustainability. The study offers only an employee perspective; however, it is equally important to understand management's perspective by studying restaurant and café owners, as they play a pivotal role in enforcing hygiene standards and designing a more holistic food safety ecosystem. Other researchers might study food safety from the viewpoint of top management and owners. The study provided demographic details of the respondents, but could not correlate them with food safety knowledge. Correlating demographic factors with food safety knowledge could have enabled policymakers and practitioners to devise more tailored training programs or specialised interventions; hence, other researchers are recommended to explore how demographic factors influence food-handling practices. Lastly, it is important to understand consumers' perceptions of food safety, especially given Kazakhstan's tourism boom, as this may highlight additional areas for improvement. Future researchers might explore the role of consumer expectations and feedback in shaping food safety practices in Kazakhstan.

### Data statement

The data includes sensitive and confidential information so will not be available to the public.

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### Ethical approval

Ethical approval for this study was considered by Eurasian Technological University's Ethics Framework and the approval number is EC172 dated 3/10/2023.

Participant information and consent form was included at the beginning of the survey and any response to the question with a 'No' to the consent form would direct the respondent to the last page which

would take them out of the survey. The respondents were made aware that once they have submitted their responses it will not be possible to withdraw their data as it was anonymous and would be difficult to retrieve their data.

### Declaration of generative AI in scientific writing

During the preparation of this work the authors used ChatGPT in places to improve the readability of the article. Thereafter, the authors reviewed and edited the content as needed and take full responsibility for the content of the published article.

### CRedit authorship contribution statement

**Mehmet Tas:** Software, Methodology, Investigation, Data curation, Conceptualization. **Sanar Muhyaddin:** Writing – review & editing, Writing – original draft, Software, Methodology, Investigation, Data curation, Conceptualization. **Sandra Nelly Leyva-Hernández:** Formal analysis. **Isabella Nyambayo:** Writing – review & editing. **Nurettin Can:** Supervision, Project administration. **Selman Tetik:** Supervision, Project administration. **Maha D. Abbas:** Writing – review & editing.

### Declaration of competing interest

The authors have nothing to declare in relation to the project.

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