



Evaluation of microbial risk factors in prepared homemade food in Al-Zawia City, Libya.

Amina K. Elzawi*, Nadia E. Bshena

Department of Medical Nutrition, University of Al- zawia, Al-zawia, Libya.

Highlights

- Foodborne infections remain a public health issue, emphasizing the need to understand microbiological dangers in home food preparation. The AE method is sensitive to corrosion activity, cracks and crack propagation in concrete.
- This study emphasizes the need for focused food safety measures including education and awareness to improve home food safety.

ARTICLE INFO

Article history:

Received 25 February 2024

Revised 17 August 2024

Accepted 18 August 2024

Keywords:

Defrosting, Hand washing, Home food, Microbiological risks.

*Address of correspondence:

Email address: a.elzawi@zu.edu.ly

A.K. Elzawi

ABSTRACT

Foodborne infections remain a public health issue, emphasizing the need to understand microbiological dangers in home food preparation. This study analyzes foodborne pathogen parameters to assess home cooking microbiological risks. A questionnaire-based cross-sectional study examined microbial 1 in home food preparation. The questionnaire gathers data providing a comprehensive understanding of microbiological risk factors. Using IBM SPSS Statistics, statistical analysis will reveal variable linkages. The study reveals profound links in home food preparation. Participants with lower levels of education have a notable correlation with increased presence of pathogens history ($p=0.00638^*$). Significantly, 22.85% of individuals indicate a previous occurrence of foodborne infections, with *Salmonella spp.* (12.85%), *E. coli* (7.15%), and *Campylobacter spp.* (2.85%) being the most commonly observed. There are strong associations between hygienic practices: hand washing ($p = 0.00014^*$), surface cleaning ($p = 0.00066^*$), and thermometer use ($p=0.00008^*$). Preservation behaviors exhibit notable correlations: checking expiry dates ($p=0.000235^*$), promptly refrigerating ($p<0.00001^*$), and defrosting techniques ($p=0.04882^*$). There is a significant correlation between education ($p=0.00638^*$) and awareness ($p=0.00129^*$) concerning pathogen history. Diverse sources of information indicate a non-significant association ($p=0.8878$). This study emphasizes the need for focused food safety measures including education and awareness to improve home food safety. Understanding these linkages allows people to adopt safer cooking practices, improving health and safety. The public health effects require awareness of home food preparation procedures to prevent microbiological risks.

1. Introduction

Home food preparation is an essential component of ensuring food safety and is closely linked to the first stage of Microbial Risk Assessment (MRA). The connection between cooking at home and MRA highlights the significance of assessing and regulating potential risks related to microbial contamination in household kitchens (Gwenzi *et al.*, 2021). Given the fact that households are increasingly becoming the primary setting for preparing meals, it is crucial to recognize and tackle these dangers. As more people cook food at home, it is crucial to assess and control the possible microbial risks involved in the process (Tesson *et al.*, 2020 and Ehuwa *et al.*, 2021). Key risk factors in home kitchens include inappropriate storage, inadequate hygiene standards, cross-contamination, and suboptimal cooking temperatures. The dangers are further exacerbated by the inadequate segregation of raw and cooked meals, insufficient adherence to hand hygiene practices, and the utilization of contaminated utensils. In a residential kitchen, the potential hazards are increased by the presence of pests, insufficient cleaning practices, and the use of perishable foods (Ncube *et al.*, 2022 and Alemayehu *et al.*, 2023). Raw materials, acquired from multiple sources, may contain pathogenic microorganisms such as bacteria, viruses, and parasites. Contamination is possible at any stage of planting, harvesting, manufacturing, or transporting. Typical sources encompass uncooked meat, poultry, eggs, and just harvested crops (Abebe *et al.*, 2020; Kamboj *et al.*, 2020). Poor handling and storage methods may increase the danger, enabling microbes to thrive (Gallo *et al.*, 2020).

The estimation of microbial risks is heavily influenced by personal and kitchen hygiene in home food preparation. Ensuring precise cleanliness is crucial, beginning with careful hand washing before food handling (Liu *et al.*, 2023; Todd, 2023). Self-care not only entails maintaining cleanliness but also involves wearing appropriate clothing to minimize potential sources of contamination, hence reducing the chances of cross-contamination. Regular cleanliness of surfaces, utensils, and boards for cutting in the kitchen is crucial in preventing the growth and spread of hazardous germs (Wong *et al.*, 2022). The problem of cross-contamination addresses the examination of the transmission of microorganisms between surfaces and food, posing a major threat to the safety of food. Pathogen cross-contamination is the consequence of interaction between hazardous microorganisms from raw components and ready-to-eat meals or surfaces, facilitating the possible transmission of these pathogens. Failure to adequately sanitize cutting boards, utensils, and hands after coming into contact with raw meats, poultry, or other high-risk goods can result in the transmission of harmful microorganisms (Kirchner, 2020). The risk becomes greater when raw and cooked meals are stored together. Improper storage temperatures can foster an ideal environment for the proliferation of bacteria or fungi, resulting in spoiling and potential health threats. Refrigeration, freezing, and appropriate packaging are crucial elements in slowing or preventing the fast development of microorganisms (Ricci *et al.*, 2020). Preservation is essential for enhancing the durability of perishable commodities while guaranteeing their safety

for consumption. Technologies like as canning, freezing, drying, and pickling are frequently utilized to prevent the growth of microorganisms and the activity of enzymes. Every process has a distinctive impact on taste, consistency, and nutritional composition (Ariyamuthu and Albert, 2022; Arora and Kaur, 2022). The objective of the research is to thoroughly examine and comprehend the possible microbial risks associated with the process of preparing meals at home. This study seeks to identify and assess specific risk factors, evaluating their occurrence and impact on food safety in household kitchens. Ultimately, the aim is to improve the quality and safety of home-prepared meals, eliminating microbiological threats along creating a healthier cooking environment for individuals and homes.

2. Materials and methods

2.1 Study design

The study implements a cross-sectional research approach to investigate microbiological hazards associated with food preparation in households. This design facilitates the acquisition of data at a specific moment, providing an instantaneous view of participants' actions and practices regarding home food safety. The use of a questionnaire enabled the gathering of both quantitative and qualitative data, which led to an extensive understanding of the elements that impact microbiological risks. This investigation was conducted in Al-Zawia city, west of Libya in the last two months of 2023 starting from 1 November to 31 December 2023. The questionnaire was carefully designed to encompass a wide range of parameters that are relevant to microbiological hazards. The questionnaire comprised both closed-ended questions, which supported quantitative analysis, and open-ended questions to collect nuanced observations. Before complete implementation, the questionnaire performed pilot testing with a limited number of individuals to detect potential confusion assure clarity, and enhance the phrasing of questions for optimal comprehension. The questionnaire involved questions regarding the practices of food preparation and cooking, the knowledge of foodborne pathogens, the previous infections and the type of microbes that caused the infection. The educated people told us about the presence or absence of foodborne pathogens history where who don't know were asked to show us any previous lab reports of any analysis correlated with previous infection in abdomen.

2.2 Inclusion criteria and Exclusion criteria

This study encompasses individuals who are 18 years of age or over, compared to which aligns with the required age for consenting to take part in research. Participants are required to actively participate in the process of preparing food at home, making sure that their experiences and practices are in line with the investigation's focus on home food safety. Voluntary contribution is an essential necessity, enabling individuals to actively give informed consent and show an intention to share their knowledge about home food preparation. Due to ethical concerns and the need for informed permission, participants younger than eighteen are excluded from the study. Non-home food preparers are not included since their experiences may not match the study's focus on home food safety practices. Ensuring ethical norms and ensuring participants understand the study's objective, the criteria exclude those who cannot or will not provide informed consent. Non-consenting individuals, regardless of other inclusion criteria, are eliminated to protect voluntary involvement and research ethics.

2.3 Statistical analysis

The information gathered from the Questionnaire will be properly arranged for statistical analysis. The arrangement of this data provides the basis to perform statistical tests, such as using descriptive statistics to summarize demographic information and inferential statistics to investigate relationships. The statistical analysis for this research will be performed using IBM SPSS Statistics version 25. SPSS offers an accessible user interface together with an

extensive variety of tools for managing and analyzing data. The gathered data, arranged in a spreadsheet format, will be uploaded into SPSS for methodical processing. Descriptive statistics, such as frequencies and percentages, will be computed to summarize demographic variables, thereby offering a full overview of participant characteristics. SPSS will be used for performing inferential statistical tests, such as chi-square or t-tests, to analyze the correlations and relationships between variables.

3. Results

3.1 Demographic characteristics distribution among participants

Overall, this table provides important demographic information about the study participants; the study's sociodemographic distribution indicates that the majority of participants (87.14%) belong to the 18-44 age group with a mean age of 25.7. There are no individuals aged below 18 or above 65 participating. Gender representation exhibits complete female exclusivity, with a participation rate of 100%. Regarding education, the majority of participants hold a Bachelor's degree (84.29%), suggesting a highly educated group. The proportion of participants with primary school or post-graduate degrees is relatively low, with each group accounting for 4.28%, (Table 1).

3.2 Meals prepared at home weekly

The weekly meal preparation patterns of the participants are as follows: a minority (5.71%) engage in cooking 2-3 meals per week, whereas (14.28%) prepare 4-5 meals per week. 54.29% of the participants say they prepare meals 6-7 times per week. Moreover, a significant percentage (25.71%) engages in dining out more than 7 times weekly Overall, the data on meal preparation frequency suggests a strong tendency towards regular home-cooked meals among the study participants, which may have positive implications for their dietary quality and overall health, (Table 2).

Table 1

Distribution of demographic characters

		Number	Percentage
Age	<18	0	0%
	18-44	61	87.14%
	45-65	9	12.86%
	>65	0	0%
	Mean 25.7 SD± 4.62		
Total		70	100%
Gender	Male	0	0%
	Female	70	100%
Total		70	100%
Education	Primary education	3	4.28%
	High education	5	7.15%
	Bachelor degree	59	84.29%
	Post-graduate degree	3	4.28%
Total		70	100%

Table 2

Frequency of meal preparation weekly

Meals preparation frequency	Numbers	Percentage
2-3	4	5.71%
4-5	10	14.28%
6-7	38	54.29%
>7	18	25.71%
Total	70	100%

3.3 History of foodborne pathogens

The relatively high proportion (22.85%) of participants or their family members with a history of foodborne pathogen infections suggests a potential increased susceptibility to these types of illnesses within the study population. This could be due to various factors, such as underlying health conditions, dietary habits, food preparation practices, or environmental exposures. The dominance of *Salmonella* spp. and *Escherichia coli* infections among the reported cases points to potential issues related to food safety, sanitation, or cross-contamination. Understanding the sources and transmission routes of these pathogens could help inform targeted interventions to mitigate future occurrences. 22.85% reported previous foodborne pathogen infection in their family members. *Salmonella* spp. Was the most common pathogen, reported by 12.85%, followed by *Escherichia coli* (7.15%) and *Campylobacter* spp. (2.85%). The vast majority of participants (77.14%) had no foodborne pathogen history in their family (Table 3 and Fig. 1).

Table 3

History of foodborne pathogens among participants and their family members

	N _e	%	Foodborne pathogen	N _e	%
Presence	16	22.85	<i>Salmonella</i> spp.	9	12.85
			<i>Escherichia coli</i>	5	7.15
			<i>Campylobacter</i> spp.	2	2.85
Absence	54	77.15%			
Total	70	100%			

3.4 History of foodborne pathogens correlation with hygiene practices in food preparation

Foodborne pathogen-exposed participants had different hand washing habits, with 81.43% always, 8.56% often, 5.71% occasionally, 2.85% rarely and 1.44% never wash their hands before food preparation. Washing hands habit is significantly correlated with history of foodborne pathogens (p-value = 0.00014*). When cleaning food preparation surfaces 50.02% of participants are cleaning surfaces with soap and water, 47.13% are using disinfectant and

only 2.85% use only water for cleaning surfaces, suggesting a significant connection (p-value = 0.00066*). Participants with an infection history were less likely to use a thermometer to ensure proper cooking, with none always doing. Only 4.28% use a thermometer always, where 10.01% never use it and a majority (40%) use it occasionally, 31.43% use the thermometer rarely, and 14.28% use it often. A significant correlation was found between using thermometer habits and infection history of food-borne pathogens (p-value=0.00008*). These findings suggest that specific food safety practices, such as hand washing, cleaning food preparation surfaces, and using food thermometers, may be associated with the risk of foodborne pathogen infections among the study participants. The statistically significant differences observed between the two groups highlight the importance of reinforcing these critical food safety behaviors to prevent the transmission of foodborne illnesses (Table 4).

3.5 History of foodborne pathogens correlation with habits in food preservation

The habits regarding food preservation are shown and the data reveal that most individuals are always checking expiration data (69.99%), where (21.43%) often, (4.29%) occasionally, (2.85%) rarely, (1.44%) never check the expiration date. Infection history was significantly associated with less frequent expiration date checking compared to those without an infection history (p-value=0.000235*). Individuals with a history of infections were less likely to refrigerate leftovers quickly (4.28%) compared to those without an infection history (68.58%), demonstrating a significant connection (p-value<0.00001*). A significant connection (p-value = 0.04882*) was found between defrosting practices and pathogen history, where 58.57% of individuals defrost food at room temperature, (21.43%) use microwave, and (20%) use refrigerator to defrost food. These additional findings further emphasize the importance of specific food safety practices, such as checking expiration dates, properly storing leftover food, and using safe defrosting methods, in the prevention of foodborne pathogen infections. The observed differences between the two groups highlight the need for targeted education and interventions to promote these critical food safety behaviors, (Table 5).

Table 4

Hygiene practices correlation with a history of foodborne pathogens

			History of foodborne pathogens				p. value
			Presence of infection history		Absence of infection history		
			N _e	%	N _e	%	
Hand Washing before Food preparation	Always	81.43%	6	8.57	51	72.86	0.00014*
	Often	8.56%	4	5.71	2	2.85	
	Occasionally	5.71%	3	4.28	1	1.44	
	Rarely	2.85%	2	2.85	0	0	
	Never	1.44%	1	1.44	0	0	
Total		100%	16	22.85	54	77.15	70
Cleaning Food preparing Surfaces	Disinfectant	47.13%	2	2.85	31	44.28	0.00066*
	Soap and water	50.02%	12	17.15	23	32.87	
	Only water	2.85%	2	2.85	0	0%	
Total		100%	16	22.85	54	77.15	70
Thermometer ensuring cooking	Always	4.28%	0	0	3	4.28	0.00008*
	Often	14.28%	2	2.85	8	11.43	
	Occasionally	40%	3	4.28	25	35.72	
	Rarely	31.43%	5	7.15	17	24.28	
	Never	10.01%	6	8.57	1	1.44	
Total		100%	16	22.85	54	77.15	70

*Significant difference using Pearson Chi-square test (χ^2 -test) at 0.05 levels.

Table 5

Food preservation habits and history of foodborne pathogens history

			History of foodborne pathogens				p. value
			Presence of infection history		Absence of infection history		
			No	%	No	%	
Checking expiration date	Always	69.99%	5	7.15	44	62.84	0.000235*
	Often	21.43%	7	10	8	11.43	
	Occasionally	4.29%	2	2.85	1	1.44	
	Rarely	2.85%	2	2.85	0	0	
	Never	1.44%	1	1.44	0	0	
Store leftover method	Refrigerator immediately	72.86%	3	4.28	48	68.58	<0.00001*
	Room temperature	27.14%	13	18.57	6	8.57	
Defrost of frozen food	Refrigerator	20%	0	0	14	20	0.04882*
	Microwave	21.43%	3	4.28	12	17.15	
	Room temperature	58.57%	13	18.57	28	40	

*Significant difference using Pearson Chi-square test (χ^2 -test) at 0.05 levels.

Table 6

Foodborne pathogens history Correlation with education, awareness and source of information about foodborne pathogens.

			History of foodborne pathogens				p. value
			Presence of infection history		Absence of infection history		
			N _o	%	N _o	%	
Education level	Primary education	4.28%	3	4.28	0	0	0.00638*
	Secondary education	7.15%	2	2.85	3	4.28	
	Bachelor degree	84.29%	10	14.28	49	70.02	
	Post-graduate degree	4.28%	1	1.44	2	2.85	
Total		100%	16	22.85	54	77.15	70
Awareness of Food-borne pathogens	Very aware	25.72%	1	1.44	17	24.28	0.00129*
	Somewhat aware	28.56%	2	2.85	18	25.71	
	Not very aware	41.44%	10	14.28	19	27.16	
	Not aware	4.28%	3	4.28	0	0	
Total		100%	16	22.85	54	77.15	70
Sources of information	Websites	22.86%	4	5.71	12	17.15	0.8878
	Food show	10%	2	2.85	5	7.15	
	Social media	67.14%	10	14.28	37	52.86	
Total		100%	16	22.85	54	77.15	70

*Significant difference using Pearson Chi-square test (χ^2 -test) at 0.05 level.

3.6 Foodborne pathogens history Correlation with education, awareness and source of information about foodborne pathogens

History of foodborne pathogens infection was significantly associated with a level of education (p-value=0.00638*) with a majority of individuals having a bachelor's degree (84.29%), (7.15%) with secondary education, and the same percentage of (4.28) for primary education and post-graduate education. Infection history was associated with awareness level (p-value=0.00129*) where (25.72%) are very aware, (28.56%) are somewhat aware, (41.44%) of participants are not very aware, (4.28%) are not aware. Websites (22.86%) and food shows (10%) were used by people with and without infection histories. Social media use was higher among participants (67.14%), indicating no significant correlation between a source of information and a history of foodborne pathogens infection (p-value=0.8878), (Table 6).

4. Discussion

The microbial risks associated with preparing food at home involve the possibility of harmful microorganisms contaminating and multiplying, resulting in foodborne diseases. To avoid these risks and maintain a healthy home environment, it is vital to give priority to proper hygiene, adhere to safe cooking methods, and exercise careful food handling. This discussion explores the complex relationship between hygiene practices and food preservation behaviors in home food preparation. Through an analysis of the history of infection surrounding foodborne diseases, our objective is to reveal intricate associations, providing an in-depth comprehension of the

mechanisms involved in maintaining food safety within households. In this investigation, we deliberately focused on individuals actively involved in home food preparation, revealing a demographic composition where an overwhelming 87.14% fell within the 18-44 age brackets, boasting a mean age of 25.7. Strikingly, our participant cohort was exclusively composed of females, with a notable 84.29% holding a bachelor's degree, indicating a well-educated group. Comparatively, a study from Nepal underscored a diverse age range for individuals engaged in home food preparation, spanning from 17 to 43 years (Gautam and Curtis, 2021). An Ethiopian study reported 56.3% of food preparers are female, with respondents having a mean age of 22.5 years (Alemayehu et al., 2021). In our study, all participants were female, constituting 100% of the sample. This unique characteristic aligns with cultural norms observed in Libya, where women typically assume the primary role of food handlers at home. Our findings resonate with global trends reported in a 2021 study, emphasizing the predominant role of women in frequent cooking activities (Wolfson et al., 2021). During our investigation, a significant percentage (5.71%) of participants stated preparing 2-3 meals per week, whereas a greater percentage (14.28%) involved in meal preparation 4-5 times weekly. Over half (54.29%) of the participants had a strong habit of cooking meals 6-7 times per week. remarkably, a large number (25.71%) reported dining out more than 7 times weekly. By contrast, an investigation revealed a median frequency of 5 meals per week (Wolfson et al., 2021). A separate study emphasized notable disparities, as 36% of the participants reported preparing more than 7 meals per week at home, while only 13% were able to manage 0-2 meals per week

(Wolfson *et al.*, 2020). Moreover, the dietary patterns experienced significant shifts during and after the COVID-19 pandemic, as European countries observed a notable increase in the daily preparation of meals at home as a result of the recommended self-isolation measures (Skotnicka *et al.*, 2021). The behavior change illustrates how external factors have a significant impact on the way individuals prepare their meals. Our study revealed useful results on the frequency of foodborne pathogen infection in the households of participants, with 22.85% reporting such occurrences. *Salmonella spp.* has been found to be the most common pathogen, infecting 12.85% of households, followed by *E. coli* (7.15%) and *Campylobacter spp.* (2.85%). Remarkably, the majority (77.14%) indicated that their families had no previous history of foodborne infections. worldwide data indicate that foodborne infections have a significant impact, affecting 7.69% of the worldwide population each year. These health conditions contribute to 7.5% of the total yearly mortality, amounting to 56 million deaths. Australia has a significant prevalence of *Campylobacter*-related cases, with *Salmonella* being the subsequent most common. In comparison to other locations, Europe has a substantial number of cases associated with *Campylobacter spp.* and *Salmonella spp.* (Lee and Yoon, 2021). In 2021, a systematic review conducted in Ethiopia revealed that the overall prevalence of foodborne pathogens, including *Salmonella spp.*, pathogenic *E. coli*, *Shigella*, and *Campylobacter spp.*, was estimated to be 8% (Belina *et al.*, 2021).

Our study indicates a significant correlation (p -value=0.00014*) between hand-washing habits before food preparation and the history of foodborne pathogens. This aligns with a recent 2023 study that highlighted a substantially reduced risk of cross-contamination (P . value < 0.0001) for participants who actively engaged in hand washing or completed more thorough hand washing steps (Kirchner *et al.*, 2023). Moreover, a 2022 study demonstrated a positive correlation ($r=0.34$, $P=0.032$) between hand washing practices and the total coliform load in hand swab samples, providing further evidence of the link between hand hygiene practices, infection, and varied microbial risks (Ahmednur *et al.*, 2022). The results of our study revealed a strong correlation (p -value=0.00066*) between those who have had previous infection and their decreased likelihood of using disinfectants on surfaces used for food preparation. This corresponds with the results obtained in Sharjah, United Arab Emirates, where over fifty percent of the participants said that they cleaned blades and cutting boards (Saeed *et al.*, 2021). Consistent with our findings, research conducted in 2019 provided evidence that there is a significant and positive relationship ($p=0.01$) between the presence of foodborne germs and different surfaces, such as cutting boards, refrigerator handles and sink tap surfaces (Sibanyoni and Tabit, 2019). This highlights the significance of routinely cleaning these surfaces using disinfectant. Furthermore, a study conducted in 2017 showed that the presence of contaminants on surfaces utilized in food preparation, such as cutting boards and kitchen towels, was strongly correlated with the absence of cleaning products, underscoring the need to maintain good sanitation (Borrusso and Quinlan, 2017). Approximately 50% of the respondents in Pakistan stated that they clean food contact surfaces, such as cutting boards, tables, and knives, using antibacterial soap before food preparation (Ahmed *et al.*, 2021). 84.6% of the population in Ethiopia frequently washed food contact surfaces to prevent food contamination (Azanaw *et al.*, 2021). The results of our study showed a strong correlation (p -value = 0.00008*) between those who had previously been infected and a decreased tendency to use a thermometer to ensure food was cooked properly. None of the participants consistently followed this practice. These results are consistent with the data from Ethiopia, where more than half (52.9%) of the participants indicated that they never utilize a thermometer to evaluate the complete cooking of food (Azanaw *et al.*, 2021). In contrast, a study conducted in 2020 revealed that those who were more knowledgeable about foodborne pathogens and had better food safety habits were more inclined to possess a thermometer and use it regularly for different types of food (Her *et al.*, 2020). An earlier study conducted in 2003

highlighted the importance of using a thermometer to ensure proper cooking of food. This was found to be crucial in preventing illnesses caused by different pathogens, such as *Campylobacter jejuni*, *Salmonella* species, and *Escherichia coli* O157:H7 (Hillers *et al.*, 2003). This evidence highlights the crucial importance of employing thermometers to guarantee food safety and avert foodborne infections. The results of our study showed significant changes in the monitoring of expiry dates and behaviors related to food storage, which were impacted by previous occurrences of foodborne infections. Among the participants, the majority (69.99%) who did not have a history of illness consistently examined expiry dates. However, those with an infection history were considerably less likely to check expiration dates often (p -value = 0.000235*). Furthermore, persons who had a history of illness were significantly less inclined to rapidly refrigerate leftovers (4.28%) compared to those who did not have a history of infection (68.58%), as shown by a significant association (p -value < 0.00001*). The results align with research conducted in the UAE, which revealed that 75% of those who contracted foodborne illnesses frequently failed to refrigerate cold foods. This underscores a strong correlation ($P < 0.001$) (Saeed *et al.*, 2021). In Pakistan, 71.3% of the population demonstrated awareness of the importance of storing cooked food at temperatures below 4°C (Ahmed *et al.*, 2021). In contrast, there was a global variation in habits, as 14.2% of respondents in Bangladesh failed to store leftover cooked food in a cool location within two hours (Rabeya *et al.*, 2022). A 2020 research conducted in Japan discovered associations between microbiological contamination and the frequency/method of cleaning refrigerators (Mori *et al.*, 2020). In Pulipakkam Village, India, 89% of the population failed to refrigerate prepared food within 2 hours, whereas 66.6% regularly verified expiry dates (Lakshmi, 2021). A 2020 research conducted in South Africa highlighted the need to verify the expiration dates of ingredients to ensure food safety (Marutha and Chelule, 2020). This viewpoint was shared by 93.5% of the participants from Bangladesh (Rabeya *et al.*, 2022). The study revealed a noteworthy correlation (p -value=0.04882*) between defrosting methods and a previous occurrence of foodborne infections, with 58.57% of participants opting for defrosting food at room temperature. This is consistent with worldwide norms, as indicated by a 2021 survey, in which 47% of women in Saudi Arabia thawed meat on the kitchen counter (Arfaoui *et al.*, 2021). In research conducted in the UAE, more than 50% of the participants expressed a preference for thawing food at room temperature (Saeed *et al.*, 2021). The social viewpoints about defrosting procedures differ, as indicated by the majority of Lebanese women (80% of respondents) who choose the safer approach of thawing food in a cool environment (El Haddad *et al.*, 2020). Nevertheless, a survey conducted in 2012 unveiled contrasting viewpoints, with 58.4% of participants deeming thawing as an acceptable approach, while 21% favored thawing at room temperature, and 20.6% expressed a preference for thawing in the sink (Langiano *et al.*, 2012). The wide range of worldwide practices highlights the cultural and geographical differences in understanding of food safety and adherence to suggested guidelines. These findings emphasize the necessity of focused educational initiatives to improve knowledge about proper food handling techniques, particularly thawing, to reduce the likelihood of foodborne diseases. The study revealed a noteworthy correlation (p -value=0.00638*) between previous infection with foodborne pathogens and level of education, with a majority of people having a bachelor's degree (84.29%). The level of awareness also showed a significant correlation with the history of infection (p -value=0.00129*), with 41.44% of individuals reporting low awareness. A majority of participants, namely 67.14%, used social media as a source of information. However, there was no notable connection between a source of information and having a history of foodborne pathogens infection, as indicated by a p -value of 0.8878. This corresponds to the results obtained in the United Arab Emirates, where a notable correlation was seen between individuals' educational levels and their general understanding of food safety. Specifically, 51.8% of participants who possessed a college or university degree demonstrated a higher

level of knowledge in this area (Saeed *et al.*, 2021). Furthermore, a study conducted in 2020 highlighted the significance of education in promoting safer methods of food preparation and mitigating the likelihood of foodborne diseases (Evans *et al.*, 2020). A study done in the United States and Japan emphasized the importance of parental duties, indicating that people have a heightened awareness of food safety issues upon becoming parents (Jussaume and Judson, 1992). Women in Lebanon exhibited a significant degree of awareness (74.81%) (El Haddad *et al.*, 2020), which aligns with a previous study conducted in 2014 that found a 73% level of knowledge on food safety (Meysenburg *et al.*, 2014). A study found that 28.3% of online users saw web-based applications as a significant source of knowledge on safe food handling techniques (Seow *et al.*, 2022). Regarding food safety, 62% of respondents in Malaysia expressed faith in social media as a reliable source of information, while scientists and family members were also considered trustworthy sources (Soon, 2020). Similarly, research conducted in Romania highlighted the widespread use of social media as the main platform for obtaining knowledge about food safety (Borda *et al.*, 2021). The results highlight the complex influence of education and many sources of information on individuals' knowledge and behaviors about food safety reflecting the microbial risks in home food preparation.

5. Conclusion

This investigation highlights the crucial connections between sociodemographic characteristics, hygiene practices, and food preservation habits, which play a significant role in creating a safer home cooking environment. The consequences of these results have practical significance for the well-being of society, reaching beyond the realm of academia. By realizing and dealing with such associations, individuals can have the ability to adopt safer methods, hence improving food safety as a whole. As we progress, it is crucial that we focus on the promotion of public awareness and the implementation of specific interventions in order to establish healthier and safer home environments.

References

- Abebe, E., Gugsu, G., Ahmed, M. (2020) 'Review on major food-borne zoonotic bacterial pathogens', *Journal of Tropical Medicine*, 2020, (1), p. 4674235.
- Ahmed, M.H., Akbar, A., Sadiq, M.B. (2021) 'Cross-sectional study on food safety knowledge, attitudes, and practices of food handlers in Lahore district, Pakistan', *Heliyon*, 7(11), pp. 403-410.
- Ahmednur, M., Esmail, M., Feresu, F. (2022) 'Handwashing Practice of Food Establishment Customers, Microbial Quality of Handwashing Water, and Associated Factors in Ginjo Kebele, Jimma Town, Southwest Ethiopia', *Environmental Health Insights*, (16), pp. 759-771.
- Alemayehu, G., Shaleka, D., Ashenafi, M. (2023) 'Food safety and water sanitation and hygiene among food insecure households: the case of Woreda 10 of Arada sub-city, Addis Ababa, Ethiopia', *International Journal of Food, Nutrition and Public Health (IJFNPH)*, 13(2), pp. 81-98.
- Alemayehu, T., Aderaw, Z., Giza, M., Diress, G. (2021) 'Food safety knowledge, handling practices and associated factors among food handlers working in food establishments in Debre Markos Town, Northwest Ethiopia, 2020: institution-based cross-sectional study', *Risk Management and Healthcare Policy*, (14), pp. 1155-1163.
- Arfaoui, L., Mortada, M., Ghandourah, H., Alghafari, W. (2021) 'Food safety knowledge and self-reported practices among Saudi women', *Current Nutrition & Food Science*, 17(8), pp. 891-901.
- Ariyamuthu, R., Albert, V.R., Je, S. (2022) 'An overview of food preservation using conventional and modern methods', *Journal of Food and Nutrition Sciences*, 10(3), pp. 70-79.
- Arora, L., Kaur, R. (2022) 'An Overview on Food Preservation Methods', *International Journal of Innovative Research in Computer Science & Technology*, 10(2), pp. 164-168.
- Azanaw, J., Dagne, H., Andualem, Z., Adane, T. (2021) 'Food safety knowledge, attitude, and practice of college students, Ethiopia, 2019: A cross-sectional study', *BioMed Research International*. doi: 10.1155/2021/6686392
- Belina, D., Hailu, Y., Gobena, T., Hald, T., Njage, P.M. (2021) 'Prevalence and epidemiological distribution of selected foodborne pathogens in human and different environmental samples in Ethiopia: a systematic review and meta-analysis', *One health outlook*, 3(1), pp. 1-30.
- Borda D, Mihalache OA, Dumitraşcu L, Gafiţianu D, Nicolau AI. (2021) 'Romanian consumers' food safety knowledge, awareness on certified labelled food and trust in information sources', *Food Control*, 120, 107544. doi.org/10.1016/j.foodcont.2020.107544
- Borruso, P.A., Quinlan, J.J. (2017) 'Prevalence of pathogens and indicator organisms in home kitchens and correlation with unsafe food handling practices and conditions', *Journal of Food Protection*, 80(4), pp. 590-597.
- Ehuwa, O., Jaiswal, A.K., Jaiswal, S. (2021) 'Salmonella, food safety and food handling practices', *Foods*, 10(5), p. 907
- El Haddad, R.F., Yahfoufi, N., Abou Haidar, M., Hoteit M. (2020) 'Knowledge, attitude and practices of Lebanese married women towards food safety', *Atena Journal of Public Health*, 2, 1, pp. 1-12
- Evans, K.S., Teisl, M.F., Lando, A.M., Liu, S.T. (2020) 'Risk perceptions and food-handling practices in the home', *Food Policy*, 95, 101939. doi.org/10.1016/j.foodpol.2020.101939
- Gallo, M., Ferrara, L., Calogero, A., Montesano, D., Naviglio D. (2020) 'Relationships between food and diseases: What to know to ensure food safety', *Food Research International*, 137, doi: 10.1016/j.foodres.2020.109414.
- Gautam OP, Curtis V. (2021) 'Food hygiene practices of rural women and microbial risk for children: Formative research in Nepal', *The American Journal of Tropical Medicine and Hygiene*, 105(5), pp. 1383-1395.
- Gwenzi, W., Chaukura, N., Muisa-Zikali, N., Teta, C., Musvuugwa, T., Rzymiski, P., Abia, A.L. (2021) 'Insects, rodents, and pets as reservoirs, vectors, and sentinels of antimicrobial resistance', *Antibiotics*, 10(1), 68, doi: 10.3390/antibiotics10010068.
- Her, E.S., Almanza, B.A., Ma, J., Ge, L., Liu, Y., Lando, A., Wu, F., Verrill, L. (2020) 'Microbial awareness and risk perceptions are key to thermometer ownership and use', *Food Control*, 115, 107268, doi.org/10.1016/j.foodcont.2020.107268
- Hillers VN, Medeiros L, Kendall P, Chen G, Dimascola S. (2003) 'Consumer food-handling behaviors associated with the prevention of 13 foodborne illnesses.' *Journal of Food Protection*, 66(10), 1893-1899.
- Jussaume, R.A., Judson, D.H. (1992) 'Public perceptions about food safety in the United States and Japan 1', *Rural Sociology*, 57(2), pp. 235-249.
- Kamboj, S., Gupta, N., Bandral, J.D., Gandotra, G., Anjum, N. (2020) 'Food safety and hygiene: A review', *International Journal of Chemical Studies*, 8(2), 358-368.
- Kirchner, M., Goulter, R.M., Bernstein, C., Lavalley, A., Schaffner, D., Chapman, B., Jaykus, L.A. (2023) 'The role of hands in cross-contamination of kitchen surfaces during meal preparation', *American Journal of Infection Control*, 51(11), pp. A44-57, doi: 10.1016/j.ajic.2023.04.162.
- Kirchner, M.K. (2020) 'The Effect of Consumer Behaviors on Cross Contamination While Preparing Meals in a Consumer Kitchen North Carolina State University', *Foods*, 12, 17pp. 32-45. doi.org/10.3390/foods12173245.

- Lakshmi, N., Ramya, M.R., Felicia, J.P (2021) 'Domestic food hygiene practices among households in Pulipakkam Village, Kanchipuram District: a cross-sectional study', *International Journal of Community Medicine and Public Health*, 8(1), pp. 397-401
- Langiano E, Ferrara M, Lanni L, Viscardi V, Abbatecola AM, De Vito E. (2012) 'Food safety at home: knowledge and practices of consumers', *Z Gesundheitswissenschaften J Public Health*, 20(1), pp. 47-57.
- Lee, H., Yoon, Y. (2021) 'Etiological agents implicated in foodborne illness worldwide', *Food science of animal resources*, 41(1), pp. 1-7.
- Liu, H., Ma, T., Liu, Z., Li, Q., Shen, B., Xin, J., Feng, C., Liu, M., Liu, L. (2023) 'Quantitative risk assessment for bacterial community in residential kitchens', *Building and Environment*, 228, 109841, doi.org/10.1016/j.buildenv.2022.109841.
- Marutha, K.J., Chelule, P.K. (2020) 'Safe food handling knowledge and practices of street food vendors in Polokwane Central Business District', *Foods*, 9(11), 156. doi.org/10.3390/foods9111560
- Meysenburg, R., Albrecht, J.A., Litchfield, R., Ritter-Gooder, P.K. (2014) 'Food safety knowledge, practices and beliefs of primary food preparers in families with young children. A mixed methods study', *Appetite*, 73, pp. 121-131.
- Mori, M., Sakagami, Y., Tanaka, M., Inoue, R., Jojima, T. (2020) 'Analysis of the relationship of microbial contamination with temperature and cleaning frequency and method of domestic refrigerators in Japan', *Journal of Food Protection*, 83(7), pp. 1234-1240.
- Ncube F, Kanda A, Muzeketwa D, Chiripamberi V, Madondo MC. (2022) 'Risk factors for food poisoning among self-catering university students.' *International Journal of Environmental Health Research*, 32(1), 29-39.
- Rabeya, R., Zihad, H.B., Fakir, A., Khatun, S., Rakhi, J.J., Islam, A., Islam, R., Khan, A.S., Hossain, Hawlader M.D. (2022) 'A Community-Based Cross-Sectional Study about the Knowledge, Attitude, and Practices of Food Safety Measures among Rural Households in Bangladesh', *Journal of Nutrition and Metabolism*, doi: 10.1155/2022/7814370.
- Ricci, A., Martelli, F., Razzano, R., Cassi, D., Lazzi, C., Neviani, E., Bernini, V. (2020) 'Service temperature preservation approach for food safety: microbiological evaluation of ready meals', *Food Control*, 115, 107297. doi.org/10.1016/j.foodcont.2020.107297
- Saeed, B.Q., Osaili, T.M., Taha, S. (2021) 'Foodborne diseases risk factors associated with food safety knowledge and practices of women in Sharjah-United Arab Emirates', *Food Control*, 125, 108024. doi.org/10.1016/j.foodcont.2021.108024
- Seow, W.L., Ariffin, U.K., Lim, S.Y., Mohamed, N.A., Lee, K.W., Deva-raj, N.K., Amin-Nordin, S. (2022) 'A systematic review on the usability of web-based applications in advocating consumers on food safety.' *Foods*, 11(1), doi: 10.3390/foods11010115.
- Sibanyoni, J.J., Tabit, F.T. (2019) 'An assessment of the hygiene status and incidence of foodborne pathogens on food contact surfaces in the food preparation facilities of schools.' *Food Control*, 98, pp. 94-99.
- Skotnicka, M., Karwowska, K., Kłobukowski, F., Wasilewska, E., Małgorzewicz, S. (2021) 'Dietary habits before and during the COVID-19 epidemic in selected European countries', *Nutrients*, 13(5), 1690. doi: 10.3390/nu13051690.
- Soon, J.M. (2020) 'Consumers' awareness and trust toward food safety news on social media in Malaysia' *Journal of Food Protection*, 83(3), pp. 452-459.
- Tesson, V., Federighi, M., Cummins, E., de Oliveira, Mota J, Guillou S, Boué G. (2020) 'A systematic review of beef meat quantitative microbial risk assessment models.' *International Journal of Environmental Research and Public Health*, 17(3), 688. doi: 10.3390/ijerph17030688.
- Todd, E.C. (2023) 'Personal Hygiene and Food Worker Health.' In *Food Safety Management* (pp. 699-734). Academic Press.
- Wolfson, J.A., Ishikawa, Y., Hosokawa, C., Janisch, K., Massa, J., Eisenberg, D.M. (2021) 'Gender differences in global estimates of cooking frequency prior to COVID-19', *Appetite*, 161, 105117. doi: 10.1016/j.appet.2021.105117.
- Wolfson, J.A., Leung, C.W., Richardson, C.R. (2020) 'More frequent cooking at home is associated with higher Healthy Eating Index-2015 score', *Public Health Nutrition*, 23(13), pp. 2384-2394.
- Wong, W., Yoke, S., Mahyudin, N.A., Ho, J.A., Abidin, Z., Ungku, U.F. (2022) 'Evaluation of Self-Efficacy-Based Intervention: Improving School Food Handlers' Selected Food Safety Behavior', *Food Protection Trends*, 42(1), pp. 8-21