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Knowledge, attitudes, practices, and risk perception of foodborne diseases: a study with food handlers from food services

Conhecimentos, atitudes, práticas e percepção de risco de doenças de transmissão hídrica e alimentar: estudo com manipuladores de alimentos de serviços de alimentação

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ABSTRACT

Introduction: Foodborne diseases (FBD) occur due to inadequate food handling; therefore, studies to evaluate food production's hygienic and sanitary aspects are important. **Objective:** To evaluate the knowledge, attitudes, self-reported practices (KAP), and risk perception of FBD from the perspective of food handlers in food services. **Method:** Questionnaires were administered through face-to-face interviews, containing questions about the socio-demographic profile, KAP, and the risk perception of FBD. The sample consisted of 30 handlers from 20 small food service establishments in Laranjeiras do Sul-PR. All participants signed an informed consent form. **Results:** Only 66.7% of the participants had participated in Safe Food Handling Practices training. The general average of knowledge was 84.7%, which was considered sufficient. All attitudes evaluated were above 70.0% for positive attitudes. Some handlers had negative attitudes toward hand hygiene (26.7%), food thawing (10.0%), and fruit and vegetable sanitation (10.0%). The interviewees showed adequate practices for most questions and inadequate practices, mainly for thawing (53.3%), wearing a uniform (20.0%), and temperature of perishable foods (10.0%). Food handlers had a low perception of FBD risk when asked about their own practice with food (93.3%), as well as for thawing at room temperature (53.4%), and use of non-potable water (30.0%). **Conclusions:** Knowledge and attitude were not translated into practice. It is necessary to conduct training in safe food handling practices to improve the knowledge of food handlers about the correct handling of food and, above all, to increase risk perception and motivate positive attitudes and appropriate practices to produce safe food.

KEYWORDS: Food Safety; Safe Food; Safe Food Handling Practices; Training

RESUMO

Introdução: As doenças de transmissão hídrica e alimentar (DTHA) ocorrem devido às inadequações na manipulação de alimentos, sendo assim, estudos para avaliar aspectos higiênico-sanitários da produção de alimentos são importantes. **Objetivo:** Avaliar os conhecimentos, atitudes e práticas autorreferidas (CAP) e a percepção de risco de DTHA, pela perspectiva de manipuladores de alimentos de serviços de alimentação. **Método:** Foram aplicados questionários, por meio de entrevistas, contendo questões sobre o perfil sociodemográfico, CAP e a percepção de risco de DTHA. A amostra consistiu em 30 manipuladores de 20 pequenos estabelecimentos de serviços de alimentação de Laranjeiras do Sul-PR. **Resultados:** Somente 66,7% dos participantes haviam participado de formação de boas práticas. A média geral de conhecimento foi de 84,7%, considerada suficiente. Todas as atitudes avaliadas foram acima de 70,0% para atitudes positivas. Alguns manipuladores tiveram atitudes negativas para higienização das mãos (26,7%), descongelamento de alimentos (10,0%)

e higienização de frutas e hortaliças (10,0%). Os entrevistados apresentaram práticas adequadas para a maioria das questões e inadequadas principalmente para descongelamento (53,3%), uso do uniforme (20,0%) e temperatura dos alimentos perecíveis (10,0%). Os manipuladores tiveram baixa percepção de risco de DTHA dos alimentos manipulados por eles (93,3%), bem como de descongelamento à temperatura ambiente (53,4%) e uso de água não potável (30,0%). **Conclusões:** O conhecimento e a atitude não foram traduzidos em prática. Faz-se necessária a realização da formação de boas práticas a fim de melhorar o conhecimento dos manipuladores sobre o manuseio correto dos alimentos e, principalmente, aumentar a percepção de risco e motivar atitudes positivas e práticas adequadas para a produção de alimentos seguros.

PALAVRAS-CHAVE: Segurança dos Alimentos; Alimentos Seguros; Boas Práticas de Manipulação; Treinamento

INTRODUCTION

Food contamination can occur due to biological, physical, and chemical hazards at any point in the food chain during harvesting, processing, storage, distribution, transportation, and preparation[1]. Inadequate food handling practices and utensils can encourage contamination and affect consumer health. Therefore, it is important to properly sanitize food and handle it properly to prevent foodborne diseases (FBD)[2]. Everyone involved in the food production chain is responsible for ensuring safe food. In food services, managers and food handlers must be aware of the risks of FBD[1] to recognize and implement actions to minimize them.

A Brazilian food legislation, RDC Nº. 216 of September 15, 2004[3], at the federal level, establishes various procedures to be performed regarding safe food handling practices for food services to reduce or prevent food contamination. This regulation presents various hygienic and sanitary aspects of food handling, such as food handler´s personal hygiene, food handling hygiene, pest control in food premises, use of treated and potable water, hygienic equipment and utensils, among other guidelines. According to this legislation, the food handler is anyone who comes into direct or indirect contact with food.

Good manufacturing and good handling practices were intensified as measures to prevent contamination by the SARS-CoV-2 virus among employees and to guarantee food safety during the COVID-19 pandemic, which began in March 2020[4]. This period was marked by an increase in household food production in Laranjeiras do Sul, and new small food service businesses were established as an alternative source of income. The increase in food handlers and the need to avoid crowds and physical contact in face-to-face food safety training resulted in a demand for training for food producers.

Laranjeiras do Sul is a city in the center-south of the state of Paraná state, where there is a great demand for artisanal products of various origins produced by small businesses and informal food handlers. Many of the products sold in the city are frequently produced without following good manufacturing practices, as reported in a previous study[5]. In addition, few studies have been conducted to diagnose the reality of food safety in this region.

An important strategy for evaluating hygienic and sanitary aspects of food handling is to diagnose the self-reported knowledge, attitudes, and practices (KAP) and risk perception of FBD of food handlers[6]. These studies are important for revealing the food production reality and planning training aimed at the local needs[6,7,8] of food handlers. Consequently, this strategy can minimize the FBD risk, contributing to the goal of reducing diarrheal diseases according to the World Health Organization's Global Strategy for Food Safety[9].

This study aimed to evaluate the KAP and the risk perception of FBD from the perspective of food handlers in small food service establishments.

METHOD

Study planning and target audience

Data collection took place between March and June 2021. A questionnaire was administered to assess the KAP and the risk perception of FBD concerning the activities carried out by the food handlers. In addition, the first part of the questionnaire contained a section on the socio-demographic profile of the interviewees.

Two trained interviewers asked the questions, recorded the answers, and, at the end, clarified any doubts about the questionnaire and food safety. The questionnaire was administered through a face-to-face interview, following the COVID-19 pandemic prevention protocols, or by videoconference with audio and video, according to the interviewees' preference and internet availability.

A cross-sectional design and non-probabilistic sampling were used since only the handlers accessible to the researchers were included. The sample consisted of 30 food handlers over 18 who agreed to participate in the study, involving 20 small food service establishments in the city of Laranjeiras do Sul, Paraná.

Research tool

The questionnaire used in this research was based on previous studies[10,11], which evaluated the KAP of food handlers in food

services. The questions were based on the current Brazilian legislation on safe food handling practices for food services[3] and the Five Keys to Safer Food Manual[12].

This study was approved by the Human Research Ethics Committee of the Federal University of the Fronteira Sul (CEP/SH) (Approval Nº 5929405, CAAE: 42769721.9.0000.5564) on the Brazilian Platform, and all participants signed an informed consent form before starting the interview. The data was analyzed together to maintain the confidentiality of the participants. Those legally responsible for the establishments signed an authorization form to collect the data, which clarified that the research had academic objectives and the confidentiality of detailed information about each location and participant.

The questionnaire contained the socio-demographic profile of the participants, such as age, gender, schooling, experience in the establishment, experience in the food sector, participation in safe food handling practices training, and the time since the last safe food handling practices training. At the end, an open question asked, "What is safe food?". The questionnaire was then divided into four parts, each containing ten questions on self-reported knowledge, attitudes, and practices and eight questions on risk perceptions of FBD.

The knowledge assessment in Part I had three answer options: "yes", "no", or "I don't know". Correct answers varied between yes and no in order to avoid response bias. Incorrect or "I don't know" answers were classified as "errors". The results were expressed as absolute numbers (n) and percentages (%) of correct answers and errors. Percentages below 50% were classified as insufficient knowledge, between 51% and 75% as average knowledge, and between 76% and 100% as sufficient knowledge[10].

In part II, the attitudes assessment, the options varied between "agree", "disagree", or "I don't know". The ten attitude statements in the questionnaire were positive, so each answer was classified as positive or negative for each question. Negative attitudes were answered as "disagree" or "I don't know". The results were expressed as absolute numbers (n) and percentages (%) of positive and negative attitudes.

For part III, evaluation of self-reported practices, each question could be answered according to frequency as "never", "rarely", "sometimes", "often", or "always". The results were expressed as each frequency's absolute numbers (n) and percentages (%).

Furthermore, part IV evaluated the risk perception of FBD. The questions had five answer options, classifying the risk as "very low", "low", "regular", "high", or "very high". The results were expressed as absolute numbers (n) and percentages (%) of risk perception.

Data analysis

The results of the socio-demographic profile were expressed using descriptive statistics – absolute number (n) and percentage (%) of each alternative. The keywords and terms used by the interviewees in the open-ended question about safe food were compiled and organized employing a word cloud using the free online tool WordCloud®.

The knowledge questions were analyzed as a hit or miss, the "I don't know" option was considered a miss. Attitude statements were analyzed as positive or negative. Self-reported practices were determined for the five frequencies and risk perception for the five levels. The tables show the absolute number (n) and percentage (%) of responses for each question and alternative evaluated, as described in the "Research tool" section. Data analysis was conducted using Microsoft Excel® software Version 2307.

RESULTS AND DISCUSSION

Participants' socio-demographic profile

Table 1 shows the socio-demographic profile of the 30 food handlers linked to 20 small food service establishments located in the city of Laranjeiras do Sul, Paraná, including two bakeries, a bistro-type restaurant and 17 individual micro-entrepreneurs (MEI). Of the MEIs, only three had a physical store in the city for on-site service and consumption, four sold their products at the local farmer's market, and ten produced at home, direct to consumer delivery. MEIs mainly sold salty snacks, sweets, pasta, and handmade cakes, which are common commerce in the region and are in high demand, in agreement with a previous study conducted in the city [5].

Most participants were female, accounting for 76.7% of the sample, aged between 18 and 59, with 30.0% aged 20-29 and 23.3% aged 40-49. The participants had a heterogeneous level of education, with incomplete primary education (23.3%), incomplete higher education (23.3%), and complete secondary education (20.0%) standing out. Unlike some studies with Brazilian food service workers, the prevalence was male[13,14,15], age group between 30 and 49 years[13] and diverse educational levels, ranging from a majority with incomplete primary education[13] to complete secondary and higher education[14]. On the other hand, in other studies in the same segment, most food handlers were women with complete secondary education[15,16]. The divergence in the profile of food handlers in the different studies highlights the need to obtain information of the food handlers group to plan actions aligned with the group's characteristics.

These results show much variation in the socio-demographic profile of food handlers in food services nationwide. The literature describes that the education level is not necessarily a predictor of the correct food safety practices of the food handlers. However, it does help in the implementation of the food safety management system and the understanding and interpretation of procedures[10,15].

Most interviewees (73.3%) had more than 2 years of experience in the food sector and only 26.7% had less than 1 year. Regarding experience in the food service establishment, 60.0% of the

Table 1. Socio-demographic profile of food handlers in food services located in Laranjeiras do Sul, Paraná.

Variable	n	%
Gender		
Male	7	23.3
Female	23	76.7
Age		
18-19 years	1	3.3
20-29 years	9	30.0
30-39 years	5	16.7
40-49 years	7	23.3
50-59 years	3	10.0
No answer	5	16.7
Education		
Incomplete Elementary School	7	23.3
Complete Elementary School	0	0.0
Incomplete High school	5	16.7
Complete High School	6	20.0
Incomplete Higher Education incomplete	7	23.3
Complete Higher Education	5	16.7
Experience in the food sector		
≤ 1 year	8	26.7
2-5 years	11	36.6
6-10 years	3	10.0
≥ 11 years	8	26.7
No answer	0	0.0
Experience in the food service establishment		
≤ 1 year	11	36.7
2-5 years	8	26.7
6-10 years	6	20.0
≥ 11 years	4	13.3
No answer	1	3.3
Participation in safe food handling practices training		
Never	10	33.3
Participated	20	66.7
Period since the last safe food training		
No training	10	33.3
≤ 1 year	7	23.3
2 years	8	26.7
3-5 years	5	16.7

Source: Prepared by the authors, 2023.

interviewees had worked there for more than 2 years, and only 36.7% had worked there for less than 1 year. These results show that the food handlers had experience in food production. This result is similar to a previous study in which 90.7% of food service handlers in Vitória-ES had previous experience in the area[16].

Most handlers (66.7%) were trained in safe food handling practices. Even though this percentage represented most interviewees who had undergone training in safe food practices, a third of the sample (33.3%) had no training in safe food handling. Similarly, 62.9% of food truck operators in the state of Rio de Janeiro also did not have the training required by legislation, and 42.6% had taken the course more than 6 months previously[14], indicating the need for retraining[17]. Similar results were found in other studies, in which 26.7% and 31.7% of food handlers in Vitória[16] and Santos-SP[10], respectively, had never attended training in the area, which indicates the reality of many Brazilian food services, even though it is a legal requirement[3].

This result highlights the need and urgency to apply training, complying with health legislation[3,18], and enabling these professionals to handle food, given that they had no basic training before starting food production. In addition, 43.3% had participated in training over 2 years ago, showing a long period without recycling their knowledge. Data collection was carried out in 2021, during the COVID-19 pandemic, a period in which in-person training was canceled, and many handlers were unable to take the online safe food handling practices course recommended on the National Health Surveillance Agency's website and by the local Health Surveillance Agency because they had difficulty with online teaching.

Periodic training in good handling practices for all food handlers is required by current legislation[3,18]. It is considered a measure for preventing FBD, helping to improve the hygienic and sanitary quality of food for consumers. In addition, food producers need to undergo biannual training to refresh and remind them of their knowledge of safe food handling practices[17]. The lack of hygiene and health training can contribute to inadequate practices regarding personal hygiene, the environment, and the temperature at which food is stored, among others, which favor microbial contamination and multiplication.[6]

In the open question about the definition of safe food by food handlers, the words "good, handling, sanitized, well, and correct" appeared most frequently, as shown in the word cloud (Figure). The highlighted words show that most interviewees had a basic knowledge of food safety, relating it to processes to reduce biological hazards, such as sanitization.

Assessment of knowledge, attitudes, and self-reported practices (KAP) and risk perception of FBD

The results regarding food handlers' knowledge of food safety are shown in Table 2.

The overall average of correct knowledge was 84.7%, considered sufficient when above 76.0%[10]. Question 2, referring to knowledge about food having a spoiled smell or taste, had the highest percentage of errors (60.0%). This result showed that most food handlers were unaware that sufficient quantities of pathogenic microorganisms to cause FBD and food outbreaks do not alter the sensory characteristics of food[19].

The question "Is washing utensils and equipment with detergent enough to eliminate microorganisms that cause disease?" was the second with the highest percentage of errors (33.3%). These participants were unaware that, in addition to cleaning, which removes organic and inorganic waste, sanitization must also be done to eliminate microbiological contaminants[20]. This result differed from a study with catering service handlers in Portugal, in which the highest knowledge results were obtained for utensil hygiene[7]. Therefore, the cleaning and disinfection steps are important approaches to be implemented in training programs for food handlers in the region studied.

The third question with the highest percentage of errors (23.3%) referred to thawing food at room temperature. This lack of knowledge about thawing temperature recommendations by some food handlers is worrying, as temperatures above 5ºC are in the so-called "danger zone", as it is a favorable condition for the growth of pathogenic and spoiling microorganisms[12].

The use of non-potable water in food preparation showed an error rate of 16.7%. This result indicates that the handlers were unaware of the importance of using drinking water to wash and prepare food to avoid microbiological contamination. A study conducted with farmers in Laranjeiras do Sul found that they did not use drinking water to clean food[5]. Similar to the knowledge results, the highest error percentages in a study with food services in Vitória[16] were questions related to waterborne diseases and food thawing. However, it differed for hand hygiene, which, in this study, had more than 90.0% correct answers.

The remaining five questions on food safety were more than 90.0% correct. However, the themes of the error questions are worrying since these data converge with the main causal factors of FBD risk in Brazil, represented by failures in the time x temperature binomial, contamination by food handlers, equipment and utensils, and contaminated water and raw materials[21].

There is a need to plan periodic training courses on safe food handling practices for food handlers, focusing mainly on food contamination by pathogenic microorganisms, surface, and food disinfection processes, food thawing, and the need to use drinking water. Food handlers trained for under 6 months had better knowledge scores[10], proving the importance of recycling knowledge. Planning training based on diagnostic strategies tends to impact the transformation of knowledge into practice positively[6]. It is also suggested that this training be carried out in the workplace, as it is a strategy with a more significant impact on increasing the knowledge of food handlers[22]. The use of active methodologies, different from traditional training, has also been motivated with the aim of changing behavior

Source: Prepared by the authors, 2023.

Figure. Word cloud for the open question to define safe food.

based on knowledge. Other factors that can affect knowledge scores include age, level of education, and work experience.[7]

Table 3 shows the data relating to the evaluation of the attitudes towards food safety of the handlers.

Handlers' attitudes towards food safety were considered to be either positive or negative. Nine questions had 90.0% positive attitudes, and only the hand hygiene question had 73.3% positive attitudes. This result shows that most handlers have positive attitudes towards handling food hygienically to minimize the risk of FBD to consumers.

For the items "sanitize hands frequently during food preparation", "thaw food at refrigeration temperature", and "sanitize fruit and vegetables with bleach diluted in water prevents FBD", some food handlers had negative attitudes (26.7%, 10.0%, and 10.0% respectively), showing that some food handlers had negative attitudes towards FBD prevention.

The food handlers were aware of the importance of proper hand hygiene (Table 2), but some had negative attitudes when asked if they agreed with frequent hand hygiene to prevent illness. This result differed from a study of food services in which the question about "hand hygiene after using toilets and handling waste" had one of the highest percentages of positive attitudes (98.7%)[16], probably because the question was more objective and related to handling objects considered dirty.

Lack of hand hygiene before handling food can increase the count of *Staphylococcus aureus*, mesophiles, and total

Table 2. Assessment of food safety knowledge of food service handlers in Laranjeiras do Sul, Paraná.

Knowledge issues	Correct N (%)	Error N (%)
01 - Does frequent hand hygiene during food preparation reduce the risk of foodborne illness for the consumer?	29 (96.7)	1 (3.3)
02 - Does food not fit for consumption always smell strange and taste spoiled?	12 (40.0)	18 (60.0)
03 - Can food be prepared with non-potable water?	25 (83.3)	5 (16.7)
04 - Is washing utensils and equipment (plates, cutlery, plastic boxes, etc.) with detergent enough to eliminate microorganisms that cause disease?	20 (66.7)	10 (33.3)
05 - Can adornments (rings, earrings, watches, bracelets, necklaces, piercings, and wedding rings) during food handling favor food contamination?	30 (100.0)	0 (0.0)
06 - Can a food handler with illnesses such as diarrhea, the flu, or a sore throat increase the risk of food contamination?	29 (96.7)	1 (3.3)
07 - Can using food after its expiration date increase the risk of illness for the consumer?	29 (96.7)	1 (3.3)
08 - Does indirect contact (using the same board, knife, etc.) between raw food and ready-to-eat food increase the risk of illness for the consumer?	30 (100.0)	0 (0.0)
09 - Is washing fruit and vegetables with bleach diluted in water safe for consumption?	27 (90.0)	3 (10.0)
10 - Can thawing food at room temperature increase the risk of discomfort or illness?	23 (76.7)	7 (23.3)

Source: Prepared by the authors, 2023.

Table 3. Evaluation of handlers' attitudes towards food safety in food services located in Laranjeiras do Sul, Paraná.

Attitude statements	Positive N (%)	Negative N (%)
01 - Frequent hand hygiene during food preparation can prevent discomfort or foodborne illness.	22 (73.3)	8 (26.7)
02 - Learning more about proper food handling is important for me and my work with food.	30 (100.0)	0 (0.0)
03 - Sanitizing the environment, equipment, and utensils before handling food prevents foodborne illnesses.	28 (93.3)	2 (6.7)
04 - The safe handling (preparation) of food to avoid contamination and illness is one of my responsibilities at work.	29 (96.7)	1 (3.3)
05 - Food that has passed its sell-by date should not be consumed, even if there is no change in the smell or taste of the food.	30 (100.0)	0 (0.0)
06 - Wearing adornments (rings, earrings, watches, bracelets, necklaces, piercings, and wedding rings) during my work can contaminate the food.	30 (100.0)	0 (0.0)
07 - When I have wounds or injuries on my hands, I should not touch the food.	30 (100.0)	0 (0.0)
08 - Food should be thawed at refrigeration temperature (refrigerator).	27 (90.0)	3 (10.0)
09 - Wearing a clean cap, boots, and uniform is an important attitude in preventing food contamination.	30 (100.0)	0 (0.0)
10 - Sanitizing fruit and vegetables with bleach diluted in water prevents foodborne illnesses.	27 (90.0)	3 (10.0)

Source: Prepared by the authors, 2023.

coliforms, which can exceed the critical limits recommended in the literature[23] of a maximum *S. aureus* count of 10^2 CFU/hand, posing a health risk to consumers[24]. In addition, in the context of the COVID-19 pandemic in which the study was carried out, hand hygiene was considered an effective attitude. Health agencies highly encouraged hand hygiene to reduce transmission and contamination by the virus since sanitizing utensils and surfaces and hand antisepsis during food preparation minimizes the virus' contagion risk among workers in the establishment[4]. Consequently, 26.7% of food handlers who disagreed with frequent hand hygiene for disease prevention was considered high, especially considering the data collection was carried out during a pandemic in which this habit was significantly reinforced to prevent the transmission of the SARS-CoV-2 virus. This result indicates the need for training that motivates attitudes towards hand hygiene, increasing knowledge about the dangers that can be present on the hands and contaminate food.

The negative attitude towards thawing food is in agreement with the question of knowledge on this subject, which was the third question with the highest percentage of errors, demonstrating the need for training actions that increase knowledge and motivate positive attitudes towards thawing food.

Regarding negative attitudes towards the sanitization of fruit and vegetables, it is worth noting that the sanitization of these foods is fundamental for the elimination/reduction of the microbial load, which can contaminate food from cultivation techniques, such as the use of organic fertilizer or the irrigation of contaminated water, storage, to the hygiene conditions of the food handler and the environment involving equipment and utensils in the preparation of meals[25]. Similarly, 10.0% of the participants did not know the correct hygiene steps (Table 2), revealing the need to include this topic in planning training actions for the public.

These results can be explained by the fact that 33.3% of the food handlers have not undergone training in safe food handling practices, and 43.4% have done so more than a year ago. Annual training can increase knowledge but must be based on the food handler's reality to motivate them to perform hygienic and sanitary attitudes such as correct hand and food hygiene, and it must be carried out with examples of the routine and hygiene products from the site itself[6]. In addition to increasing knowledge, training courses, when planned according to the needs of the location and using appropriate techniques, can motivate changes in behavior, leading to safer practices.[26,27]

Table 4 shows the results of the questions regarding self-reported food safety practices on a frequency scale from "never" to "always".

The food handlers showed adequate and frequent practices, with values above 90.0% for the questions about hand, workplace, fruit and vegetables hygiene, and handling food with short nails, without adornment, and with protected hair. Unlike a study with 35 food handlers from food trucks in Rio de Janeiro, only 40.0% answered that they sanitized their hands with alcohol 70.0%[14]. The troublesome result was that 18.0% of the vehicles did not

Table 4. Self-reported food safety practices of food handlers in food services located in Laranjeiras do Sul, Paraná.

Self-reported practice issues	Never N (%)	Rarely N (%)	Sometimes N (%)	Often N (%)	Always N (%)
01 - Do you frequently clean and disinfect your hands during food preparation?	0 (0.0)	0 (0.0)	0 (0.0)	5 (16.7)	25 (83.3)
02 - Before handling food, do you keep your nails short and remove all adornments (rings, earrings, watches, bracelets, necklaces, piercings, and wedding rings)?	0 (0.0)	0 (0.0)	2 (6.7)	2 (6.7)	26 (86.6)
03 - Is your hair completely covered at work?	1 (3.3)	0 (0.0)	0 (0.0)	2 (6.7)	27 (90.0)
04 - Do you clean and disinfect the workplace after finishing work?	0 (0.0)	0 (0.0)	0 (0.0)	5 (16.7)	25 (83.3)
05 - Do you handle food when you are ill or have cuts on your hands?	21 (70.0)	3 (10.0)	5 (16.7)	0 (0.0)	1 (3.3)
06 - Do you defrost food at room temperature?	14 (46.7)	3 (10.0)	6 (20.0)	1 (3.3)	6 (20.0)
07 - Do you use food after its expiration date when it doesn't change in smell or taste?	29 (96.7)	0 (0.0)	1 (3.3)	0 (0.0)	0 (0.0)
08 - Do you sanitize fruit and vegetables with bleach diluted in water?	1 (3.3)	0 (0.0)	0 (0.0)	3 (10.0)	26 (86.7)
09 - When entering the food handling area, do you wear a specific uniform (clothes, boots, and cap)?	1 (3.3)	0 (0.0)	2 (6.7)	3 (10.0)	24 (80.0)
10 - During your work, do you worry about the temperature of perishable food?	0 (0.0)	0 (0.0)	3 (10.0)	0 (0.0)	27 (90.0)

Source: Prepared by the authors, 2023.

have a sink with drinking water for hand hygiene, as required by state legislation[14]. This item was not assessed in this research, which only assessed self-reported practices. In addition, 18.0% of popular restaurants in 11 Brazilian cities were non-compliant regarding correct hand washing[28]. In snack bars in Itaqui-RS, 71.4% did not perform hand hygiene when handling ready-to-eat food[29]. These conclusions from various studies corroborate the importance of addressing this issue in training, the presence of exclusive sinks and posters for hand hygiene and health surveillance inspection. In addition, coconut sellers in the Philippines did not wash their fruit or their hands because they did not have a water supply near their premises[30].

Most food handlers in this study (96.7%) reported never using expired food, even if it had no sensory alterations. Some of the interviewees answered that they "sometimes" (16.7%) or "always" (3.3%) handle food with some illness or cut on their hands, so the importance of this hygienic habit should be addressed in safe food handling training. Some food handlers (14.7%) in food services in the state of Espírito Santo also reported working even when they were ill or had cuts on their hands, probably because they were unaware of the risks involved and worried about jeopardizing their jobs[16].

There was no predominance of thawing practice at refrigeration temperature, as expected for safe food production practices. Only 46.7% of the handlers reported never thawing food outside the fridge, 10.0% rarely did it at room temperature, 20.0% sometimes, 3.3% frequently, and 20.0% reported always doing it improperly. Similarly, most respondents from food services located in the capital of Espírito Santo (50.7%)[16] and the city of Santos (34.6%)[10] stated that they defrosted food at room temperature. This result was similar to this study in which 53.3% reported thawing food at room temperature with varying frequency.

Most food handlers (76.7%) reported that thawing food at room temperature increases the risk of FBD, characterizing adequate knowledge on this topic (Table 2). Most of these food handlers (90.0%) also agreed that thawing should be done at refrigeration temperature (Table 3), indicating positive attitudes. These results show that knowledge and attitudes have not been transformed into practice (self-reported). These data corroborate the literature on the shortcomings of the KAP model and indicate the need for training that differs from traditional training, which does not favor translating knowledge into attitude and practice[6,10].

This data is troublesome, as thawing food at an inadequate temperature favors the multiplication of pathogenic microorganisms and the occurrence of FBD. Incorrect food thawing was predominantly found in a study of residential kitchens, with 32.0% of the households evaluated leaving perishable food exposed to room temperature[31]. These data indicate that this inadequate practice can be brought from household habits, demonstrating the importance of disseminating adequate food safety practices for the population to implement in their homes.[32]

In addition, 10.0% of the handlers replied that they "sometimes" worry about the temperature of perishable food. This result is an incorrect practice observed in recent publications; 24.0% of food trucks in the state of Rio de Janeiro showed non-compliance in storing perishable raw materials at room temperature and without an adequate refrigeration system in the vehicles[14]. Moreover, 60.0% of the snack bars in Itaqui did not have temperature control of the equipment and food on sale, nor did any of the hotels evaluated monitor the temperature of the food.[29]

The main microorganisms that cause FBD and the primary indicators used to assess the hygiene of handling practices, raw materials, processing conditions, and spoilage are mesophilic aerobes, known as those whose ideal temperature range for proliferation is between 20 °C and 40 °C[33]. Therefore, the lack of temperature control compromises the microbiological quality of food and is one of the causes of FBD outbreaks in the country.[21]

Regarding the item on the use of a specific uniform (clothes, boots, and cap) when entering the food handling area, 10.0% of the handlers marked "never" or "sometimes" used. The use of a work uniform is a mandatory item for food handlers[3], and the uniform must be used for the handling area, cleaned, and changed daily to avoid biological contamination, as well as physical contamination of the food, since hair, dust, threads of clothing, among others, can come with the clothing[34].

Table 5 shows the data obtained from the research regarding food handlers' risk perception of FBD in the different situations presented.

The risk perception of the food they handled causing discomfort or illness to the consumer ranged from "very low" to "fair" (93.0%). On the other hand, the evaluation results of self-reported practices indicated inadequate practices, demonstrating that the handlers handled food unsafely but did not perceive the risk of FBD in their practices.

This low-risk perception can favor the neglect of proper practices and indicates that the handlers do not understand the severity and consequences of the establishment's nonconformities[35]. The risk perception of FBD was also not found among restaurant workers when they had no knowledge of food safety and had an optimistic bias, illusion of control, and external locus of control[36]. The optimistic bias is represented by the handler's perception that their work and practice offer a lower risk of FBD than that of their peers[37]. The illusion of control is related to the individual believing they have total control of the situation. The external locus of control represents people who believe that external factors (luck, fate, faith, spiritual, environmental, or other people) control their decisions and their lives[38,39]. All these factors can affect the behavior and motivation of food handlers, which can impact the risk perception and jeopardize food safety[38,39]. This study did not evaluate these other cognitive factors related to the behavior of food handlers, so it is suggested that

future research also include these factors for data collection and discussion.

Risk perception is variable and individual. People who do not have constant awareness and periodic training on the importance of safe food handling practices may base their perceptions on the cultural environment in which they were raised based on their beliefs[40]. In addition, handlers with many years of experience, as in this study, and participation in ineffective training in the area can lead to excessive self-confidence, which prevents correct action to reduce the risk of FBD[36,41].

The questions with the highest percentages of risk perception between "very low" and "fair" show that employees at the sites studied had a low-risk perception and did not understand the severity and consequences of storing food at the wrong temperature (26.7%), preparing food with non-potable water (30.1%) and that thawing food at room temperature (53.4%) could pose a health risk. Non-potable water can contain microorganisms that are harmful to health, so using it can contaminate food[1]. Perishable food at room temperature becomes an ideal medium for developing most deteriorating and pathogenic microorganisms[12].

In addition, most of the food handlers (68.0%) with a low perception of risk on these two questions had not taken a course in safe food handling practices or had been trained for more than a year. This result highlights the need for periodic training of food handlers, as ongoing training programs, information, and awareness of food handlers can contribute to the production of safe food for consumers[8,42], as food contamination is often associated with the lack of ongoing training for food handlers to carry out hygiene practices[8,43].

Bearing in mind that each individual's risk perception is related to their values, beliefs, and experiences[35], the handlers may have related these practices to something familiar that they do in their cultural environment, to what they have learned from their family and believe that they do not generate risks to the consumer's health. It is hypothesized that, as reported in the literature[44], food handlers have an optimistic bias and consider that other people are more likely to transmit FBD than themselves, believing that other handlers are worse than themselves.

For these training courses to contribute to an increase in risk perception and changes in attitudes and practices, they need to be based on the reality and needs of each location. In addition, it is essential to use methods other than the traditional ones because, as well as helping to increase knowledge, it is necessary to motivate the handlers to have appropriate attitudes and increase their risk perception of FBD[6].

CONCLUSIONS

The food handlers in this study showed little knowledge of sensory evaluation of contaminated food, thawing at the correct temperature, and sanitizing equipment and utensils. Some had negative attitudes towards frequent hand hygiene, thawing food, and hygiene. They had inadequate self-reported practices concerning thawing food and a low perception of risk. Food handlers also had lower risk perceptions about thawing food at room temperature, using non-potable water in food preparation, and whether their food posed a risk to consumer health.

Table 5. Risk perception of FBD by food handlers in food services located in Laranjeiras do Sul, Paraná.

Risk perception issues	Very low N (%)	Low N (%)	Regular N (%)	High N (%)	Very high N (%)
01 - What is the risk of the food you handle causing discomfort or illness to the consumer?	19 (63.3)	8 (26.7)	1 (3.3)	0(0.0)	2 (6.7)
02 - What is the risk of food not being stored at the correct temperature, spoiling, and causing discomfort or illness for the consumer?	1 (3.3)	5 (16.7)	2 (6.7)	10 (33.3)	12 (40.0)
03 - What is the risk of discomfort (malaise) or illness for the consumer if you wear adornments (rings, earrings, watches, bracelets, necklaces, piercings, and wedding rings) during food preparation?	2 (6.7)	2 (6.7)	3 (10.0)	14 (46.6)	9 (30.0)
04 - What is the risk of discomfort (sickness) or illness for the consumer if you use the same utensil (board, knife, etc.) between raw food and ready-to-eat food?	1 (3.3)	0 (0.0)	5 (16.7)	14 (46.7)	10 (33.3)
05 - What is the risk of a person experiencing symptoms such as vomiting, nausea, and/or diarrhea after consuming food prepared with non-potable water?	2 (6.7)	2 (6.7)	5 (16.7)	8 (26.6)	13 (43.3)
06 - What is the risk of a person experiencing symptoms such as vomiting, nausea, and/or diarrhea after consuming raw fruit or vegetables sanitized with bleach diluted in water?	16 (53.3)	8 (26.7)	2 (6.7)	3 (10.0)	1 (3.3)
07 - What is the risk of discomfort (malaise) or illness for the consumer if food is used after its expiration date?	2 (6.7)	0 (0.0)	4 (13.3)	15 (50.0)	9 (30.0)
08 - What is the risk of discomfort or illness for the consumer if the food is thawed at room temperature?	5 (16.7)	5 (16.7)	6 (20.0)	10 (33.3)	4 (13.3)

Source: Prepared by the authors, 2023.

These results can be used as a diagnosis to develop training strategies for these food handlers, focusing on correct thawing and other difficulties identified in this study to increase knowledge, modify practices, and increase the risk perception of FBD. Training these professionals also aims to prepare them so that these establishments can provide safe food in Laranjeiras do Sul, which will impact consumer health. The data obtained in this study also corroborates the literature on the relationship between knowledge, attitudes, practices, and risk perception of FBD, boosting scientific understanding of the factors that interfere with safe food handling behavior.

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Authors' Contributions

Leandro SLP - Acquisition, analysis, data interpretation, and writing of the work. Andrade GS - Acquisition and writing of the work. Zanin LM - Analysis, data interpretation, and writing of the work. Bainy EM - Conception, planning (study design), analysis, data interpretation, and writing of the work. All the authors approved the final version of the work.

Conflict of Interest

Authors have no potential conflict of interest to declare, related to this study's political or financial peers and institutions.