Food safety knowledge, attitude and practices related to refrigeration safety

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It is crucial that we have access to nutritious food in order to support life and promote good health. Unsafe food that contains harmful microbes, viruses, parasites, or chemicals causes ailments ranging from diarrhoea to cancer. It is well-recognized that maintaining food safety requires keeping food in the refrigerator at a proper temperature. It is also crucial to regulate and maintain the storage temperature, which will vary based on the type of food stored. The main aim of this study is to assess the knowledge, attitudes and practices of consumers towards food safety. Gender, age, educational level, number of children and frequency of food preparation are the factors that affect an individual's knowledge and attitude about food safety. It is essential to plan and conduct training programmes on food safety and appropriate handling practices for different foods to prevent foodborne diseases and associated risk factors.

Keywords: Diseases and risk factors, food-handling practices, food safety, refrigeration, storage temperature.

TO sustain life and enhance good health, it is essential to have access to sufficient amounts of safe and nourishing food[1]. Several diseases, ranging from diarrhoea to cancer, are caused by unsafe food that contains pathogenic microbes, viruses, parasites or harmful chemicals. Malnutrition and disease get out of control as a result, especially affecting the elderly, the sick, young children and newborns. To help ensure food safety and better food systems, effective cooperation between governments, producers and consumers is required. Security in food and nutrition, trade and tourism are all supported by the availability of safe food, promoting sustainable development. Urbanization and changes in consumer behaviour have increased the number of people who buy and eat meals prepared in public settings. The increased consumer demand for a larger variety of foods brought about by globalization has led to a longer and more complex global food chain. Due to these difficulties, it is now more important than ever for food-handlers and manufacturers to ensure food safety. On account of how fast and widely products are distributed, local incidents can easily turn into global emergencies. Altering environmental factors, such as dehydration, pickling, salting, smoking, freezing, etc., that prevent the growth of germs are some methods to prevent food from being spoiled. The elimination of water, using acid, oil and spices, chemical preservatives, and low temperatures can all produce food spoilage circumstances[2].

It has been established that keeping food refrigerated at the right temperature is essential for food safety. Controlling and maintaining the storage temperature, which will vary depending on the type of food, is of utmost importance. Additionally, lowering the temperature at which perishable items are stored will help slow down the rate at which the vast majority of bacteria reproduce. These factors contribute to decomposition, leading to a reduction in product quality and illnesses among consumers. At –18°C, refrigeration brings the metabolism of organic matter to almost zero (the international standard for most frozen products). At this temperature, modifying activities in food, such as specific enzymatic reactions or the metabolic breakdown of proteins, are partially or completely inhibited. This lowers the rate of breakdown and spoilage of food items while avoiding potential health problems following intake[3].

The most common type of heat treatment is pasteurization. It entails boiling milk at high temperatures to eradicate pathogenic microorganisms that can lead to diseases. In order to kill heat-stable and heat-labile bacteria, milk is heated to a high temperature and then quickly chilled. It does not completely eradicate all bacteria, some of which can cause the milk to spoil after a few days, even though they are harmless in the proportions present. Therefore, without adequate storage, pasteurization alone does not result in a safe product on the shelf. Pasteurized milk must be stored in a refrigerator, but it can also be kept in a freezer for prolonged preservation[2].

Methodology

The English-language review papers, research papers and online write-ups about food safety and refrigeration techniques that were published between 2005 and 2022 were examined. The publications relevant to the study were searched using a variety of data-gathering tools and web browsers, including Research Gate, Academia, Shodganga, Krishikosh and Google Scholar. The references provided in the printed articles were also carefully examined to find the most relevant research publications. When looking for relevant

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research publications, search terms such as 'food safety', 'awareness', 'refrigeration procedures' and 'safe food handling practices' were most frequently used.

Discussion

Reviews pertaining to food safety were examined and are discussed below.

Food safety knowledge, attitude and practices

Redmond *et al.*[4] evaluated consumer attitudes and perceptions towards microbial food safety in domestic kitchens. The findings revealed that while views towards some practices, including chilling, were negative, attitudes towards other practices, including cross-contamination, cooking and storage, were positive.

Mclntyre *et al.*[5] examined the food safety knowledge of trained food-handlers certified under the FOODSAFE training programme and evaluated food safety knowledge, attitudes and self-reported hand-washing practices in trained and untrained food-handler groups. The results showed that food-handlers who had received training scored much higher on knowledge tests than those who had not. Based on sex, no differences between the groups were found. Both trained and untrained groups showed an improvement in knowledge scores as a result of supervisory level and years of experience. However, the improvement in knowledge of the untrained group depended significantly on age. The workplace and educational background of food workers were linked to significantly higher knowledge ratings. Compared to the untrained food-handler group, the FOODSAFE-trained group reported considerably better hand-washing practices and attitudes.

Hand-washing before and during food preparation is crucial among the control strategies for household microbiological dangers[6].

Yella *et al.*[7] have mentioned that practices in domestic kitchens are a key contributor to foodborne illnesses. Food safety is influenced by both how it is prepared and stored.

Shabib and Mosilhey[8] studied food safety knowledge, attitude and practices of male food handlers employed in restaurants of King Saud University, Saudi Arabia. The results showed that food-handlers demonstrated good food and personal cleanliness habits. Their attitudes were positive, with a total mean score of 2.69 and mean scores of 80.76, 18.02 overall. This is particularly significant as it dramatically impacts food safety. Knowledge and attitudes were found to have a significant positive correlation ($r_s = 0.371$, $P < 0.05$), as were knowledge and training ($r_s = 0.107$, $P < 0.05$), knowledge and personal hygiene ($r_s = 0.303$, $P < 0.05$), training and personal hygiene ($r_s = 0.174$, $P < 0.05$), and knowledge and attitudes ($r_s = 0.173$, $P < 0.05$). Despite being significant and favourable, these correlations were not extremely strong. Although the knowledge, attitude and practice level of the food-handlers were excellent, the study showed that several issues of cleanliness, and time and temperature management need to be emphasized.

Rahman *et al.*[9] conducted a cross-sectional study. The results revealed that age and ethnicity had a significant impact on food safety knowledge ($P < 0.05$), whereas food safety training and knowledge seemed to have an impact on attitude ($P < 0.05$). However, the duration of food trading had an inverse association with food-safety practices ($P < 0.05$), regardless of how much knowledge, attitude, training or age of the food vendors impacted the practice.

Poor and improper handling practices, as well as unhygienic conditions at the consumer level, are serious issues regarding food safety. Consumers do not take into account the type of food when cleaning the refrigerator. The main food items with safety concerns include meats, ready-to-eat salads and readymade bread since they are prone to pathogen contamination[10].

Ruby *et al.*[11] concluded that consumers had good knowledge regarding hand hygiene in food-handling. Only 23.3% of respondents deeply understood how temperature affects bacterial development in food. The level of awareness about food safety varied with gender, age, education, number of children and frequency of food preparation.

Khalifa *et al.*[12] studied knowledge, attitude and practice about food safety among the Saudi population. The results showed that majority of them (75.7%) had positive attitudes and behaviours about health, food safety and hand-washing before eating. The people also had a negative attitude towards other relevant issues, such as not reading the label of instructions on canned food (59.5%), the insignificance of checking the temperature of the refrigerator (77.9%) and the insignificance of changing the knife used for chopping vegetables and meat (66.9%).

AI Kandari *et al.*[13] reported that most food handlers had adequate knowledge, with 53.5 ± 6.68 (70%) exhibiting good understanding, particularly in terms of personal cleanliness (93%). Lack of understanding about cross-contamination and sanitation (68%), as well as food pathogens (51%) and time and temperature management (63%), is an area of concern. A mean score of 69.12 ± 9.97 (94%) in the attitude of respondents reveals that they had a positive approach.

Using standardized questionnaires, a global study on knowledge, attitudes, and practices in food safety was conducted among consumers in developing countries in Asia and Africa. Data were obtained from 453 consumers, including 265 from Africa and 188 from Asia. Among consumers from Africa and Asia, there were significant differences in knowledge, attitudes, and practices related to food safety ($P < 0.05$). Consumers in Cameroon had the lowest understanding of food safety in Africa (73.15 ± 16.43), followed by Ghana (78.19 ± 15.84) and Nigeria (88.16 ± 8.88). Similar to customers in Iran, consumers in Asia had the least awareness regarding food safety (73.33 ± 19.84) compared to Malaysia (88.36 ± 11.64) and Pakistan

(89.42 ± 9.89). About 89% of those surveyed were aware of food poisoning, and 304 (67.1%) consumed food that was left at room temperature for an extended period. In general, respondents from Asia were more knowledgeable about food safety than those from Africa[14].

Ncube *et al.*[15] revealed in their study that food handlers with basic food safety training scored much better on food safety knowledge than those without training ($P < 0.05$). Based on the sociodemographic traits of food handlers, there were no variations in knowledge or attitudes about food safety ($P > 0.05$). Food safety knowledge and attitudes all had a substantial positive connection ($r_s = 0.371$, $P < 0.05$), as did food safety knowledge and self-reported food-handling practices ($r_s = 0.242$, $P < 0.05$), as well as food safety knowledge and observed food-handling practices ($r_s = 0.254$, $P < 0.05$).

Soon *et al.*[16] conducted an online survey to determine food safety knowledge, attitudes and practices among consumers in Malaysia. The findings revealed that while attitudes significantly influenced food safety practices ($\beta_1 = 0.534$, $P > 0.05$), food safety knowledge had a negative and negligible relationship with practices ($\beta_1 = -0.284$, $P > 0.05$). The results indicate that food safety practices are not directly affected by knowledge regarding the same.

Practices related to refrigeration safety

Kennedy *et al.*[17] have mentioned that knowledge and temperature surveys varied widely, but consumers with superior food safety awareness reported lower levels of bacterial contamination in their refrigerators as well as fewer cases of food-related diseases.

Towns *et al.*[18] studied food safety-related refrigeration and freezer practices and attitudes of consumers. Their findings revealed that average attitudinal scores showed that participants agreed it was crucial to take the necessary precautions to prevent foodborne illnesses at home; however, 68.8% of the participants performed poorly in the practice section of the survey. Only 12.3% and 24.7% of the participants reported having a thermometer in their freezer and refrigerator respectively. Also, 84% of the respondents mentioned not knowing how to keep eggs in their refrigerator properly.

According to Obande and Young[19], 43.3% of the respondents were unaware of the highest temperature that a refrigerator should be set at to avoid microbial development, and 83.7% mentioned that they 'never' or 'rarely' used a thermometer to check the temperature of their refrigerator. The fact that the smell and sight of food can be used as a sign of food safety was mistakenly 'accepted' or 'strongly agreed' by many respondents (43.1%), and 64.1% of them admitted to doing so frequently or always.

In a descriptive study conducted by Nkhebenyane and Lues[20] to assess the knowledge, attitudes and practices of hospice food-handlers, the results revealed that more than half of the participants (68%) had never received basic training on food safety. In the knowledge questionnaire, the average proportion of accurate responses was 66.8%. On average, the participants were 35 years old (SD : 9.27). The use of gloves to handle or distribute unwrapped food items had a substantial impact on attendance at food-safety training ($\chi^2 = 8.411$, P-value = 0.012), as well as hand-washing after using gloves ($\chi^2 = 12.560$, P-value = 0.001). The knowledge attitudes and practices mean score was 78.38 overall. With respect to food safety awareness, there was a statistically significant difference between trained and untrained food handlers ($P < 0.001$). Regarding the ideal temperature for a refrigerator, particularly hot, ready-to-eat food, there was a lack of understanding.

Ovca *et al.*[21] studied temperature and storage conditions in domestic refrigerators. The results showed gaps related to cold storage and cross-contamination. Age, type and load of the refrigerator had no noticeable effect, which points to the thermostat setting as the primary determinant of refrigerator temperature. With a considerable risk of cross-contamination in overpacked refrigerators, food distribution inside refrigerators was correlated with their load.

Cao[22] studied the impact of food safety knowledge and attitudes on food handling behaviours. The results revealed that the respondents' awareness of food safety positively influences their attitudes and behaviours, yet there were individual variations.

Jovanovic *et al.*[23] evaluated consumers' food safety knowledge and practices, and temperature distribution in household refrigerators in Serbia. The results revealed that food safety awareness was significantly lacking among those in charge of food shopping and storage in their houses. The variation in temperature across homes and the distribution of temperature in the refrigerators were of concern.

Safe food practices according to FSSAI

These have been retrieved from https://foscos.fssai.gov.in/consumergrievance/tips-for-safe-food[24].

Clean: Wash hands and surfaces often. In the kitchen, bacteria can be transferred from hands to cutting boards, utensils, counter tops and food. Wash hands with warm water and soap for at least 20 sec before and after handling food. After preparing each food item and before moving on to the next, wash cutting boards, plates, utensils and countertops with hot, soapy water. To clean kitchen surfaces, one can use paper towels. If cloth towels are used, wash them frequently in the washing machine using the hot cycle.

Separate: Separate raw meats from other foods. Bacteria can be transferred from one food product to another, which is known as cross-contamination. This is particularly common when working with raw meat, poultry, seafood and

eggs. The crucial aspect is to keep these foods, along with their juices, away from ready-to-eat foods.

Cook: Cook to the right temperatures. When food attains an internal temperature high enough to eradicate the disease-causing bacteria, it has been cooked safely. For the correct internal temperatures, refer to the safe cooking temperatures chart. Always check the internal temperature of cooked foods with a food thermometer to ensure that they are prepared safely.

Chill: Refrigerate foods promptly. Foods should be immediately refrigerated since harmful bacteria cannot develop quickly in cold temperatures. Do not overload the refrigerator. To keep food safe, cold air must travel. One of the effective approaches to lower the risk of foodborne diseases is to maintain a refrigerator temperature of 40°F or lower.

Conclusion

The primary objective of this study was to assess consumers' perceptions regarding food safety and practices involving refrigeration as well as their knowledge and attitudes in these areas. Numerous studies have evaluated consumer knowledge, attitudes and practices regarding food safety. According to a review of the literature, gender, age, educational level, number of children and frequency of food preparation are the factors that affect one's knowledge and attitudes about food safety. The findings demonstrated that a small percentage of respondents read labels when buying packaged, canned and frozen products. Most customers were aware of the effects of cross-contamination and poor storage techniques. Various studies have shown that consumers were aware that poor cooking techniques and unclean handling conditions are the main contributors to foodborne diseases. They were ignorant about the ideal temperatures for storing foods while handling them in a refrigerator. Consumer practices with respect to food chilling were likewise poor. Some studies found no benefit to switching knives when simultaneously handling raw meat, vegetables and fruits. Additionally, it has been demonstrated that consumers who received basic training performed better in terms of knowledge and attitudes toward food safety than untrained consumers. Results were influenced by the subject's workplace and background information. The opinions of trained subjects towards hand-washing were favourable. A significant number of participants never checked the temperature of their refrigerator. Few people were aware of the risks associated with consuming expired food. Majority of the consumers used sight and smell to determine whether the food was safe. Thus to prevent, foodborne illnesses and risk factors associated with them, it is imperative to organize and conduct training programmes on food safety and suitable handling techniques for various foods.

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Received 25 March 2023; re-revised accepted 7 September 2023

doi: 10.18520/cs/v125/i10/1063-1067