

ORIGINAL ARTICLE

Knowledge and good food handling practices for products of animal origin in the home setting

Conhecimento e boas práticas de manipulação de produtos de origem animal no ambiente domiciliar

Eduarda de Cássia Lima Brugeff¹ , Fernando de Almeida Borges² , Daniele Bier^{1*} 

¹Universidade Católica Dom Bosco (UCDB), Departamento de Ciências Agrárias, Campo Grande/MS - Brasil

²Universidade Federal do Mato Grosso do Sul (UFMS), Faculdade de Medicina Veterinária e Zootecnia, Campo Grande/MS - Brasil

*Corresponding Author: Daniele Bier, Universidade Católica Dom Bosco (UCDB), Departamento de Ciências Agrárias, Rua Avenida Tamandaré 6000, CEP: 79117-900, Campo Grande/MS - Brasil, e-mail: danielebier@ucdb.br

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Abstract

Good food handling practices should be adopted in the home setting, as inadequate practices could lead to the outbreak of foodborne illnesses. The aim of the present study was to investigate knowledge and good food handling practices for products of animal origin by consumers in the home setting and test associations with the socioeconomic characteristics of the respondents. A questionnaire was answered by a non-probabilistic sample. The questionnaire was available online on free access digital platforms for seven days and was used to collect information on the gender, age, income, and schooling of the respondents as well as safe food handling practices in the home setting. Data analysis involved descriptive statistics and the chi-square test to compare the frequencies of the answers per category. A total of 666 responses were obtained. Most respondents were women, had a university/college education, were between 30 and 59 years of age, and had an income of more than four times the monthly minimum wage. The majority of respondents reported positive practices and attitudes regarding food handling in the home setting; 99.5% washed their hands prior to handling food, 89% performed the cooking of animal products and 85.6% washed the cutting surface after cutting each food. Associations were found between some attitudes reported by consumers and the categories of gender, age, schooling, and income ($p \leq 0.05$). Women had more good food handling practices compared to men. The results suggest that most respondents practiced good food handling practices. Safe practices were related to the level of schooling, monthly income and age of the participants.

Keywords: Consumers; Foodborne illness; Food handlers; Health risks; Residence; Safe food.

Resumo

As boas práticas de manipulação devem ser adotadas no ambiente doméstico, pois algumas atitudes de risco são realizadas pelos consumidores, podendo levar à ocorrência de surtos alimentares. O objetivo do presente trabalho foi avaliar o conhecimento e as boas práticas de manipulação dos alimentos de produtos de origem animal realizadas pelos consumidores no ambiente domiciliar, de acordo com o perfil socioeconômico dos respondentes.



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Por amostragem não probabilística, utilizou-se um questionário, no formato online, disponibilizado durante sete dias em plataformas digitais com livre acesso, contendo perguntas para traçar o perfil dos consumidores, como questões sobre gênero, idade, renda mensal e nível de escolaridade, bem como perguntas sobre as práticas de manipulação de alimentos segura nos domicílios. A estatística descritiva e o teste de qui-quadrado das frequências das respostas por categoria foram aplicados aos dados. Obteve-se ao todo 666 respostas, sendo a maioria dos respondentes pertencentes ao gênero feminino, possuíam ensino superior, na faixa etária variando entre 30 e 59 anos, e com renda mensal acima de quatro salários mínimos. A maioria dos participantes apresentou respostas positivas quanto às condutas de boas práticas no ambiente doméstico: 99,5% higienizavam as mãos antes da manipulação, 89% realizavam a cocção dos produtos de origem animal e 85,6% higienizavam a superfície de corte a cada alimento que era cortado. Em algumas atitudes reportadas pelos consumidores, houve associação entre a classificação de gênero, faixa etária, escolaridade e/ou renda ($p \leq 0,05$). As mulheres apresentaram mais hábitos de boas práticas em comparação aos homens. Infere-se que a maior parte dos respondentes aplicava as boas práticas de manipulação. De acordo com os resultados obtidos, supõe-se que a execução de práticas seguras esteja relacionada ao nível de escolaridade, à renda mensal e à idade dos participantes.

Palavras-chave: Consumidores; Doenças transmitidas por alimentos; Manipuladores de alimentos; Riscos à saúde; Residência; Alimento seguro.

Highlights

- Consumers do not believe that home can be a risky place for foodborne illness
- Food handling practices are related to the schooling level, monthly income and age
- The most people implement safe food handling practices in the home setting

1 Introduction

Safe food is free of chemical, physical and microbiological contamination. However, foods are subject to contamination in any step of the production process up to the time of consumption (World Health Organization, 2020; Centers for Disease Control and Prevention, 2020). The ingestion of contaminated foods can result in foodborne illnesses, which are estimated to be the cause of 600 million illnesses as well as 420 thousand deaths every year (Pan American Health Organization, 2019). Products of animal origin (POAO) require special attention in the control of foodborne diseases, as they can be an important source of contamination from the microbiota of production animals and resist industrial conditions (Nespolo, 2021).

Epidemiological data on foodborne illnesses in Brazil reveal that 37.7% of outbreaks between 2012 and 2021 originated in the home environment (Brasil, 2022). The incidence of outbreaks demonstrates poor health education and knowledge on the part of the population regarding good food preparation and storage practices (Farias et al., 2019). Moreover, the proportion of outbreaks in residences is estimated to be higher than that reported, as victims tend not to seek medical assistance when the symptoms are mild, leading to the non-identification of cases by public health authorities (Ifope Educacional, 2020).

The occurrence of outbreaks in the home setting may be the result of inadequate practices and attitudes during the handling of foods, the habits of the person preparing the food, inadequate cleaning of the place where the food is prepared, inadequate cooking and cross-contamination of foods (Deon et al., 2014; Li et al., 2018; Bressa & Oliveira, 2020). However, the adoption of safe practices in homes depends on the context and place where individuals live, the level of schooling, the quality of information that they have on the subject and their capacity to apply such knowledge when preparing food (Teo et al., 2016).

Therefore, the aim of the present study was to investigate knowledge and good food handling practices for products of animal origin by consumers in the home setting and test associations with the socioeconomic characteristics of the respondents. The consumers' behavior towards food safety should be thoroughly considered for planning preventive measures to eliminate risks.

2 Materials and methods

A descriptive study was conducted using a non-probabilistic sampling method. Data collection occurred between July and August 2019 through the use of an online questionnaire with close-ended questions.

2.1 Questionnaire

An online questionnaire was created using the Google Forms platform (Google Inc) to evaluate knowledge of good food handling practices in the homes of consumers. The questionnaire was divided into two sections and was available to the public for a period of seven days. The access link was made available through social groups and pages for laypersons and those related to food safety to reach consumers both in and outside the food and nutrition field.

The first section was used for the collection of socioeconomic characteristics and contained questions addressing gender, age, level of schooling, monthly income *per capita* and state of residence. The second section was for the collection of data on practices related to food safety and contained questions addressing sanitary food handling practices, personal hygiene, the washing of foods, cross-contamination, temperature control as well as the freezing, thawing and storage of products of an animal origin. The response options in this section were “yes”, “no” and “I prefer not to answer”.

2.2 Ethical statements

Participants gave consent to enter the survey by clicking on the “accept” button prefaced by the statement “I am aware that my responses are confidential, and I agree to participate in this survey”. They were able to withdraw from the survey at any time without giving a reason.

2.3 Statistical analysis

Contingency tables were created. The frequencies of answers to each question were compared among the categories of each factor (schooling, gender, age and income) using the chi-squared test ($p < 0.05$). For questions with a significant effect of the factors, the effect of each category was evaluated based on the overlap of 95% confidence intervals (CI) using the GraphPad Prism 6.0 software (GraphPad Software Inc., San Diego, CA, USA).

3 Results and discussion

3.1 Results

A total of 666 respondents from 25 states of Brazil answered the questionnaire. The only exceptions were the states of Amapá and Roraima. The characteristics of the respondents are displayed in Table 1. Women predominated the sample, accounting for 85.6% of the respondents, whereas men accounted for 14.4%.

Regarding the level of schooling, most respondents (66.9%) had a complete university/college education and 24.9% had an incomplete university/college education. Only 4.4% had complete or incomplete primary school and high school educations (29%) and 3.7% had a trade school education.

The most prevalent income was more than four times the monthly minimum wage (39.9%), followed by three times the monthly minimum wage (20%), two times the monthly minimum wage (17.8%), four times the monthly minimum wage (14.1%) and less than or equal to the monthly minimum wage (8.1%).

Some differences in good food handling practices were found between the different classifications of gender, age group, schooling and income (Figures 1 to 4).

Three hundred twenty-four respondents (48.6%) were between 18 and 29 years of age, 332 (4.8%) were between 30 and 59 years of age and 10 (1.5%) were 60 years of age or older. Significant differences among age groups were found regarding care with storing foods after purchase and cleaning packages. A great number of respondents 30 years of age or older washed packages prior to placing them in the freezer or refrigerator ($p \leq 0.05$). Most participants did not check the temperature of the refrigerator or freezer prior to placing products of animal origin (75.1%). A larger proportion of respondents who checked the temperature were 60 years of age or older ($p \leq 0.05$). Respondents 18 to 29 years of age were more likely to store grocery items, cleaning products, fruits and vegetables before refrigerated or frozen products, whereas respondents 30 years of age or older put away refrigerated or frozen items first (Table 2 – Figure 1).

Table 1. Characteristics of respondents.

Gender	%
Female	85.6
Male	14.4
Prefer not to answer	0.0
Age	%
18-29 years	48.6
30-59 years	49.8
60 years or older	1.5
Schooling	%
Incomplete primary school	0.2
Complete primary school	0.6
Incomplete high school	0.5
Complete high school	3.2
Incomplete university/college	24.9
Complete university/college	67.0
Trade school	3.8
Family income	%
Less than monthly minimum wage	2.3
Monthly minimum wage	5.9
2 x monthly minimum wage	17.9
3 x monthly minimum wage	20.0
4 x monthly minimum wage	14.1
More than 4 x monthly minimum wage	39.9

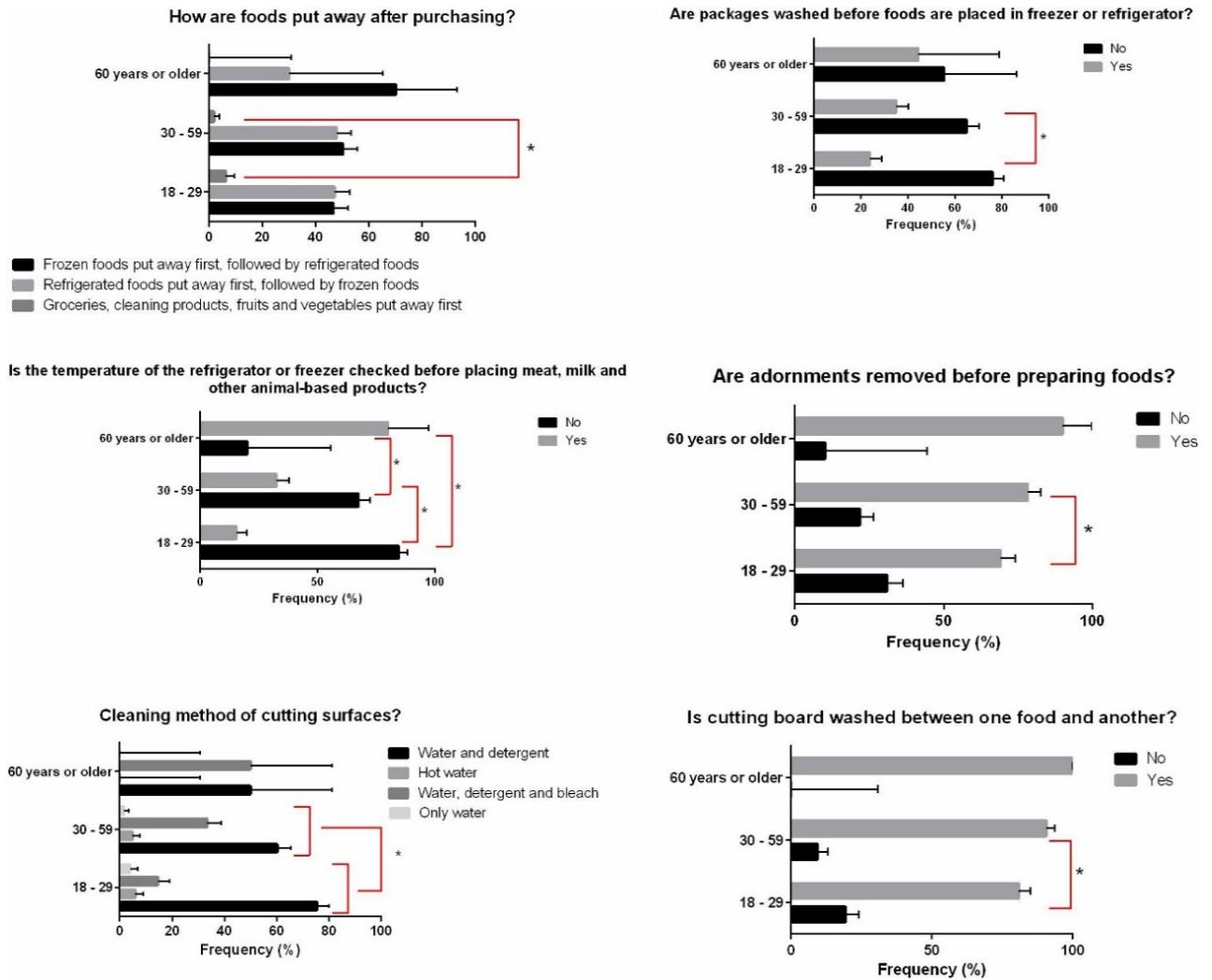


Figure 1. Mean and standard error of frequency of food handling practices according to age group of respondents. *Non-overlapping of 95% confidence intervals of proportions.

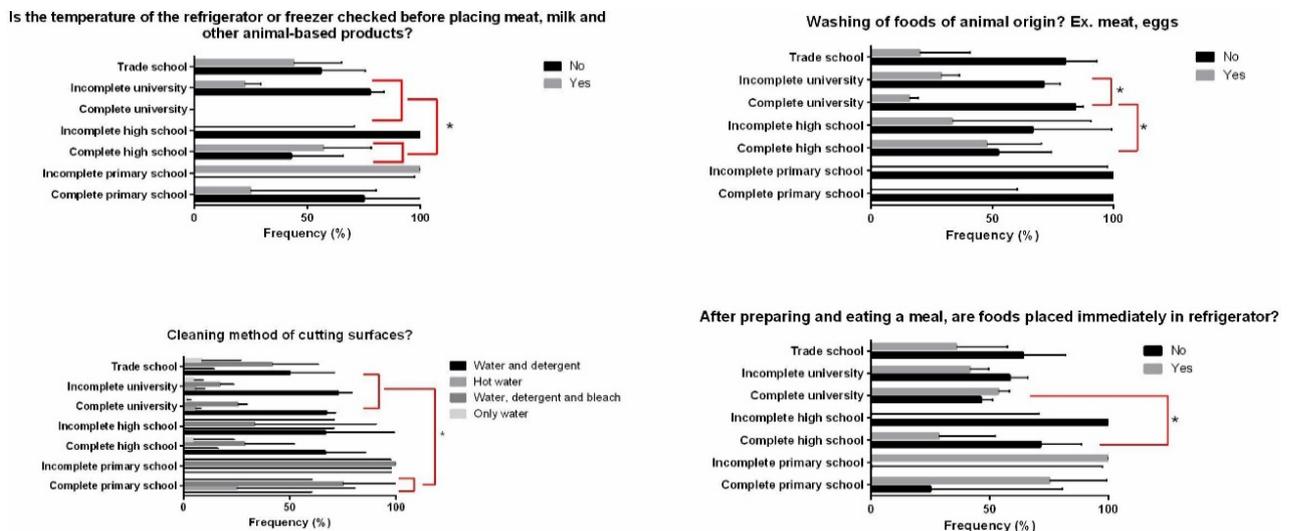


Figure 2. Mean and standard error of frequency of food handling practices according to schooling of respondents. *Non-overlapping of 95% confidence intervals of proportions.

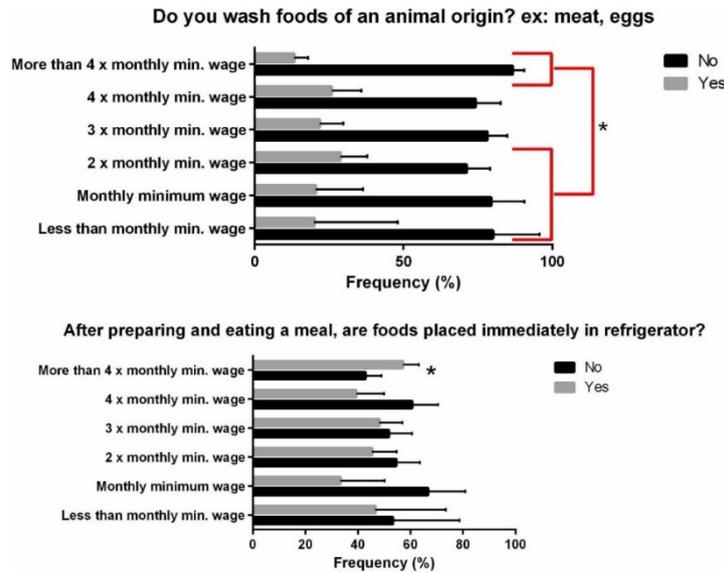


Figure 3. Mean and standard error of frequency of food handling practices according to income of respondents. *Non-overlapping of 95% confidence intervals of proportions.

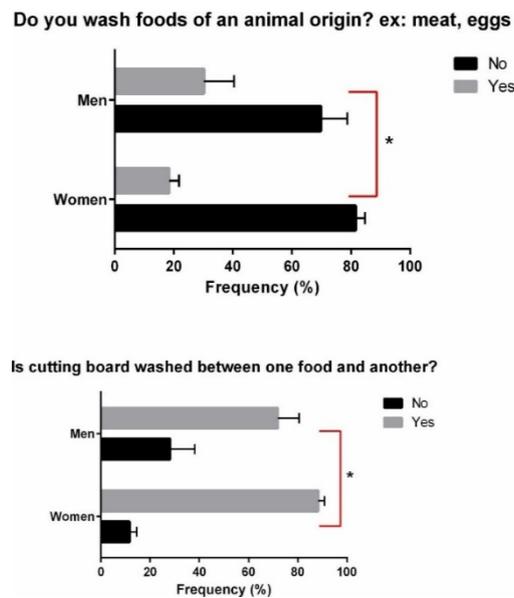


Figure 4. Mean and standard error of frequency of food handling practices according to the gender of respondents. *Non-overlapping of 95% confidence intervals of proportions.

A total of 79.3% of respondents reported not washing foods of animal origins, such as meat and eggs, prior to handling or consumption. However, differences were found among the categories of schooling (Figure 2), income (Figure 3) and gender (Figure 4). The washing of foods occurred more among respondents with an incomplete or complete high school education compared to those with an incomplete or complete university/college education ($p \leq 0.05$) (Table 2 – Figure 2). The washing of foods occurred more among respondents with an income up to two times the monthly minimum wage compared to those who earned more than four times the monthly minimum wage ($p \leq 0.05$) (Table 2 – Figure 3). Additionally, more men reported this practice compared to women ($p \leq 0.05$) (Table 2 – Figure 4).

Table 2. Good food handling practices for products of animal origin in the home setting according to each factor (schooling, gender, age and income) with *p*-values (chi-squared test).

Practices	<i>p</i> -value/factor			
	Income	Schooling	Age	Gender
How are foods put away after purchasing?	0.6203	0.5145	0.0321	0.0726
Are packages washed before being placed in the freezer or refrigerator?	0.6431	0.7673	0.005	< 0.0001
Is the temperature of the refrigerator or freezer checked before placing meat, milk and other animal-based products?	0.6195	0.0013	< 0.0001	0.1283
Is the cleaning of foods performed with clean, treated water?	0.8446	0.9983	0.7084	0.4852
Do you wash foods of animal origin? ex: meat, eggs	0.0093	0.0004	0.3277	0.711
Do you generally heat/boil/cook foods of animal origin? ex: meat, eggs	0.2995	0.7654	0.8538	0.3498
Do you wash your hands before handling and preparing food?	0.8468	0.245	0.2038	0.3585
Do you remove personal adornments (ring, bracelet, watch, etc.) before preparing foods?	0.8051	0.4309	0.0144	0.0126
What cutting surface (board) is used most?	0.2574	0.6852	0.3892	0.1778
What method is used for cleaning cutting surfaces?	0.1771	0.0259	< 0.0001	0.2034
Is the cutting board washed between one food and another?	0.3405	0.2103	0.0006	0.4689
After preparing and eating a meal, is the food immediately placed in the refrigerator?	0.01	0.0072	0.1232	0.7673

A difference in the income of the respondents was also found for the practice of storing food in the refrigerator immediately after preparation or the consumption of a meal. The habit of refrigerating foods after consuming the meal was found in the majority of respondents who received more than four times the monthly minimum wage, whereas a large part of respondents who earned up to four times the monthly minimum wage reported allowing the food to cool to room temperature prior to storing it in the refrigerator ($p \leq 0.05$) (Table 2 – Figure 3).

Most respondents (94.7%) reported washing foods with clean, treated water, with no significant differences among the categories of age, income, or schooling ($p \leq 0.05$). No significant differences among categories were found on questions addressing the washing of one’s hands, the removal of personal adornments and the cooking of foods (Table 2). Most respondents reported washing their hands (99.5%) and removing adornments (73.4%) prior to handling and preparing foods and 89% reported heating or boiling foods of an animal origin prior to consumption.

The most widely used cutting surface was plastic (60.8%), but 21% reported using a wooden surface. No significant differences among the categories of the respondents were found with regard to the cutting surface (Table 2). The predominant method for cleaning cutting surfaces was water and detergent, as reported by 67.3% of the respondents. However, a significant difference among age groups was found, as the main choice was water and detergent among respondents 18 to 29 years of age, whereas the main choice was water, detergent and bleach among those from 30 to 59 years of age (Table 2 – Figure 1). The majority of respondents (85.6%) reported washing the cutting surface between one food and another, which diminishes the occurrence of cross-contamination. However, this habit was more frequent among respondents 30 years of age or older (Table 2 – Figure 1).

When asked about the thawing method adopted, 53% reported thawing foods under refrigeration and 13.7% reported thawing foods in a microwave oven. Other methods for thawing foods were to leave the meat immersed in water (7.7%) and the use of warm water (0.9%).

3.2 Discussion

Most of the respondents in the present study were women, which is in agreement with findings reported in other studies conducted in Brazil (Uggoni & Salay, 2012; Deon et al., 2014; Teo et al., 2016), Chile

(Torres et al., 2018), Ireland (Moreb et al., 2017), Italy (Losasso et al., 2012) and the United States of America (USA) (Yap et al., 2019).

Differences between genders are found in terms of the level of awareness regarding adequate practices that should be adopted when preparing foods (Losasso et al., 2012). Women in the present study also exhibited better food handling practices compared to men, as observed for the more frequent practice of washing utensils or the cutting surface between one food and another, whereas the inadequate practice of washing products of an animal origin was more frequent among men. A greater tendency of women to adopt good food handling practices and a higher level of knowledge on the subject has been previously described (Moreb et al., 2017; Jevšnik et al., 2022).

Individuals in different age groups and with different levels of schooling and income reported different sanitary food handling practices. Yap et al. (2019) also found that some practices varied according to the category of the variables analyzed. By evaluating food handlers in the home setting, Deon et al. (2014) found that a higher schooling level was associated with a reduction in the time spent on household tasks. In contrast, data in the literature indicate that the execution of household tasks tends to increase with the increase in schooling level (Instituto Brasileiro de Geografia e Estatística, 2020).

The washing of packages prior to being placed in the refrigerator occurred more often among respondents 30 years of age or older. Practices related to food safety were found more in individuals between 30 and 59 years of age in a previous study (Murray et al., 2017). Sanlier (2009) found that safe practices in the home setting tend to improve with age, suggesting that this may be the result of greater knowledge and perception on the part of older individuals regarding the risk of foodborne illnesses.

Most respondents did not check the temperature of the refrigerator prior to storing food. Jevšnik et al. (2022) reported that the highest percentage of respondents never checked the temperature of domestic refrigerators, a similar result was observed in this study. Refrigerators with a higher temperature have a greater chance of being contaminated by *Listeria* spp. and fecal coliforms (Borrusso & Quinlan, 2017), contributing to outbreaks of foodborne illnesses. However, Bolek (2020) found that individuals between 25 and 50 years of age reported this practice more and 42% of the consumers checked the temperature of the freezer, including the temperature of products. In the present study, this practice was reported with greater frequency by respondents 60 years of age or older.

Storing foods after purchasing was performed in different ways among the different age groups. Younger individuals were more likely to store groceries, cleaning products, fruits and vegetables prior to storing refrigerated or frozen foods. Studies have shown that younger individuals have habits that indicate the need for additional education with regard to food safety due to less knowledge about safe practices in handling and preparing food (Moreb et al., 2017; Islam et al., 2023). The established order of storing foods is refrigerated items first, followed by frozen items and, lastly, non-perishable items (Ellis, 2021). Perishable items should be placed in a refrigerator or freezer within a maximum of two hours (Food Safety and Inspection Service, 2016). A previous study found that most consumers put away foods in the recommended order (Torres et al., 2018), as found in the present study among respondents 30 years of age or older, who first put away refrigerated or frozen foods.

Most respondents did not wash foods of animal origin prior to handling or consumption, which is considered correct behavior. The washing of animal products, such as meat, can lead to the cross-contamination of other foods, utensils and surfaces in the kitchen (Centers for Disease Control and Prevention, 2020). This practice was found more among men, individuals with up to a high school education and those with an income of up to two times the monthly minimum wage.

Safer habits in the home setting were found among consumers with a higher level of schooling, which is in agreement with the findings described by Torres et al. (2018). A higher level of schooling and/or income enables greater access to information and the capacity to use such information when handling food, with a

greater awareness of the risk of foodborne illnesses, as also reported in studies by Islam et al. (2023) and Wang et al. (2019).

The practice of storing food in the refrigerator soon after preparing it or eating a meal was performed by most individuals with a higher income, whereas a large portion of individuals who earned up to four times the monthly minimum wage allowed the food to cool to room temperature before placing it in the refrigerator. This finding lends strength to the notion that a higher family income is related to a better perception of risk and, consequently, the execution of safer practices (Lin et al., 2005). In contrast, Teo et al. (2016) found that a large portion of consumers left foods after preparation exposed to room temperature for 30 to 45 minutes. For sanitary reasons, foods after cooking should be stored in such a way as to not enable microbial multiplication (Brasil, 2004). The control of the time-temperature binomial is essential to avoiding microbial multiplication in food. However, a previous study found that 28% of consumers did not know the temperature range for storing hot foods ready for consumption (Bolek, 2020).

Irrespective of category or group, the majority of respondents used clean, treated water, washed their hands and removed personal adornments prior to handling food. These are considered safe practices and in accordance with legal determinations for good food processing practices (Brasil, 2004). Similar results also demonstrate that most individuals have a satisfactory level of information regarding personal hygiene during the handling and preparation of food (Moreb et al., 2017; Yap et al., 2016). Washing one's hands should be frequent and with soap and water in order to diminish the number of microorganisms on the skin, thereby promoting food safety and reducing the occurrence of foodborne illnesses in the home environment (United States Department of Agriculture, 2020; Centers for Disease Control and Prevention, 2021).

Most respondents reported heating or boiling foods of animal origin prior to consumption. Poorly cooked animal products, especially meats, expose consumers to the possible presence of microorganisms, such as *Salmonella*, *Escherichia coli* and other pathogenic bacteria (Centers for Disease Control and Prevention, 2020). Cooking should be performed in such a way that animal-based foods reach at least 70 °C to ensure the sanitary-hygienic quality of what will be consumed (Brasil, 2004). Moreover, thermal treatment should be monitored by thermometers, as visual inspection is not sufficient to ensure that food has reached adequate temperature (Reynolds, 2018).

Cutting surfaces are the main vehicle of cross-contamination in the domestic kitchen (United States Department of Agriculture, 2022). Irrespective of the categories of the respondents, the most widely used cutting surface in the present study was plastic. However, a part of the respondents used wooden cutting boards. Wood is porous, enabling the retention of inorganic substances, such as water, and organic substances, such as food scraps and microorganisms (Santos, 2018), becoming a microbiological contaminant in the kitchen. Abreu & Cabral (2005) isolated *Salmonella* sp., *E. coli* and other enterobacteria on the surface of wooden cutting boards. Despite these findings, two studies found greater use of wooden cutting boards among consumers (Mol et al., 2018; Langiano et al., 2012).

United States Department of Agriculture (2022) recommends cleaning cutting surfaces with hot water and detergent, which was the practice used by the majority of respondents in the present study. A study pointed out that most of the interviewees correctly cleaned the cutting surfaces, however, unsafe practices were detected, such as cleaning the cutting board with a damp cloth before use and using the other side of the board to cut the food (Islam et al., 2023). Safe practices in the home setting for the prevention of the cross-contamination of foods include washing cutting surfaces with hot water, detergent and bleach (Food and Drug Administration, 2018). In the present study, a significant difference among age groups was found regarding the use of the most correct method for cleaning surfaces (water, detergent and bleach), as this practice was performed more among the respondents between 30 and 59 years of age, suggesting that this group has greater knowledge of cleaning procedures. The adoption of proper cleaning procedures for cutting surfaces significantly reduces the microbial load and the occurrence of cross-contamination in the kitchen (Oliveira & Siliano, 2017; Soares et al., 2020). The reduction in the contamination level of these surfaces

reduces the population of pathogens that pose a risk to human health and reduces the number of spoilage microorganisms, thereby preserving food for a longer period of time (Souza et al., 2017).

Most respondents washed the cutting surface between one food and another, which avoids the occurrence of cross-contamination in the home environment and cases of foodborne illnesses (Food Standards Agency, 2018). However, this habit was more frequent among respondents 30 years of age or older. Investigating good food handling practices among older people in a state of the midwestern region of the USA, Yap et al. (2016) found that 93.6% of the interviewees washed cutting boards between foods. Another study found that individuals 55 years of age or older adopted more cleaning practices, but also had practices that increased the chances of cross-contamination, such as washing meat and the use of the same cutting surface between foods (Reynolds, 2018).

Regarding the thawing of foods, the recommendation is refrigeration at a temperature less than 5 °C or in a microwave oven if the food is submitted to immediate cooking (Brasil, 2004). Most respondents in the present study reported thawing foods under refrigeration, which is in agreement with findings from a previous study. By investigating the knowledge of consumers regarding safe food handling practices, Uggioni & Salay (2012) found that 57.7% of the respondents thawed foods in the refrigerator. The habit of thawing foods at room temperature, which was reported by 24% of the respondents, is considered a risk behavior that favors contamination (Ergönül, 2013). Other studies report that this practice is performed by a large number of people (Langiano et al., 2012; Torres et al., 2018; Yap et al., 2016).

4 Conclusion

The majority of respondents in the present study adopted good food handling practices in the home setting. The findings suggest that the execution of safe practices is related to the level of schooling, monthly income and age of the participants. However, some risk behaviors were reported, such as washing products of animal origin, the maintenance of foods at room temperature and the non-verification of the temperature of the refrigerator, which indicated a lack of knowledge regarding safe foods at particular points of the preparation, handling and storage of foods. The use of educational methods with content involving good practices in the handling and preparation of POAO through booklets, lectures, and short films, among others, can favor behavioral changes in consumers, thus reducing cases of foodborne illnesses.

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