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Minimally Processed Vegetables: Consumer Profile, Consumption Habits, and Perceptions of Microbiological Risk

ABSTRACT

This study was conducted to characterize the profile of Brazilian consumers of minimally processed vegetables (MPV) by analyzing consumption habits and perceptions of microbiological risk. An online survey with 27 closed-end questions was administered using Google Forms. The survey consisted of questions regarding participants' demographic characteristics, consumption of fresh vegetables and MPV, and perception of the microbiological risk associated with the consumption of MPV. The majority of the 1,510 participants (77.5%) were women, 42.3% were 26 to 40 years of age, 42.3% were married, 19.7% were students, 54.4% had a graduate degree, and 39.4% had a monthly family income between 5 and 15 times the minimum wage. Most participants (95.3%) reported consuming fresh vegetables, but only 45.4% reported the consumption of MPV. Among MPV consumers, convenience and practicality were the main determining factors (77.8%) in the purchase of these products. The high price of MPV was the main limiting factor (66.4%). Pearson's chi-square test indicated that only monthly family

income was positively associated with the consumption of vegetables and the perception of microbiological risks related to MPV. These data contribute to a better understanding of the profile of Brazilian MPV consumers and will be important as an exposure assessment component of vegetable risk assessment models.

INTRODUCTION

Health authorities around the world recommend the consumption of vegetables because of the many health benefits of these products, which are often consumed fresh, without undergoing processing after harvesting. However, over the past decades, the consumption of minimally processed vegetables (MPV), also known as fresh-cut vegetables, has been widespread in Brazil and many other countries (9, 21).

MPV are vegetables that undergo one or more processing steps (e.g., selection, cutting, washing, rinsing, centrifuging, packaging, storage, and transport) after harvesting (3, 12, 47, 48). Among these steps, washing plays an important role in the quality and safety of the final product. Sanitizers,

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mainly chlorine-based compounds, are commonly used in the wash water to reduce the microbial load, prevent cross-contamination, and inactivate pathogenic microorganisms that may be present (47). Consequently, MPV are usually sold as sanitized and ready for consumption.

The MPV market emerged in Brazil in the mid-1970s with the expansion of fast-food chains in the southeastern region of the country (38, 47). Changes in consumers' lifestyles, such as increases in the number of daily activities and less time to prepare food, have driven demand for practical and convenient foods (1, 3, 47). Data from several studies have indicated that MPV consumption is growing worldwide (15, 41). Although no official data on the MPV market have been collected in Brazil, the increase in consumer demand and interest in these products have been reported in some studies (6, 39, 47). The dietary guidelines for the Brazilian population recommend that natural or minimally processed foods should be the basis of a healthy diet, including a wide variety of foods mostly from plants (9). Therefore, consumption of MPV is a simple and quick way to include healthy foods in daily meals (9, 18, 48).

Although MPV usually go through a washing step in which sanitizers are often used to reduce cross-contamination and maintain the quality of the wash water, microbial reduction on produce is limited and the reduction of certain microorganisms to a specific level of safety cannot be assured (33, 47). Because MPV are ready-to-eat commodities and do not require additional treatment before consumption, any contamination present can increase the risk of foodborne outbreaks (24, 47). In Brazil, between 2000 and 2021 14,588 foodborne outbreaks were recorded by the Ministry of Health (11), resulting in 266,247 illnesses and 212 deaths. Among these outbreaks, 3,582 (1.3%) were associated with the consumption of vegetables. However, no information was available on whether these vegetables were consumed raw or as MPV. In the United States, data from the Centers for Disease Control and Prevention (13) revealed that 51 foodborne outbreaks (including 5 multistate outbreaks) linked to leafy greens were reported between 2014 and 2018. From 2019 to 2021, nine multistate outbreaks were reported, and MPV were linked to some of them. In 2021, four multistate outbreaks were linked to the consumption of contaminated packaged salads: one caused by *Escherichia coli* O157:H7 (in 4 states, resulting in 10 illnesses, 10 hospitalizations, and one death), one caused by *Salmonella* Typhimurium (in 4 states, resulting in 31 illnesses and 4 hospitalizations), and two caused by *Listeria monocytogenes* (one in 8 states, resulting in 10 illnesses, 10 hospitalizations, and 1 death; and the other in 13 states, resulting in 18 illnesses, 16 hospitalizations, and 3 deaths).

Several studies have been conducted to evaluate the microbiological quality and safety of MPV in Brazil and in many other countries, and pathogenic bacteria have been detected in these products (4, 5, 16, 17, 19, 20, 23, 25, 28, 29, 33, 36,

40, 46–48). Although data from several studies on pathogenic organisms are available for MPV, no specific legislation for these types of products has been enacted in Brazil. The Brazilian National Health and Sanitary Surveillance Agency has not set a specific good manufacturing technical standard for MPV. However, MPV industries follow regulations at the federal level related to good manufacturing practices, such as Portaria MS 1.428/1993, Portaria SVS 326/1997, and RDC 275/2002 (7, 8, 10), proscribed for all kinds of food processing plants. In the state of Rio Grande do Sul in southern Brazil and in the city of São Paulo in southeastern Brazil, specific technical standards have been published related to good manufacturing practices and standard operating procedures for the manufacturing of minimally processed fruits and vegetables (44, 49).

To ensure quality and microbiological safety, processing plants must adopt strategies to control bacterial contamination during the production of MPV that include good handling practices during all stages of production: primary production, harvest, storage, and processing (23, 47). Despite the growing demand for minimally processed products and the advantages associated with their consumption (mainly practicality), studies on the profiles and eating habits of MPV consumers are lacking.

MATERIALS AND METHODS

Sampling and survey instrument

A cross-sectional study was carried out that included use of a questionnaire that was prepared on the Google Forms platform and publicly disseminated via the Internet and social networks between February and March 2021, with anonymous voluntary participation. The inclusion criteria for participants were being ≥ 18 years of age and residing in Brazil. No incentives were offered to participants. The Web link to the questionnaire was sent to the researchers' contact network by e-mail and to community groups through social networks, thus generating a snowball sample where volunteers were asked to spread the questionnaire link through their personal network to increase the total number and diversity of participants. Data were collected from individuals with access to some digital equipment connected to the Internet, resulting in a non-probabilistic sample with convenience bias. Approval for the study was obtained from the Faculty of Pharmaceutical Sciences Research Ethics Committee (CAAE 33999720.0.0000.0067).

The questionnaire was composed of 27 questions divided into three categories: (i) demographic characteristics (gender, age, marital status, profession, education, monthly family income, number of children, and number of residents in the same home); (ii) consumption of fresh vegetables and MPV; and (iii) perception of the microbiological risk associated with the consumption of MPV. A brief definition and examples of MPV were included in

the questionnaire (before the questions about MPV consumption habits) to clarify possible questions from participants about these products (see Supplemental Material).

Questions about the perception of microbiological risk were created based on the Likert scale, which provided better verification of each participant's degree of knowledge and level of agreement with the statements. Participants were asked to assign scores from 1 to 5 to the situations presented in the questions: 1, totally disagree; 2, disagree; 3, indifferent (or neutral); 4, agree; and 5, totally agree.

Data analysis

Descriptive analyses were performed to assess response rates. The Pearson chi-square test was used to observe possible associations between participant demographic characteristics (gender, age, marital status, educational level, and monthly family income) and consumption of fresh vegetables and MPV and perception about the microbiological risks associated with MPV consumption. Statistical analyses were performed using Minitab Statistical Software (2021, <https://www.minitab.com/en-us/>), and results were considered significant at $P \leq 0.05$.

RESULTS

Of the 1,510 adults (≥ 18 years of age) from all Brazilian states that responded to the questionnaire, the majority (57.7%) were from the southeastern region (Fig. 1). Most (77.5%) were women, 42.3% were 26 to 40 years of age, and 42.3% were married. Most participants (54.4%) had a graduate degree, and 19.7% were undergraduate or graduate students. Regarding family income, most respondents (39.4%) reported receiving between 5 and 15 times the Brazilian minimum wage (BRL\$5,225 to 15,675 per month). More than half of the respondents (53.1%) reported not having children, and most of them (58.5%) lived in households with two or three people (Table 1).

Regarding the consumption of fresh foods, the participants were asked whether they consumed fresh vegetables and where and how often they bought these items (with more than one choice possible). A total of 1,439 participants (95.3%) reported eating fresh vegetables. Although some participants reported not consuming these products, they reported purchasing them for their families. Supermarkets were the most common place of purchase (78.9%), followed by grocery stores (58.8%) and farmers' markets (40.5%).

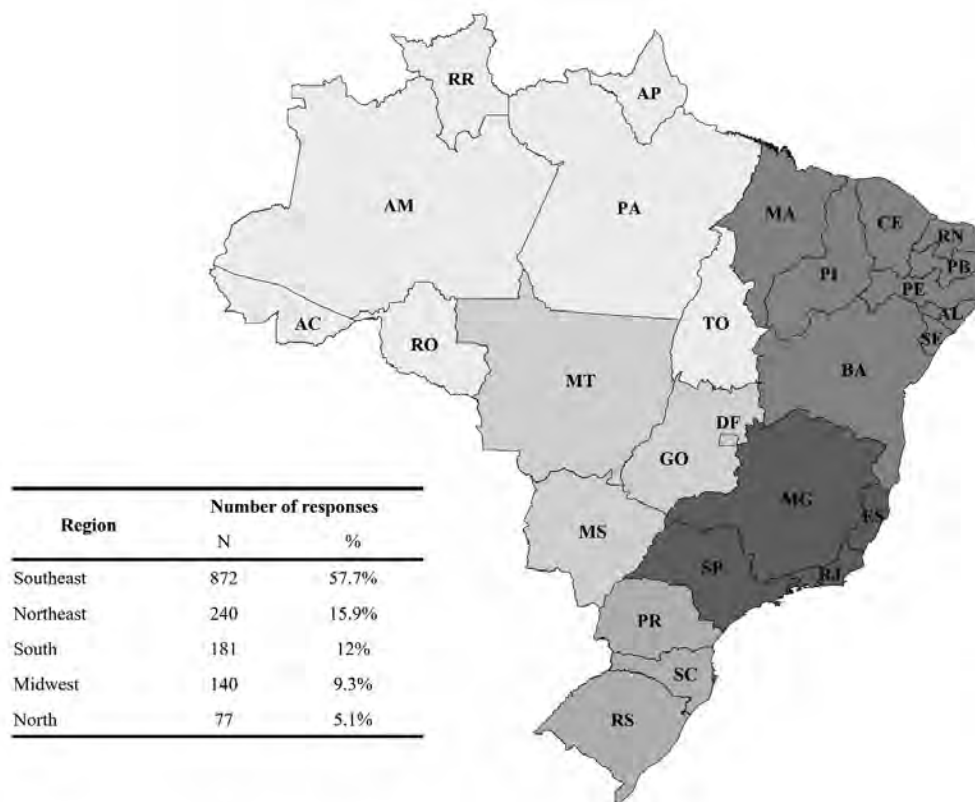


FIGURE 1. Distribution of respondents by Brazilian region. (Map created with MapChart.) Southeastern region: ES, Espírito Santo; MG, Minas Gerais; RJ, Rio de Janeiro; SP, São Paulo. Southern region: PR, Paraná; SC, Santa Catarina; RS, Rio Grande do Sul. Northeastern region: AL, Alagoas; BA, Bahia; CE, Ceará; MA, Maranhão; PB, Paraíba; PE, Pernambuco; PI, Piauí; RN, Rio Grande do Norte; SE, Sergipe. Midwestern region: DF, Distrito Federal; GO, Goiás; MT, Mato Grosso; MS, Mato Grosso do Sul. Northern region: AC, Acre; AM, Amazonas; AP, Amapá; PA, Pará; RO, Rondônia; RR, Roraima; TO, Tocantins.

TABLE 1. Participant demographic characteristics

Category	Group	N	%
Reported gender	Female	1,171	77.5
	Male	333	22.1
	Not answered	6	0.4
Age (yr)	18 to 25	280	18.5
	26 to 40	638	42.3
	41 to 55	376	24.9
	56 to 70	199	13.2
	>70	17	1.1
Reported marital status	Married	638	42.3
	Single	588	38.9
	Common-law marriage	161	10.7
	Divorced	99	6.6
	Widow, widower	24	1.6
Educational level	Graduate degree	821	54.4
	Undergraduate degree	318	21.1
	Complete high school	316	20.9
	Technical education	40	2.6
	Complete elementary school	13	0.8
	Illiterate	1	0.1
	Not answered	1	0.1
Profession	Student	297	19.7
	Public servant	237	15.7
	Teacher	217	14.4
	Health professionals	152	10.1
	Autonomous professional	99	6.6
	Liberal professional (e.g., lawyer, architect, journalist, businessman)	94	6.2
	Other	414	27.4
Monthly family income (times the Brazilian minimum wage) ^a	<1	56	3.7
	1–3	206	13.6
	3–5	313	20.7
	5–15	595	39.4
	>15	222	14.7
	Not answered	118	7.8
No. of children	None	802	53.1
	1 or 2	593	39.3
	3 or 4	106	7
	5 or 6	5	0.3
	>6	4	0.3

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TABLE 1. Participant demographic characteristics (cont.)

Category	Group	N	%
No. of residents in the same household	2 or 3	883	58.5
	4 or 5	428	28.3
	Living alone	156	10.3
	6 or 7	34	2.3
	≥8	9	0.6

^aMinimum wage in Brazil in 2021 was BRL\$1,045 per month.

TABLE 2. Participant fresh vegetable consumption habits

Behavior	N	%
Consumed		
Yes	1,439	95.3
No	71	4.7
Place of purchase		
Supermarket	1,192	78.9
Grocery store	888	58.8
Farmers' market	611	40.5
Direct from producer	177	11.7
Do not purchase	6	0.4
Purchase frequency		
1–2 times per week	926	61.3
3–4 times per week	219	14.5
5–6 times per week	53	3.5
Daily	147	9.7
Every 15 days	128	8.5
Once per month	22	1.5
Do not know	11	0.7
Never	4	0.3

The most common purchase frequency (61.3%) was once or twice weekly (*Table 2*).

With respect to MPV, 926 (61.3%) of the 1,510 participants reported knowing what these products were. However, 825 (54.6%) reported not consuming MPV mainly because of distrust in hygienic quality (64.4%), high price (50%), lack of habit (43%), preference for bulk products (38%), loss of nutrients (18.7%), lack of availability at usual food outlets (17.3%), and little variety (6.3%). Other

reasons also were given (29.3%). Among the 825 non-consumers of MPV, 46 (5.6%) also did not consume fresh vegetables (data not shown).

Data on MPV consumer habits are listed in *Table 3*. Among the 685 (45.4%) of respondents that were consumers, the majority (34.7%) reported eating MPV two to three times weekly, and supermarkets were the main place of purchase (81.8%), followed by grocery stores (52.1%) and farmers' markets (18.4%). The main purchase frequency (56.1%)

TABLE 3. Participant MPV consumption habits

Behavior	N	%
Consumed		
Yes	685	45.4
No	825	54.6
Consumption frequency		
Once per week	131	19.1
2–3 times per week	238	34.7
4–5 times per week	85	12.4
Daily	86	12.6
Every 15 days	85	12.4
Once per month	54	7.9
Do not consume but buy for the family	6	0.9
Place of purchase		
Supermarket	560	81.8
Grocery store	357	52.1
Farmers' market	126	18.4
Direct from producer	27	3.9
Purchase frequency		
1–2 times per week	384	56.1
3–4 times per week	46	6.7
5–6 times per week	8	1.2
Daily	6	0.9
Every 15 days	148	21.6
Once per month	66	9.6
Do not know	17	2.5
Never	3	0.4
Factors that encourage purchase		
Convenience and practicality	533	77.8
Quick preparation	347	50.7
Quality	246	35.9
Reduction of waste	190	27.7
Variety and availability	178	26
Hygiene	172	25.1
Cost vs. benefit	153	22.3
Higher yield	138	20.1
Healthier	71	10.4
Trust and credibility	38	5.5
Factors that limit purchase		
High price	455	66.4
Lack of product	184	26.9
High perishability	135	19.7

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TABLE 3. Participant MPV consumption habits (cont.)

Behavior	N	%
Factors that limit purchase		
Distrust of hygienic quality	95	13.9
Preference for bulk product	89	13
Lack of habit	73	10.7
Nutritional loss	66	9.6
More meals consumed at home	46	6.7
Lack of knowledge	45	6.6
Own production	16	2.3
Other	32	4.7
Varieties of MPV consumed		
Leafy greens (e.g., chard, lettuce, watercress, collard greens, endive, spinach, cabbage, arugula, parsley)	524	76.6
Vegetables (e.g., pumpkin, zucchini, eggplant, chayote, cucumber, pepper)	313	45.7
Roots, tubers (e.g., potatoes, beets, carrots, cassava, turnips, radishes)	310	45.3
Flowers (e.g., artichoke, broccoli, cauliflower)	218	31.8
Stems (e.g., celery, asparagus, palm heart)	84	12.3

was also once or twice weekly. These consumers answered questions about the main factors that determined or limited the purchase of MPV. Convenience and practicality (77.8%) and quick preparation (50.7%) were the most common reasons for purchasing these products. Limiting factors were high price (66.4%) and lack of product availability at places of food purchase (26.9%). Among the most commonly consumed MPV varieties were leafy vegetables such as lettuce, chard, watercress, collard greens, endive, spinach, cabbage, arugula, and parsley.

Consumers were also asked about their understanding of MPV labeling. Of the 685 participants, 280 (40.9%) reported checking labels every time they bought MPV, but 44 (6.4%) never checked labels. The label items indicated as most commonly checked were expiration date (84.1%), date of manufacture (61.3%), and information on hygiene or washing (42.5%) (Table 4).

Regarding the participants' perception of the microbiological risk associated with the consumption of MPV, most disagreed that MPV are totally free of pathogenic microorganisms (49%) or other contaminants that pose health risks (31.8%) and agreed that MPV may be involved in foodborne disease outbreaks (49.1%). Most participants (58.7%) disagreed that there is no concern about the microbiological safety of MPV, even though these products have been sanitized by producers (Fig. 2).

Results of the Pearson chi-square test indicated that only the variable monthly family income was positively associated with the consumption of fresh vegetables and

MPV. Individuals with higher income, regardless of gender, age, marital status, and educational level, tended to consume more vegetables. Monthly family income was also the only variable that was associated with the perception of microbiological risk; individuals with higher incomes were more aware of the microbiological risks associated with the consumption of MPV. Participants with a monthly family income of up to the minimum wage were the group least likely to consume or purchase MPV (2%), whereas those with a monthly family income of 5 to 15 times the minimum wage had the highest rate of consumption (42%). Higher income participants also tended to have higher education levels ($P \leq 0.05$), which could have contributed to greater awareness of microbiological risks.

DISCUSSION

The present study covered all Brazilian regions, with most of the data coming from the southeastern region including the states of Espírito Santo, Minas Gerais, Rio de Janeiro, and São Paulo. This region of Brazil is the most populous and wealthy, accounting for ca. 53% of the gross domestic product. Data from the last agricultural census released by the Brazilian Institute of Geography and Statistics (IBGE) revealed that ca. 21,649 tons of fresh vegetables were produced in Brazil in 2017, and 38.7% of this production came from the southeastern region. Although most survey responses (57.7%) came from southeastern Brazil, the rest of the country was represented in our study; 15.9% of responses came from the northeastern and 12% came from southern

TABLE 4. Knowledge about MPV labeling

Behavior	N	%
Label reading frequency		
Every time (100%)	280	40.9
Often (70%)	148	21.6
Sometimes (50%)	112	16.4
Rarely (20%)	101	14.7
Never (0)	44	6.4
Items checked on labels		
Expiration date	576	84.1
Date of manufacture	420	61.3
Information about hygiene or washing	291	42.5
Total product quantity	265	38.7
Conservation mode, storage temp	220	32.1
List of ingredients	218	31.8
Place of origin	168	24.5
Nutritional table	108	15.8
Brand	101	14.7
Do not usually read label	59	8.6
Allergens (e.g., whether it contains gluten)	42	6.1
Batch	25	3.6

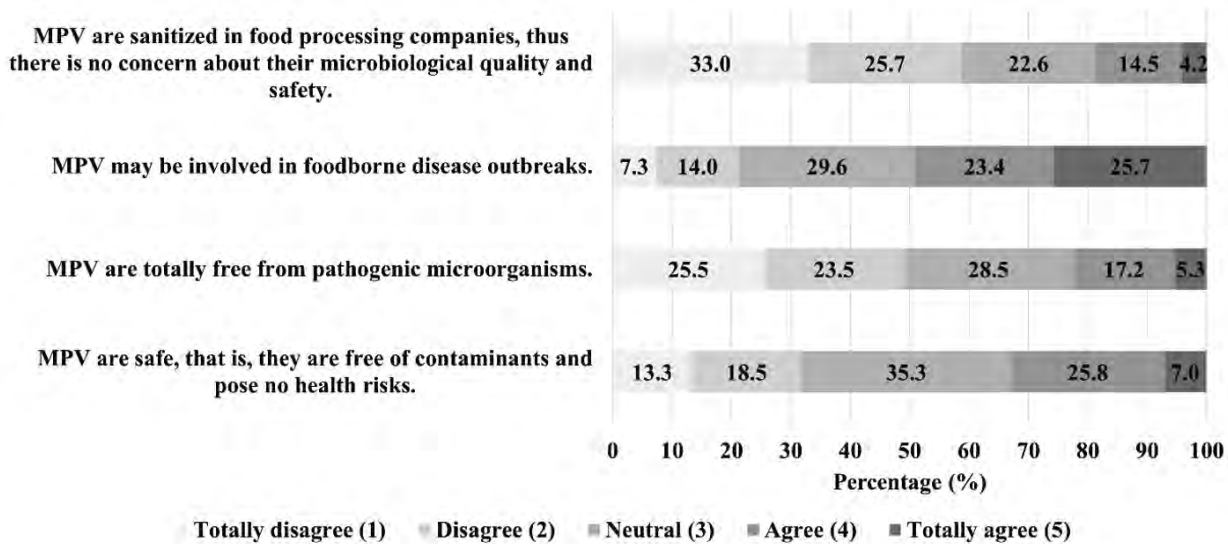


FIGURE 2. Participants' perceptions of microbiological risk associated with MPV consumption.

Brazil. These three regions contain 88% of the Brazilian population, even though they cover only 36% of the Brazilian territory (27).

The greater representation of women in the present study may be due to the fact that women are usually the food buyers for their households and they are more interested than men in participating in this type of research project, as reported by other researchers (22, 51). The survey was not designed to target a specific social segment, but responses from individuals with a graduate degree prevailed. Similar results have been obtained in other studies conducted in Brazil in which the behavior of Brazilian consumers was evaluated; the participation of individuals with a high educational level were also more prevalent (22, 31). According to the most recent Brazilian demographic census, the educational level of the Brazilian population in 2019 was as follows: 14% held an undergraduate degree, 30% had completed high school, and the remaining 66% did not have a high school degree, including the 6.9% who had no formal education (27). Hence, the present survey failed to reach the most vulnerable segments of the population, who have limited if any access to the Internet. Regarding housing, the highest percentage of participants reported living in households with two or three people (most with none or fewer than two children), also in agreement with data published in the 2019 IBGE report, which determined that the national average was 3.3 inhabitants per household (27).

Most participants in the present study (1,439; 95.3%) reported eating fresh vegetables. This result corroborates data collected in a nationwide study conducted by the Center for Epidemiological Research in Nutrition and Health of the University of São Paulo and published by NutriNet Brazil (53). That study addressed the consumption of vegetables before and after the onset of the COVID-19 pandemic. Of the 10,116 participants, 8,831 (87.3%) reported that they used to consume fresh vegetables regularly. The onset of the pandemic coincided with a 1.8% increase in consumption of these products.

Data on the production and consumption of MPV in Brazil are still scarce. The available information comes from a few scientific studies conducted in selected cities, in which increased commercialization of these products was attributed to changes in lifestyle and the growing presence of MPV in supermarkets and grocery stores (6, 39, 47). Although most participants reported familiarity with MPV, only 45.4% consumed these products. The present study was not designed to address the proximity of participants to establishments that sell MPV; the assumption was that the purchase decision is more related to consumers' lifestyle. Convenience and quick preparation were identified as the main determining factors for consumption, consistent with the fact that changes in lifestyle, particularly the lack of time to prepare food, have increased the demand for these products (26). The main reasons given for not consuming

these products were distrust of their hygienic quality and their higher price.

Similar results were found by Perez et al. (43), who conducted a survey with 246 participants in Brazilian supermarkets in Belo Horizonte, MG; 56 (23%) used to consume MPV regularly, mainly due to convenience (46%) and short preparation time (21%). The main reasons for nonconsumption were high prices (31.9%), preference for selecting and preparing fresh vegetables (23%), and distrust of the hygienic quality of these products (17.9%). Sato et al. (50) conducted a similar survey with 42 individuals in São Paulo city; 27 (64.3%) reported buying MPV on a regular basis. The main reasons for purchasing these products were convenience (88.9%) and hygiene quality (29.6%), and the main reason for not purchasing was high price (52%). Amorim and Nascimento (2) found similar results in supermarkets and grocery stores in two cities in the state of Rio de Janeiro. Among 180 interviewed individuals, 120 (66.7%) reported buying MPV regularly because of convenience (58.3%) and quality (25%). Even though the reasons for not buying these products were not addressed, most interviewed individuals considered MPV expensive (29.2%) or very expensive (30%). All these studies were conducted in the southeastern region of Brazil. To our knowledge, the present study is the first to address consumption habits and perceptions regarding MPV in all regions of the country.

Concerning the hygienic or sanitary quality of MPV, these products usually go through a disinfection step during processing and are sold as ready for consumption. However, studies carried out in Brazil and other countries have revealed the presence of pathogenic microorganisms in these products, which may occur due to hygiene failures at various points in the production chain (47). This finding is concerning because MPV are eaten raw usually without additional treatment (e.g., cooking) before consumption. Although some researchers have evaluated the occurrence of pathogenic microorganisms in MPV in Brazil, others have used more complex tools, such as quantitative microbiological risk assessment (QMRA), to estimate the impact of the consumption of contaminated MPV on consumer health. Sant'Ana et al. (45) developed a QMRA model to estimate the risks of infection with *Salmonella* and *L. monocytogenes* in the population of São Paulo, focusing on the retail and consumption steps. Their simulations revealed that the risks of foodborne illnesses due to the consumption of MPV were higher for *Salmonella* than for *L. monocytogenes*. However, the risk of infection and the number of cases predicted in the exposed population were reduced in scenarios where the prevalence and level of pathogens were decreased and when MPV were stored at <5°C. Maffei et al. (34) developed a QMRA model to estimate the impact of cross-contamination during MPV washing on the risk of salmonellosis in São Paulo. Their

model indicated that higher chlorine concentrations resulted in a lower risk of illness. In simulations with < 5 ppm of available chlorine, most (>96%) of the predicted illnesses arose from cross-contamination. Thus, available chlorine concentrations of less than 5 ppm increase the chance of cross-contamination. The authors concluded that the concentration of chlorine should be kept at >10 ppm to minimize the risk of illness due to the consumption of MPV.

Regarding price, MPV are more expensive than fresh vegetables mainly due to the cost of production, transport, and storage, which requires refrigeration. In Brazil, MPV costs at least twice as much as fresh vegetables. In the present study, monthly family income was associated with the consumption of fresh vegetables and MPV and with the perception of microbiological risks linked to these products. These results are consistent with those of other studies in which a direct relationship was found between family income and purchase or consumption of fresh produce (14, 30, 37). In Brazil, a recent study based on data from household budget surveys for 2008 to 2009 and 2017 to 2018 revealed that the amount of fruits and vegetables purchased by Brazilian households is higher in households with higher incomes (42). The smallest amounts were purchased by the group with incomes up to two times the minimum wage, and the largest amounts were purchased by the group with incomes >14 times the minimum wage.

The relationship between family income and perception of microbiological risks also can be explained by the fact that consumers who most buy or consume fresh vegetables and MPV are more attentive to the characteristics of these products. Lopes et al. (32) conducted a study about consumer perceptions of the quality and safety of MPV and observed that the higher the frequency of consumption, the greater the consumer's knowledge about the quality and safety of these products. Silveira et al. (52) conducted a study to compare the level of nutritional knowledge between obese and nonobese women and found a positive association between the level of nutritional knowledge and family income; women from both groups with a higher income had more knowledge.

Almost half of the participants in the present study reported distrust in the microbiological quality and safety

of MPV and agreed that these products may be involved in foodborne outbreaks. The survey did not address the reasons for this distrust. However, because most consumers are not used to purchasing this type of product, doubts and uncertainties are expected. Some consumers may follow news about the occurrence of foodborne outbreaks associated with the consumption of MPV, mainly outside Brazil.

The results of this study contribute to a better understanding of Brazilian consumers of MPV, providing information on demographics, consumption habits, and perceptions of microbiological risk. Most previous food consumption surveys have been focused on the nutritional status of a population rather than consumer behaviors. To accurately characterize the risk of foodborne illness from exposure to a microbiological hazard in a certain food, data on the frequency of MPV consumption, amount consumed, and preparation and consumption methods must be collected (35). This information can then be used to support the development of QMRA models associated with the consumption of these products.

CONCLUSIONS

The data obtained in this study indicated that although most consumers reported familiarity with MPV, fewer than half of them consumed these products; high price was cited as the most limiting factor for purchase. Family income was the only variable that had a significant impact on the consumption of fresh vegetables and MPV and on the perception of microbiological risks associated with these products. Overall, these data contribute to a better understanding of Brazilian MPV consumers and can be used as part of the exposure assessment component in vegetable-related risk assessment models.

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