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How do the interview environment, sociodemographic aspects and risk perception impact attitudes related to food? A survey in the Midwest of Brazil

Peter REMBISCHEVSKI[1], Eloisa Dutra CALDAS[2]*

Abstract

This study aimed to assess the food-related attitudes through the application of a structured questionnaire to 1,000 individuals applied in three environments (groups) in the Federal District of Brazil (supermarkets, universities and hospitals/clinics) using multivariate logistic regression, with special focus on pesticides and genetically modified (GM) food. Outpatients in hospital/clinic, women and older individuals were significantly more likely to adopt diets or attitudes considered or perceived as healthy (including high consumption of fruits and vegetables, acquiring organic food, and adopting procedures to remove pesticide residues from food). When income and/or education impacted the results, the correlation was negative. Over 60% of the population believe it is possible to produce food without using pesticides, mainly the hospital/clinic group, younger individuals, and women, and 95.3% think that the presence of pesticides in food should be indicated on the labels, mainly the hospital/clinic group and older individuals. High worry about pesticides and GM food was associated with most healthy food-related attitudes. The results of this study are important for food-related communication strategies conducted by health authorities, aiming at driving specific population segments to a healthier and more conscious diet.

Keywords: food consumption; consumer attitudes; pesticides; genetically modified food.

Practical Application: the results can guide government authorities on communication strategies related to food

1 Introduction

Food is a basic human need, but the act of eating also has strong symbolisms, such as maintaining the family unit, in addition to social, cultural and religious connotations, among other forms of integration (Kaptan et al., 2018). Several factors can influence the consumption profile of individuals, such as age, gender, marital status, number of children, income and education (Dosman et al., 2001). In general, in the less favored socioeconomic strata, the priority is to have access to food that guarantees their survival, and often the characteristic "being healthy" takes a back seat (French et al., 2019). For instance, the long-lasting unsafe food issues and recent animal disease outbreaks in Vietnam positively impacted the decision to buy traceable pork in the supermarket (Dang & Tran, 2021) Sensory aspects are also strong determinants in food consumption decisions, and foods rich in sugar, salt and fat are the ones that most activate our gustatory sensory senses, bringing us a sensation of pleasure that can lead to eating disorders (May & Dus, 2021; Schulte et al., 2015).

The consumption of fruits and vegetables (F&V) and cereals constitutes a healthy diet, being an important factor for weight maintenance and protection against the development of chronic non-communicable diseases (World Health Organization, 2018). Some authors attribute to organic foods an extra protection against these diseases, due to the lower presence of pesticides and heavy metals, and greater presence of some nutrients, such as flavonoids (Barański et al., 2014). Availability of healthy foods at home and encouraging their consumption in the school environment are also important (Amuta et al., 2015). Moreover, individuals' health status can also promote changes in eating habits, aiming at their improvement or preservation. Particularly during the COVID-19 pandemic, the first reports of improvement in healthy food consumption indicators have emerged, aimed at strengthening the immune system and reducing obesity, widely propagated, and recognized as factors associated with the progression of the disease (Di Renzo et al., 2020; Steele et al., 2020).

Studies conducted in Brazil and elsewhere indicate a high risk perception about the presence of pesticides in food (Arrebola et al., 2020; Nguyen et al., 2020; Rembischevski et al., 2022). Although it is expected that pesticide risk perception affects the decision of buying organic food, studies that investigate this effect in detail are limited, and to the best of our knowledge, were not yet conducted in Brazil. The use of technologies in food production, such as genetic engineer, has also raised concern among some population groups (Christiansen et al., 2017). Hakim et al. (2020) showed that the willingness to buy genetically modified (GM) foods in a Brazilian city was positively affected by the reduced price and perceived quality but negatively affected by the risk perception. Understanding what drives the attitudes related to food among different population strata is crucial for government

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[1] *Agência Nacional de Vigilância Sanitária – ANVISA, Brasília, DF, Brasil*
[2] *Laboratory of Toxicology, Department of Pharmacy, Faculty of Health Sciences, Universidade de Brasília – Unb, Campus Darcy Ribeiro, Brasília, DF, Brasil*
*Corresponding author: eloisa@unb.br

authorities to develop efficient policies on regulation and risk communication strategies.

The general objective of this study was to assess the attitudes towards food of individuals interviewed in three different environments in the Federal District (Brazil): supermarkets, universities (only students), and hospitals/clinics (outpatients). The hypothesis to be confirmed are: 1) the interview environment impacts the attitudes related to food and food consumption; 2) the attitudes are impacted by the sociodemographic characteristics of the participants, and 3) the attitudes are associated with risk perception related to pesticides and GM foods. To the best of our acknowledgement, this is the first time that the impact of the interview environment on reported food-related attitudes is investigated.

2 Methods

2.1 Study population and questionnaire

The study was conducted in the Federal District, Midwest of Brazil, from May 2018 to January 2020. An objective questionnaire was applied to 1,000 individuals who were in three different environments at the time of the study: 1) Supermarkets (N = 400); 2) Students in public and private universities (N = 300); and 3) Outpatients in public hospitals and private clinics (N = 300). Individuals were approached at random in the three environments until the pre-established number of interviewees was reached (convenience sampling). Only individuals 18 years old or over, literate, and with no serious intellectual or physical impairment participated in the study and signed the Informed Consent form. The study was approved by the Ethics Committee of the Faculty of Health Sciences, University of Brasilia (71667117.5.0000.0030).

The questionnaire was previously tested with 20 individuals with the expected profile of the study participants, for final adjustments of the questions and answer options (improve understanding and eliminating redundancies). Participants' sociodemographic profile is described in detailed elsewhere (Rembischevski et al., 2022). In summary, 57.8% were women, 46.7% were between 18 and 30 years old, 55.5% had incomplete or complete college and 49.8% had a household monthly income between 2 and 10 minimum wages (MW), which at the end of 2019 valued about US$250. The hospital/clinic group had the lowest education level (42.5% up to high school) and income (42.4% up to 2 MW) among the three environmental groups.

In addition to the sociodemographic questions, the questionnaire contains six questions related to risk perception issues, which were addressed previously (Rembischevski et al., 2022), three questions regarding trust on information sources related to food risks, which are not discussed here, and 11 questions regarding food-related attitudes, which is the focus of this paper. The food-related attitudes questions are: 1) the consumption (low, medium or high) of canned/industrialized food, fruits and vegetables (F & V), meat and eggs, cereals/grains and carbohydrates (pasta, bread); 2) characteristics sought in the food (tasty, nutritious, healthy, safe and/or low price); 3) whether food can be deleterious to health (often, occasionally, rarely/never); 4) read food labels (always, almost always, sometimes, not usually, just the expiration date); 5) why do not read the labels (small letters, do not understand, not interested, do not have time/patience); 6) acquire organic products (exclusively, almost always, sometimes, never, I would like but it is expensive, I do not know what it is); 7) believe it is possible to produce food without pesticides (all foods, some foods, maybe, no, do not know); 8) think labels should indicate the presence of pesticides (at least say if it is present, indicate all of them, no need, do not know); 9) apply procedures to remove or reduce pesticide residues in food (always, frequently, rarely, never); 10) know the meaning of the T symbol (yes, maybe, no, never notice it); and 11) do not buy food with this symbol (always/almost always, sometimes, not relevant).

2.2 Statistical analysis

Data from the questionnaires were inserted in Epi Info™ 7.2.2.6, and statistical analysis was performed in IBM SPSS Statistics V.28. Multinomial logistic regression analyses were performed to test the impact (main effects) of belonging to a group and of the sociodemographic parameters (gender, age, income, and education) on dependent variables (food-related attitudes). The parameters age, education, and family income were categorized. First, the impact of each parameter was tested separately (bivariate analysis), and those that showed significance ($p < 0.05$) were included in the adjusted model (multivariate). Results are given in odds ratio (OR [lower level-upper level at 95% confidence], p). When tested for multicollinearity, no variable overlapped in the adjusted model (Variance Inflation Factor lower than 4 and tolerance higher than 0.1), which explained the observed data (goodness of fit gave $p \geq 0.05$ in the Pearson chi-square test). Additionally, associations among food-related attitudes and risk perception to pesticides and GM foods, investigated by Rembischevski et al. (2022), were assessed. Only the results of the multivariate analysis that gave significance are reported.

3 Results

3.1 Food consumption profile and habits

About half of participants reported high F&V consumption (mainly from the hospital/clinic group), 33.7% medium consumption, and 15.6% low consumption (mainly from the university group) (Figure S1A; Supplementary Material). The multivariate analysis confirmed the significant difference between the groups (high *vs* low), with hospital/clinic, and supermarket indicating a higher F&V consumption frequency compared to the university group (OR = 4.96 and 2.33, respectively; Table 1). The hospital/clinic group also indicated a higher frequency than the supermarket group (OR = 2.13 [1.80-2.52]; p = 0.001). Individuals aged 50 years and older indicated higher F&V consumption compared to other age groups, as well as women compared to men. Considering age as a continuous variable, a positive association with the response was confirmed, with about 80% more chance of consuming more F&V for each 20-year increment (OR = 1.81 [1.22-3.80]; p = 0.003). Lower-income individuals had a lower chance of consuming F&V more frequently (OR = 0.553; high *vs* low), a trend that was maintained when comparing high *vs* medium consumption (Table 1). Education did not significantly impact F&V consumption.

About 5% of the individuals from the hospital/clinic indicated more frequently high consumption canned/industrialized food, followed by the supermarket (13%) and university groups (19%) (Figure S1B). Indeed, the multivariate model (high *vs* low) confirmed that the hospital/clinic group less frequently reported high canned/industrialized food consumption than university group (OR = 0.442), as well as older individuals in relation to the lowest age groups (OR = 0.202 and 0.519; Table 1), with significant difference between the oldest and intermediate age groups (OR=0.389 [0.297-0.511]; $p < 0.001$). A negative association with age as continuous variable showed that, for every 20-year increase in age, there is a 2.65-fold [1.66-4.86; $p < 0.001$] more likely to report low canned/industrialized food consumption.

Frequencies of cereal, carbohydrate (e.g. pasta and bread) and meat/egg consumption did not vary significantly among the groups, nor were they influenced by any sociodemographic variable ($p > 0.05$; data not shown), except for the report of a lower frequency of carbohydrate consumption for the age group over 49 years old in relation to those up to 24 years old (OR = 0.455 [0.249-0.828]; $p = 0.01$).

Respondents were asked to inform the main characteristic they look for in a food, giving them the possibility to choose more than one option. The multivariate model showed that the tasty option was significantly less chosen by the hospital/clinic group compared to the university group (OR = 0.482), as well as by older individuals (ORs of 0.317 and 0.576), being also less selected by lower income respondents (OR = 0.695) (Table 2). The option "to be healthy" was significantly more selected by the supermarket group than the university group (OR = 1.51), individuals aged 50 years and older (OR = 1.89) and women (OR = 1.33), and the hospital/clinic group selected the low-price option significantly less than university (OR = 0.602; Table 2). No variables significantly affected the choice of nutritious and safe characteristics.

Most respondents (92.2%) considered that foods could be (at least occasionally) deleterious to health, with women considering so more than men (OR = 2.32 [1.39 - 3.88]; $p = 0.001$), and individuals with less education having an inverse perception (0.258 [0.137 - 0.486]; $p = 0.000$).

More than 80% of participants reported that they read food labels (always, almost always, sometimes or just expiration date), but only gender and income variables had a significant impact on the response. Women have this habit more than men (OR = 1.51 [1.07-2.15]; $p = 0.021$), while individuals with lower family income do it less (OR = 0.663 [0.462-0.950]; $p = 0.025$). Of those who reported not having this habit or reading only expiration date, the main reason given by the hospital/clinic (66.7%) and supermarket (57.4%) groups was the small letters in the label, while 47.9% of the university group mentioned lack of time/patience.

Table 1. Multivariate regression analysis for the consumption of fruits and vegetables and canned/industrialized food, according to population group and sociodemographic characteristics (only significant results). Education did not give significance in any case. OR [LL-UL], p.

Variable		Fruits & vegetables	Canned/industrialized
		High (ref. low)	High (ref. low)
Group (ref. university)	Hospital/clinic	4.96 [2.34-10.53], 0.000	0.442 [0.204-0.958], 0.038
	Supermarket	2.33 [1.30-4.18], 0.005	ns
Age, years (ref. up to 24)	50 or over	2.74 [1.26-6.00], 0.011	0.202 [0.0877-0.465], 0.000
	25 to 49	ns	0.519 [0.296-0.909], 0.022
Gender (ref. men)	Woman	1.76 [1.18-2.63], 0.006	ns
Income (ref. > 5 MW)	Up to 5	0.553 [0.360-0.848], 0.007	ns
		High (ref. medium)	Medium (ref. low)
Age, years (ref. up to 24)	50 or over	3.02 [1.76-5.18], 0.000	0.260 [0.137-0.494], 0.000
Gender (ref. men)	Woman	2.30 [1.69-3.13], 0.000	ns
Income (ref. > 5 MW)	Up to 5	0.482 [0.342-0.680], 0.000	ns

OR = odds ratio [lower level-upper level at 95% confidence]; ns = not significant ($p > 0.05$).

Table 2. Multivariate regression analysis for the characteristics of the food search by the participants and canned/industrialized food, according to population group and sociodemographic characteristics (only significant results). Yes (Ref. no). Education did not give significance in any case. OR [LL-UL], p.

Variable		Tasty	Healthy	Low cost
Group (ref. University)	Hospital/clinic	0.482 [0.281-0.828], 0.008	ns	0.602 [0.388-0.935], 0.024
	Supermarket	ns	1.51 [1.01-2.26], 0.048	ns
Age. years (ref. up to 24)	50 or over	0.317 [0.190-0.530], 0.000	1.89 [1.21-2.95], 0.005	ns
	25 to 49	0.576 [0.366-0.907], 0.017	ns	ns
Gender (ref. men)	Woman	ns	1.33 [1.02-1.73], 0.032	ns
Income (ref. > 5MW)	Up to 5	0.695 [0.495 - 0.975], 0.035	ns	ns

OR = odds ratio [lower level-upper level at 95% confidence]; ns = not significant ($p > 0.05$).

3.2 Food attitudes related to the presence of pesticides in food

About 40% of the population reported buying sometimes organic products, a percentage that drops to 23% when considering always or almost always. The university group was the one that least reported buying these products exclusively (0.7%), while the hospital/clinic group the one that have most chosen this option (5.4%) (Figure S2A). The inverse was found for the option "I would like to, but I think it is expensive" (31.4% and 20.2%, respectively). Less than 2% of respondents did not know the meaning of organic food (Figure S2A). In the multivariate model (Table 3), only group and income had a significant impact on the response, with hospital/clinic (OR = 2.11) and supermarket (OR = 1.79) groups claiming to purchase organic foods (at least sometime) more frequently than the university group, as well as individuals with lower incomes reported doing it less frequently (OR = 0.596).

More than 60% of the population of the three groups believe that it is possible to produce food without pesticide use, but the university group is the one that least believes this for all foods (14.8%), and the hospital/clinic the one that believes the most (34.4%) (Figure S2B). About 9% do not believe this is possible for any food. Only gender and age group significantly affected this belief in the multivariate model (Table 3). Individuals aged 50 and older are the ones who least believe in this possibility (OR = 0.526) and women the ones who most believe in it (OR = 1.63).

Most participants (95.3%) indicated that the presence of pesticides in food should be indicated on labels; 46.3% of the hospital/clinic group considered that all of them should be mentioned (Figure S2C). Indeed, in the multivariate model, the hospital/clinic group considered more frequently that all pesticides should be informed compared to the university group (OR = 4.85), as well as individuals aged 50 years or over (OR = 1.70; Table 3). Between 65.2% (university) and 82.4% (hospital/clinic) reported performing some procedure to remove pesticide residues from food before consumption (always or frequently). In the multivariate model, only individuals aged 50 years or over (OR = 2.62) and women (OR = 2.26) were more likely to undergo this procedure (Table 3).

3.3 Food attitudes related to genetically modified foods

The T symbol on the food label, signaling that the product contains GM foods marketed in Brazil, was recognized by 33.7% of participants, but 17.8% have never noticed it. In the multivariate model, the hospital/clinic group recognized it significantly less than the university group (OR = 0.522), as well as the participants with less education (OR=0.389) (Table 4).

For most respondents (52.3%) who recognized the T symbol or were not sure about, this information had no relevance on food choice, 37.6% buy the food anyway (always, sometimes), and only 8.4% do not buy it at all. Individuals over 24 years old (OR = 6.40 and 2.03) and women (OR = 1.54) reported not buying products with the T symbol (at least sometimes) significantly more in the multivariate model (Table 4).

3.4 Association among food-related attitudes and risk perception

Table 5 shows the significant associations among the food-related attitudes (this study) and risk perception (high, medium, or low) related to the presence of chemicals and pesticides in food and to GM food.

Individuals that reported high F&V consumption had also a higher chance to acquire organic food, use procedures to decrease pesticide residues and worry more about the presence of chemicals in food (OR = 2.38 to 6.98), although they were not significantly associated with a high worry over pesticides and GM food. Individuals with high worry over these two hazards had 2 to 5 times higher chance to acquire organic food, apply procedures to decrease pesticides, believe that food can cause harm to health and that food may be produced without pesticides. They also had about 12 to 20 times higher chance to worry about chemicals in food and find it necessary to indicate the presence of pesticides in the label. Furthermore, individuals that apply procedures to reduce pesticide residues had a higher chance to worry about chemicals in food (OR = 4.99) and to judge that the presence of pesticides should be indicated on the label (OR = 6.26), although a higher chance to believe that food can be produced without pesticides was not significant (Table 5).

4 Discussion

Adequate F & V consumption strongly contributes to providing a diverse and nutritious diet and could prevent at least 5.6 million annual deaths worldwide from diet-related chronic diseases (Aune et al., 2017). In the present study, most respondents reported a higher frequency of F&V consumption

Table 3. Multivariate regression analysis for questions related to pesticides, according to population group and sociodemographic characteristics (only significant results). Education did not give significance in any case. OR [LL-UL], p.

Variable		Acquire organic food (yes)[a]	Possible to produce without pesticides (all/some food) [b]	Inform the presence of pesticide in the label (all pesticides)	Procedures to remove/ reduce pesticides (yes)[e]
Group (ref. University)	Hospital/ clinic	2.11 [1.29-3.46], 0.03	ns	4.85 [1.18-19.91], 0.028[c]	ns
	Supermarket	1.79 [1.17-2.74], 0.008	ns	ns	ns
Age. years (ref. up to 24)	50 or over	ns	0.526 [0.306-0.905], 0.020	1.70 [1.07-2.68], 0.024[d]	2.62 [1.51-455], 0.001
	25 to 49	ns	ns	ns	ns
Gender (ref. men)	Woman	ns	1.63 [1.06-2.51], 0.025	ns	2.26 [1.68-3.05], 0.000
Income (ref. > 5MW)	Up to 5	0.596 [0.445-0.797], 0.000	ns	ns	ns

OR = odds ratio [lower level-upper level at 95% confidence]; ns = not significant (p > 0.05); [a] Ref. never/expensive /don´t know; [b] Ref. maybe/none; [c] Ref. not relevant; [d] Ref. only the presence/not; [e] Ref. rarely/never.

Table 4. Multivariate regression analysis for questions related to genetic modified food, according to population group and sociodemographic characteristics (only significant results). Income did not give significance in any case. OR [LL-UL], p.

Variable		Recognize the T symbol on the label[a] (yes)[b]	Consume food with the T symbol[a] (yes/sometimes)[c]
Group (ref. university)	Hospital/clinic	0.522 [0.316-0.862], 0.011	ns
Age, years (ref. up to 24)	50 or over	ns	6.40 [2.96-1383], 0.000
	25 to 49	ns	2.03 [1.14-3.62], 0.017
Gender (ref. men)	Woman	ns	1.54 [1.04-2.30], 0.033
Education (ref. college or higher)	Up to high school	0.389 [0.262-0.577], 0.000	ns

OR = odds ratio [lower level-upper level at 95% confidence]; ns = not significant (p > 0.05); [a] T indicates the presence of a genetically modified component in the food; [b] Ref. no; [c] Ref. not relevant.

Table 5. Association between attitudes related to food and risk perception, OR [LL-UL], p.

	Acquisition of organic food (always/almost always)	Procedures to decrease pesticides in food (always/ frequently)	Worry related to chemicals in food (high)	Worry about pesticides in food (high)	Worry about OGM in food (high)
F&V consumption (high)	2.63 [1.80-3.85], 0.000	2.38 [1.59-3.57], 0.000	6.98 [3.99-12.21], 0.000	ns	ns
Acquisition of organic food (always/almost always)	x	2.32 [1.72-3.12], 0.000	3.70 [2.49-5.51], 0.000	3.06 [1.85-5.08], 0.000	1.97 [1.35-2.89], 0.000
Procedures to decrease pesticides in food (always/ frequently)	x	x	4.99 [3.27-7.63], 0.000	4,86 [2.90-8.12], 0.000	2.51 [1.68-3.78], 0.000
Worry related to the presence of chemicals in food (high)	x	x	x	19.4 [9.00-41.8], 0.000	16.7 [8.46-32.8], 0.000
Whether food can be deleterious to health (frequently)	ns	ns	5.27 [2.72-10.2], 0.000	4.97 [2.22-11.1], 0.000	2.06 [1.03-4.14], 0.042
Produce food without pesticides (all/some)	2.14 [1.38-3.30], 0.000	ns	2.24 [1.26-3.96], 0.006	4.11 [2.20-7.66], 0.000	2.65 [1.48-4.76], 0.001
Indicate the presence of pesticides in food label (all pesticides/whether it contains or not)	3.58 [1.76-7.31], 0.000	6.26 [2.99-13.1], 0.000	9.43 [3.66-24.3], 0.000	16.4 [6.60-40.6], 0.000	11.6 [2.64-51.0], 0.001

OR = odds ratio [lower level-upper level at 95% confidence]; ns = not significant (p > 0.05).

than the other types of food categories presented (meat/eggs, carbohydrate, cereals and canned/processed food). Although the design of the questionnaire does not allow quantitative inferences in this regard, household surveys have shown that F&V consumption in Brazil is below the WHO recommendation, of at least 5 servings or 400 g daily (Machado et al., 2016; Brito & Caldas, 2021).This apparent discrepancy with the results of this study may reflect the expression of social desirability, a bias commonly observed in research of this type, where interviewees, consciously or unconsciously, seek to satisfy moral or social expectations when answering a questionnaire, tending to attribute to themselves attitudes that they believe are expected by society, or how they would like to be (Tracey, 2016).

F&V consumption was positively associated with age, female gender and income, in line with studies conducted in Brazil (Machado et al., 2016) and other countries (Prättälä et al., 2007). Although income was significantly associated with education in this population (Rembischevski et al., 2022), education did not significantly impact F&V consumption, contrary to what was found in other studies (Thornton et al., 2014; Machado et al., 2016). It is believed that education may promote a healthier diet as it increases the knowledge and ability to understand nutrition and health (Rippin et al., 2020; Turrell & Kavanagh, 2006). However, although individuals in the hospital/clinic group had lower income and education, this group was about 5 times more likely to report high F&V consumption than the university group and 2 times more likely than the supermarket group. It is possible that the health care context of individuals in the hospital/clinic group encourages changes in eating behavior, fostering the adoption of healthier practices (Boyington et al., 2009). This attitude is also corroborated by the fact that hospital/clinic group have marked proportionally less the low-price option, regarding the characteristics looked for in food, compared to the other groups, despite being the least economically favored. The relationship was inverted regarding canned/industrialized food consumption, which was significantly lower among the hospital/clinic group and people over 24 years of age. A significantly lower frequency of carbohydrate consumption was also found for older individuals, a pattern that confirms the concern of this

subpopulation with health, as carbohydrate rich diet have been associated with many metabolic disorders, including diabetes and obesity (Feng et al., 2015).

Ultra-processed food consumption has been linked to an increased risk of cardiovascular disease (Srour et al., 2019) and several types of cancer (Fiolet et al., 2018). However, canned or processed food is not necessarily unhealthy, and it is not always the processing that makes the food less healthy (Meijer et al., 2021). On the other hand, Marsola et al. (2021) pointed out that some ultra-processed foods that are excessively caloric and/or have an excess of sodium, sugar and additives are perceived by many individuals as healthy (healthy-stereotyped foods), such as gelatin and cereal bars. The authors observed that men and low-income individuals have less accuracy in the perception of certain foods, such as ultra-processed foods, i.e., they have less ability to recognize them as such.

Taste significantly relates to specific macronutrient content in foods and Liem & Russell (2019) have hypothesized that healthy diets have different taste profiles compared to unhealthy diets. Indeed, foods rich in sugar, salt and fat, which are characteristic of nutrient poor foods, are the ones that most activate our gustatory senses (Liem & Russell, 2019; May & Dus, 2021). So, when a given population did not prioritize tasty food, they are indeed prioritizing healthy food. In the present study, "tasty" was the food characteristic significantly less chosen by the hospital/clinic group, older individuals and lower income respondents, while "to be healthy" was significantly more selected by the supermarket group, older individuals, and women. These two characteristics correlate well and supports the findings about F&V consumption as described earlier. Although having lowest income among the three groups, "cost" was the characteristic significantly less selected by the hospital/clinic group, in agreement with other food-related attitudes that theoretically demands a higher income (F&V consumption and buying organic food).

Various studies have shown that the information provided on food labels can influence consumer's choices, leading to a healthier diet (Ni Mhurchu et al., 2018; Christoph et al., 2018). In the present study, women were 50% more likely to read food labels than men, a pattern that was also found in another Brazilian study (Sousa et al., 2020). Those with lower income reported significantly less this habit, although education had no significant impact on this attitude. In Canada, about one third of the study participants could not understand basic information on nutrition labels, a performance that was associated with lower socioeconomic status (Sinclair et al., 2013). The most recent Brazilian food labeling regulation includes alerts on nutrients critical to human health to help consumers make more conscious food choices (ANVISA, 2020). Future studies should investigate the impact of this legislation on the habit of reading labels, especially for low-income individuals, and on the population's consumption decisions.

In China, older individuals and those with a higher education level and income tend to buy more organic food (Xie et al., 2015). In the present study, about 68% of the participants acquire organic food at least sometimes, and having higher income and belonging to the hospital/clinic or supermarket group were the most predictive factors for higher organic food acquisition (chance ~ 2x greater), consistent with the fact that these foods are, in general, more expensive than conventional foods (Livre.jor, 2021; Xie et al., 2015) and with the greater importance given by the hospital/clinic to health than to price, as already mentioned. This again suggests that the hospital/clinic environment itself at the time of the interview have a more important impact than economic vulnerability. However, contrary to the hospital/clinic, the supermarket group's sensitivity to organic food was not reflected in their expectation of seeing the presence of pesticides indicated on the label. It is possible that the individuals interviewed in the supermarket recognized the low feasibility of an eventual measure of this nature due to the space limitation on the food packing.

Williams & Hammitt (2001), also using multiple regression analysis, reported that Americans perceive organic foods as healthier than conventional foods, since the presence of pesticides was seen as having a greater negative impact on food safety than factors related to microbiological risks. In a review study, Turra et al. (2015) showed that organic foods are also perceived as healthier than conventional foods by Brazilian consumers, which is the main motivation for their consumption, but not everyone was able to accurately describe what they mean, with a confusion with natural food. A study conducted in all Brazilian states using the snowball technique (participating subjects recruit others to participate) through questionnaires collected by email and social networks showed that consumers find that organic food can improve quality of life, in addition to being more sustainable (Martins et al., 2020). Moreover, women expressed a greater desire to consume organic foods compared to men, which was not confirmed in the present study. On the other hand, women in the present study believe more in the possibility of producing food without pesticides, while individuals aged 50 years and over were more skeptical in this aspect compared to younger ones, perhaps reflecting the fact that a significant growth of organic agriculture in Brazil only occurred in the last decade (Vilela et al., 2019).

Studies that investigated whether organic and conventional foods are nutritionally different gave discrepant results (Dall'Asta et al., 2020; Brantsæter et al., 2017; Smith-Spangler et al., 2012). However, the perception that organic food would be safer or healthier is supported by some studies. Findings from the NutriNet-Santé Prospective Cohort Study in France have shown a significant reduction in cancer risk among high consumers of organic food (68 946 participants; Baudry et al., 2018) and of type 2 diabetes (33,256 participants; Kesse-Guyot et al., 2020).

An important proportion of interviewees mentioned they perform some procedure to reduce pesticides residues in food, although such procedures may have been confused to some degree with hygiene and microbiological contamination. Once again, being female and older were the most determining factors. In this case, popular intuition is in line with the vast existing literature demonstrating the effect of various forms of food processing to reduce the levels of pesticides present, including washing with running water (Cabrera et al., 2014; Li et al., 2021; Mozzaquatro et al., 2022).

In Brazil, current legislation requires that food products containing more than 1% of GM organisms in its composition

should have on the label a bold T symbol and a sentence stating that the product contains genetically modified components (Brasil, 2003). Hakim et al. (2020) found that about 75% of consumers interviewed in a São Paulo state city did not recognize the T symbol, a similar rate found in the present study. The authors also found that younger consumers with a high education level and concern regarding the consumption of GM foods were more likely to recognize the T symbol. Indeed, individuals with lower education level in the Federal District recognized less the T symbol, as well as those in the hospital/clinic group, who has the lowest education level among the three groups, although age had no significant impact on this recognition. Labeling GM products, however, has been the subject of great controversy in the country, mainly by the productive sector, which argues that such warning is not science-based (Law Project 4148/08). In the United States, mandatory label information on the presence of bioengineered food (at levels higher than 5%) came into effect as of 01/01/2022 (7 CFR Part 66; Doc. No. AMS-TM-17-0050; RIN 0581-AD54), although some food organizations do find it unconstitutional (National Law Review, 2022).

GM food ranked 10th place in the worry scale among the 11 hazards investigated in the same population (Rembischevski et al., 2022). This low risk perception is also reflected by the fact that less than 20% of the interviewees reported not acquiring GM food. For most respondents, the T symbol had no relevance on food choice, like what was found among American students (Oselinsky et al., 2021), but contrary to the study conducted in a Brazilian city, where 70.7% of interviewees considered using the T symbol information as a consumption decision factor (Hakim et al., 2020)

Bonem et al. (2015) suggested that age differences in risk preferences may vary across domains, with older adults tending to see more risk in behaviors related to health than young adults. Indeed, it is well recognized that younger individuals are less concerned with healthy eating (Antúnez et al., 2022), probably due to their greater sense of invulnerability, being related to the characteristic known as optimistic bias or unrealistic optimism. This characteristic is the tendency of people to form biased beliefs that increase well-being and contribute to the maintenance of individuals' physical and mental health (Miles & Scaife, 2003; Jefferson et al., 2017). Accordingly, younger individuals in this study ate less F&V and more canned/processed food, favored tasty to heathy food and do not perform any procedure to reduce pesticide residues.

The search (or intention) for food free of pesticides, as well as attitudes related to attempts to reduce it, finds support in other countries and have been attributed to the aversion of a large part of the population to chemical substances (chemophobia) and the importance given to the naturalness of foods (Saleh et al., 2021; Hartmann et al., 2018; Dickson-Spillmann et al., 2011). In a broader context, Ropeik (2015) noted that as early as the mid-1970s, interviewees faced with the question of which word came to mind first when hearing the word chemicals, with the top responses being toxic, dangerous, deadly, or cancer. Indeed, the concern about the presence of chemical pesticides in food seems to remain high in most countries, as discussed previously.

In this study, high concern about pesticides, assessed previously by Rembischevski et al. (2022), did not significantly impact F&V consumption, although high F&V consumers do tend to acquire organic food more frequently. The perception that the benefits of consuming F&V surpass the fear over pesticides, a hazard that had the second highest worry score among the participants (Rembischevski et al., 2022), was confirmed by Oliveira et al. (2022), although a cohort study involving about 160,880 Americans suggested that dietary exposure to pesticide residues may offset the beneficial effect of F&V consumption on mortality (Sandoval-Insausti et al., 2022).

In Greece, consumers express high concerns over pesticides in food, but at the same time they recognize the beneficial contributions of the use of these products to food security (Simoglou & Roditakis, 2022). Furthermore, the desire to see the name of all pesticides on the labels, or at least an indication of their presence, was also not associated with F&V consumption in the present study, which somehow seems consistent with the judgment of greater benefit in relation to the risks. The other correlations between risk perception and attitudes seen in Table 5 were as expected. It is natural that people who had high concern with pesticides also express a desire to see these substances indicated on the label, acquire more organic food, and apply procedures to reduce pesticide residues in food. A little less intuitive were the positive correlations observed between these same items and concern about GM food, suggesting the indirect mental relationship people make between GM crops and pesticide use.

This study has some limitations that should be addressed. The first is related to the questionnaire itself, including tiredness of interviewees during the questionnaire answering process and the way the answer options were outlined, which could have affected the outcome. Secondly, as the study used a convenience sampling, the interviewed population is not meant to reflect the whole Federal District Population. Furthermore, people who agreed to participate in the study are probably more interested and sensitive to the food safety issue than individuals who refused to participate, many of whom were not interested or are not worried about it.

4 Conclusions

The results of this study did confirm to some extent the three raised hypothesis. Belonging to an interview location group proved to be predictive of food-related attitudes in some cases, with the hospital/clinic group most often presenting attitudes more consistent with an eating behavior considered or seen as healthy than the other groups (F&V and organic food consumption). Although this group was the least economically and educationally favored group, their response probably reflected the concerns about their own health during the interview. Being older, having higher income and being a woman were also predictive for healthier eating habits. High worry about pesticides and genetically modified food was indeed associated with most attitudes related to food, indicating a direct relationship with risk perception.

Altogether, the results indicate that the sociodemographic aspects and the environment/context of the individual when called to reflect about food habits may shape individuals' perceptions and attitudes and have a direct impact on consumption decisions. The results of this study should be considered by Brazilian health authorities when discussing food-related communication strategies, aiming at driving the population to a healthier and more conscious diet.

Conflict of interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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Supplementary material

Supplementary material accompanies this paper.

Figure S1. Frequency of fruit and vegetables and canned and processed food consumption (Hospital/clinic, n = 300, supermarket, n = 400 and university, n = 300).

Figure S2. Food attitudes related to the presence of pesticides in food. (Hospital/clinic, n = 300, supermarket, n = 400 and university, n = 300).

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