**Artículo Original**

# Association between dietary patterns and altered mammographic findings

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## ABSTRACT

**Introduction:** Breast cancer is one of the main types of cancer in women. Previous studies assessed the relationship between diet and breast cancer risk, however, studies that evaluate the relationship between diet and mammographic findings are scarce.

**Aim**: To evaluate the association between dietary patterns and mammographic findings of women monitored by a mastology service of the Brazilian Unified Health System.

**Materials and Methods**: Cross-sectional study that evaluated data from 504 women. Two 24-hour dietary recalls were applied and dietary patterns were identified by principal component factor analysis. The mammography reports were classified into normal and altered mammographic findings. Logistic regression models were applied to evaluate the association between dietary patterns and mammographic findings. The analyses were performed in the software Stata and R and considered significant values of p <0.05.

**Results**: Three dietary patterns was identified: "traditional Brazilian" (rice, beans, red meat, breads, oils and fats and coffees and teas), "Western" (sugar sweetened beverages, eggs, cakes, pies and cookies, fast-food snacks and, sweets and desserts) and "prudent" (whole grains, fruits, vegetables, tubers and their products, dairy and chicken). Women with less adherence (OR 0.54 CI 95% 0.30:0.95) to the "traditional Brazilian" dietary pattern had 46% lower odds for having altered mammographic findings. No associations were found between "Western" and "prudent" dietary patterns with mammographic findings.

**Discussion**: The "traditional Brazilian" dietary pattern characterized by typical Brazilian foods such as rice and beans, was inversely associated with altered mammographic findings. This showed that women who have less adherence to this pattern had lower odds for having this outcome.

**Conclusion:** We observed that women with less adherence to the "traditional Brazilian" pattern had lower odds for altered mammographic findings. We suggest that further studies should be performed, preferably with a longitudinal and case-control design.

## INTRODUCTION

Breast cancer is the most common type of cancer and the leading cause of cancer in women[1]. In Brazil, according to the National Cancer Institute, a risk of 61.61 new cases was esti-

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mated for every 100,000 women for the period 2020-2022[2]. One of the main methods for the early detection of breast cancer is mammography. It consists of a diagnostic imaging examination that uses ionizing radiation[3] and the results are commonly classified according to the Breast Imaging Reporting and Data System (BIRADS), prepared by the American College of Radiology (ACR)[4].

Diet may play a role in the preventive approach to breast cancer, where a balanced and diversified diet is recommended, which the intake of red meat, animal fat, and fried food is considered a possible risk factor for breast cancer development. Conversely, the intake of fruits and vegetables is correlated with the reduction of this risk[5,6].

A recent study conducted by our research group identified an association between the consumption of phosphorus and magnesium and the results of mammograms classified according to BIRADS[7]. However, diet is a complex exposure and studies that evaluate the diet in a more holistic way are relevant. A more holistic approach to the evaluation of the diet is through the analysis of dietary patterns, which combines food and nutrients correlated with consumption patterns[8].

Most studies use an approach to assess nutrients or isolated foods, instead of assessing dietary patterns. Studies that relate mammography results to diet are scarce. Thus, the aim of this study was to assess the relationship between dietary patterns and altered mammographic findings in women followed up by the Brazilian Unified Health System mastology service.

## MATERIALS AND METHODS

### Study Design and Population

This study examined data from the Prevendo Project: Health, Aging, Diet, and Inflammation, a cross-sectional study that aims to develop, validate, and/or standardize instruments for health promotion and prevention of chronic noncommunicable diseases (NCDs) in the Unified Health System (SUS) in Brazil. The Prevendo project was approved by the Human Research Ethics Committee of the State University of Ceará under protocol number 314.351. It followed the recommendations for research with human beings, Resolution 466/2012 of the Brazilian National Health Council and the Declaration of Helsinki. All participants provided written informed consent.

The study population consisted of women monitored by SUS who sought care at a health unit, that acts as a reference service in mastology (SRM) in the SUS. In summary, 672 women who sought care at the aforementioned service and met the inclusion criteria were interviewed. The inclusion criteria were as follows: consenting to participate in the study, age ≥18 years, absence of cancer at any anatomical site, absence of any disease that prevented participation in any stage

of the study (for example, cognitive impairment), those monitored by the SUS, those who underwent mammography at the service, and who were not pregnant or lactating.

### Data Collection and Analysis

Data collection was carried out between 2016 and 2017 and included the application of a structured questionnaire containing questions regarding sociodemographic data (age, education, income, marital status, and self-declared color), lifestyle (smoking and food consumption), and anthropometrics (weight, body mass index [BMI] and waist circumference [WC]). Data on mammography reports were also collected.

Data collection was carried out by appropriately trained nutritionists and nutrition students. Data on age were collected in full years, and women were categorized into adults (19 to 59 years old) and elderly (≥60 years old). Education level was defined in years of complete study and was categorized as follows: ≤8 years of study, 9 to 11 years of study, and ≥12 years of study. Marital status was categorized as having a partner (in formal union or not) and without a partner (single, widowed, or divorced). The self-reported race was categorized as white, brown, or black. Income was obtained in minimum wages and classified as less than 3 minimum wages (<3) and equal to or above to 3 minimum wages (≥3). The current minimum wage established by the Brazilian government at the time of data collection was R$ 937.00 (in 2017). A smoking habit was categorized as a smoker or a non-smoker.

Anthropometric data were obtained according to the protocol of the Centers for Disease Control and Prevention[9]. Weight and height were obtained using a Filizola® anthropometric scale with an attached stadiometer, capacity of 200 kg (100 g range), and 2.00 m (1.0 cm range). Based on these data, the BMI was calculated and classified according to the WHO recommendations for adult women[10] and according to the Pan American Health Organization (PAHO/WHO) for elderly women[11]. The WC was measured with an inelastic tape, directly on the skin, at the midpoint of the distance between the last rib and the iliac crest, in a horizontal direction, without causing compression on the skin, with the participant standing, feet together, arms extended, and with a relaxed abdomen. WC was classified as adequate (<88 cm) or elevated (≥ 88 cm)[11]. Food consumption was investigated through the administered of two 24-hour dietary recalls (R24h), one of which refers to a weekend day. The first R24h was administered at the time of the interview and the second by telephone contact.

### Dietary Patterns

From the food consumption data obtained, more than 500 reported unique foods and drinks were identified. To reduce the number of variables, the listed foods and beverages were grouped into 22 food groups (Table 1), based on their nutri-

**Table 1.** Food groups. Prevendo Project, 2016-2017

| Food groups | Description |
|---|---|
| Rice | Rice, rice with vegetables and rice dishes. |
| Whole grains | Brown rice, brown bread, oats, other oat-based dishes and other whole foods. |
| Fruits | All fruits |
| Vegetables | All vegetables. |
| Tubers and product | Sweet potatoes, potatoes, pumpkin, manioc, yam and tuber-based products. |
| Beans | Beans, legumes, nuts and legumes-based dishes. |
| Sugas sweetened beverages | Soft drinks, fruit juices, fruit drinks, milk-based beverages with sugar. |
| Red meat | Beef, pork, and other types of meat, meat preparations. |
| Processed meat | Ham, salami, sausage, and processed beef, pork, chicken, and fish. |
| Dairy products | Whole and skim milk, yogurts, cheeses, and cheese preparations. |
| Fish and seafood | Fish and seafood, fish and seafood preparations. |
| Chicken | Chicken and chicken preparations. |
| Eggs | Eggs and eggs preparation. |
| Bread | White and wheat bread, toasts, sandwiches. |
| Cakes, pies and cookies | Cakes and pies, sweet biscuits, stuffed cookies. |
| Oils and fats | Vegetable oils, butter and margarine. |
| Pastas | Pasta, lasagna, and pasta preparations. |
| Fast-foods snacks | Pizzas, hamburgers, deep-fries and baked savory snacks, cheese bread, French fries, popcorn, hot-dog, cup noodles and others fast foods. |
| Sweet and desserts | Sweets pastries, jams, treats, chocolates, breakfast cereals and cereal bar. |
| Corn and corn products | Corn, corn flour and other corn preparations. |
| Coffee and tea | Coffee, coffee and milk and tea. |

tional characteristics and frequency of consumption. The Kaiser-Meyer-Olkin test (KMO) and the Bartlett sphericity test was used to prove the applicability of the principal component factor analysis to the data. The adequacy of the data is proven when the KMO is >0.5, and Bartlett p<0.05. In our data, for the KMO test, a value of 0.59 was obtained, and in the Bartlett sphericity test, a value of p <0.001 was obtained.

After this procedure, dietary patterns were identified through principal component factor analysis. Subsequently, orthogonal varimax rotation was performed, which aims to improve data interpretability. To determine the number of standards retained for the analyses, eigenvalues >1 were used as the criterion. A scree plot analysis was also per-formed, which is a graphical representation of the eigenvalues. Factor load values ≥|0.3| were considered as components of each pattern, and then each factor was interpreted and named according to the characteristics of the food groups with the highest factor loading.

### Reports of mammograms using the BIRADS system

Mammograms were performed at the service mentioned and were classified according to BIRADS system. The classification of BIRADS ranges from 0 to 6. BIRADS 0 is considered inconclusive, and it is recommended that a new examination be performed. BIRADS 1 and 2 are considered benign find-

ings. BIRADS 3 is characterized as a probably benign finding. BIRADS 4 is classified as altered, as it presents suspicious lesions that require additional histological or cytological evaluation. BIRADS 5 is considered highly suggestive of malignancy. BIRADS 6 is considered a proven malignancy[4].

Considering this classification, the results of mammograms were categorized into normal mammographic findings, which comprised BIRADS 1 and 2, and altered mammographic findings, which comprised BIRADS 3, 4, and 5[5]. BIRADS 3 was included in the group of altered mammographic findings because there were changes detected, although most likely benign[4]. Women with BIRADS 0 were excluded from the analysis as the results were inconclusive[4]. No information was collected from women with BIRADS 6, as the presence of cancer was an exclusion criterion from the study. The sample determination process is shown in Figure 1.

### Statistical Analyses

The results of mammographic findings were presented as proportions and differences in the prevalence of mammographic findings. Age, education status, income, self-reported race, marital status, BMI, and waist circumference were obtained through bivariate analyses using Pearson's chi-square test.

Crude and adjusted analyses using logistic regression were used to assess the association between dietary patterns (exposure) and mammographic findings (outcome). The variables that presented $p < 0.20$ in the bivariate analyses entered the multiple logistic regression model as adjustment variables. The factorial scores of the dietary patterns were transformed into tertiles, and the 3rd tertile (the one with the highest adherence) was used as a reference for the analysis of associations. Values of $p < 0.05$ were defined as indicating statistical significance.

The analysis of dietary patterns was performed using Stata software, version 14.0, and the analysis of the associations between dietary patterns and mammographic findings, was performed using R software, version 3.6.3.

## RESULTS

Table 2 shows the characteristics of study participants according to the mammographic findings. In total, 16.7% of the women had mammographic findings. Among them, 29.8% were elderly, 48.8% had less ≤8 years of study, 90.5% received less <3 minimum wages, 66.7% declared themselves brown, 51.2% had a partner, 42.8% were obese and 63.1% had high waist circumference.

Three dietary patterns were derived and together they explain 25.5% of the variation in the total food consumption of this population. The first pattern presented factorial loads ≥0.3 for the groups of rice, beans, red meat, breads, oils and fats, and coffees and teas. The Brazilian population routinely

**Figure 1.** Flowchart showing the sample process for analysis between mammographic findings. Prevendo Project, 2016-2017
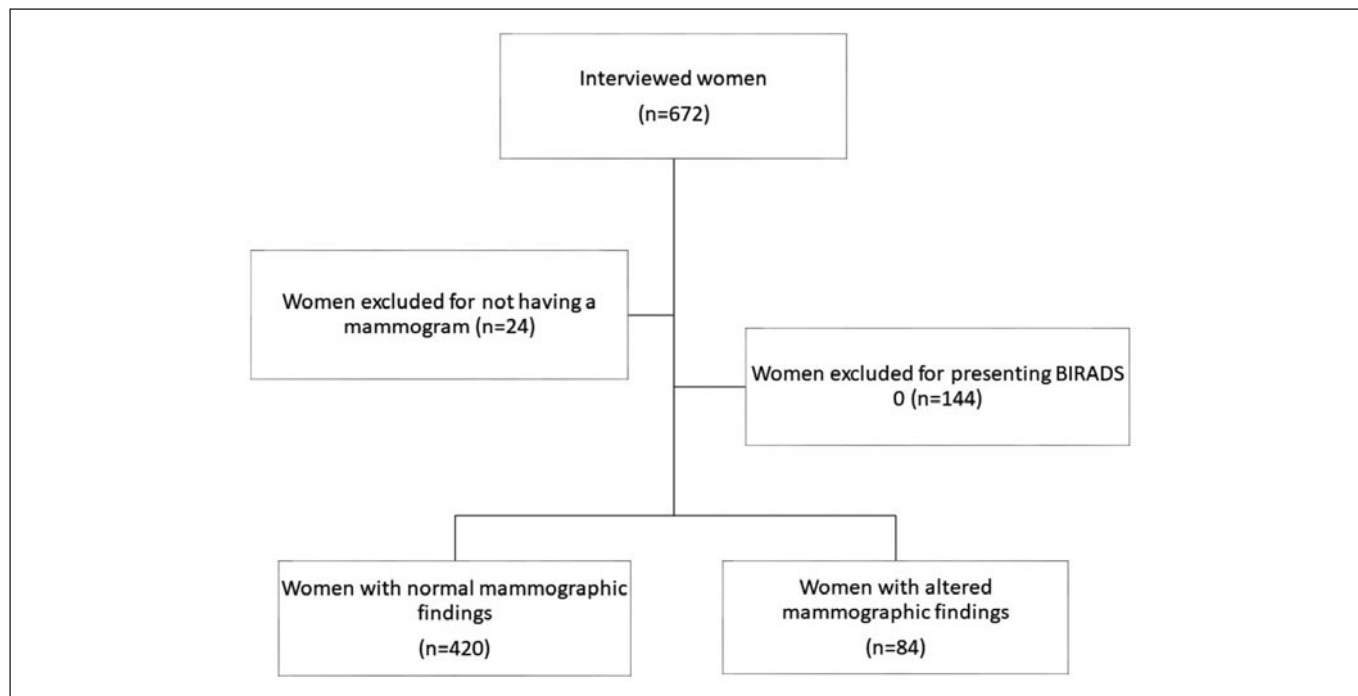


Normal mammographic findings: BIRADS 1 and 2. Altered mammographic findings: BIRADS 3, 4 and 5. Women with BIRADS 6 were not included.

**Table 2.** Distribution of women in mammographic findings according to sociodemographic characteristics and nutritional status. Prevendo Project, 2016-2017

| Characteristics | Normal mammographic findings | | Altered mammographic findings | | p-value* |
|---|---|---|---|---|---|
| | % | n | % | n | |
| Age | | | | | 0.068 |
| Adults | 79.3 | 333 | 70.2 | 59 | |
| Elderly | 20.7 | 87 | 29.8 | 25 | |
| Educational level | | | | | 0.318 |
| ≤8 years of study | 50.7 | 213 | 48.8 | 41 | |
| 9 to 11 years of study | 37.4 | 157 | 44.1 | 37 | |
| ≥12 years of study | 11.9 | 50 | 7.1 | 6 | |
| Income | | | | | 0.006 |
| <3 minimum wages | 77.4 | 325 | 90.5 | 76 | |
| ≥3 minimum wages | 22.6 | 95 | 9.5 | 8 | |
| Self-declared color | | | | | 0.990 |
| White | 24.3 | 102 | 25.0 | 21 | |
| Brown | 67.4 | 283 | 66.7 | 56 | |
| Black | 8.3 | 35 | 8.3 | 7 | |
| Marital status | | | | | 0.904 |
| Having a partner | 50.5 | 212 | 51.2 | 43 | |
| Without a partner | 49.5 | 208 | 48.8 | 41 | |
| BMI | | | | | 0.584 |
| Normal | 26.0 | 109 | 27.4 | 23 | |
| Overweight | 33.3 | 140 | 29.8 | 25 | |
| Obese | 40.7 | 171 | 42.8 | 36 | |
| WC | | | | | 0.159 |
| Adequate | 45.7 | 192 | 36.9 | 31 | |
| Elevated | 54.3 | 228 | 63.1 | 53 | |

*Pearson's chi-square test.

consumes these foods and, for this reason; this pattern has been called "traditional Brazilian". The second pattern showed higher factor loads for sugar sweetened beverages, eggs, cakes, pies and cookies, fast-food snacks and, sweets and desserts. Because these foods contain high amounts of sugars, sodium, and fats, in addition to a high level of processing and are consistent with Western diets, this pattern has been called "western". The third and final dietary pattern showed high factor loads for whole grains, fruits, vegetables, tubers and their products, dairy products, and chicken, and for this reason, it was called "prudent". The factorial scores of the dietary patterns are shown in Figure 2.

**Figure 2.** Factor loadings of the food groups in each dietary pattern



Normal mammographic findings: BIRADS 1 and 2. Altered mammographic findings: BIRADS 3, 4 and 5. Women with BIRADS 6 were not included.

In the analysis of crude logistic regression, women with less adherence (odds ratio [OR] 0.51 95% confidence interval [CI] 0.28:0.89) to the "traditional Brazilian" pattern had lower odds for having altered mammographic findings. Inverse and significant association was also identified in the adjusted analysis, where women with moderate (OR: 0,54 95% CI 0,30:0,95 and less adherence (OR 0.48 95% CI 0.27:0.88) to the "traditional Brazilian" pattern had lower odds for having altered mammographic findings, compared to women with highest adherence. No associations were found between "Western" and "prudent" dietary patterns with mammographic findings (Table 3).

## DISCUSSION

To our knowledge, this is the first study to investigate the association between dietary patterns and mammographic findings according to BIRADS system. To our knowledge, this is the first study to investigate the association between dietary patterns and mammographic findings according to BI-RADS system. We identified that women with lower adherence to the "traditional Brazilian" pattern had lower odds for altered mammographic findings.

In addition to the "traditional Brazilian" pattern, we also identified the "Western" and "prudent" pattern and together, they explained 25.5% of the variance of the diet. The "traditional Brazilian" dietary pattern explained the largest portion of the variation in the diet of the women evaluated, representing 9.6%. In addition to loads highly traditionally Brazilian foods such as rice and beans, it also loads highly red meat, breads, oils and fats, coffees and teas, foods that are widely consumed by the Brazilian population. The second pattern,

**Table 3.** Crude and adjusted analysis of the association between mammographic findings and dietary patterns. Prevendo Project, 2016-2017

| Variables[a] | Altered mammographic findings % | Crude analysis OR (95% CI) | Adjusted analysis OR (95% CI)[o] |
|---|---|---|---|
| **"Traditional Brazilian" pattern** | | | |
| Higher adherence | 22,4 | Ref | Ref |
| Moderate adherence | 14,8 | 0,60 (0,34:1,05) | **0,54 (0,30:0,95)** |
| Less adherence | 12,7 | **0,51 (0,28:0,89)** | **0,48 (0,27:0,88)** |
| **"Western" pattern** | | | |
| Higher adherence | 14,6 | Ref | Ref |
| Moderate adherence | 15,2 | 1,04 (0,57:1,92) | 1,03 (0,55:1,93) |
| Less adherence | 20,0 | 1,46 (0,83:2,60) | 1,38 (0,77:2,51) |
| **"Prudent" pattern** | | | |
| Higher adherence | 16,6 | Ref | Ref |
| Moderate adherence | 16,6 | 0,99 (0,55:1,79) | 0,98 (0,54:1,75) |
| Less adherence | 16,9 | 1,02 (0,58:1,81) | 0,97 (0,54:1,75) |

Higher adherence: 3st tertile. Moderate adherence: 2st terile. Less adherence: 1st tertile.
[o] Model adjusted for income, age and waist circumference. In bold, statistically significant values.

called "Western", explained 8.6% of the variation in the diet and was characterized by a high loading of sugar sweetened beverages, ultra-processed foods (fast-food, cakes, pies, and cookies), sweets and desserts, and eggs. In the third pattern, called "prudent", the percentage of explanation of the diet variance was 7.3% and was characterized by the presence of healthy foods such as whole grains, fruits and vegetables, chicken, dairy products, and tubers.

These percentages of the explained variations are well distributed and demonstrate that the food groups present in the three dietary patterns contribute equally to characterize the eating habits of the women evaluated. The dietary patterns derived here were similar to those described in other studies that evaluated Brazilian women[12-14].

In our study, 16.7% of the women assessed had altered mammographic findings, according to the BIRADS system classification. A few studies have evaluated the mammograms of Brazilian women. However, in a study conducted in Acre, in the North region of Brazil, which evaluated 7,982 mammography examinations, it was observed that 16.6% of the examinations showed some change in the mammogram, adding categories 3, 4, and 5 of the BIRADS system[15]. These results were similar to those found in our study. However, in the Northeast region, in a study carried out among 270 women from a municipality in Paraíba, a prevalence of 1.11% of BIRADS 3, 4, and 5[16] was observed. Another study that evalu-

ated 600 women followed up at an outpatient clinic of a university hospital from Barreto, in the Southeast region, the authors observed 5.2% of BIRADS 3, 4, and 5[17].

Finally, the inverse association found between altered mammographic findings and adherence to the "traditional Brazilian" pattern is relevant. According to the World Cancer Research Fund (WCRF) dietary recommendations, consumption of red meat as well as fat and refined cereals, such as breads, should be moderate, although evidence is limited, according to the WCRF's Continuous Update Project (CUP)[6]. The results obtained in our analyses showed that women who have less adherence to the "traditional Brazilian" pattern had lower odds for altered mammographic findings. As previously described, this pattern was attributed to rice, beans, red meat, oils and fats, breads, coffees and teas. These foods, with the exception of rice and beans, are reported to have limited and inconclusive evidence in relation to breast cancer, according to the latest WCRF publication that deals with the relationship between diet, nutrition, physical activity, and breast cancer[6]. As this pattern was the one that most represented the dietary habits of the women evaluated, explaining 9.6% of the variability of the diet, we believe that a possible explanation for the inverse association found must be related to the probable high consumption of these foods. Conversely, the WCRF recommendations moderate food consumption in this area.

In our study, no associations were found between the "prudent" pattern, characterized by the presence of whole grains, fruits, vegetables, dairy products, tubers, and chicken, with the results of mammographic findings. In addition, we expected that the "western" pattern would be associated with mammographic alteration, as it is basically characterized by ultra-processed and sugar-rich foods, which are associated with breast cancer risk[18,19]. Although the WCRF presents inconclusive results about these foods in the etiology of breast cance[6].

As previously mentioned, this is the first study to assess the association between dietary patterns and the results of mammograms classified according to BIRADS. For this reason, it is difficult to make comparisons, as there are no studies on these variables in the literature. Thus, we searched the literature for studies that evaluated dietary patterns and the risk of breast cancer. Therefore, according to systematic reviews and meta-analyses, we observed that there are studies that have associated a healthy or prudent pattern with a lower risk of breast cancer. In contrast, few studies have found an association between breast cancer risk and unhealthy or Western dietary patterns[20-23].

In a case-control study that evaluated women with and without breast cancer and identified three dietary patterns, the authors noted that the identified pattern that were characterized by the presence of whole grains, fruits and vegetables, olive oil, and fish were associated with the absence of breast cancer. However, no associations were found with the pattern characterized by the presence of red meat, poultry and white meat, dairy products, margarine and butter, fried foods, and sausages[24]. In our study, no associations were found between the "Western" and "prudent" patterns with the results of mammograms in the women evaluated.

In our study, the "traditional Brazilian" pattern was associated with altered mammographic findings, and this result may suggest that the foods that characterizes this pattern may have some association with changes in the breast. In a study conducted among the same population assessed here, it was shown that women with abnormal mammographic findings have a higher average consumption of red meat than women without mammographic changes[25]. Some studies have demonstrated an inconsistency between the consumption of red meat and the risk of breast cancer[6,26-28]. In addition to the presence of red meat in the pattern, we also have oils and fats and breads as foods that should be consumed at a moderate level and that are associated with the risk of breast cancer[7]. Rice and beans, typically Brazilian foods, classified as healthy foods[29], also characterize the pattern associated with mammographic changes. In addition, women with abnormal mammographic findings and with a higher inflammation had a lower dietary carbohydrate quality[30].

Our study has some limitations. First, this is a cross-sectional study, and therefore, it is not possible to establish a cause-and-effect relationship. Second, the measurement of food consumption is subject to error, and even if actions have been taken to mitigate these errors, the data may continue to contain inaccuracies. A positive aspect of our study is the evaluation of the diet through the analysis of dietary patterns using a multivariate method, the principal component factor analysis. This approach seems to be more interesting, as it can capture the consumption of food and nutrients together, in addition to considering the correlation between the foods. Finally, our study did not collect data on menopausal status; therefore, it was not possible to stratify the sample before and after menopause, which could add more data of interest.

## CONCLUSION

In conclusion, we observed that women with less adherence to the "traditional Brazilian" pattern are less likely to have altered mammographic findings. We suggest that further studies should be performed, preferably with a longitudinal and case-control design. This would ensure that the relationships between dietary patterns and the risk of developing breast cancer are more appropriately investigated, especially with the dietary patterns that include the foods present in the "traditional Brazilian" diet pattern of this study.

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