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ORIGINAL ARTICLE

Diet quality index and its components have not associated with the development of breast cancer risk assessed by the diet quality index: a case-control study

Índice de qualidade da dieta e seus componentes não se associaram ao desenvolvimento de câncer de mama: um estudo caso-controle

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ABSTRACT

Objective: To investigate if the diet quality and its components are associated with breast cancer risk. **Methods:** A case-control study was conducted with 332 women, 114 who were diagnosed with breast cancer, and 218 control individuals. Groups were matched for age, body mass index, and menopausal status. The quality of diet was assessed using Brazilian Healthy Eating Index Revised (BHEI-R) and its components. Food consumption was measured through three 24-h dietary recalls and assessed using the NDS-R software. For statistical analyses, it was performed an adjusted logistic regression, estimation of the Odds Ratio (OR), and 95% confidence interval (95%CI), with a p-value <0.05. **Results:** The BHEI-R score, classified into quartiles, did not differ between groups in the lowest quartile of diet quality (p=0.853). The components total cereals (p=0.038), saturated fat (p=0.039) and Gord_AA (fat, alcohol, and added sugar) (p=0.023) had higher scores among the case group. The scores for total fruits (p=0.010) and milk and dairy products (p=0.039) were higher among the control group. The BHEI-R components and the quality of diet were not associated with the outcome. **Conclusion:** Diet quality, assessed by the BHEI-R and its components, was not associated with breast cancer.

Keywords: Diet. Eating. Nutritional status. Diet surveys. Body composition. Neoplasms.

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INTRODUCTION

Breast cancer (BC) represents a global public health problem. Excluding non-melanoma skin tumors, it is the most common malignancy among women worldwide. In 2020, 2.3 million new cases were detected globally[1]. In Brazil, there are an estimated 66,280 thousand new cases in each year of the triennium 2020–2022[2,3]. Among them, it is recognized that only 5.0–10.0% will result from hereditary causes[4]. Therefore, the identification of external cause factors is of paramount importance for the primary prevention of the disease[5,6].

Adopting healthy habits can reduce new cases of BC[3] by up to 30.0%. More nutritious diets, especially fruits and vegetables, play a beneficial role in this process[6,7]. On the other hand, consumption of some foods and beverages is associated with a higher risk, such as ultra-processed foods, alcoholic beverages, animal fats, and high energy density[8,9].

In addition to studying foods and nutrients as potential risk factors for BC, it is also necessary to consider the synergistic effect of foods, that is, the interaction that can potentiate or attenuate them. Thus, the importance of studying this effect through the application of dietary indices[10,11] is highlighted. They use the recommended intake of nutrients and food groups as an indicator of diet quality[12] and can be used as risk measures for BC, recurrence and death from the disease[13,14], filling the lack of evidence that addresses diet quality and BC.

Different indices that assess diet quality are found in the literature, such as the Healthy Eating Index 2010 (HEI-2010), the Alternative Healthy Eating Index 2010 (AHEI-2010), and the Revised Diet Quality Index (IQD-R)[15], the latter an adaptation of the AHEI-2010 validated for the Brazilian population[16] based on national recommendations[17] and which can be used to measure the quality of the diet of patients with BC[16].

Considering the scarcity of studies and their controversial results[10,12,18] regarding the relationship between BC and diet quality, the objective of this study was to evaluate the latter according to IQD-R and its components, as well as the association with BC risk.

METHODS

Design, study population, and inclusion and non-inclusion criteria

This is a case-control study that integrates the matrix project (cohort) entitled "Impact of chemotherapy treatment on body composition, lipid and glycemic profile of women with BC treated in Goiânia", conducted with newly diagnosed women treated at the Breast Imaging Center of Excellence (*Centro Avançado de Diagnóstico da Mama* – CORA), Mastology Program, Hospital das Clínicas, Universidade Federal de Goiás (HC/UFG/EBSERH), from August 2014 to January 2018.

For both groups, the first eligibility criteria were being a user of the Unified Health System (*Sistema Único de Saúde* – SUS) and being aged between 30 and 80 years old. The case group consisted of women recently diagnosed with primary BC, confirmed by the anatomopathological report (maximum two weeks), in stages IA-III, without starting chemotherapy and/or hormone therapy, who did not have any other neoplasm or who were not being treated for another type of neoplasm, and who were treated at CORA. The control group consisted of healthy women recruited from other outpatient clinics at the hospital, professionals, and students from UFG courses. The criterion used to determine eligibility for the control group was the performance of a mammogram or clinical breast examination (for those younger than 40 years old) in the last 12 months, without changes in the reports or personal history of BC or other malignant neoplasms. The study used 2:1 pairing; for each case, two controls were matched according to body mass index — BMI (underweight, normal weight, overweight, and obese), menopausal status (pre- and post-menopause), and age (±5 years), with the three participants having been included in the cohort over the same period.

Women in the case and control groups who had metastases, recurrences, and/or were treated for BC and/or any other types of cancer, with cognitive difficulties and/or psychiatric illnesses that made it impossible to understand the work and collect the information necessary for the survey were not included. In addition, women with amputations, immobilization of limbs, paraplegia, orthopedic problems, use of a hip prosthesis, or any other reason that prevented the performance of anthropometric measurements and exams required in the research protocol, as well as pregnant and lactating women, were not included.

Sample

The sample size calculation was based on the proportion of women from Goiás who had the recommended consumption of fruits and vegetables[19]. We considered a ratio between cases and control of 1:2, proportion of exposed people of 31.2%, α of 5%, and test power (β=1–α) of 80%, totaling a minimum sample required of 104 cases and 207 controls. The Epi-InfoTM 2017 software, version 7.2.1.0® was used for the calculation.

Data collection and variables of interest

Data collection took place in the baseline period of the cohort (2014–2018). Interviews were carried out through the application of a standardized questionnaire, by previously trained nutritionists and nutrition academics. Data were obtained on age (years), marital status (lives with or without a partner), place of birth, education (up to complete elementary school, up to incomplete high school, and complete high school to complete higher education), monthly per capita income in current minimum wages at the time and self-reported race (white, brown, black/yellow/indigenous). The categorization of race was made considering the lower proportion of black/yellow/indigenous women (20%) in the sample, as well as the fact that the highest risk for BC occurs in white women compared to other ethnicities[20].

Clinical variables included menopausal status and family history of the disease (first-degree relatives). Behavioral variables were the consumption of ethanol (grams/day) according to the frequency, quantity, and types of drinks consumed mentioned in the standardized questionnaire and the practice of physical activity, through the application of the short version of the International Physical Activity Questionnaire (IPAQ)[21]. Women who practiced moderate/vigorous physical activities and achieved at least 600 Metabolic Equivalent of Task (MET)-min/week were classified as active; those who had less than 600 MET-min/week were considered sedentary[21].

The measurement of anthropometric measurements followed the techniques of Lohman et al.[22]. Waist circumference (WC) (cm) was classified as a normal risk in women measuring up to 80 cm; increased risk when >80 cm and <88 cm; greatly increased risk of metabolic complications when >88 cm[23]. The waist/height ratio was obtained by the quotient between WC and height[24].

Body weight was evaluated by means of dual-energy X-ray absorptiometry (DXA) (General Electric Medical Systems Lunar®, DPX NTVR, with ENCORE 2011 software, version 13.60, GE Healthcare, Madison, USA), as well as body composition of fat and lean mass (%) and relative skeletal muscle index (RSMI). The RSMI was calculated by dividing skeletal muscle mass by height. BMI was calculated using the equation weight (kg)/height (m^2)[23].

The visceral adiposity index (VAI) was calculated using the equation by Amato et al.[25]. To calculate the lipid accumulation product (LAP), the Kahn[26] equation was used. The conicity index (CI) was calculated using the equation of Bennasar-Veny et al.[27].

Three 24-hour food recalls (R24h) were applied on non-consecutive days to assess food consumption, one being a weekend day, using the Multiple Pass Method[28]. In order to reduce possible memorization and filling errors, a photo album with images of utensils and food portions was used[29]. Conversion[30,31] of the amounts of food in grams or milliliters was performed. Food consumption was calculated using the Nutrition Data System for Research software, version 2010 (NDS-R, Nutrition Coordinating Center, University of Minnesota, USA). Preparations that were not included in the NDS-R® were included with the term "user recipe", showing that there is a standard recipe entered. In addition, food composition tables[30,31] that present foods and ingredients from regional cuisine were consulted, as well as the label of food products. During fieldwork, the R24h were thoroughly checked by nutrition experts to identify and resolve possible filling failures. The consistency of R24h that totaled energy below 800 kcal and above 3,500 kcal[32] was checked, and the totality (n=30) was included in the analysis.

After obtaining data on food consumption, the diet was evaluated through the IQD-R, a method capable of analyzing various components of the diet based on energy density, evaluating its quality, regardless of the amount of food consumed. This index is formed by 12 components, of which nine are food groups ("total fruits", "whole fruits", "total vegetables", "dark green and orange vegetables", "total cereals", "whole grains ", "milk and dairy products", "meat, eggs and vegetables", "oils"), two are nutrients ("saturated fat" and "sodium") and one represents the sum of the energy value derived from the ingestion of solid fat, alcohol and added sugar (Gord_AA)[16]. Scores were assigned to the components of interest to calculate the IQD-R, based on energy density (portion/1,000 kcal). When the consumption of a component was equal to or greater than the recommendation, the total score was assigned (5, 10 or 20 points according to the analyzed food component). Consumption values below the recommendation received a proportional score. The absence of consumption received a score of zero. The total IQD-R score was obtained by the sum of the component scores and presents scores from 0–100 points. The highest ones indicate intake close to the recommendation and the lowest suggest less adherence to the recommended values for consumption[16].

Statistical analysis

The database was built in Excel® 10.0 software, in double entry. Data quality and reliability were evaluated using the Epi-Info™ 2014 program (version 7.1.5).

The total and component IQD-R scores were categorized by quartiles (lowest quartile, Q1, *versus* other quartiles, Q2–Q4). A descriptive analysis of continuous data was performed, which are presented as medians and interquartile ranges (IQR), and of categorical data, in relative absolute frequencies. For continuous variables, the Shapiro-Wilk normality test was performed and, given the non-normality of almost all variables, the Mann-Whitney test was chosen. For categorical variables, Pearson's χ^2 or two-tailed Fisher's exact tests were applied when there was a low frequency (n≤5) of individuals in the cells of the contingency tables. All analyses were performed comparing:

1. Quartile categories (Q1 *vs.* Q2–Q4) for cases and controls;
2. Cases and controls for Q1.

To investigate the association between BC and diet quality (IQD-R and its components), an adjusted logistic regression analysis was performed with an estimate of the odds ratio (OR) and a 95% confidence interval (95%CI). This analysis used the presence or absence of the disease as an outcome and, as independent variables, the IQD-R and its components. The sociodemographic, clinical, behavioral, and anthropometric characteristics of the sample were tested as possible adjustment variables. Those variables that, in the backward logistic regression model, presented p<0.20 were included, as follows: percentage of fat, use of hormone replacement therapy, waist-to-height ratio, LAP, education, *per capita* income, history of BC, and physical activity. Collinearity was tested between variables and only those with a coefficient lower than 0.5 were considered. When making the adjustments, we sought to mitigate possible confounding effects of these variables known to be related to the outcome in this sample, in order to estimate more isolatedly the influence of the IQD-R on breast cancer.

In the final adjusted model, the insertion of adjustment variables was performed in a single step, organized in increasing order of statistical significance with the outcome. The significance level adopted was 5.0% and the Stata software, version 14, was used.

Ethical aspects

The study was approved by the Research Ethics Committee of Hospital das Clínicas of Universidade Federal de Goiás (HC/UFG/EBSERH), under Opinion number 751.387/2014 and Amendment 3.642.562/2019. It followed the rules of Resolution 466/2012. All individuals received guidance on the research and provided their consent, signing the Informed Consent Form.

RESULTS

A total of 332 women participated in the study, 114 cases and 218 controls. Most were postmenopausal (58.0%), with no difference in menopausal status between cases and controls in terms of diet quality (p=0.539) (data not shown in the table), and lived with a partner (59 .0%); 47% were brown. When comparing cases and controls, it was observed that the controls had higher education (p=0.003), higher *per capita* income (p=0.003), and more cases of family history of BC (p=0.011). All other variables did not differ between cases and controls. Table 1 presents the characterization of the sample.

The total score of the IQD-R and its components, according to quartiles, are shown in Table 2. Among the participants in Q1, the cases had a lower score for the total fruits (p=0.010) and milk/dairy products (p=0.039) and higher ones for total cereals (p=0.038) and Fat_AA (p=0.0023) in relation to controls. The nutritional profile of the sample's diet, according to the IQD-R score, is presented as supplementary material.

The analysis of the association between the IQD-R and its components and the development of BC is shown in Figure 1. The total score of the IQD-R and its components was not associated with the investigated outcome. The IQD-R categorized by quartiles (OR 0.85; 95%CI 0.41–1.74; p=0.652) was also not associated with the cancer outcome (data not shown in the figure).

DISCUSSION

The IQD-R and its components were not associated with the development of BC. Among the case group, there was a lower mean score in the components total fruit and milk and dairy products when compared to the control group. On the other hand, considering the total cereal components, saturated fat, and Fat_AA, the opposite was true.

Although the Fat_AA component is composed of elements traditionally known to be part of unhealthy diets, being described in the literature as risk factors for BC[8,33-35], in this sample no association was observed. Alcohol is a dietary risk factor for breast cancer, even at low levels[34]. The International Agency for Research on Cancer (IARC) indicates that, among premenopausal women, consumption of 10 g of ethanol/day may increase risk by 5% (95%CI 1.02–1.08); among postmenopausal women, the increase in risk is greater (relative risk — RR=1.09; 95%CI 1.07–1.12)[36]. The possible mechanisms for this relationship remain unclear in the literature[36]. However, it is recognized that the adverse effects of alcohol consumption arise from the impact on lipid metabolism, including the production of prostaglandins, lipid peroxidation and generation of free radicals, which are genotoxic and carcinogenic. In addition, there is release of acetaldehyde, alteration in hormonal metabolism causing high concentrations of free estrogen, androgens, and insulin-like growth factor, providing an ideal pro-inflammatory environment for the promotion and progression of malignant tumors[36]. Furthermore, there is a relationship between alcohol consumption and folate deficiency[36], which can cause instability in the DNA during its replication and repair[37].

Although current evidence is inconclusive regarding the consumption of saturated fats and the risk of BC[36], systematic reviews associate increased risk with the type of tumor. Consumption greater than 20.0% of the total energy value is associated with a higher risk of developing the ER+/PR+ subtype[38]. This relationship is possibly due to hormonal changes, with a specific increase in free estrogen levels, in addition to the ability of dietary fats to modulate intracellular signaling cascades capable of influencing carcinogenesis[39].

As with alcohol and saturated fat, a dietary pattern with a high amount of added sugar can promote BC[40]. The intake of food items included in the Fat_AA component (fats, added sugar, and alcohol) may be related to the development of BC through inflammatory and oxidant effects[41]. Inflammation may be associated with the initiation of cellular changes in the breasts through the infiltration of Th2 cells, chronic activation of humoral immunity, and pro-tumor inflammatory cells of innate immunity[42,43].

Sedaghat et al.[10] evaluated the association of BC with HEI-2010. The components evaluated were not associated with the disease, except for the group composed of added sugar and solid fats in post-menopause (OR=0.87; 95%CI

Table 1. Sociodemographic, clinical, behavioral, and anthropometric characterization for controls and cases, according to quartiles of the Revised Diet Quality Index. Goiania (GO), Brazil. 2015–2017 (n=332).

Characteristics	Controls n=218 (65.66%)			Cases n=114 (34.34%)			Q1 controls *vs.* Q1 cases
	Q1 (n=54)	Q2-Q4 (n=164)	p-value	Q1 (n=28)	Q2-Q4 (n=86)	p-value	p-value
Age (years)	48.5 (37–58)	53 (45.0–60.5)	0.019	49 (39.5–53.5)	51 (44–61)	0.176	0.811
Post-menopause	27 (50.0)	97 (59.5)	0.221*	16 (57.1)	52 (60.4)	0.756	0.539*
Race							
White	18 (33.3)	64 (39.0)		8 (28.6)	24 (27.9)		
Brown	23 (42.6)	68 (41.5)	0.680*	17 (60.7)	47 (54.6)	0.688	0.217*
Yellow/black/indigenous	13 (24.1)	32 (19.5)		3 (10.7)	15 (17.4)		
Marital status							
With partner	31 (57.4)	99 (60.4)	0.772*	18 (64.3)	48 (55.8)	0.430	0.547*
Without partner	23 (42.6)	64 (39.0)		10 (35.7)	38 (44.2)		
Education							
Up to complete MS	9 (17.3)	29 (18.7)		11 (39.3)	33 (38.8)		
Up to incomplete HS	32 (21.1)	35 (22.6)	0.937*	11 (39.3)	24 (28.2)	0.415	**0.003***
HS to complete HE	32 (61.5)	91 (58.7)		6 (21.4)	28 (32.9)		
per capita MW	1.2 (0.8–2.1)	1.9 (0.6–1.9)	0.376	0.7 (0.4–1.0)	0.6 (0.3–1.0)	0.255	**0.003**
FH BC							
With cases in the family	1 (1.9)	18 (11.0)	0.051	5 (17.9)	24 (27.9)	0.824	**0.011***
Without cases in the family	53 (98.1)	146 (89.0)		23 (82.1)	62 (72.1)		
Physical activity level (MET/min/week)	653.5 (160.0–1878.0)	960.0 (240.0–1920.0)	0.720	497.5 (49.5–1249.0)	487.5 (0.0–1.440.0)	0.868	0.389
Alcohol consumption (g/day)	49.6 (33.1–84.0)	26.4 (9.6–50.4)	**0.017**	16.8 (0.0–67.2)	16.8 (0.0–67.2)	0.498	0.061
Height (meters)	1.6 (1.5–1.6)	1.6 (1.5–1.6)	0.706	1.6 (1.5–1.6)	1.6 (1.5–1.6)	0.143	0.103
Weight (kg)	65.7 (57.1–73.3)	68.6 (61.4–76.8)	0.102	63.8 (59.4–73.3)	63.8 (59.0–74.4)	0.979	0.922
BMI (kg/m²)	26.7 (22.6–28.7)	28.1 (24.6–30.7)	**0.039**	26.4 (23.5–29.6)	25.6 (23.4–29.7)	0.780	0.446
WC (cm)	86.8 (78.0–95.0)	91.5 (83.0–100.5)	**0.007**	93.0 (80.0–100.0)	88.8 (82.8–97.1)	0.632	0.103
Body fat (%)	44.4 (40.4–49.1)	46.2 (41.8–50.4)	0.161	45.2 (42.2–50.0)	46.3 (40.8–49.5)	0.976	0.635
Lean mass (%)	53.3 (48.5–56.8)	52.1 (47.9–56.1)	0.462	53.0 (48.3–55.6)	52.0 (48.9–57.3)	0.968	0.965
RSMI (kg/m²)	6.2 (5.7–5.7)	6.3 (5.8–6.9)	0.122	6.1 (5.9–6.7)	6.1 (5.7–6.9)	0.695	0.803
Conicity index	1.5 (1.4–1.5)	1.5 (1.4–1.6)	**0.049**	1.5 (1.4–1.6)	1.5 (1.4–1.6)	0.636	0.254
WHtR	0.5 (0.5–0.6)	0.6 (0.5–0.6)	**0.019**	0.6 (0.5–0.6)	0.6 (0.5–0.6)	0.818	0.268
VAI	1.3 (0.9–2.0)	1.8 (1.1–2.8)	**0.028**	1.4 (0.9–2.6)	1.7 (1.1–2.3)	0.469	0.514
LAP	53 (27.9)	156 (27.1)	0.775	30.7 (18.5–38.2)	24.7 (18.2–35.1)	0.361	0.287

Values are presented in absolute (n) and relative (%) frequencies or median and interquartile ranges. p-values obtained by Mann-Whitney test or *Fisher's exact test, α 5%. Bold: significant values (p<0.05); MS: middle school; HS: high school; HE: higher education; MW: minimum wage; FH BC: family history of breast cancer; MET: Metabolic Equivalent of Task; BMI: body mass index; WC: waist circumference; RSMI: relative skeletal muscle index; WHtR: waist/height ratio; VAI: visceral adiposity index; LAP: lipid accumulation product.

0.77–0.99) and for the instrument's total score in premenopausal women (OR=0.27; 95%CI 0.10–0.69), which were associated with a lower risk of developing BC.

The Fat_AA component score was higher among women diagnosed with BC in Q1, revealing a possible reduction in the consumption of foods such as fats, alcohol, and added sugar. Food is a key factor in post-cancer diagnosis; thus, patients are encouraged to seek a healthier eating pattern in response to the diagnosis and to start anticancer treatment[44,45]. As for the women in the control group, it can be deduced that they remained with their dietary routines.

Among women in Q1 of the IQD-R, there was lower consumption of total fruits, which can negatively influence the recurrence of BC, as well as the development of diet-related comorbidities, especially constipation, obesity, diabetes, and cardiovascular diseases[46]. Fruits contain fiber, vitamins, minerals, and phytochemicals, important nutritional components that help reduce the risk of disease through actions that block carcinogenesis[47].

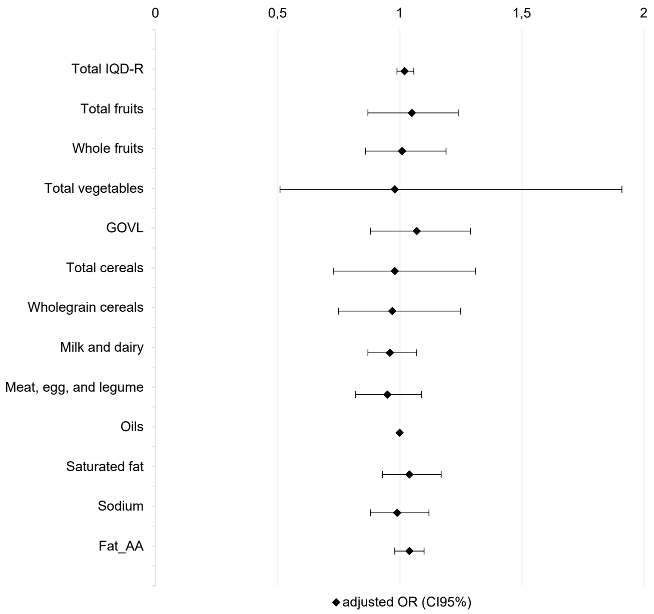
The milk and derivatives component behaved in the same way as total fruits, with lower consumption between cases. The relationship between dairy consumption and BC is controversial[48-50], as the former may increase[51] or reduce[52,53] the risk of developing the latter. A pooled analysis of more than 20 studies found no link between dairy intake, dietary calcium consumption and risk of BC[52], and showed that consuming two or more servings of milk and dairy products/day may reduce the risk of BC in post-menopause[53]. Despite the significant difference in consumption between groups, no association was found between the score for consumption of milk and dairy products and the development of the disease.

The total cereal consumption of the case group in Q1 was higher than that of the control group in the same

Table 2. Total and Component Revised Diet Quality Index, by quartiles, for controls and cases. Goiania (GO), Brazil. 2015–2017 (n=332).

Characteristics	Controls n=218 (65.66%)			Cases n=114 (34.34%)			Q1 controls *vs.* Q1 cases
	Q1 n=54	Q2-Q4 n=164	p-value	Q1 n=28	Q2-Q4 n=86	p-value	p-value
Total IQD-R (0–100)	55.0 (52.2–59.1)	70.9 (66.0–74.7)	**<0.001**	55.5 (51.4–59.5)	71.8 (67.2–76.8)	**<0.001**	0.853
Total fruits (0–5)	2.0 (1.0–5.0)	5.0 (3.6–5.0)	**<0.001**	0.2 (0–3.2)	5.0 (3.2–5.0)	**<0.001**	**0.010**
Whole fruits (0–5)	2.9 (0.1–5.0)	5.0 (4.6–5.0)	**<0.001**	0.1 (0–5.0)	5.0 (4.7–5.0)	**<0.001**	0.051
Total vegetables (0–5)	5.0 (5.0–5.0)	5.0 (5.0–5.0)	0.416	5.0 (5.0–5.0)	5.0 (5.0–5.0)	0.229	**0.015**
GOVL (0–5)	5.0 (1.2–5.0)	5.0 (5.0–5.0)	**0.012**	5.0 (0.9–5.0)	5.0 (5.0–5.0)	**0.002**	0.668
Total cereals (0–5)	4.4 (3.3–5.0)	5.0 (4.2–5.0)	**0.002**	5.0 (4.2–5.0)	5.0 (4.0–5.0)	0.700	**0.038**
Wholegrain cereals (0–5)	0 (0–0)	0.1 (0–1.3)	**0.014**	0 (0–0.6)	0 (0–0.7)	0.591	0.473
Milk and dairy (0–10)	3.2 (1.9–5.3)	4.0 (2.3–7.0)	0.069	2.3 (0.3–3.8)	3.3 (1.4–6.8)	**0.021**	**0.039**
Meat, egg, and legume (0–10)	10.0 (9.0–10.0)	10.0 (7.6–10.0)	0.068	10.00 (6.8–10.0)	10.0 (7.3–10.0)	0.864	0.257
Oils (0–10)	10.0 (10.0–10.0)	10.0 (10.0–10.0)	1.000	10.0 (10.0–10.0)	10.0 (10.0–10.0)	0.568	**<0.001**
Saturated fat (0–10)	6.0 (0–7.1)	7.8 (6.8–9.1)	**<0.001**	7.1 (5.4–8.5)	8.6 (7.3–9.8)	**0.006**	**0.039**
Sodium (0–10)	4.1 (2.5–6.6)	4.4 (2.8–5.9)	0.633	4.9 (1.9–6.1)	4.8 (2.4–6.4)	0.348	0.868
Fat_AA (0–20)	3.8 (1.4–7.3)	12.5 (9.3–15.2)	**<0.001**	6.8 (3.4–11.3)	13.8 (10.3–17.1)	**<0.001**	**0.023**

Data are presented as mean and standard deviation of the mean. p-values obtained by Mann-Whitney test with 5% significance level. Bold: significant values (p<0.05); IQD-R: Revised Diet Quality Index (*Índice de Qualidade da Dieta Revisado*); GOVL: dark green and orange vegetables and legumes; Fat_AA: component composed of calories from solid fat, trans fat, alcohol, and added sugar.



GOVL: dark green and orange vegetables and legumes. Fat_AA: solid fat, trans fat, alcohol, and added sugar; Adjusted OR: adjusted odds ratio; 95%CI: 95% confidence interval. Analyses using as the outcome the presence or absence of breast cancer, as independent variables the components of the Revised Diet Quality Index and as variables of adjustment of percentage of fat, use of hormone replacement therapy, waist-to-height ratio, product of lipid accumulation, education, *per capita* income, history of breast cancer, and physical activity.

Figure 1. Association between breast cancer and components of the Revised Diet Quality Index. Goiania (GO), Brazil. 2015-2017 (n=332).

quartile. This component reflects the consumption of refined and whole grains. However, as the consumption of whole grains by this group was close to zero, it is understood that the score for this component was primarily composed of calories from refined grains. Diet patterns composed of high intake of fats, red and processed meats, added sugar, and refined grains may contribute to the development of BC[33].

Although this study did not find an association between diet quality and BC, as also verified in other studies[54,55], it is worth mentioning that an adequate diet, which promotes the supply of nutrients in a balanced way, is essential at any stage of life[56]. And it is especially important in promoting the health of newly diagnosed women with BC, focusing on reducing the side effects of treatment, preventing recurrences and metastases, and even increasing survival from the disease[36]. The fact that no associations were found should not be seen as a disincentive to the consumption of healthy foods.

The present study is relevant because it uses a validated instrument (IQD-R), based on the recommendations of the Food Guide for the Brazilian Population to promote health through the prevention of nutritional deficiencies and non-communicable chronic diseases (NCDs)[17]. Furthermore, the use of the IQD-R is relevant for the assessment of diet quality since, regardless of energy intake and through the evaluation of its components, we can also infer nutritional content[16]. Women classified here in Q1 of the IQD-R had worse nutritional content, for example, with higher intake of added sugar, total and saturated fats and cholesterol (the latter for controls), and lower consumption of fiber, potassium, calcium, magnesium and folate, as well as iron and vitamins D and K (both for controls) and vitamin C (for cases). Thus, we demonstrate that the IQD-R can be a tool used to promote healthier eating, with a view to mitigating the chance of developing NCDs[16] as well as BC, and we reinforce the relevance of its application.

Furthermore, the methods chosen for the assessment of food consumption (NDS-R) and body composition (DXA) are considered the gold standard and bring greater reliability to the work, since most population-based studies only use BMI as a parameter of anthropometric adequacy.

Among the limitations of the research is the failure to perform the analysis by subgroups of menopausal status, since this is a risk factor for BC. Furthermore, one cannot rule out the possibility that the study participants responded to the 24hR by reporting a diet considered healthier, which could mask true food consumption and underreport foods considered unhealthy[57]. Furthermore, data from the literature reveal changes in food consumption, with the adoption of healthier habits, in post-diagnosed BC women[44], facts that may have impacted the results described here.

It is concluded that the IQD-R and its components were not associated with the development of BC. It is reinforced that the association between food consumption and BC remains controversial in the literature, especially in view of the different methods of evaluating diet quality. Thus, it is suggested that future research be developed to better understand the role of diet quality in health outcomes.

REFERENCES

1. Sung H, Ferlay J, Siegel RL, Laversanne M, Soerjomataram I, Jemal A, et al. Global cancer statistic 2020: GLOBOCAN estimates of incidence and mortality worldwide for 36 cancers in 185 countries. CA Cancer J Clin 2021; 71(3): 209-49. https://doi.org/10.3322/caac.21660
2. International Agency for Research on Cancer. Global cancer statistics 2020: GLOBOCAN. Global Cancer Observatory. Lyon: IARC, 2020.
3. Instituto Nacional de Câncer José Alencar Gomes da Silva. Estimativa 2020: incidência de câncer no Brasil. Rio de Janeiro: INCA; 2020.
4. Couch FJ, Shimelis H, Hu C, Hart SN, Polley EC, Na J, et al. Associations between cancer predisposition testing panel genes and breast cancer. JAMA Oncol 2017; 3(9): 1190-6. http://doi.org/10.1001/jamaoncol.2017.0424
5. Kolak A, Kamińska M, Sygit K, Budny A, Surdyka D, Kukiełka-Budny B, et al. Primary and secondary prevention of breast cancer. Ann Agric Environ Med 2017; 24(4): 549-53. http://doi.org/10.26444/aaem/75943
6. McKenzie F, Ferrari P, Freisling H, Chajès V, Rinaldi S, Batlle J, et al. Healthy lifestyle and risk of breast cancer among postmenopausal women in the European Prospective Investigation into Cancer and Nutrition cohort study. Int J Cancer 2015; 136(11): 2640-8. https://doi.org/10.1002/ijc.29315
7. Latino-Martel P, Cottet V, Druesne-Pecollo N, Pierre FHF, Touillaud M, Touvier M, et al. Alcoholic beverages, obesity, physical activity and other nutritional factors, and cancer risk: a review of the evidence. Crit Rev Oncol Hematol 2016; 99: 308-23. https://doi.org/10.1016/j.critrevonc.2016.01.002
8. Instituto Nacional de Câncer José Alencar Gomes da Silva. Dieta, nutrição, atividade física e câncer: uma perspectiva global. Rio de janeiro: INCA; 2020.
9. Elizabeth L, Machado P, Zinöcker M, Baker P, Lawrence M. Ultra-processed foods and health outcomes: a narrative review. Nutrients 2020; 12(7): 1955. https://doi.org/10.3390/nu12071955
10. Sedaghat F, Heidari Z, Jalali S, Doustmohammadian A, Ehteshami M, Rashidkhani B. Healthy eating index 2010 and breast cancer risk. Nutr Cancer 2018; 70(6): 860-6. https://doi.org/10.1080/01635581.2018.1490781
11. Chandran U, Bandera EV, Williams-King MG, Sima C, Bayuga S, Pulick K, et al. Adherence to the dietary guidelines for Americans and endometrial cancer risk. Cancer Causes Control 2010; 21(11): 1895-904. https://doi.org/10.1007/s10552-010-9617-3
12. Shahril MR, Sulaiman S, Shaharudin SH, Akmal SN. Healthy eating index and breast cancer risk among Malaysian women. Eur J Cancer Prev 2013; 22(4): 342-7. https://doi.org/10.1097/CEJ.0b013e32835b37f9
13. Hirko KA, Willett WC, Hankinson SE, Rosner BA, Beck AH, Tamimi RM, et al. Healthy dietary patterns and risk of breast cancer by molecular subtype. Breast Cancer Res Treat 2016; 155(3): 579-88. https://doi.org/10.1007/s10549-016-3706-2
14. Kroenke CH, Fung TT, Hu FB, Holmes MD. Dietary patterns and survival after breast cancer diagnosis. J Clin Oncol 2005; 23(36): 9295-303. http://doi.org/10.1200/JCO.2005.02.0198
15. George SM, Ballard-Barbash R, Manson JE, Reedy J, Shikany JM, Subar AF, et al. Comparing indices of diet quality with chronic disease mortality risk in postmenopausal women in the Women's Health Initiative Observational Study: evidence to inform national dietary guidance. Am J Epidemiol 2014; 180(6): 616-25. https://doi.org/10.1093/aje/kwu173
16. Previdelli AN, Andrade SC, Pires MM, Ferreira SRG, Fisberg RM, Marchioni DM. A revised version of the Healthy Eating Index for the Brazilian population. Rev Saude Publica 2011; 45(4): 794-8. https://doi.org/10.1590/s0034-89102011005000035
17. Brasil. Ministério da Saúde. Secretaria de Atenção à Saúde. Departamento de Atenção Básica. Guia alimentar para a população brasileira. 1ª ed. Brasília: Ministério da Saúde; 2006.
18. Ceccatto V, Di Pietro PF, Previdelli AN, Vieira FGK, Schiavon CC, Engel R, et al. Brazilian healthy eating index revised (BHEI-R) of women before and during adjuvant treatment for breast cancer. Nutr Hosp 2014; 30(5): 1101-9. https://doi.org/10.3305/nh.2014.30.5.7439
19. Brasil. Ministério da Saúde. Secretaria de Vigilância em Saúde. Departamento de Vigilância de Doenças e Agravos não Transmissíveis e Promoção da Saúde. Vigitel Brasil 2014: vigilância de fatores de risco e proteção para doenças crônicas por inquérito telefônico. Brasília: Ministério da Saúde; 2015.

20. Chlebowski RT, Chen Z, Anderson GL, Rohan T, Aragaki A, Lane D, et al. Ethnicity and breast cancer: factors influencing differences in incidence and outcome. J Natl Cancer Inst 2005; 97(6): 439-48. http://doi.org/10.1093/jnci/dji064

21. Craig CL, Marshall AL, Sjöström M, Bauman AE, Booth ML, Ainsworth BE, et al. International physical activity questionnaire: 12-country reliability and validity. Med Sci Sports Exerc 2003; 35(8): 1381-95. https://doi.org/10.1249/01.MSS.0000078924.61453.FB

22. Lohman TG, Roche AF, Martorell R. Anthropometric standardization reference manual. Champaign: Human Kinetics Books; 1988.

23. World Health Organization. Obesity: preventing and managing the global epidemic. Geneva: World Health Organization; 2000.

24. Ashwell M, Hsieh SD. Six reasons why the waist-to-height ratio is a rapid and effective global indicator for health risks of obesity and how its use could simplify the international public health message on obesity. Int J Food Sci Nutr 2005; 56(5): 303-7. https://doi.org/10.1080/09637480500195066

25. Amato MC, Giordano C, Galia M, Criscimanna A, Vitabile S, Midiri M, et al. Visceral adiposity index: a reliable indicator of visceral fat function associated with cardiometabolic risk. Diabetes Care 2010; 33(4): 920-2. https://doi.org/10.2337/dc09-1825

26. Kahn HS. The "lipid accumulation product" performs better than the body mass index for recognizing cardiovascular risk: a population-based comparison. BMC Cardiovasc Disord 2005; 5: 26. https://doi.org/10.1186/1471-2261-5-26

27. Bennasar-Veny M, Lopez-Gonzalez AA, Tauler P, Cespedes ML, Vicente-Herrero T, Yañez A, et al. Body adiposity index and cardiovascular health risk factors in Caucasians: a comparison with the body mass index and others. PLoS One 2013; 8(5): e63999. https://dx.doi.org/10.1371/journal.pone.0063999

28. Moshfegh AJ, Rhodes DG, Baer DJ, Murayi T, Clemens JC, Rumpler WV, et al. The US department of agriculture automated multiple-pass Method reduces bias in the collection of energy intakes. Am J Clin Nutr 2008; 88(2): 324-32. https://doi.org/10.1093/ajcn/88.2.324

29. Lopes R, Botelho R. Álbum fotográfico de porções alimentares. São Paulo: Metha; 2008.

30. Fisberg RM, Slater B. Manual de receitas e medidas caseiras para cálculo de inquéritos alimentares: manual elaborado para auxiliar o processamento de dados de inquéritos alimentares. São Paulo: Signus; 2002.

31. Pinheiro ABV, Lacerda EMA, Benzecty EH, Gomes MCS, Castro VM. Tabela para avaliação de consumo alimentar em medidas caseiras. 5ª ed. Rio de Janeiro: Atheneu; 2008.

32. Assumpção D, Domene SMA, Fisberg RM, Barros MBA. Qualidade da dieta e fatores associados entre idosos: estudo de base populacional em Campinas, São Paulo, Brasil. Cad Saúde Pública 2014; 30(8): 1680-94. https://doi.org/10.1590/0102-311X00009113

33. Dandamudi A, Tommie J, Nommsen-Rivers L, Couch S. Dietary patterns and breast cancer risk: a systematic review. Anticancer Res 2018; 38(6): 3209-22. https://doi.org/10.21873/anticanres.12586

34. Kerr J, Anderson C, Lippman SM. Physical activity, sedentary behaviour, diet, and cancer: an update and emerging new evidence. Lancet Oncol 2017; 18(8): e457-71. https://doi.org/10.1016/s1470-2045(17)30411-4

35. Godinho-Mota JCM, Gonçalves LV, Mota JF, Soares LR, Schincaglia RM, Martins KA, et al. Sedentary behavior and alcohol consumption increase breast cancer risk regardless of menopausal status: a case-control study. Nutrients 2019; 11(8): 1871. https://doi.org/10.3390/nu11081871

36. World Cancer Research Found. American Institute for Cancer Research. Diet, nutrition, physical activity and cancer: a global perspective. Continuous update project expert report 2018. Geneva: World Health Organization; 2018.

37. Hazra A, Selhub J, Chao WH, Ueland PM, Hunter DJ, Baron JA. Uracil misincorporation into DNA and folic acid supplementation. Am J Clin Nutr 2010; 91(1): 160-5. http://doi.org/10.3945/ajcn.2009.28527

38. Sieri S, Chiodini P, Agnoli C, Pala V, Berrino F, Trichopoulou A, et al. Dietary fat intake and development of specific breast cancer subtypes. J Natl Cancer Inst 2014; 106(5): dju068. https://doi.org/10.1093/jnci/dju068

39. De Cicco P, Catani MV, Gasperi V, Sibilano M, Quaglietta M, Savini I. Nutrition and breast cancer: a literature review on prevention, treatment and Recurrence. Nutrients 2019; 11(7): 1514. https://doi.org/10.3390/nu11071514

40. Debras C, Chazelas E, Srour B, Kesse-Guyot E, Julia C, Zelek L, et al. Total and added sugar intakes, sugar types, and cancer risk: results from the prospective NutriNet-Santé cohort. Am J Clin Nutr 2020; 112(5): 1267-79. https://doi.org/10.1093/ajcn/nqaa246

41. Pourmasoumi M, Karimbeiki R, Vosoughi N, Feizi A, Ghiasvand R, Barak F, et al. Healthy Eating Index/Alternative Healthy Eating Index and breast cancer mortality and survival: a systematic review and meta-analysis. Asia Pac J Oncol Nurs 2016; 3(3): 297-305. https://doi.org/10.4103/2347-5625.189819

42. DeNardo DG, Coussens LM. Inflammation and breast cancer. Balancing immune response: crosstalk between adaptive and innate immune cells during breast cancer progression. Breast Cancer Res 2007; 9(4): 212. https://doi.org/10.1186/bcr1746

43. Figueiredo CRLV. O intrigante paradoxo da inflamação associada ao câncer: uma atualização. J Bras Patol Med Lab 2019; 55(3): 321-32. https://doi.org/10.5935/1676-2444.20190029

44. Thomson CA, Flatt SW, Rock CL, Ritenbaugh C, Newman V, Pierce JP. Increased fruit, vegetable and fiber intake and lower fat intake reported among women previously treated for invasive breast cancer. J Am Diet Assoc 2002; 102(6): 801-8. https://doi.org/10.1016/s0002-8223(02)90180-x

45. Marinho EC, Custódio IDD, Ferreira IB, Crispim CA, Paiva CE, Maia YCP. Relationship between food perceptions and health-related quality of life in a prospective study with breast cancer patients undergoing chemotherapy. Clinics (São Paulo) 2018; 73: e411. https://doi.org/10.6061/clinics/2018/e411

46. Pierce JP, Natarajan L, Caan BJ, Parker BA, Greenberg ER, Flatt SW, et al. Influence of a diet very high in vegetables, fruit, and fiber and low in fat on prognosis following treatment for breast cancer: the Women's Healthy Eating and Living (WHEL) randomized trial. JAMA 2007; 298(3): 289-98. https://doi.org/10.1001/jama.298.3.289

47. Bao PP, Shu XO, Zheng Y, Cai H, Ruan ZX, Gu K, et al. Fruit, vegetable, and animal food intake and breast cancer risk by hormone receptor status. Nutr Cancer 2012; 64(6): 806-19. https://doi.org/10.1080/01635581.2012.707277

48. Julibert A, Bibiloni MDM, Bouzas C, Martínez-González MÁ, Salas-Salvadó J, Corella D, et al. Total and subtypes of dietary fat intake and its association with components of the metabolic syndrome in a mediterranean population at high cardiovascular risk. Nutrients 2019; 11(7): 1493. https://doi.org/10.3390/nu11071493

49. Christopoulos PF, Msaouel P, Koutsilieris M. The role of the insulin-like growth factor-1 system in breast cancer. Mol Cancer 2015; 14: 43. https://doi.org/10.1186/s12943-015-0291-7

50. García EV, Sala-Serra M, Continente-Garcia X, Cano GS, Puigpinós-Riera R. The association between breast cancer and consumption of dairy products: a systematic review. Nutr Hosp 2020; 37(3): 589-98. https://doi.org/10.20960/nh.02649

51. Willet WC, Ludwig DS. Milk and health. N Engl J Med 2020; 382(7): 644-54. https://doi.org/10.1056/NEJMra1903547

52. Missmer SA, Smith-Warner SA, Spiegelman D, Yaun SS, Adami HO, Beeson WL, et al. Meat and dairy food consumption and breast cancer: a pooled analysis of cohort studies. Int J Epidemiol. 2002; 31(1): 78-85. http://doi.org/10.1093/ije/31.1.78

53. McCullough ML, Rodriguez C, Diver WR, Feigelson HS, Stevens VL, Thun MJ, et al. Dairy, calcium, and vitamin D intake and postmenopausal breast cancer risk in the Cancer Prevention Study II Nutrition Cohort. Cancer Epidemiol Biomarkers Prev 2005; 14(12): 2898-904. http://doi.org/10.1158/1055-9965.EPI-05-0611

54. Witte JS, Ursin G, Siemiatycki J, Thompson WD, Paganini-Hill A, Haile RW. Diet and premenopausal bilateral breast cancer: a case-control study. Breast Cancer Res Treat 1997; 42(3): 243-51. https://doi.org/10.1023/a:1005710211184

55. Willett WC, Hunter DJ, Stampfer MJ, Coldtiz G, Manson JE, Spiegelman G, et al. Dietary fat and fiber in relation to risk of breast cancer. An 8-year follow-up. JAMA 1992; 268(15): 2037-44. http://doi.org/10.1001/jama.1992.03490150089030

56. Gabe KT, Jaime PC. Práticas alimentares segundo o guia alimentar para a população brasileira: fatores associados entre brasileiros adultos, 2018. Epidemiol Serv Saúde 2020; 29(1): e2019045. https://doi.org/10.5123/S1679-49742020000100019

57. Scagliusi FB, Lancha Júnior AH. Subnotificação da ingestão energética na avaliação do consumo alimentar. Rev Nutr 2003; 16(4): 471-81. https://doi.org/10.1590/S1415-52732003000400010

RESUMO

Objetivo: Avaliar se a qualidade da dieta e seus componentes estão associados ao desenvolvimento de câncer de mama. **Métodos:** Trata-se de estudo caso-controle com a participação de 332 mulheres, sendo 114 casos e 218 controles. Os grupos foram pareados por idade, índice de massa corporal e estado menopausal. A qualidade da dieta foi avaliada pelo Índice de Qualidade da Dieta Revisado (IQD-R) e seus componentes. O consumo alimentar foi mensurado por meio da aplicação de três recordatórios alimentares de 24 horas e analisados no *software* NDS-R. Foi realizada regressão logística ajustada, estimativa de *odds ratio* (OR) e intervalo de confiança de 95% (IC95%), com valor de p<0,05. **Resultados:** A pontuação do IQD-R, classificada em quartis, não diferiu entre os grupos no quartil inferior de qualidade da dieta (p=0,853). Os componentes cereais totais (p=0,038), gordura saturada (p=0,039) e Gord_AA (gordura, álcool e açúcar de adição) (p=0,023) tiveram maior pontuação no grupo caso. Já a pontuação de frutas totais (p=0,010) e leites e derivados (p=0,039) foi maior no grupo controle. Os componentes do IQD-R, assim como a qualidade da dieta, não se associaram ao desfecho investigado. **Conclusão:** A qualidade da dieta, avaliada pelo IQD-R e os seus componentes, não se associou ao câncer de mama.

Palavras-chave: Dieta. Ingestão de alimentos. Estado nutricional. Inquéritos sobre dieta. Composição corporal. Neoplasias.

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