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Food intake and the nutritional status of women undergoing chemotherapy

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Abstract *The objective behind this study was the analysis of food intake and the nutritional status of women with breast cancer (BC) undergoing chemotherapy (CT). The quantitative dietary evaluation was performed in accordance with Dietary Reference Intakes (DRI), whereas the qualitative evaluation was performed through the Brazilian Healthy Eating Index – Revised (BHEI-R). From among the total number of patients (n = 20), 60% (n = 12) presented waist circumference, equal to or higher than 88cm. It was noted that 75% (n = 15) individuals were overweight. The average intake for calcium, copper, iron, dietary fiber, magnesium, potassium, vitamin A, niacin, vitamin B6 and zinc, were found to be below adequate intake levels, while the intake of vitamin C, phosphorus, manganese, sodium and thiamine were all found to be above DRIs recommendations. As for the analysis of the BHEI-R, 80% (n = 16) of the patients presented a "diet that needs modifications", while 20% (n = 4) presented a "healthy diet". Noted from these observations was the presence of a high overweight rate, a discrepancy in the intake of micronutrients and a diet that needed improvements. In this manner, the establishment and use of a nutritional intervention protocol are very important when it comes to the improvement of the diet in patients with BC and who are undergoing CT.*

Key words *Food Intake, Nutritional status, Breast neoplasms, Chemotherapy, Obesity*

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Introduction

According to estimates from the World Health Organization (WHO), in 2012 there were around 14.1 million new cases of cancer in the world and 8.2 million deaths associated with the disease[1]. In Brazil, it was estimated that in 2015 there were 576 thousand new cases of cancer. Breast cancer is the neoplasm type that affects women worldwide whether they are from developing or developed countries. The estimative of new cases of BC in Brazil was around 57.120 in 2015[2].

Among the cited risks associated with BC are age, ethnicity, race, geographic variation, early menarche, late menopause, nulliparity, first birth in advanced age, family history of cancer before forty years, exposure to ionizing radiation, overweight, consumption of alcohol, and use of oral contraceptives[3]. Obesity is related to the risk of developing along with a worse prognosis of BC. Besides, there is an association between the elevated Body Mass Index (BMI) and the development and prognosis of cancer[4]. The energy balance, the interaction of energy consumption, participation in physical activities, the BMI and metabolic rate are also relevant factors to the development of this neoplasm[5].

Chemotherapy is a form of treatment for cancer, being a systemic approach that allows for the cure of some types of tumour and permits the anticipated treatment of non-detectable metastasis. This model of treatment causes many side effects, which are associated with the fact that they do not affect only the tumorous cells. Among such effects, are found myelosuppression, vomiting, nausea, diarrhea and alopecia[6].

According to Berteretche et al.[7], food aversions developed by patients with cancer stem from the relationship between the discomfort brought by the chemotherapy treatment and the taste of the food being consumed. Further still, some affirm to the hypothesis that during the time the antineoplastic drug is active, the sensorial taste cells are impaired, which produces a decrease in sensibility and flavours.

By taking into consideration that food is not consumed singly, since there is diversity during the process of consumption, there exists great interest in the global standards of diet concerning cancer, by means of diet quality indexes[8]. There are studies that have used dietary indexes, relating such to the risk of developing breast cancer, risk of recurrence and death due to the disease. These indexes are based on a variety of parameters, such as alimentary groups, variety and/or diversity of diet and specific nutrients[9]. The researchers Previdelli et al.[10] adapted the *Healthy Eating Index* (HEI), which gave rise to the Brazilian Healthy Eating Index – Revised (BHEI-R). This Index evaluates the conformity with a healthy diet, being based upon the combination of a diverse number of food groups, nutrients and components of the diet, in relation to dietary recommendations. The BHEI-R is made up of a twelve component system, which determines a variety of aspects of a healthy diet, those being the intake of total whole fruits, total vegetables, dark green and orange vegetables and legumes, total grain, whole grain, milk and dairy, meats, eggs and beans, oils, saturated fat, sodium and SoFAAS (Calories from solid fats, alcoholic beverages, and added sugars)[10].

In light of the above, the objective of this study was the analysis of food intake and the nutritional status of women with breast cancer, undergoing chemotherapy in the Oncology Sector of the Brazilian university hospital (HC-UFU, Uberlandia, Minas Gerais, Brazil).

Methods

This was a transversal study, where an evaluation was made of all patients that were attended at the Oncology Sector during the months of March to August 2014. These patients fell into the inclusion criteria and signed a Terms of Consent Agreement. All those women that were in the first cycle of chemotherapy participated in the study, independent of being curative, neoadjuvant, adjuvant or palliative.

The research study was implemented at the Chemotherapy Clinic, by means of authority given from the Hospital Board and approval from the ethics committee in research with human subjects (protocol number 721.977/14). The volunteers were invited to participate in the study, where emphasis was placed upon participation being voluntary. In this study, the tumours were classified in accordance with the main breast cancer classifications, which is on size, lymphatic involvement and metastasis (TNM classification); through the histological, pathological and molecular. In order to identify the tumour subtypes, the estrogen receptor (ER), progesterone receptor (PR) and the HER2 were all used. The molecular classification for breast cancer was performed on three types, those being Luminal, HER2 and Triple negative. In this classification, for those cases where the tumorous cells presented a genetic ex-

pression similar to luminal epithelial cells of the mammary gland, the cancer is classified as Luminal. If the expression is similar to breast basal cells, the cancer is classified as Basal-like or Triple negative. Those cells that overexpress the human epidermal growth factor receptor 2 (HER2) are classified as HER2. Triple negative or Basal-like tumours present (ER, PR and HER2 negatives).

In this study, the patients included had age equal to or higher than 18 years old, with recently diagnosed breast cancer and who presented physical, verbal and cognitive conditions for responding to the necessary mechanisms at data collection.

The anthropometric variables evaluated were current weight and height for calculating the Body Mass Index (BMI), Waist Circumference (WC) and Waist-to-height ratio (WHtR).

For the measurement of weight and height and the BMI classification for adult patients, the methods and cutoff values recommended by the World Health Organization (WHO)[11] were adopted, and for elderly people , the nutritional status was evaluated according to cutoff values proposed by the Pan-American Health Organization (PAHO)[12].

For the WC analysis, the measure of the midpoint between the lower costal margin and the iliac crest was used[13], with a standard two centimetres above the navel, and cutoff points for classification of the increased risk of metabolic complications, with a value higher or equal to 80cm, and substantially increased, with a value higher or equal to 88cm[14]. For the WHtR the cutoff used was ≥ 0.5 as an indication of excessive abdominal fat[15].

The information relevant to food intake was obtained by means of 24-Hour Dietary Recall (24HR). Three 24HR recalls were applied on non-consecutive days, including one at the weekend, in order to better reproduce the food habits of the sample under study. The application of the 24HR was performed through telephone interviews. The interviewer encouraged the patients to describe all consumed foods from the day before, from the moment they awoke to the moment they went to sleep.

Through use of the 24HR data, the following were analysed: total energy from the patient's diet, carbohydrates, protein, lipids, total fiber, calcium, iron, zinc, phosphorous, potassium, magnesium, manganese, sodium, copper, total cholesterol, vitamin A, thiamine, riboflavin, pyridoxine, niacin, vitamin C, saturated fatty acids, monounsaturated and polyunsaturated.

The values from these nutrients were calculated by means of the software Dietpro® version 5.7i, using as a reference the Brazilian Table of Food Composition (Tabela Brasileira de Composição de Alimentos (TACO))[16]. An average was taken from the values obtained over the three 24HR recalls.

The quantitative evaluation for the consumption of nutrients was performed by means of a comparison of values from the intake averages based on individual necessity in accordance with the values recommended by the Dietary Reference Intakes (DRIs)[17] and Brazilian Cardiology Society[18] (only for monounsaturated, polyunsaturated and saturated fats).

The qualitative evaluation was performed by the Brazilian Healthy Eating Index – Revised (BHEI-R) proposed by Previdelli et al.[10], based on the Dietary Guidelines for the Brazilian Population (2006)[19]. The data taken in homemade measures from the 24HR were converted into units of measure by the software Dietpro®, along with the saturated fat, energy and sodium values. The value for the portion was obtained by means of a specific spreadsheet from the Microsoft Excel® program, into which the weight – expressed in grams, for each food was inserted and the quantity of portions was generated for each food group present on the table. The complete preparation were separated into their respective ingredients. After obtaining the number of portions, the scores for the BHEI-R were calculated.

The number of daily portions was defined for 1,000 kcal/day. For intake superior or equal to the portions recommended for the group's food of 1,000 kcal/day, the maximum score is given and zero for no intake. However, the proportion for the components saturated fat, sodium and SoFAAS is inverse (the higher the consumption, lower will be the score). The intermediary values were calculated in accordance with the quantity consumed.

In order to characterize the quality of the diet across the population, the total score for the index was divided into three categories, those being "inadequate diet", considered scores below 51 points, "diet requires modification", between 51 and 80 points and "healthy diet", with a score above 80 points[20].

A descriptive analysis was performed by means of the software Microsoft Excel®, with calculations taken for average, median and standard deviation of the anthropometric variables, age and intake of macro and micronutrients.

Results

Twenty women participated in the present study. The sample group had a homogeneous distribution and 100% of patients presented invasive ductal carcinoma. The average age of the participants was 53.4 ± 11.0 years. Table 1 presents the clinical characteristics of the patients and demonstrates that the majority presented lymphatic invasion.

In terms of the tumour stage, 40% were larger than 2cm and less than 5cm and a majority were moderately differenced (G2).

Upon analysing the immunohistochemical characteristics, it was found that the majority of patients exhibited positive for the Estrogen Receptor, while 45% of the patients presented positive for the Progesterone Receptor.

Further still, in accordance with (Table 1), a majority of the patients presented negative for Receptor 2 of the human epidermal growth factor (HER2). Regarding the molecular phenotype, 25% were classified as triple negative phenotype, which represents the worst prognosis.

From the anthropometric data for patients (Table 2) and the cutoff values for WC, the majority exhibited WC equal or superior to 88cm, which indicates an elevated risk concerning metabolic complications. Through the waist-to-height ratio (WHtR), the majority of patients presented values above the recommended (0.5), which indicated excess fat in the abdominal region.

A general classification was performed of the nutritional status, according to the Body Mass Index (BMI) of the 20 women, where it was found that 10% (n = 2) were classified as underweight, 15% (n = 3) were normal weight and 75% (n = 15) were "Excessive Weight". We included in the classification of "Excessive Weight", overweight and obese women. In relation to the food intake (Table 3), it was noted that the average intake for calcium, copper, iron, niacin, dietary fiber, magnesium, potassium, vitamin A, vitamin B6 and zinc were below the recommended set out in Dietary Reference Intakes (DRIs), while averages for phosphorus, manganese, sodium, thiamine and vitamin C were above the recommended.

Regarding the intake of macronutrients (Table 4), one notes that they are in agreement with that recommended by DRIs. Besides, the recom-

Table 1. Clinical and hormonal characteristics of women with breast cancer attended by the Oncology Sector of the Brazilian university hospital (HC-UFU, Uberlandia, Minas Gerais, Brazil), in 2014.

Variable	Patients	
	No.	%
Lymph node Status		
cN0	6	30
cN1-3	14	70
Tumour staging		
cT1	5	25
cTis	0	0
cT2	8	40
cT3	5	25
cT4	2	10
Tumour grade		
G1	2	10
G2	12	60
G3	6	30
ER Status		
Negative	8	40
Positive	12	60
PR Status		
Negative	11	55
Positive	9	45
HER2 Status		
Negative	16	80
Positive	4	20
Molecular Subtypes		
Luminal	12	60
HER2	3	15
Triple negative	5	25

Abbreviations: ER = Estrogen receptor; HER2 = human epidermal growth factor receptor 2; PR = Progesterone receptor.

Table 2. Mean ± Standard Deviation of the age and the anthropometric variables of women with breast cancer attended by the Oncology Sector of the Brazilian university hospital (HC-UFU, Uberlandia, Minas Gerais, Brazil), in 2014.

Variable	Total (N = 20) Mean ± SD
Age	53.4 ± 11.0
Weight (kg)	73.0 ± 15.4
Height (cm)	160.0 ± 10.0
BMI (kg/m^2)	29.1 ± 6.7
WC (cm)	92.3 ± 20.2
WHR	0.6 ± 0.1

Abbreviations: BMI = Body Mass index; SD = Standard Deviation; WC = Waist Circumference; WHtR = Waist-to-height ratio.

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Table 3. Mean ± Standard Deviation for the intake of energy, macronutrients, nutritional recommendations and percentage of suitability in relation to nutritional recommendations (DRIs), after analysis of the 24-Hour Dietary Recall (24HR) for women with breast cancer attended at the Oncology Sector of the Brazilian university hospital (HC-UFU, Uberlandia, Minas Gerais, Brazil), in 2014.

Variable	Age Group (years)	Mean ± SD (Minimum – Maximum)	Nutritional Recommendations (AMDR*)	Suitability percentage
Energy (Kcal/day)	31 -70	1191.79 ± 458.31 (274.6-2427.7)	---	---
Carbohydrates (g/day)	31 -70	165.98 ± 68.92 (44.0-400.9)	45 – 65%	57.7%
Monounsaturated fats (g/day)	31 -70	11.65 ± 5.85 (1.8-26.1)	≤ 20%	8.8%
Polyunsaturated fats (g/day)	31 -70	11.95 ± 6.21 (1.6-33.3)	≤ 10%	9.0%
Saturated fat (g/day)	31 -70	12.73 ± 6.17 (1.3-28.9)	< 10%	9.6%
Lipids (g/day)	31 -70	38.51 ± 19.14 (6.4-104.4)	20 – 35%	29.1%
Protein (g/day)	31 -70	48.53 ± 21.90 (12.1-91.9)	10 – 35%	16.3%

Abbreviations: AMDR = Acceptable Macronutrient Distribution Range; * Brazilian Cardiology Society.

mendations for the intake of monounsaturated, polyunsaturated and saturated fats presented themselves as on the recommended limit. However, within the limits in accordance with Brazilian Cardiology Society[18].

Regarding the BHEI-R analysis, the majority of women presented a "diet requires modification" (n = 16), while 20% (n = 4) presented a "healthy diet". The components of BHEI-R that present lower scores were Whole grain cereals, Milk and Dairy, Saturated Fat and Sodium (Table 5).

Discussion

Noted here was the fact that a majority of patients exhibited a positive lymph-nodal status, which indicates that they had already had metastasis, and in relation to the tumour stage, the results showed that the cancer is invasive.

According to Abreu and Koifman [21], the dimension of the cancer in conjunction with the condition of the axillary lymph-nodal condition, are the two most relevant indicators for the prognosis of breast cancer. These form the basis of the TNM staging system (Tumour/Lymphatic nodes/Metastasis), agreed upon and declared by the Union for International Cancer Control (UICC). The most significant prognostic information is to know the axillary involvement and the number of damaged lymph nodes. Besides, a number of studies show that there is a direct relationship between the patient survival rates and the number of damaged lymph nodes.

The histological measure represents the malignancy potential of the tumour, thus demonstrating its high or low metastatic capacity. Prognostic indexes for breast cancer, which use the association of disease stage and histological measure, are constantly used thus aiding in the improvement of result prediction[21].

According to the data established in this study, a majority of patients presented the classification of Waist Circumference with elevated risk for developing metabolic complications, along with the Waist-to-height ratio (WHtR) presenting values above the recommended, which indicates excessive fat levels in the abdominal region.

In the study from Felden and Figueiredo[22], it was also noted that abdominal fat is a risk factor, when it comes to the development of breast cancer evaluated by WC. It was found that those women with a WC > 88 cm were shown to hold a greater possibility of developing the disease than those with a WC between 80-87 cm. Similar re-

Table 4. Mean ± Standard Deviation of the intake of micronutrients and suitability percentage in relation to nutritional recommendations (DRIs), after analysis of the 24-Hour Dietary Recall (24HR) for women with breast cancer attended at the Oncology Sector of the Brazilian university hospital (HC-UFU, Uberlandia, Minas Gerais, Brazil), in 2014.

Variable	Age Group (years)	Mean ± SD (Min – Max)	EAR/AI*	Suitability percentage
Calcium (mg/day)	31 – 70	430.74 ± 242.75 (59.9-991.7)	800	53.8%
Copper (mcg/day)	31 – 70	430 ± 220 (80-1280)	700	61.4%
Cholesterol (mg/day)	31 – 70	179.15 ± 128.23 (15.3-638.3)	< 300	< 300
Iron (mg/day)	31 – 50	5.49 ± 2.70 (2.6-10.8)	8,1	67.8%
	51 – 70	4.45 ± 2.48 (1.7-9.6)	5	89.0%
Dietary Fiber (g/day)	31 – 50	15.56 ± 6.38 (3.4-29.6)	25*	62.2%
	51 – 70	13.51 ± 6.02 (4.2-29.2)	21*	64.3%
Phosphorous (mg/day)	31 – 70	709.57 ± 296.67 (151.5-1509.3)	580	122.3%
Magnesium (mg/day)	31 – 70	161.04 ± 60.52 (65.9-314.7)	265	60.8%
Manganese (mg/day)	31 – 70	1.87 ± 1.22 (0.4-7.3)	1.8*	103.9%
Niacin (mg/day)	31 – 70	10.82 ± 6.56 (0.7-34.2)	11	98.4%
Potassium (mg/day)	31 – 70	2620.2 ± 975.0 (936.0-4551.3)	4700*	55.75%
Vitamin A (mcg/day)	31– 70	233.08 ± 1117.25 (0-8721.9)	500	46,62%
Riboflavin (mg/day)	31 – 70	0.87 ± 0.63 (0-3.6)	0.9	96.67%
Sodium (mg/day)	31 – 50	1951.55 ± 762.38 (948.3-3806.3)	1500*	130.1%
	51 – 70	1521.23 ± 659.03 (297.2-2973.4)	1300*	117.0%
Thiamine (mg/day)	31 – 70	1.09 ± 1.08 (0-4.9)	0.9	121.1%
Vitamin B6 (mg/day)	31 – 50	0.42 ± 0.34 (0-1.2)	1.1*	38.2%
	51 – 70	0.38 ± 0.28 (0-1)	1.3*	29.2%
Vitamin C (mg/day)	31 – 70	183.61 ± 175.55 (0-617.8)	60	306.0%
Zinc (mg/day)	31 – 70	6.53 ± 4.09 (1.8-21.1)	6.8	96.03%

EAR, Estimated Average Requirement; AI = Adequate Intake.

sults were identified in the study by Mobarakeh et al.[23], in which 81.1% of the participants diagnosed with breast cancer, presented a WC greater than or equal to 80 cm.

In addition, a high occurrence was observed of overweight individuals among these patients, as evinced by the BMI. As stated in Miranda et al.[24], women diagnosed with breast cancer and

Table 5. Mean ± Standard Deviation for the alimentation group scores in accordance with the Brazilian Healthy Eating Index – Revised (BHEI-R), after analysis of the 24-Hour Dietary Recall (24HR) for women with breast cancer attended at the Oncology Sector of the Brazilian university hospital (HC-UFU, Uberlandia, Minas Gerais, Brazil), in 2014.

Components of the BHEI-R (Minimum and Maximum Scores)	Mean ± SD (Minimum - Maximum)
Total Grains[a] (0-5)	4.8 ± 0.7 (2.3 – 5.0)
Whole Grains (0-5)	0.7 ± 1.5 (0.0 – 5.0)
Total Fruits[b] (0-5)	4.4 ± 1.3 (0.0 – 5.0)
Whole Fruits[c] (0-5)	4.3 ± 1.6 (0.0 – 5.0)
Total Vegetables (0-5)	4.8 ± 0.5 (3.2 – 5.0)
Dark Green and Orange Vegetables and Legumes[d] (0-5)	4.5 ± 1.1 (1.3 – 5.0)
Milk and Dairy[e] (0-10)	3.5 ± 2.3 (0.0 – 6.9)
Meat, Eggs and Beans (0-10)	9.2 ± 0.9 (6.3 – 10.0)
Oils[f] (0-10)	10,0 ± 0,0 (10.0 – 10.0)
Saturated Fat (0-10)	4.2 ± 3,9 (0,0 – 10,0)
Sodium (0-10)	4,5 ± 2.1 (0.7 – 9.2)
SoFAAS[g] (0-20)	18.8 ± 2.0 (13.3 – 20.0)
BHEI-R TOTAL (0-100)	74.1 ± 5.7 (63.6 – 82.7)

[a] Total grains = includes grains, roots, and tubers. [b] Includes fruits and natural fruit juices. [c] Excludes fruit juices. [d] Includes legumes only after the maximum score for meats, eggs and beans has been reached. [e] Includes milk and dairy and soya based drinks. [f] Includes mono and polyunsaturated fats, oils from oleaginous vegetables and fish oils. [g] SoFAAS: Calories from solid fats, alcoholic beverages, and added sugars.

underwent adjuvant chemotherapy exhibited an increased disposition to weight gain. Although there is still no clear motive found as to this weight gain, it may be as much related to food intake, the reduction in physical exercise, the modification in basal metabolic rate (BMR) or to menopause, as it may be to the type of chemotherapy protocol used, which themselves can be related to the modification in the corporal composition of these patients. In addition, the excess and gaining of weight after the diagnosis are considered risk factors, as much for the recurrence as for death from cancer for the survivors of this disease[25].

Studies from Miranda et al.[24] and Tartari et al.[26] also found the incidence of overweight individuals in accordance with the BMI, among oncological patients. However, highlighted here is that the BMI becomes a restricted parameter for the oncology patient; this is due to the elevation in the concentration of inflammatory mediators such as cytokines. This can go on to cause protein degradation as much as it can cause the increase in extracellular liquid, thus provoking water retention. The effects caused by these situations therefore make any accurate determination to the nutritional status of the patient a complicated task[24].

In accordance with the intake of micronutrients, the patients showed a low vitamin A intake. Similar findings were encountered in the study conducted by Chaves et al.[27], in which the participants presented an insufficient intake of vitamin A, related to the high prevalence of overweight individuals. A possible relationship of overweight individuals with the consumption of vitamin A, may be linked to the thyroid metabolism. Correspondingly, Zimmermann[28] notes that the insufficient intake of this nutrient presents various effects concerning the pituitary-thyroid axis, related to thyroid gland metabolism modulation, peripheral metabolism of the thyroid hormone and thyrotropin (TSH) synthesis by the pituitary.

The low intake of calcium was also encountered in the study from Tartari et al.[26], these researchers suggested a connection to a possible aversion to dairy products. There exists a possible correlation between the inadequate intake of calcium and weight control through various mechanisms. In the intestinal tract, this mineral provides a link with fatty acids and this restricts calcium absorption. In addition, its participation in the regulation of body temperature and in the increase of thermogenesis has been regarded as having an anti-obesity effect[29].

Intakes below the recommended were also seen in the consumption of iron, shown through the study performed by Tartari et al.[26], which demonstrates that the treatment may lead to the aversion of red meats, the principal source of heme iron. However, Ambrosi et al.[30] differed in their findings, by providing evidence for a considerable increase in the intake of iron among women under treatment for breast cancer.

In relation to the vitamin C, its intake was above the recommended, and according to Neumann et al.[31], may be related to central or abdominal obesity when below the recommended. In the meta-analysis by Harris et al.[32], the consumption of vitamin C was correlated to a lower mortality rate by breast cancer. One of the hypothesis is that vitamin C can influence the progression of cancer by means of its anti-oxidant properties, thus neutralizing the free radicals.

On the other hand, the intake of dietary fiber was below the recommended, this was a similar result as to that encountered by Tartari et al.[26]. The regular intake of fibers is a protective factor against the development of breast cancer. These data corroborate with those encountered in the study Healthy, Eating, Activity and Lifestyle (HEAL), which demonstrated a decrease of around 32% in breast cancer in women that ingested higher quantities of fiber[33].

The association that exists between zinc and obesity has been studied in relation to the involvement this nutrient has in the role of leptin and insulin resistance. Zinc is an important appetite regulator and its deficiency leads to a diminished food intake. Therefore, appetite can be increased through a supplement of this mineral[34].

Regarding the macronutrients, the patients presented an intake within the recommended. In the study conducted by Surwillo and Wawrzyniak[35], it was noted that when it came to mean caloric consumption, the intake of carbohydrates and proteins was insufficient in those patients with breast cancer. However, in the study by Ambrosi et al.[30] there was noted a substantial increase in intake of energy and lipids during the treatment of this disease.

In regards to some of the components from the BHEI-R, it was noted that they reach an average score, which is indicated as adequate. This was a different result to that encountered by Ceccatto et al.[9], in which only the total fruit groups, whole fruits, total vegetables, dark green and orange vegetables and legumes obtained an adequate average score.

Besides, a majority of patients presented scores for "diet requires modification", where this result, similar to the study by Previato[36], was also realized with women with breast cancer. However, in the study by Oliveira et al.[37], also realized with patients with breast cancer, a "bad quality" dietary pattern was noted, in this case the diet was evaluated by the Adapted Healthy Eating Index.

It is worth noting that there may have occurred some limitations in this study concerning the methodology used, when referring to the area of data collection. The data for food intake were reported by the very patients by telephone interview, which in itself may have led to errors, as it is information collected from past events, which may have underestimated intake.

In addition, the BMI is a flawed method, which can mask over the nutritional status, as it uses as its principal data weight and not body composition. The size of the sample also may limit the findings of this study, as it deals with a small number of patients.

Conclusion

There was noted in the sample under study, an elevated overweight, imbalance in the intake of micronutrients, dietary fiber and a diet that needs improvements. In this manner, the creation and the use of a nutritional intervention protocol is of great importance for the improvement to the diet of patients with breast cancer that are undergoing chemotherapy. This process should target the avoidance of weight gain and the imbalance of macro and micronutrients, since these imbalances can lead to, besides weight gain, to the risk of the recurrence of the cancer. Therefore, it is suggested that prospective studies are performed, which are aimed at follow-ups with patients during all chemotherapy cycles and the realization of studies that evaluate a higher number of women.

Collaborators

IB Ferreira worked on data collection, data compiling and preparation of the manuscript. EC Marinho worked on data collection, data compilation, result analysis and compilation of the article. IDD Custódio worked on analysis, data interpretation and elaboration of the manuscript. CA Gontijo worked on the elaboration of the manuscript. CA Crispim worked on the elaboration of the manuscript. CE Paiva worked on article design and interpretation of results. YCP Maia worked on article design, analysis, data interpretation and elaboration of the manuscript.

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