



Original/*Cancer*

## Brazilian Healthy Eating Index Revised (BHEI-R) of women before and during adjuvant treatment for breast cancer

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### Abstract

**Introduction:** Different therapeutic modalities for cancer trigger side effects that affect the selection of food by changing dietary patterns.

**Aims:** To evaluate changes in the diet quality of women in adjuvant treatment for breast cancer.

**Methods:** Sociodemographic, clinical and anthropometric data of 78 women were collected. The Brazilian Healthy Eating Index Revised and its components were obtained from food frequency questionnaire applied before and after the treatment. At baseline, participants were classified according to tertiles of diet quality.

**Results and Discussion:** The score of the Brazilian Healthy Eating Index Revised (BHEI-R) in the lowest tertile was 48.4 to 75.2 points, the second tertile was 75.7 to 81.8 points, and the upper tertile was 82.0 to 95.7 points. During treatment, of the women classified in the first tertile, 62% improved their diet score quality passing to the upper tertiles. Women classified in the second tertile, did not significantly alter the diet quality during the treatment, although 46% went to the third tertile. Patients classified in the third tertile significantly reduced the average score of the Index by 7.3 points during the treatment. Among these women, 38% and 20% decreased their score for the second and first tertiles respectively, where the reduction in the diet quality was due to reducing the score of components Total fruits, Total vegetables, Dark Green and orange vegetables and Legumes, Total grains and Solid fats, Alcohol and Added sugar.

**Conclusion:** Dietary changes, which were observed after breast cancer diagnosis, significantly altered the quality of diet among the women participating in the study.

### ÍNDICE BRASILEÑO DE ALIMENTACIÓN SALUDABLE REVISADO (IBAS-R) DE MUJERES ANTES Y DURANTE EL TRATAMIENTO ADYUVANTE PARA CÁNCER DE MAMA

### Resumen

**Introducción:** Diferentes modalidades terapéuticas para los efectos secundarios de activación de cáncer que afectan a la selección de los alimentos por el cambio de los patrones dietéticos.

**Objetivo:** Evaluar los cambios en la calidad de la dieta de mujeres en tratamiento adyuvante para cáncer de mama.

**Métodos:** se obtuvieron datos sociodemográficos, clínicos y antropométricos de 78 mujeres. El Índice Brasileño de Alimentación Saludable y sus componentes se obtuvieron a partir de cuestionarios de frecuencia alimentar aplicados antes y al final del tratamiento. Los participantes fueron clasificados según terciles de calidad de la dieta con base en las informaciones del inicio del estudio.

**Resultados:** Las puntuaciones del Índice de Calidad de la dieta en el tercil inferior fue 48,4-75,2 puntos, en el segundo tercil fue 75,7-81,8 puntos, y en el tercil superior 82,0-95,7 puntos. Durante el tratamiento, 62 % de las mujeres pertenecientes al primer tercil mejoraron su calidad, pasando para los terciles medio o superior. Las mujeres clasificadas en el segundo tercil no alteraron significativamente la calidad de la dieta durante el tratamiento, a pesar de que 46 % pasó para el tercil superior. Las pacientes pertenecientes al tercer tercil redujeron significativamente la puntuación promedio del Índice en 7,3 puntos durante el tratamiento. Entre estas mujeres, 38% y 20% disminuyeron su puntuación para el segundo y primer tercil, respectivamente. La reducción de la calidad de la dieta fue el resultado de la disminución en la puntuación de los componentes Frutas totales, Verduras totales, Verduras y legumbres de color verde oscuro y naranja, Cereales totales y grasas sólidas, Alcohol y Azúcar añadido.

**Conclusión:** Los cambios observados en la alimentación después del diagnóstico de cáncer de mama alteró significativamente la calidad de la dieta de las mujeres participantes del estudio. Intervenciones nutricionales

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Recibido: 19-III-2014.  
1.ª Revisión: 2-V-2014.  
Aceptado: 31-VII-2014.

**Future nutrition interventions are important to aid in food choices during the treatment.**

(*Nutr Hosp.* 2014;30:1101-1109)

DOI:10.3305/nh.2014.30.5.7439

Key words: *Diet. Diet surveys. Breast cancer. Adjuvant chemotherapy. Adjuvant radiotherapy.*

**Abbreviations**

BMI: Body Mass Index.  
FFQ: Food Frequency Questionnaire.  
PAL: Physical Activity Level.  
BHEI-R: Brazilian Healthy Eating Index Revised.  
SoFAAS: Solid fats, Alcohol and Added sugar.  
WHO: World Health Organization.

**Introduction**

Breast cancer represents the greatest world incidence of all female malignancies, being that in Brazil it is responsible for the highest number of deaths by cancer in women<sup>1</sup>. The factors associated with the risk in developing the disease and recurrence are related to the interaction of changeable genetic and environmental factors such as smoking, consumption of alcoholic beverages, diet, obesity and sedentary lifestyle<sup>2</sup>.

Different therapeutic methods for cancer trigger side effects such as nausea, vomit, and a change in taste perception, affecting food selection<sup>3</sup>. Furthermore, patients with breast cancer alter their eating habits because they believe that, aside from the possible direct effects of a healthy diet preventing a secondary cancer, there is a series of psychological benefits. Some of these benefits are a better self-esteem and better mood, although the concern with diet can be affected by the stress of having to face the diagnosis and chemotherapy<sup>4</sup>.

Studies about changes in eating patterns after a breast cancer diagnosis are controversial. When evaluating changes in food consumption, researchers found an increase in the consumption of fruits, vegetables and legumes, whole cereals, and a reduction of fat intake<sup>5</sup>. On the other hand, another study showed results in an opposite direction, with a reduction in energy intake, carbohydrates, proteins, lipids, fruits and vegetables, and increased fat intake after the breast cancer diagnosis<sup>6</sup>.

A recent study evaluated food intake before and after breast cancer treatment verified a significant increase in the intake of foods from food groups including meats and eggs, milk and milk products, fruits, legumes, oils and fats<sup>7</sup>. Furthermore, a significant increase in the daily intake of calories, total lipids, calcium, iron, copper, poly-unsaturated fatty acids, omega 3 and omega 6, as well as a significant decrease of vitamin B<sub>2</sub><sup>8</sup> was also observed.

**futuras son importantes para ayudar en la elección de alimentos durante el tratamiento.**

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Palabras claves: *Dieta. Encuestas sobre dietas. Cáncer de mama. Quimioterapia adyuvante. Radioterapia adyuvante.*

Nevertheless, considering that foods and nutrients are not consumed in an isolated manner, given the diversity of food intake, there is increased interest in literature in studying global patterns of diet in cancer by means of dietary indexes<sup>9</sup>.

Dietary indexes can be determined by means of one or more parameters such as adequate nutrient ingestion, number of portions consumed from each food group (milk and milk products, meats, cereals, fruits and vegetables) and quantity of different food types present in the diet<sup>10</sup>. Different studies have utilized dietary indexes as indicators for prognosis and death due to cancer<sup>11,13</sup>.

Given the scarcity of studies that evaluate diet quality of individuals during cancer treatment, this study aimed to utilize the Brazilian Healthy Eating Index Revised (BHEI-R) to investigate whether dietary changes during adjuvant breast cancer treatment altered diet quality. This was done so that future nutritional intervention strategies should be proposed in order to improve prognosis and reduce recurrence risk of the disease.

**Methods**

*Study design*

This is a nonrandomized clinical study that evaluated women with breast cancer before and after adjuvant treatment, between the years 2006 and 2011, at *Carmela Dutra* Hospital, located in the city of Florianópolis, Brazil.

The women were interviewed in two phases: pre-surgery (basal) and post-treatment. Women were identified as ineligible to participate if they: had previous cancer history or undergone any surgical procedure in the timeframe of one year or less prior; had confirmation of benign tumors without malignancy; were pregnant or nursing mothers; were patients who tested positive for Human Immunodeficiency Virus; and had received neoadjuvant antineoplastic treatment.

During treatment, patients were contacted by telephone in order to monitor termination of treatment and subsequent scheduling with the team of mastology clinical reevaluation and new data collection as to the type of adjuvant treatment realized. During both phases, data was collected in a standardized manner by trained professionals.

Based on the criteria exposed above, 139 women participated in the basal period from October 2006 un-

til May 2010. However, 27 had a benign diagnosis, and the final sample for the basal period was composed by 112 women. In the post-treatment period, 34 patients were lost (21 were not found, 7 did not attend the consults after three scheduling attempts, 3 declined, 1 had an incomplete questionnaire, 1 relapse, and 1 died). At the end, 78 women participated in both phases of the study.

Study procedures were approved by the Ethics Committee of the Federal University of Santa Catarina, protocol numbers 145/06 and 099/08. Upon voluntary agreement, the women were informed of the objectives and methods of the study, signing a free and clarified consent form during both phases of the research.

Socio-demographic, clinical and anthropometric data was collected using an adapted questionnaire of the previous study<sup>8,14</sup>. In order to calculate Body Mass Index (BMI), weight and height were collected and classified according to the World Health Organization (WHO)<sup>15</sup>. The Physical Activity Level (PAL) of each participant was calculated by obtaining the estimate ratio of total energy expenditure and basal energy expenditure<sup>16</sup>, and classified according to standardized cutoff points.

#### *Nutritional parameters*

Food consumption data were obtained from a quantitative Food Frequency Questionnaire (FFQ) containing 112 items, which was adapted from the questionnaire validated by Sichieri and Everhart<sup>17</sup> for the Brazilian adult population. The only adjustment made was the inclusion of some consumed frequently food in the southern Brazil, such as oyster, shellfish, lard, cream, honey and jelly. A pilot study was made for to test the validity of this FFQ adapted against four 24-hour dietary recalls among thirty-five adult women residents in Florianópolis city. Results of the FFQ and the 24-hour recalls were correlated to a similar degree as in studies of other populations. The correlation coefficients concerning the eleven food groups that we analyzed varied from 0.60 for beans at 0.33 for cereals.

The FFQ was administered by previously trained nutritionists or undergraduate nutrition students. Dietary data collection occurred retrospectively referring to one year, that is, in the first interview, food intake referred to the year prior to surgery. In the second interview food intake referred to the year of adjuvant treatment.

A photographic record of dietary surveys and household items of various sizes were used to assist respondents in identifying the portions consumed<sup>18</sup>. The amounts of food reported as household measures were converted into their respective weights and volumes, in grams (g) or milliliters (mL), respectively, as previously described<sup>8,14</sup>. For each subject, individual dietary intake of each food was converted to daily frequency

and seasonal foods such as fruits and vegetables had their estimated daily intake calculated considering the season. Dietary intake of all food items obtained by the FFQ use was classified and analyzed according the food groups of the BHEI-R. The nutritional composition of foods and drinks of the FFQ for calculation of the components specific of the BHEI-R was based on the Brazilian Table of Food Composition<sup>19</sup> and on the Table of the U.S. Department of Agriculture<sup>20</sup>.

In order to evaluate diet quality, the BHEI-R proposed by Previdelli et al.<sup>21,22</sup> was used, taken from the Fisberg et al.<sup>23</sup> Brazilian Healthy Eating Index (BHEI), adapted for the Brazilian population.

In short, the BHEI-R is an indicator developed in accordance to current references for a healthy diet. The index is composed of 12 components, nine of which are based on the food groups of the Dietary Guidelines for the Brazilian Population (*Guia Alimentar para a População Brasileira*)<sup>24</sup>, expressed in energy density, with a maximum score of five points for Total fruits, Whole fruits, Total vegetables, Dark Green and Orange vegetables and Legumes, Total grains and Whole grains; the remaining components present a maximum score of ten points: Milk and dairy products, Meats, eggs and legumes and Oils. Two other components, based exclusively on nutrients, Sodium and Saturated fat, have a maximum score of ten points. Lastly, there is total calories derived from solid fat, alcohol and added sugar (SoFAAS) with a maximum score of 20 points. The intermediate scores for all components were calculated proportionately to the quantity consumed, therefore the total index score varies between zero and 100 points<sup>21</sup>.

The reliability and validity of the BHEI-R was previously done according to its psychometric properties. The authors confirmed that the index is able to measure the diet quality regardless the energy intake. So, the BHEI-R can be used both to evaluated as to monitor the diet quality of Brazilian people<sup>22</sup>.

In order to calculate BHEI-R of mixed foods from the FFQ composed of more than one food item and/or preparation, the items were separated in their respective ingredients based on three tested recipes<sup>25</sup>. After this procedure, the average quantity in grams of each ingredient was classified under each corresponding group of the BHEI-R.

#### *Statistical Analysis*

Statistical analysis was done using STATA<sup>®</sup> statistics Software, version 11.1.

Categorical variables were expressed in absolute and relative frequency, while continuous variables were expressed as mean  $\pm$  standard deviation (SD) for parametric data and median and interquartile ranges (IQ) for nonparametric data.

Data collected from women in the basal period (age, schooling, income, BMI, level of activity, menopausal

state, stage of tumor, use of chemotherapy, radiotherapy or hormone therapy - tamoxifen), was evaluated according to BHEI-R tertiles and compared using the ANOVA test or test for homogeneous and continuous variation tendencies, and Chi-square for categorical variables.

To investigate the differences in the tertiles of the BHEI-R and their components according to the time (in the basal period and during treatment (DT)), paired *t test* or the *Wilcoxon's test* was done. The percentage of women who maintained and altered diet quality during treatment was also calculated. The significance level was set at  $P < 0.05$ .

## Results

Participants were classified at the beginning of the study (basal BHEI-R) into three categories according

to BHEI-R tertiles: 1<sup>st</sup> tertile (48.4 to 75.2 points), 2<sup>nd</sup> tertile (75.7 to 81.8 points) and 3<sup>rd</sup> tertile (82.0 to 95.7 points). The following criteria did not differ among women in the three levels of diet quality at the beginning of the study: age, schooling, *per capita* income, BMI, level of physical activity, menopausal state, stage of tumor and type of treatment. In all three categories it was observed that the majority was sedentary and that average BMI corresponded to an overweight state (Table I).

The average score of the BHEI-R did not statistically differ between the basal period ( $77.9 \pm 9.07$ ) and during treatment ( $77.7 \pm 10.41$ ). While analyzing BHEI-R components during the basal period and during treatment, the components that reached an average score of five points were Total fruits, Whole fruits, Total Vegetables and Dark Green and Orange vegetables and Legumes (Table II).

The median score for Total cereals, Whole cereals, Milk and milk products, and Saturated fat was lower

**Table I**  
Sociodemographic, anthropometric, clinical and therapeutic characteristics of women with breast cancer ( $n = 78$ ) second tertiles of Brazilian Healthy Eating Index Revised (BHEI-R) at baseline, Florianópolis (SC), 2006-2011

Characteristics	BHEI-R Tertiles (baseline)			P
	1 <sup>st</sup> tertile 48.4 to 75.2 (scores)	2 <sup>nd</sup> tertile 75.7 to 81.8 (scores)	3 <sup>rd</sup> tertile 82.0 to 95.7 (scores)	
Age <sup>a</sup> (years)	48.7±9.5	50.5±11.8	56.0±11.7	0.069*
Schooling <sup>b</sup> (years of study)	8 (4;11)	5 (3;11)	4 (3;9)	0.175**
Per capita income <sup>b,c</sup>	1.20 (0.93;1.93)	1.02 (0.75;1.75)	0.84 (0.51;1.54)	0.145**
BMI <sup>a</sup> (kg/m <sup>2</sup> )	27.7± 4.5	27.0±3.9	28.4±5.6	0.187***
Physical Activity Level (PAL), n (%)				0.269 <sup>#</sup>
Low Activity ( $\leq 1.39$ )	22 (85)	24 (92)	19 (73)	
Moderate Activity (1.40-1.59)	4 (15)	1 (4)	5 (19)	
Active ( $\geq 1.60$ )	-	1 (4)	2 (8)	
Menopausal Status, n (%)				
Yes	11 (44)	12 (46)	19 (73)	0.065 <sup>#</sup>
No	15 (56)	14 (54)	7 (27)	
Tumoral Stage, n (%)				0.360 <sup>#</sup>
0	-	2 (100)	-	
I	10 (35)	10 (35)	9 (30)	
II (A/B)	11(39)	6 (22)	11 (39)	
III (A/B/C)	5 (26)	8 (42)	6 (32)	
Chemotherapy, n (%)	19 (73)	17 (65)	19 (73)	0.781 <sup>#</sup>
Radiotherapy, n (%)	21 (81)	17 (65)	14 (54)	0.118 <sup>#</sup>
Hormone Therapy, n (%)	21 (81)	16 (62)	13 (75)	0.065 <sup>#</sup>

<sup>a</sup>mean ± standard deviation.

<sup>b</sup>median and interquartile interval.

<sup>c</sup>calculated as minimum wage income of the current year in Real (R\$).

\*Anova trend.

\*\*Trend test for homogeneous variables.

\*\*\*Anova heterogeneity test.

<sup>#</sup>Chi-square.

BMI: Body Mass Index.

PAL: Physical Activity Level.

**Table II**

Brazilian Healthy Eating Index Revised (BHEI-R) scores and its components in the baseline period and during the first year of treatment (DT) of breast cancer (n = 78), Florianópolis (SC), 2006-2011

Components of the BHEI-R	Baseline	DT	P
BHEI-R Score (0 – 100) <sup>a</sup>	77.9±9.07	77.7±10.41	0.907
Total Fruits (0 – 5) <sup>b</sup>	5.0 (5.0;5.0)	5.0 (3.9;5.0)	0.002
Whole Fruits (0 – 5) <sup>b</sup>	5.0 (5.0;5.0)	5.0 (5.0;5.0)	0.937
Total Vegetables (0 – 5) <sup>b</sup>	5.0 (4.0;5.0)	5.0 (4.0;5.0)	0.727
Dark Green and Orange Vegetables and Legumes (0 – 5) <sup>b</sup>	5.0 (4.6;5.0)	5.0 (3.6;5.0)	0.423
Total Grains (0 – 5) <sup>b</sup>	4.3 (3.5;5.0)	4.5 (3.2;5.0)	0.609
Whole Grains (0 – 5) <sup>b</sup>	0.2 (0.0;0.7)	0.3 (0.0;1.7)	0.103
Milk and dairy products (0 – 10) <sup>b</sup>	5.8 (2.7;7.8)	4.7 (3.0;7.6)	0.191
Meat, eggs and legumes (0 – 10) <sup>b</sup>	9.9 (7.2;10.0)	9.0 (6.6;10.0)	0.348
Oils (0 – 10) <sup>b</sup>	10.0 (10.0;10.0)	10.0 (10.0;10.0)	0.149
Saturated Fat (0 – 10) <sup>b</sup>	7.3 (4.1;8.5)	7.3 (4.0;9.0)	0.464
Sodium (0 – 10) <sup>b</sup>	10.0 (9.5;10.0)	10.0 (10.0;10.0)	0.029
Calories from SoFAAS (0 – 20) <sup>b</sup>	19.1 (12.2;20.0)	18.6 (13.6;20.0)	0.744

Baseline: period corresponding 1 year before of treatment

DT: period corresponding first year of treatment

<sup>a</sup>mean ± SD and Paired *t*-test

<sup>b</sup>median and interquartile range and Wilcoxon test

SoFAAS: calories from solid fat, alcohol, and added sugar

than the maximum recommended score (< 5 or 10 points), and the Meat, eggs and legumes and SoFAAS components had median scores that were close to a maximum score of 10 to 20 points respectively. Components such as Total fruits, Whole fruits, Total vegetables, and Dark Green and Orange vegetables and Legumes had a maximum median score of 5 points, and Oils and Sodium reached a maximum median score of 10 points. During treatment, a significant decrease in the Total fruits component score and an increase in the sodium component ( $p < 0.05$ ) was observed by the interquartile range (Table II).

As to the changes in diet quality, according to the BHEI-R tertiles in the basal period, women who were in the 1<sup>st</sup> tertile increased 7.4 points during treatment

(Fig. 1), which were favored by a significant score increase of the SoFAAS component, which, in turn, was due to the decrease of solid fat, added sugar and alcohol consumption (Table III). Among the 26 women classified in the 1<sup>st</sup> tertile, ten (38%) continued in this classification while 16 improved their diet during treatment (10 were moved to the 2<sup>nd</sup> tertile and six to 3<sup>rd</sup> tertile) (Fig. 2a).

Women who were classified in the 2<sup>nd</sup> tertile in the beginning of the study did not significantly change diet quality during treatment (Fig. 1) despite showing a significant decrease in the Total fruits component (Table III). Nevertheless, it was observed that out of the 26 women classified in the 2<sup>nd</sup> tertile, 12 (46%) improved their diet during treatment moving to the

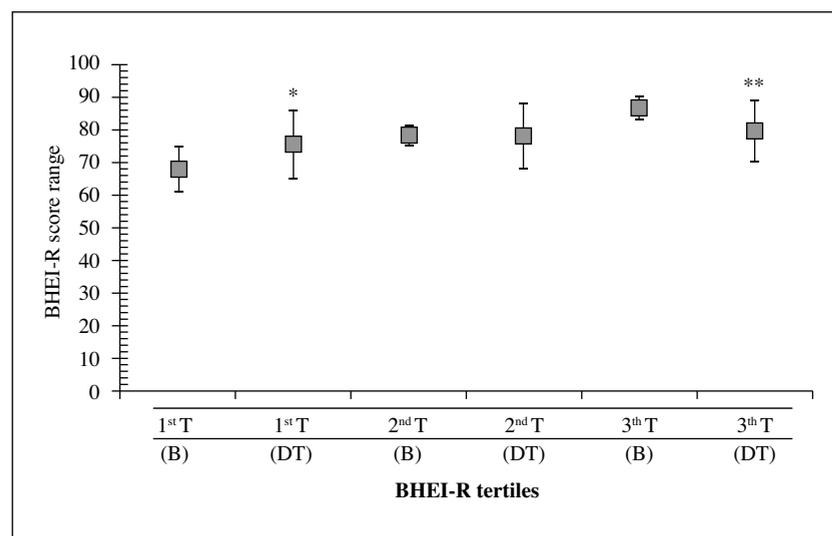


Fig. 1.—Changes in the distribution of BHEI-R at baseline and during the first year of treatment for breast cancer (n = 78), Florianópolis (SC), 2006-2011. BHEI-R: Brazilian Healthy Eating Index Revised.

T: tertile; B: baseline; DT: period corresponding first year of treatment Paired *t*-test;

\* $p < 0.01$  in relation to tertile 1 baseline.

\*\* $p < 0.001$  in relation to tertile 3 baseline.

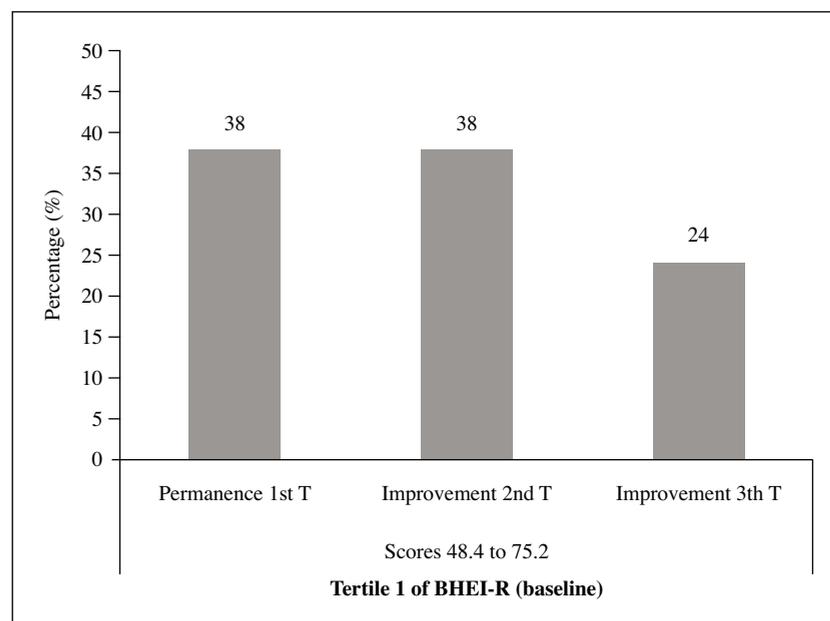
**Table III**  
*Scores of the Brazilian Healthy Eating Index Revised and its components at baseline and during treatment (DT) of women with breast cancer, classified into tertiles of BHEI-R from baseline (n = 78), Florianópolis (SC), 2006-2011*

	1 <sup>st</sup> tertile (n=26)		2 <sup>nd</sup> tertile (n=26)		3 <sup>rd</sup> tertile (n=26)	
	Baseline	DT	Baseline	DT	Baseline	DT
BHEI-R Scores (0 – 100 points) <sup>a</sup>	68.1±6.9	75.5±10.9**	78.3±2.8	78.1±10.1	86.9±3.7	79.6±9.5***
BHE-R Components <sup>b</sup>						
Total Fruits (0 – 5)	5.0 (4.5;5.0)	5.0 (3.8;5.0)	5.0 (5.0;5.0)	5.0 (3.4;5.0)	5.0 (5.0;5.0)	5.0 (4.4;5.0)**
Whole Fruits (0 – 5)	5.0 (3.4;5.0)	5.0 (5.0;5.0)	5.0 (5.0;5.0)	5.0 (5.0;5.0)	5.0 (5.0;5.0)	5.0 (5.0;5.0)
Total Vegetables (0 – 5)	5.0 (3.9;5.0)	5.0 (4.9;5.0)	4.9 (3.6;5.0)	5.0 (4.1;5.0)	5.0 (4.8;5.0)	5.0 (2.0;5.0)**
Dark Green and Orange Vegetables and Legumes (0 – 5)	5.0 (2.0;5.0)	5.0 (2.1;5.0)	5.0 (3.6;5.0)	5.0 (3.4;5.0)	5.0 (5.0;5.0)	5.0 (4.7;5.0)*
Total Grains (0 – 5)	3.6 (3.0;4.6)	4.5 (3.3;5.0)	4.5 (3.7;5.0)	4.5 (3.4;5.0)	4.5 (3.8;5.0)	4.2 (2.9;5.0)*
Whole Grains (0 – 5)	0.1 (0.0;0.3)	0.1 (0.0;1.2)	0.2 (0.0;0.4)	0.1 (0.0;1.7)	0.7 (0.0;2.7)	1.1 (0.1;2.2)
Milk and dairy products (0 – 10)	3.6 (2.3;6.8)	5.8 (2.0;7.7)	5.9 (2.6;7.8)	5.7 (2.2;7.7)	6.2 (4.1;9.4)	4.5 (3.8;5.9)
Meat, eggs and legumes (0 – 10)	9.5 (5.9;10.0)	8.1 (6.4;10.0)	9.2 (6.1;10.0)	8.5 (6.6;10.0)	10.0 (8.0;10.0)	9.8 (7.7;10.0)
Oils (0 – 10)	10.0 (10.0;10.0)	10.0 (10.0;10.0)	10.0 (10.0;10.0)	10.0 (10.0;10.0)	10.0 (10.0;10.0)	10.0 (10.0;10.0)
Saturated Fat (0 – 10)	6.9 (2.2;8.6)	7.7 (3.9;9.9)	6.3 (2.4;8.6)	7.8 (4.0;8.8)	7.5 (6.5;8.4)	6.3 (4.1;8.8)
Sodium (0 – 10)	9.9 (8.4;10.0)	10.0 (9.6;10.0)	10.0 (9.9;10.0)	10.0 (10.0;10.0)	10.0 (9.1;10.0)	10.0 (10.0;10.0)
SoFAAS <sup>c</sup> (0 – 20)	11.0 (7.9;20.0)	18.1 (13.0;20.0)*	17.1 (14.9;20.0)	17.9 (13.8;20.0)	20.0 (19.7;20.0)	20.0 (14.7;20.0)*

Baseline: period corresponding 1 year before of treatment. DT: period corresponding first year of treatment.

<sup>a</sup>mean ± SD and Paired *t*-test. <sup>b</sup>median (interquartile range) and *Wilcoxon Test*. <sup>c</sup>SoFAAS: calories from solid fat, alcohol, and added sugar.

\*p<0.05; \*\*p<0.01; \*\*\*p<0.001.



*Fig. 2a.—Percentage of women with score changes or permanence of the BHEI-R during treatment in relation to tertile 1 of BHEI-R from baseline (n = 26), Florianópolis (SC), 2006-2011. BHEI-R: Brazilian Healthy Eating Index Revised T: tertile.*

3<sup>rd</sup> tertile, while eight maintained diet quality, and six were moved to the 1<sup>st</sup> tertile (Fig. 2b).

Patients who were classified in the 3<sup>rd</sup> tertile significantly reduced BHEI-R average score by 7.3 points during treatment (Fig. 1). The components that contributed towards this decrease in 3<sup>rd</sup> tertile were Total fruits, Total Vegetables, Dark Green and Orange vegetables and Legumes, Total cereals and SoFAAS, demonstrated by the interquartile interval through a significant score reduction of these components (Table III). Within this tertile, 11 (42%) of the 26 women did not alter their diet, continuing in the same group, while ten of them moved to the 2<sup>nd</sup> tertile, and five to the 1<sup>st</sup> tertile (Fig. 2c).

## Discussion

There is evidence that a breast cancer diagnosis directly influences lifestyle changes; patients often have conflicting information about nutrition, which, together with some taboos, aversions, preferences and beliefs that are part of their eating behaviors, reflects on the general quality of their diet<sup>12</sup>.

A statistically significant reduction in the BHEI-R score was observed in the Total fruits component during treatment, which may implicate negatively on breast cancer recurrence as well as on the emergence of comorbidities associated to diet such as obesity, diabetes, hypertension and heart disease<sup>26</sup>. This result

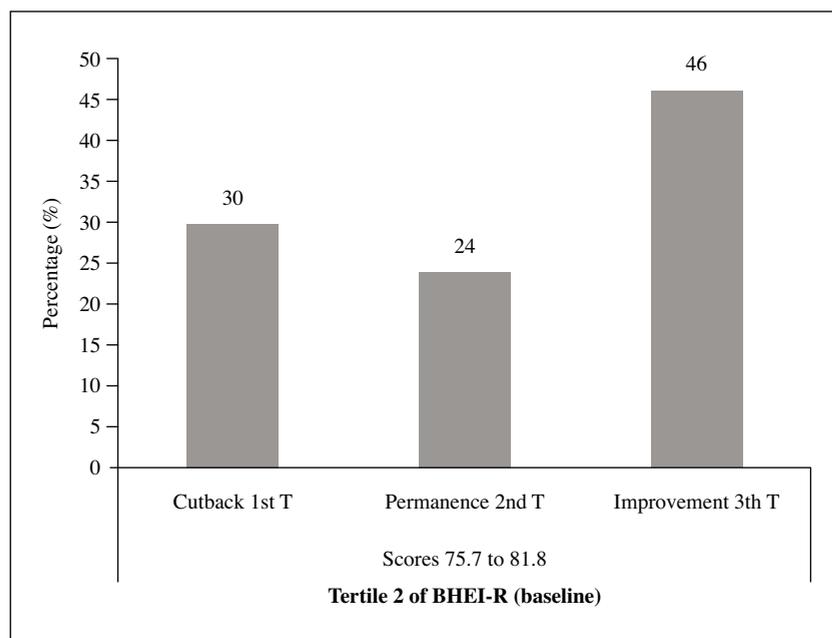


Fig. 2b.—Percentage of women with score changes or permanence of the BHEI-R during treatment in relation to tertile 2 of BHEI-R from baseline (n = 26), Florianópolis (SC), 2006-2011. BHEI-R: Brazilian Healthy Eating Index Revised T: tertile

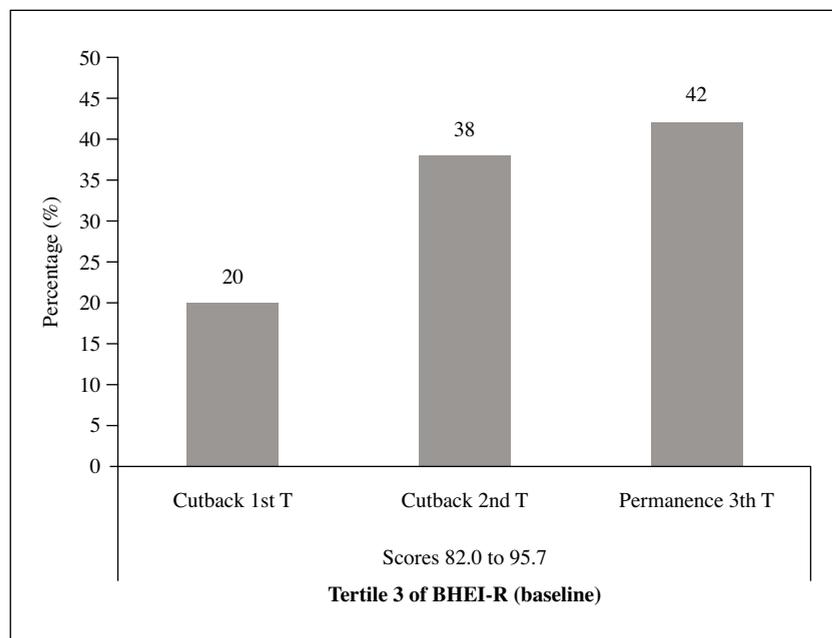


Fig. 2c.—Percentage of women with score changes or permanence of the BHEI-R during treatment in relation to tertile 3 of BHEI-R from baseline (n = 26), Florianópolis (SC), 2006-2011. BHEI-R: Brazilian Healthy Eating Index Revised T: tertile

was different from results reported in other epidemiological studies with a similar population<sup>11,26,27</sup>. Other studies showed that dietary changes during treatment resulted in an increase in fruits and vegetables consumption and a reduction in the consumption of fatty foods<sup>5,26</sup>. It is noteworthy that the adoption of a diet rich in fruits and fresh vegetables together with a reduction in fat intake can improve prognosis for breast cancer patients and reduce recurrence risk of the disease<sup>26</sup>.

Women who were placed in the 1<sup>st</sup> tertile significantly improved their diet quality, showing a significant score increase in the SoFAAS component. This means the reduction in fat, added sugar and alcohol consumption during treatment contributed towards improving diet quality. In turn, a score reduction in the SoFAAS component was observed while evaluating women classified in the 2<sup>nd</sup> and 3<sup>rd</sup> tertile, which revealed excessive consumption of miscellaneous highly caloric foods with low nutritional value. Observational studies have suggested that a high fat consumption is associated with greater disease recurrence risk, especially in postmenopausal women<sup>28</sup>. Despite the fact that high levels of sugar consumption was not related as a promoting factor for the increase of cancer risk or progression, it was observed that sugars (including refined sugar, pure honey, brown sugar, corn syrup and molasses) and sugary drinks (sodas and flavored drinks) contribute to increasing calories in the diet, which leads to weight gain. Furthermore, most foods that are rich in sugar presented low nutritional density, and often substitute more nutritious foods. Therefore limiting intake of these products is recommended as it can result in a healthier diet<sup>29</sup>.

During treatment, an increase in score of six other BHEI-R components was observed among women in the 1<sup>st</sup> tertile (Whole fruits; Whole vegetables; Whole cereals; Meats, eggs and legumes; Saturated fat and Sodium). Although not significant, this reflected on the increase of the general BHEI-R score. Despite were no statistically significant changes in the average score of the BHEI-R before and during treatment, small improvements in food intake that compose each of the above components can contribute in an important way to improving diet quality. These results reinforce the idea that the index was able to capture the heterogeneity of the dietary quality since all the BHEI-R components had a change in their punctuations<sup>22</sup>.

Alcohol consumption and its relation to greater risk of developing breast cancer is well established<sup>2</sup>, and according to the *Life After Cancer Epidemiology (LACE)* study, consuming 3 to 4 doses or more per week can increase recurrence risk, particularly in postmenopausal women who are overweight and/or obese<sup>30</sup>.

This study has some limitations. Firstly, it would be important to evaluate diet quality according to type of adjuvant treatment realized. A second limitation is given about an increase in sodium score before and during treatment. This result should be regarded with

critical, since the evaluation of nutritional composition of foods and drinks database does not consider sodium when there is addition of salt during food preparation, a fact that underestimated the final scores and reflected a score that was closer to recommendation, because studies show that salt intake through food in most countries ranges from 9 to 12 grams per person / day<sup>31,32</sup> and in Brazil, the intake is about 13 grams daily<sup>33</sup>. However, it is worth mentioning that this is the database that best reflects the composition of the main foods consumed in Brazil. Also, the FFQ that was used presents limitations in obtaining information about sodium consumption. Conversely, the FFQ is the most practical and informative evaluation method on dietary intake<sup>34</sup>.

There are no studies which are similar to the present one that used dietary indexes in the food intake evaluation of pre and post-diagnosis of breast cancer, making the comparison of results difficult. The present study shows originality in its prospective design and for the use of the BHEI-R<sup>21</sup>, a dietary index of diet analysis previously developed for the Brazilian population.

In general, the reduction of the overall diet quality during treatment may have been influenced by compromised physical and emotional health, which in turn, influences food choices<sup>12</sup>.

Although our study does not have the goal of studying occasional factors of changes in diet such as feelings, attitude and depression of these women, but only of studying the changes that occurred in their diet during treatment, it was observed that, in general, the women needed multi-professional care where interaction among all forms of behavioral changes which impact nutrition may reflect on long term prognosis<sup>11</sup>. Future studies will be able to investigate the relation between these factors on changes of food intake of this population.

## Conclusion

The results of this study showed that changes in diet took place after a breast cancer diagnosis, which significantly altered diet quality. In this respect, strategies for directed nutritional education encouraging adherence to a healthy diet are necessary in order to result in improved diet quality, also taking into account all repercussions of treatment.

Future studies should evaluate other factors that might be associated to changes in food habits such as types of chemotherapy protocols, side effects and aversion to foods during this period, aiming to encourage improved diet quality during treatment.

## Acknowledgements

To the *Maternidade Carmela Dutra* Hospital team, to *Centro de Pesquisas Oncológicas CEPON*), to

*Fundação de Amparo à Pesquisa e Inovação do Estado de Santa Catarina (FAPESC) (Edital PPSUS 15.952/2009), to Conselho Nacional de Desenvolvimento Científico e Tecnológico (Edital Universal do CNPq, MCT/CNPq 14/2008), and to Programa de Reestruturação e Expansão das Universidades Federais (CAPES Reuni).* Finally, to all the women who agreed to participate with hard work and dedication.

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