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# Body fat and poor diet in breast cancer women

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**Abstract**

***Background:*** **Breast cancer is the most common cancer in women worldwide. Differences in breast cancer incidence suggest a significant role of environmental factors in the aetiology: obesity, central adiposity, excess body fat and some dietary factors have been suggested as risk factors. This pilot study aimed to analyse the pattern of nutritional status, body fat, and the usual dietary intake among women diagnosed with breast cancer, consecutively referred to the Radiotherapy Department of the University Hospital Santa Maria.**

***Patients and methods:*** **Throughout 2006, 71 consecutive women with breast cancer were included. Evaluations: weight (kg) & height (m), determined with a SECA® floor scale + stadiometer to calculate body mass index (BMI), waist circumference, percentage body fat with bipolar hand-held bio-impedance analysis (BF-306®), Food Frequency Questionnaire validated for the Portuguese population to assess the usual dietary intake. Frequency analysis and Mann-Whitney U test were used to evaluate prevalence and associations.**

***Results:*** **Mean age was 60 ± 12 (36-90) years. Invasive ductal carcinoma was the most frequent histology (68%), p < 0.05. Most patients were in stage I (30%) or stage IIA (25%) of disease *vs* IIB (10%), IIIB (4%), IV (4%) or others (21%), p < 0.05. Regarding nutritional status, 82% were overweight/obese; 89% of patients had a %body fat mass above the maximum limit of 30% *vs* only 8 (11%) with %body fat within normal range (p < 0.002); 62% pts had a waist circumference > 88 cm (prevalence analysis: p < 0.04), and 61% of pts had gained weight after diagnosis. Univariate analysis did not show any association between histology, BMI, %body fat and waist circumference; by multivariate analysis there was an association between higher BMI, %body fat & aggressive histologies (p < 0.005). Food frequency analysis showed a low intake of vegetables and wholegrain cereals rich in complex carbohydrates (sources of fibre and phytochemicals), of fatty fish & nuts, primary sources of n-3 PUFA's and a high intake of saturated fat; more aggressive histologies were**

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**GRASA CORPORAL Y MALA ALIMENTACIÓN EN MUJERES CON CÁNCER DE MAMA**

**Resumen**

***Antecedentes:*** **el cáncer de mama es el cáncer más frecuente en mujeres en todo el mundo. Las diferencias en la incidencia de cáncer de mama sugieren un papel significativo de los factores ambientales en su etiología: se han propuesto la obesidad, la adiposidad central, el exceso de grasa corporal y algunos factores dietéticos como factores de riesgo. El propósito de este estudio piloto fue analizar el patrón del estado nutricional, la grasa corporal y consumo dietético habitual en mujeres diagnosticadas de cáncer de mama y remitidas de forma consecutiva al Servicio de Radioterapia del Hospital Universitario de Santa María.**

***Pacientes y métodos:*** **A lo largo de 2.006, se incluyeron 71 mujeres consecutivas con cáncer de mama. Evaluaciones: peso (kg) & talla (m), determinados mediante una báscula + estadiómetro SECA® para calcular el índice de masa corporal (IMC), la circunferencia de la cintura, el porcentaje de grasa corporal con el análisis bipolar manual de bioimpedancia (BF-306®), el cuestionario Food Frequency Questionnaire validado en versión portuguesa para evaluar el consumo dietético habitual. Se emplearon el análisis de frecuencia y la prueba U de Mann-Whitney para evaluar la prevalencia y las asociaciones.**

***Resultados:*** **la edad media fue 60 ± 12 (36-90) años. La histología más frecuente fue el carcinoma ductal invasivo (68%), p < 0,05. La mayoría de las pacientes estaba en estadio I (30%) o estadio IIA (25%) de la enfermedad frente a los estadios IIB (10%), IIIB (4%), IV (4%) y otros (21%), p < 0,05. Con respecto al estado nutricional, el 82% tenía sobrepeso / obesidad; el 89% de las pacientes tenía un % de grasa corporal por encima del límite máximo de 30% frente a sólo (11%) con un % de grasa corporal dentro del rango normal (p < 0,002); 62% pacientes tenían una circunferencia de la cintura > 88 cm (análisis de prevalencia: p < 0,04) y 61% de ellas había ganado peso tras el diagnóstico. El análisis univariado no mostró asociación alguna entre la histología, el IMC, el % de grasa corporal ni la circunferencia de la cintura; mediante el análisis multivariado se mostró una asociación entre un mayor IMC, el % de grasa corporal e histologías agresivas (p < 0,005). El análisis de frecuencia de alimentos mostró un consumo bajo de vegetales y cereales integrales ricos en complejos carbohidratados (fuentes de fibra o histoquímicos) o de ácidos grasos de pescados o frutos secos, fuentes primarias de ácidos grasos poliinsaturados n-3 y un consumo elevado de grasas saturadas; las histologías más agresivas se correlacionaban con un**

**correlated with low intake of green leafy vegetables (p = 0.05) and n-3 fatty acids food sources (p = 0.01).**

***Conclusions:*** **Our findings show a vast prevalence & homogeneous pattern of overweight/obesity, excessive body and abdominal fat, as well as weight gain after diagnosis, combined with diets deficient in protective nutrients. Further investigation is warranted as cancer rates in Portugal continue to increase.**

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Key words: *Breast cancer. Diet. Obesity. Body fat. Waist circumference.*

**consumo bajo de verduras (p = 0,05) y de fuentes de ácidos grasos n-3 (p = 0,01).**

***Conclusiones:*** **nuestros hallazgos muestran una amplia prevalencia y un patrón homogéneo de sobrepeso / obesidad, y una cantidad excesiva de grasa corporal y abdominal, así como de ganancia de peso tras el diagnóstico, junto con deficiencias dietéticas en nutrientes protectores. ¡Se requiere investigación adicional puesto que las tasas de cáncer siguen aumentando en Portugal!**

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Palabras clave: *Cáncer de próstata. Dieta. Obesidad. Grasa corporal. Circunferencia de la cintura.*

## Introduction

Breast cancer is the most commonly diagnosed cancer and the second most common cause of cancer mortality among women worldwide.[1] Both genetic and environmental influences may be involved in its aetiology. Epidemiological studies suggested an association between nutritional status and breast cancer incidence: e.g. body weight, body mass index (BMI) and waist circumference may be risk factors for the disease,[2,3] and indeed risk may be reduced via behavioural changes in diet and physical activity.[1] Inconsistent results suggest that the risk of developing breast cancer is approximately 30% higher among postmenopausal women with a BMI > 31 kg/m$^2$, compared with women with a BMI of about 20 kg/m$^2$.[4] The role of total body fat on increased risk of breast cancer is still contradictory, ranging from a positive relation[5] to no association.[6,7] Nevertheless, waist circumference as a direct measure of abdominal adiposity[8] has been found to be a strong predictor of breast cancer: higher central adiposity increases breast cancer risk among postmenopausal women from 1.4 to 5.2 times than that of women with lower central body fat.[9] Moreover, dietary intake influences anthropometric measures, and the literature recognizes the benefits associated with a dietary pattern high in fibre, fruits and vegetables and antioxidants and low in saturated fat in reducing cancer incidence.[10,11]

The increasing prevalence of obesity,[12,13] highlights the importance of determining obesity and excess body fat in breast cancer. This pilot study aimed to assess nutritional status focusing on BMI, %body fat, central adiposity, as well as the usual dietary intake of women with breast cancer, and to explore potential inter-relations between clinical and nutritional factors.

## Patients and Methods

### *Patients*

This pilot cross-sectional study was carried out in the outpatient Radiotherapy Department of the University Hospital of Santa Maria in Lisbon throughout 2006; 71 women with histologically confirmed breast cancer were consecutively included and evaluated. The study was approved by the University Hospital Ethics Committee and was conducted in accordance with the Helsinki Declaration, adopted by the World Medical Association in 1964, amended in 1975 and updated in 2002. After written informed consent, data were collected by centrally trained and supervised interviewers and recorded in an individual form pre-constructed for statistical analysis. Data included demographics, clinical parameters, anthropometric measures, changes in weight and food intake over the previous 6 months, and the usual dietary intake.

### *Nutritional parameters*

Measurements were performed in the morning, all patients were fasting, shoeless and wearing lightweight clothing; height was measured using a stadiometer and weight determined using a SECA® floor scale. BMI was then calculated using the formula [weight (kg)/ height (m)$^2$] and classified according to WHO's criteria as: normal when 18.5-24.9 kg/m$^2$, overweight if 25-29.9 kg/m$^2$ and obese if ≥ 30 kg/m$^2$.[14] Waist circumference was measured midway between the lower margin of the last rib and the iliac crest, in a horizontal plane using a non-stretchable flexible tape; values were further categorised as normal if < 88 cm and as central obesity if ≥ 88 cm.[15] Body percentage of fat mass was determined using a hand-held bipolar bio-impedance instrument (Omron BF306, Omron Healthcare Europe BV, Hoofddorp, The Netherlands); measurements were further categorised into two groups: normal if < 30% and excessive body fat if ≥ 30%.[16]

Patients' usual dietary intake in the previous year was assessed by a Food Frequency Questionnaire validated for the Portuguese population.[17] This comprises a detailed review of the usual intake throughout the previous year in what concerns: types of foods and the frequency of intake per day, week or month, and in what amount; open questions were applied to report and

complete the evaluation with all foods not included in the questionnaire but consumed regularly and at least once a week. Further, the foods included in the questionnaire were grouped into broad categories such as dairy products, meat, fish and eggs, fats, sweets and desserts, vegetables, fresh and dried fruits and beverages. Within these categories, respondents' intakes were classified as low (≤ 4 times/week) or high (≥ 5 times/week or if consumed daily).

*Statistical analysis*

Statistical analyses were performed using the SPSS statistical software (SPSS for Windows 14.0). Frequency analysis was used to assess prevalences of nutritional status and also to evaluate food intake. Mann-Whitney U test was used to evaluate associations between parameters of nutritional status, tumour stage and histology grades. Bivariate correlations and Spearman correlation coefficient with 2 tailed test of significance, assessed correlations. A concordance analysis using the Kappa coefficient was calculated to measure the rate of agreement between parameters of nutritional status. A multivariate analysis of variance (ANOVA) adjusted for age and for potential errors given by the small sample size, was used to explore associations between various clinical and nutritional variables. Data are presented as numbers and percentages and *p* values ≤ 0.05 were considered statistically significant.

## Results

Patients' mean age was 60 ± 12 (36-90) years, 79% of women were above 50 years old, the median age for menopause.[18] Invasive ductal carcinoma was the predominant histology (68%); the majority of patients were diagnosed with early stage breast cancer: 34% in stage I, 24% in stage IIA and 10% in stage IIB of the disease, whilst 32% of patients had advanced breast cancer: stage IIIB (1%), IV (3%) or others (28%), $p < 0.05$ (table I).

Nutritional status revealed that 34 (48%) were overweight and 24 (34%) were obese *vs* only 13 (18%) patients with an adequate BMI ($p < 0.001$); in addition 48 (68%) patients had gained weight during the past 12 months, $p < 0.01$. Furthermore, 17 (24%) patients had a %body fat between 30%-35% and 46 (65%) patients had a %body fat ³35% *vs* only 8 (11%) with a %body fat within normal range ($p < 0.002$). In 44 (62%) patients, waist circumference was higher than the maximum cut-off value of 88 cm (table II). To confirm evaluation consistency, a concordance analysis was performed: there was an agreement between BMI and %body fat (Kappa coefficient = 0.89, $p < 0.001$), and between BMI and waist circumference (Kappa coefficient = 0.45, $p < 0.005$). Potential univariate associations between BMI, waist circumference, %body fat, histology and tumour stage were tested through the non-parametric Mann-Whitney U test and Spearman correlation coefficient and failed to reveal any association or correlation ($p < 0.38$). However, by multivariate analysis of variance, there was an association between higher BMI, %body fat and more aggressive histologies ($p < 0.05$), and all these variables worsened with age.

**Table I**
*Patient's tumour characteristics*

| *Parameters* | *N (%)* |
|---|---|
| *Age*[1] | |
| < 50 | 15 (21%) |
| = 50 | 56 (79%) |
| *Tumour histological grade* | |
| Invasive ductal carcinoma | 48 (68%) |
| Others | 23 (32%) |
| *Tumour stage* | |
| I | 21 (30%) |
| IIA | 18 (25%) |
| IIB | 7 (10%) |
| IIIB | 3 (4%) |
| IV | 3 (4%) |
| Others | 19 (27%) |

Data are presented as numbers and percentages of patients; [1]Median age for menopause is 50 years old.[18]

Table III shows the patients' poor dietary pattern. The analysis of the reported food frequency of usual intake showed that over half of the patients had low intake of both milk and cheese (52% and 56% respectively); there was a generalized low intake of vegetables, almost all patients consumed cooked vegetables ≤ 4 times per week and consequently had a poor intake of in fibre and phytochemicals. Intake of foods rich in complex carbohydrates such as whole grain cereals was also sparse (17%) whereas white bread (refined flour) was frequently consumed by almost half of the subjects (46%), and rice and baked potatoes were the next most common starch products consumed between 4-6 times per week by 65% of patients. There was also

**Table II**
*Categories of BMI, % body fat and waist circumference*

| *Nutritional parameters* | *Nº of patients (%)* |
|---|---|
| *BMI (kg/m²)* | |
| < 25 | 13 (18%) |
| 25-29 | 34 (48%) |
| = 30 | 24 (34%) |
| *% body Fat* | |
| < 30 | 8 (11%) |
| 30-35 | 17 (24%) |
| ≥ 35 | 46 (65%) |
| *Waist circumference (cm)* | |
| < 88 | 27 (28%) |
| ≥ 88 | 44 (62%) |

Data are presented as number and percentage of women. For BMI, % body fat and waist circumference, patients are distributed according to international reference values and cut-offs.[14-16]

**Table III**
*Frequency of food intake*

| | *Foods* | *Low intake* | | *High intake* | |
|---|---|---|---|---|---|
| *Dairy products* | Milk | 37 | 52% | 34 | 48% |
| | Yoghurt | 24 | 34% | 47 | 66% |
| | Cheese | 40 | 56% | 31 | 44% |
| *Meat, fish & egg* | Chicken | 70 | 99% | 1 | 1% |
| | Turkey/rabbit | 70 | 99% | 1 | 1% |
| | Beef/Pork | 67 | 94% | 4 | 6% |
| | Ham/Sausage | 61 | 86% | 10 | 14% |
| | Fatty Fish | 61 | 86% | 10 | 14% |
| | Lean Fish | 63 | 89% | 8 | 11% |
| | Seafood | 71 | 100% | 0 | 0% |
| | Eggs | 69 | 97% | 2 | 3% |
| *Fat* | Olive Oil | 14 | 20% | 57 | 80% |
| | Sunflower/Soya Oil | 65 | 92% | 6 | 8% |
| | Butter | 37 | 52% | 34 | 48% |
| *Starchy foods* | White Bread | 38 | 54% | 33 | 46% |
| | Whole Bread/ Cereal | 25 | 35% | 46 | 65% |
| | Rice | 63 | 89% | 8 | 11% |
| | Pasta | 65 | 92% | 6 | 8% |
| | French Fried Potato | 71 | 100% | 0 | 0% |
| | Baked Potato | 61 | 86% | 10 | 14% |
| | Biscuits | 50 | 70% | 21 | 30% |
| *Sweets & desserts* | Ice Cream | 67 | 94% | 4 | 6% |
| | Croissant/Cake/Chocolate | 66 | 93% | 5 | 7% |
| | Sugar | 34 | 48% | 37 | 52% |
| *Vegetables* | Cabbage | 69 | 97% | 2 | 3% |
| | Broccoli | 65 | 92% | 6 | 8% |
| | Spinach/ other greens | 66 | 93% | 5 | 7% |
| | Common Beans | 66 | 93% | 5 | 7% |
| | Carrot | 52 | 73% | 19 | 27% |
| | Fresh Tomato | 41 | 58% | 30 | 42% |
| | Beans/Pea/Broad beans | 71 | 100% | 0 | 0% |
| | Vegetable Soup | 27 | 38% | 44 | 62% |
| *Fresh & dried fruits* | Apple/Pear | 17 | 24% | 54 | 76% |
| | Orange/Banana/Kiwi | 45 | 63% | 26 | 37% |
| | Strawberry/ Cherry | 28 | 39% | 43 | 61% |
| | Peach | 23 | 32% | 48 | 68% |
| | Grapes | 36 | 51% | 35 | 49% |
| | Nuts | 68 | 96% | 3 | 4% |
| | Olives | 65 | 92% | 6 | 8% |
| *Drinks* | Wine | 56 | 79% | 15 | 21% |
| | Beer | 70 | 99% | 1 | 1% |
| | Coke | 71 | 100% | 0 | 0% |
| | Coffee | 33 | 46% | 38 | 54% |

Data are presented as number and percentage of patients: Low Intake: ≤ 4 times/week, High Intake: ≥ 5 times/week.

a reduced intake of foods rich in PUFA, mainly from dietary sources of n-3 fatty acids such as nuts (low in 96% of patients) and fatty fish (low in 86% of patients), but almost half of the patients (48%) reported a high intake of butter, thus a high intake of saturated fat. Overall, the consumption of fresh fruit was moderate (76%). Alcohol consumption was low for all patients, with only 1% drinking beer and 21% drinking wine ≥ 5 times per week. More than half of the patients (54%) had a high coffee intake.

Potential associations between different components of the diet and breast cancer aggressiveness were explored, but no association was found; however, we did find a correlation between low intake of green leafy vegetables ($p = 0.05$) and of n-3 fatty acids food sources ($p = 0.01$) with more aggressive histologies.

## Discussion

In the 1980's, the Europe against Cancer programme fixed the goal of reducing cancer mortality by 15% in Europe by the year 2000. Evaluation of the outcomes of the programme revealed that Portugal and Spain are among a limited number of European countries that showed an increased number of cancer deaths compared to those predicted.[19] Nonetheless, the World Cancer Research Fund states that cancer is a preventable disease; a review of the past 30 years of authoritative estimates of the role of food, nutrition and lifestyles in the prevention of cancer, have suggested that approximately 30% of cancers are preventable.[1] Breast cancer is no exception.

The role of body fat on breast cancer risk is uncertain; old studies questioned the association between body fat and breast cancer,[6,7] whilst others showed that body fat affects breast cancer risk by influencing sex hormone binding globulin (SHBG) availability.[20] In this study conducted in 71 women with breast cancer, there was a high prevalence of overweight, obesity and most had a waist circumference higher than the upper cut-off value. Waist circumference is typically used as a measure for central adiposity, which is a clinical marker of insulin resistance and metabolic syndrome; hyperinsulinaemia is central in the latter thereby reducing SHBG levels that increase free oestradiol, a recognized risk factor for breast cancer.[21] Other hypothesis is that obesity increases breast cancer risk.[22] After menopause, SHBG levels drop, further aggravated by obesity which is strongly associated with an increased level of circulating oestrogen,[23] thus more free oestradiol is available to enter the cells. A high BMI is therefore associated with an even greater increase in free oestradiol concentration than the two-fold increase in total oestradiol.[21] It is noteworthy that the majority of patients gained weight over the preceding year.

Additionally, an increased risk associated with higher body fatness was statistically significant in 7 out of 19 cohort studies and in 32 out of 56 case-control studies. Risk was shown to increase between 8-13% for every 5 kg/m$^2$ of BMI.[1] Our data showed that 89% of women had a body fat mass greater than normal; univariate analysis however did not show any association between BMI, central obesity, %fat mass and histological grades. Although a Type II error cannot be ruled out, when data were examined by a multivariate analysis of variance adjusted for the small sample size, we did find a significant association between higher BMI, increased %body fat and more aggressive histologies, and all these variables worsened with age.

Among dietary factors, fat intake has historically been linked to breast cancer through correlations between per capita fat consumption and breast cancer mortality, and results of animal studies measuring the response to high fat intake.[24] On the other hand, epidemiological data have shown that a high PUFA intake leads to a decreased risk of developing tumours after the age of 50,[25,26] and that high saturated fat intake may increase circulating oestrogen levels which then promote the growth of malignant mammary cells.[27] Also, some case control studies have suggested that high intake of dietary fibre may reduce the risk of breast cancer by altering the metabolism of oestrogen,[28,29] a finding not supported by others.[30,31] In the current study, analysis of reported dietary intake showed in about half of the women: a low consumption of vegetables, primary source of fibre and phytochemicals, of whole grains rich in complex carbohydrates, as well as a low intake of fatty fish and nuts, primary sources of n-3 PUFA's, concomitantly with a high intake of saturated fat via butter and dairy. Of note that in this cohort we did find a correlation between low intake of green leafy vegetables ($p = 0.05$) and of n-3 fatty acids food sources ($p = 0.01$) with more aggressive histologies.

In conclusion, despite the many limiting factors, e.g small patient cohort, food intake over the past year may not indicate their intake in former decades, we do however consider the results relevant, since this is the first study of nutritional variables among Portuguese women with breast cancer, the most frequent cancer among women in Portugal and worldwide. Our findings show an alarmingly high prevalence of excess body weight, body fat and the metabolically more active central obesity concomitantly with unbalanced diets poor in protective foods and nutrients; our results strengthen the need for comprehensive national studies. In Portugal in the 20 year period to 2003, cancer rates have increased by 17%[32] and are not responding to European Health Promotion Initiatives in the same manner as in other European Community countries. The World Cancer Research Fund have declared almost one third of cancers to be preventable through healthy diet and lifestyles.[1] Greater focus on prevention is essential for Health Systems to cope with the financial costs of an ageing population, mainly because breast cancer predominantly affects women over 50. Although the study of nutritional factors is challenging, future research should focus not only on possible diet related risk factors for cancer, but also on how to encourage the adoption of protective diets and life styles by the general population which would concomitantly help to reduce obesity.

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