Dietary changes and food habits: social and clinical determinants in a cohort of women diagnosed with breast cancer in Barcelona (DAMA cohort)

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Abstract

Objective The aim of this study was to analyze the influence of social determinants on changes in dietary habits before and after diagnosis of breast cancer in women (Barcelona, 2003–2013).

Methods We performed a cohort study with 2,235 women diagnosed with breast cancer. The information was obtained from an ad hoc questionnaire based on recommendations from the Spanish Society of Community Nutrition. We conducted a descriptive bivariate analysis and fit logistic regression models. The dependent variable was the change in dietary habits (food groups) and the independent variables were a selection of social and clinical variables (age, social class, cohabitation, years since diagnosis, history of replaces, and treatment with chemotherapy).

Results While 5.8% of women followed a healthy diet (consumption of vegetables, fruits, farinaceous, lean meat, and sea- food) before diagnosis, 9.5% did so after diagnosis. We observed statistically significant changes in consumption of all food groups ($p < 0.001$) after diagnosis. The greatest change in consumption patterns was observed in women aged < 50 years and those from non-manual classes (high classes) [e.g., legume consumption: $OR_{<50\ years/>65\ years} = 2.9$ (95% CI 1.78–4.81); $OR_{non-manual/manual} = 2.5$ (95% CI 1.38–4.36)]. The occurrence of relapses and chemotherapy was associated with greater changes in dietary habits.

Conclusion Women with breast cancer change their eating habits after diagnosis, and these changes are conditioned by social and clinical determinants.

Keywords: Breast cancer, Dietary changes, Social inequalities, Lifestyle habits

Introduction

Breast cancer is a major global health issue [1]. It is the most commonly diagnosed cancer in women in Spain and one of the leading causes of morbidity and mortality among women [2]. According to the Spanish Society of Medical Oncology (SEOM) [3], one in eight Spanish women will suffer from breast cancer at some point in their lives. However, despite its very high incidence, survival rates have also increased significantly in recent years, with relative average 5-year survival rates of 85.2% in 2007 and 89.2% in 2012, for cases with early diagnosis [2–4].

Both disease progression and patients' quality of life are influenced by many distinct factors that affect both their physical and mental health. Many of these factors are related to lifestyle, including eating habits [1, 5]. Previous studies have demonstrated a close relationship between diet quality and quality of life in breast cancer survivors [6], although there is a need for more evidence on how these factors affect breast cancer etiology and prognosis [7, 8]. Nonetheless, eating habits are known to have an important impact on these women's general survival and overall health [6, 9, 10].

After being diagnosed with breast cancer, these patients show greater interest in dietary factors and are more open to changing their eating habits [11–14]. Irrespective of whether or not they have been given medical advice, breast cancer patients seem to change lifestyle habits after diagnosis chiefly due to the desire to recover from cancer and to deal with the side effects of some treatments [12, 14]. Since some of these women are willing to and capable of making positive changes in their diet, we should consider initiatives that emphasize the importance of a healthy diet [15].

Furthermore, not all affected women have the tools to improve their diet in the same way. In fact, eating habits are influenced by a series of complex interactions between socioeconomic, cultural, structural, geographic, and environmental factors [16]. Several determinants such as age and socioeconomic status [17, 18] have been identified that influence food availability and choice, ultimately leading to more or less balanced diets.

Understanding the nutritional habits of women with breast cancer is an essential first step for developing interventions to promote healthy habits that improve their overall health, as well as survival. Also, to create effective and equitable interventions, it is important to determine whether socio- economic factors influence the success of changes in food habits after diagnosis. Therefore, the aim of this study was to analyze the influence of social determinants on changes in dietary habits among women in Barcelona before and after a breast cancer diagnosis between 2003 and 2013.

Participants and methods

Study design and participants

We performed a mixed cohort study (retrospective–prospective) [19] using a convenience sample of women diagnosed with breast cancer at different stages of disease progression. We present the results of the first cross-sectional study, which includes 2,235 women [20].

As described in a previous article on the work protocol [20], the study population included women aged ≥ 18 years who had been diagnosed with and/or treated for breast cancer at one of the four main public hospitals in Barcelona (Hospital Clínic, Hospital Vall d'Hebron, Hospital Sant Pau, and Parc de Salut Mar) between 1 January 2003 and 31 December 2013. These hospitals are the reference hospitals that cover the entire city of Barcelona. Women were identified from the minimum basic data set (CMBD), and those who had received an ICD-9 [21]-coded diagnosis between 174.0 and 179.9 were considered as potential candidates for the study. We excluded women who either (a) died from any other cause before the study was performed or (b) had been diagnosed with any other type of cancer before their breast cancer diagnosis.

We identified 9,771 women as potential participants in the study, and each was sent by mail an information pack about the study and an invitation to participate. Those who accepted signed an

informed consent (IC) document enclosed with the information letter. Once we received informed consent, they were called to welcome the study and obtain sociodemographic data to determine the profile of women in the cohort. Subsequently, the questionnaire was sent by mail or via web. In the end, a total of 2,235 women were included in the study. This means a participation of 23.9%. Representativeness was verified with the Catalan cancer population registry existing at that time. It was approved by the Clinical Research Ethics Committee whose register number is 2015/6499/. In addition, all participating hospitals submitted the study to their internal Ethics Committee.

Sources of information and measuring instruments

After receiving the IC document, we made a first telephone contact to explain the subsequent steps in the study and to administer the first survey on sociodemographic and eco- nomic variables. Most items were Likert-scale questions collected and validated from the Health Survey of Catalonia. The second survey was, each other, a questionnaire containing 38 items to collect data on the consumption frequency (daily or weekly) of foods from the food groups defined in the current recommendations of the Spanish Society of Community Nutrition (SENC) [22]. One of the main limitations of consumer frequency questionnaires is the low ability to remember. In our case, we wanted to assess frequencies and changes. It was asked about habits and frequencies of consumption before the diagnosis of breast cancer in women who sometimes had been diagnosed 10 years ago. For this reason, an ad hoc questionnaire was used that allowed us to assess these frequencies and changes by food groups rather than by specific foods and that was easy to remember. This questionnaire, like all the other questionnaires used, was previously analyzed in a pilot test that allowed to verify the correct understanding of what was being asked. Clinical variables were obtained from the medical records of the hospitals involved in the study.

Study variables

Dependent variables

- Food habits were categorized as healthy or unhealthy, according to the criteria established by the SENC [20]. Thus, healthy consumption was defined as follows: vegetables (≥ 2 servings/day); fruit (≥ 3 pieces/day); nuts (> 2 servings/week); legumes (≥ 2 servings/week); lean meat (2–4 servings/week); fish and seafood (≥ 3 servings/week); eggs (≥ 3 servings/week); dairy products (≥ 2 servings/day); cereals (≥ 3 servings/day); olive oil (3–6 servings/day); water (≥ 1.5 liters/day).

  Based on these data, we then defined the following variables:

- Recommended diet, categorized as either yes or no, according to whether the participant followed or not the SENC recommendations on the consumption of vegetables and fruit, farinaceous products (legumes or cereals), lean meat, and fish and seafood.
- Change in consumption of food in the main food groups considered healthy, according to previous literature: vegetables, fruit, legumes, and nuts [23–25]. Changes were calculated by comparing eating habits before and after cancer diagnosis. Changes were categorized as follows: negative change—worsening (healthy consumption before diagnosis and unhealthy consumption after- ward); no change—unhealthy consumption (unhealthy consumption before and after diagnosis); no change—healthy consumption (healthy consumption before and after diagnosis); positive change—improvement (unhealthy consumption before diagnosis and healthy consumption afterward).
- Improvement in the consumption of food in the main groups of healthy foods. The proportion of women who made a positive change following their diagnosis (positive change—improvement), compared to the number of women with an unhealthy consumption pattern both before and after diagnosis (no change—unhealthy consumption).

Independent variables

Various possible explanatory variables were analyzed, selecting those that were considered relevant in the descriptive analysis as well as in the reviewed literature. The information collected in the focus groups that were carried out in parallel with the quantitative study was also taken into account and finally, statistical power criteria were also taken into account.

- Age, categorized as follows: < 50 years, 50–65 years, and > 65 years.
- Social class, based on the occupation of the main provider in the household, was classified as follows: non- manual class [the most privileged class, including social classes i, ii, and iii, according to the National Classification of Occupations (2011)] and manual class (the less privileged class, includes social classes iv, v, and vi) [26]. This classification was proposed in 2012 by the Working Group on Social Determinants of Health of the Spanish Society of Epidemiology [27].
- Years since diagnosis, categorized into < 5 years, 5–10 years, and > 10 years.
- History of one or more relapses, categorized as yes/no.
- Treatment with chemotherapy, categorized as yes/no.

Statistical analysis

We performed a descriptive analysis of the dietary habits and the clinical and socioeconomic variables of the sample. We then performed a first bivariate analysis (using the McNemar test) to analyze changes in eating habits before and after diagnosis. We performed a second bivariate analysis (using the Chi-square test) to study the relationship between the main healthy food groups and the clinical and

socioeconomic variables. Finally, we fit age-adjusted bivariate and multivariate logistic regression models to estimate odds ratios (OR) and 95% CIs to assess the possible association between increased consumption of food in the main healthy food groups and socioeconomic and clinical variables.

Statistical significance was set at $\alpha < 0.05$ for all analyses, and data were managed and analyzed using STATA v13.0.

Results

2235 women completed the study, and a description of their main features is provided in Table 1. 40.1% of the women included in the study sample were over 65 years of age, 75.5% belonged to the non-manual class, and 22.68% lived alone. Regarding the clinical characteristics related to breast cancer, 37.7% of the women in the sample had been diagnosed less than 5 years before the beginning of the study, 9.4% had suffered a relapse after the initial diagnosis, and 48.5% had been treated with chemotherapy.

The dietary habits of women in the study before and after diagnosis are shown in Table 2. We observed a statistically significant change in the consumption of all food groups after diagnosis ($p \leq 0.05$). 5.5% of women had followed a proper diet before diagnosis, increasing to 9.6% after diagnosis. We observed a positive change for most food groups, especially for consumption of nuts (13.2%), fruit (9.7%), and vegetables (8.8%). However, the percentage of women with unhealthy consumption of eggs (8.5%), dairy products (8.2%), and cereals (7.9%) increased after diagnosis.

Table 3 shows the changes detected in consumption of the main groups of healthy foods (vegetables, fruit, nuts, and legumes) after diagnosis, compared to before diagnosis. 74.4–83.7% of women in the study did not change their intake of food in these four food groups after diagnosis. While 63.5% of participants maintained healthy pattern of fruit consumption, 57.4% continued to have

an unhealthy pattern of nut consumption after diagnosis. Finally, the vegetables, fruits, nuts, and legumes consumption was improved in 10.6%, 9.9%, 15%, and 7.6%, respectively.

Table 4 shows a significant association between women's age and their social class for the four food groups studied ($p \leq 0.05$), with younger women and those in non-manual classes showing a greater proportional increase in consumption of healthy food types. We also observed an improved pattern of nut consumption in 25.1% of women living alone, compared to 19.6% of those living with one or more people. In terms of clinical variables, individuals who had suffered a relapse were more likely to show improved consumption of fruit, nuts, and legumes, whereas those who had undergone chemotherapy were more likely to show improved consumption of legumes and fruits.

Table 5 shows that individuals under 50 years of age and those from the non-manual class were more likely to show greater improvement in the consumption of the four groups of healthy foods, such as vegetable consumption (OR 3.4 95% CI 2.23–5.31 and OR 1.5; 95% CI 1.05–2.30, respectively). Similarly, living alone was associated with a greater improvement in the consumption of vegetables (OR 1.5; 95% CI = 1.03–2.12) and nuts (OR 1.6; 95% CI 1.20–2.19).

People who had had a relapse were more likely to increase fruit consumption (OR 1.9; 95% CI 1.10–3.24), nuts consumption (OR 1.7; 95% CI 1.11–2.54), and legumes consumption (OR 1.7; 95% CI 1.03–2.98) after the diagnosis. **(Table 1)**

In addition, women who had undergone chemotherapy also showed improved consumption of fruit (OR 1.5; 95% CI 1.05–2.11).

Discussion

In this study, we analyzed the influence of social determinants on changes in nutritional habits before and after the diagnosis of breast cancer (Barcelona, 2003–2013).

The proportion of women who follow the recommended diet—which involves healthy consumption

of vegetables, fruits, farinaceous products, lean meat, and fish—was very low: approximately 5% of the women in the study followed the recommended diet before being diagnosed, and just 10% did so after diagnosis. Relevant studies such as ENIDE- 2011, which assessed the nutrition of the Spanish population using data from the 2011 National Dietary Ingestion Survey, found similar results [28]. According to this study, just 2–7% of Spanish women adhere to the Mediterranean dietary pattern. Remarkably, even after being diagnosed with breast cancer, few women adhered to healthy nutritional habits [29].

Depending on the food group, we observed higher or lower adherence to the SENC recommendations. One positive observation was that > 60% of women in the study reported healthy consumption of fruit and lean meat. Similarly, most women reported correct consumption of olive oil, which is interesting in light of recent results from the PREDIMED clinical trial (primary prevention of cardiovascular disease with the Mediterranean diet), indicating that a Mediterranean diet rich in olive oil reduces the incidence of breast cancer and some cardiovascular diseases [7]. In contrast, the low percentage of women reporting correct consumption of eggs, cereals, fish, and seafood gives cause for concern. In particular, low fish consumption results in low intake of nutrients such as omega-3-related unsaturated fats, specifically DHA and EPA, which have been shown by epidemiological studies to protect against some cancers, such as breast cancer [30].

In the WHEL study Thomson et al. [31] performed a descriptive analysis of dietary intake among 3,084 women diagnosed with breast cancer. The study showed that consumption improved after diagnosis for all of the food groups analyzed, especially meat, vegetables, and fruit. Similarly, the women in our study reported significant changes in their eating habits after breast cancer diagnosis. Generally, these changes involved improved consumption of the different food groups studied, reflecting the women's interest in and concern for dietary factors and their possible effect on dis- ease outcomes [13, 31]. Although we observed an improved consumption of vegetables, fruits, nuts, legumes, lean meat, fish and seafood, olive oil, and water, that of eggs, dairy products, and

cereals decreased. The decrease in egg consumption is probably due to its high cholesterol content, which is mistakenly associated with high blood plasma levels of LDL. On the contrary, eggs are highly beneficial for health due to the high quality of egg proteins [22]. Milk and dairy products are thought to have high levels of hormones and contaminants that can be detrimental to health [32, 33]. However, these products are rich in calcium and vitamin D and are especially beneficial and necessary for a good development of bone mass [22]. Additionally, all milk and derived products comply with the European Commission obligations, including the levels of hormones, contaminants, and antibiotics, as indicated by the regulations of the Spanish Agency for Food Safety (http://www.aesan.gov.es/AECOSAN/web/seguridad_alimentaria/subdetalle/leche.htm). **(Table 2-5)**

Finally, the weight gain that many women suffer after diagnosis may explain the decrease in cereal consumption, although in the context of a healthy diet, adequate intake of cereal is not associated with overweight or obesity. In fact, cereals should be included in the basis of any healthy and balanced diet [22].

This study pays special attention to improved consumption of vegetables, fruits, nuts, and legumes by women diagnosed with breast cancer. Epidemiological research suggests that these four food groups protect against breast cancer and help increase survival and quality of life among survivors [23–25, 34]. In addition, women diagnosed with breast cancer have higher risk of secondary cancers and are more likely to suffer from other chronic diseases such as diabetes, osteoporosis, or cardiovascular problems, which can be prevented or alleviated by following a diet rich in such foods [1, 35].

In line with previous studies [13, 14], many women in our study reported that they did not change their consumption of these four food groups after diagnosis. However, approximately one-third already had healthy consumption habits (and as much as two-thirds, for fruit consumption), which was maintained after diagnosis.

Our analysis suggests that women's age and social class are the most influential factors in improving consumption of healthy food groups. Women under 50 years reported a greater change in consumption of vegetables, fruit, legumes, and nuts after diagnosis. In fact, younger women showed 2- to three-fold greater consumption of these four food groups than women over 65 years. Although age is positively associated with good eating habits, older women following healthier habits [17, 28], willingness to change is negatively associated with age [13, 31, 36].

Regardless of the indicator used [37], various studies and reviews show that more disadvantaged groups have greater difficulty in accessing a good diet, which results in a poorer quality diet [18, 38, 39]. Our results show that these inequalities also underlie changes in dietary habits, with women from the most privileged, non-manual class
[27] showing improved consumption of these four healthy groups. Socioeconomic deprivation can explain the observed differences to some extent. The lower purchasing power of less privileged classes limits their access to non-public therapeutic alternatives [40], such as nutritional advice for cancer patients. In addition, food prices may also influence this relationship since more nutritious foods, such as fresh fruit and vegetables or nuts, are often more expensive than those with poorer nutrient content [18, 41]. Other research, such as that undertaken by Salminen et al. [13], which used educational level as a proxy for socioeconomic position, observed that women with higher educational level (≥ high school) were 2.13 times more likely to report a change in their eating habits after diagnosis than those of lower level ($p < 0.002$).

Cohabitation is significantly associated with consumption of vegetables and nuts. Nonetheless, the trend remains unaltered for the four food groups studied, with women who live alone being more likely to improve their consumption of these foods. While marriage and family support have often been associated with better eating habits for this consumption [42, 43], recent data from the ENIDE-2011 study show that Spanish women follow a more varied and balanced Mediterranean diet than men [28]. In addition, women caregivers may have less disposable time and thus find it more difficult to

achieve healthy consumption of these foods than women who live alone.

When analyzing clinical variables, it may be observed that the severity of the disease (assessed by the appearance of relapses) is associated with a greater improvement in the consumption of fruits, nuts, and legumes. Women undergoing chemotherapy improved their consumption of fruit and legumes, and the same trend was observed for vegetables and nuts. The side effects of this treatment, such as nausea or weight gain, along with the desire to heal, could partly explain such differences [36].

This study faces some limitations. We used for collecting information on eating habits, the questionnaire designed ad hoc according to healthy-diet guidelines for the Spanish population established by the SENC. This was done because the aim of the study was to assess the changes that women had made in terms of the frequency of consumption of different food groups. It was not intended to study the exact frequency and quantities with measuring instruments, because being a retrospective study in some cases of 10 years, they would not have been able to remember it. In addition, such questionnaires can only be done in the presence of a trained surveyor and bearer of accurate measuring instruments. This was not the case in this study; as apart from being retrospective, the questionnaire was self-reported. To limit these memory biases, even when prospective and/or cross-sectional studies are carried out, it is decided to design a questionnaire with more generic questions on the food groups described in the food pyramid presented by the SENC. In other retrospective studies, ad hoc questionnaires have been used [44] with good results. On the other hand, as mentioned above, in order to verify that it was understood and that it did not present comprehension difficulties, a pilot was carried out with a group of 25 women.

Another limitation intrinsic to this type of study (based on self-reported data), is a memory bias [45]. On the other side, only women who volunteered to participate in the study were actually included in it, but we verified the representativeness of the sample.

Both before and after breast cancer diagnosis, few women in the study followed the recommended diet. Nonetheless, the changes observed in the consumption of the different food groups show these

women's interest in nutritional habits and their relationship with the disease. However, age, social class, and the progress and treatment of the disease create inequalities that result in greater or lesser probability of acquiring healthy habits. Thus, the results of this study support the need for programs and interventions that improve the eating habits of women diagnosed with breast cancer, which in turn takes equity into consideration in order to reduce the inequalities suggested by this study.

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Tables

Table 1 Description of socio-demographic and clinical variables among women diagnosed with breast cancer ($n = 2,235$)

	n	%
Age		
< 50 years	321	14.4
50–65 years	1,017	45.5
> 65 years	896	40.1
Misisng	1	0.0
Social class		
Manual class	509	22.8
Non-manual class	1,688	75.5
Missing	38	1.7
Cohabitation		
Living alone	507	22.7
Cohabiting/married	1,719	76.9
Missing	9	0.4
Time since diagnosis		
< 5 years	842	37.7
5–10 years	952	42.6
> 10 years	425	19.0
Missing	16	0.7
Relapse		
No	1,878	84.0
Yes	210	9.4
Missing	147	6.6
Chemotherapy		
No	1,054	47.2
Y es	1,084	48.5
Missing	97	4.3
Total	2,235	100

Table 2 Description of nutritional habits among women diagnosed with breast cancer before and after diagnosis (n=2,235)

		Before diagnosis		After diagnosis		Percentage difference	p value[b]
		n	%	*n*	%		
Recommended diet	No	1,935	86.6	1,904	85.2	− 1.4	< 0.001
	Yes	123	5.5	214	9.6	4.1	
	Missing	177	7.9	117	5.2	− 2.7	
Vegetables	Unhealthy	1,301	58.2	1,138	50.9	− 7.3	< 0.001
	Healthy	809	36.2	1,005	45.0	8.8	
	Missing	125	5.6	92	4.1	− 1.5	
Fruit	Unhealthy	673	30.1	491	21.9	− 8.2	< 0.001
	Healthy	1,454	65.1	1,670	74.7	9.76	
	Missing	108	4.8	74	3.3	− 1.5	
Nuts	Unhealthy	1,634	73.1	1,376	61.6	− 11.5	< 0.001
	Healthy	445	19.9	739	33.1	13.2	
	Missing	156	7.0	120	5.4	− 1.6	
Legumes	Unhealthy	1,417	63.4	1,338	59.9	− 3.5	< 0.001
	Healthy	704	31.5	806	36.1	4.6	
	Missing	114	5.1	91	4.1	− 1.0	
Lean meat	Unhealthy	709	31.7	629	28.1	− 3.6	< 0.001
	Healthy	1,438	64.3	1,535	68.7	4.4	
	Missing	88	3.9	71	3.2	− 0.7	
Fish and seafood	Unhealthy	1,594	71.3	1,458	65.2	− 6.1	< 0.001
	Healthy	548	24.5	710	31.8	7.3	
	Missing	93	4.2	67	3.0	− 1.2	
Eggs	Unhealthy	1,555	69.6	1,745	78.1	8.5	< 0.001
	Healthy	584	26.1	421	18.8	− 7.3	
	Missing	96	4.3	69	3.1	− 1.2	
Dairy products	Unhealthy	902	40.4	1,085	48.6	8.2	< 0.001
	Healthy	1,246	55.8	1,084	48.5	− 7.3	
	Missing	87	3.9	66	3.0	− 0.9	
Cereals	Unhealthy	1,531	68.5	1,707	76.4	7.9	< 0.001
	Healthy	607	27.2	464	20.8	− 6.4	
	Missing	97	4.3	64	2.9	− 1.5	
Olive oil	Unhealthy	30	1.3	15	0.7	− 0.76	< 0.001
	Healthy	2,130	95.3	2,158	96.6	1.3	
	Missing	75	3.4	62	2.8	− 0.6	
Water	Unhealthy	1,369	61.3	1,141	51.1	− 10.1	< 0.001
	Healthy	734	32.8	1,022	45.7	12.9	
	Missing	132	5.9	72	3.2	− 2.7	
Total		2,235	100%	2,235	100%		

[a]Recommended diet: defined as healthy consumption of vegetables, fruits, farinaceous products (legumes or cereals), lean meat, and fish

[b]McNemar test. Statistical significance: $p < 0.050$; missing items are not considered

Table 3 Changes in consumptiom of the major healthy food groups following diagnosis with breast cancer (n=2,235)

	No change						Positive change Improve-ment		Negative change Worsen-ing		Missing		Total	
	Unhealthy consumption		Healthy con-sumption		Total									
	n	%	*n*	%	*n*	%	*n*	%	*n*	%	*n*	%	*n*	%
Vegetables	1,050	47.0	758	33.9	**1,808**	**80.9**	**237**	**10.6**	**48**	**2.2**	**142**	**6.3**	**2,235**	**100**
Fruit	451	20.2	1,419	63.5	**1,870**	**83.7**	**222**	**9.9**	**30**	**1.3**	**113**	**5.1**	**2,235**	**100**
Nuts	1,283	57.4	380	17.0	**1,663**	**74.4**	**336**	**15.0**	**64**	**2.9**	**172**	**7.7**	**2,235**	**100**
Legumes	1,238	55.5	625	27.9	**1,863**	**83.4**	**170**	**7.6**	**74**	**3.3**	**128**	**5.7**	**2,235**	**100**

No change—unhealthy consumption: unhealthy consumption before and after diagnosis. No change— healthy consumption: healthy consumption before and after diagnosis. Positive change—improvement: unhealthy consumption before diagnosis and healthy consumption afterward. Negative change—worsen- ing: healthy consumption before diagnosis and unhealthy consumption afterward

Table 4 Description of the relationship between improvement of the consumption of the major healthy food groups and socio-economic and clinical variables

	Vegetables ($n=1,287$)			Fruit ($n=673$)			Nuts ($n=1,619$)			Legumes ($n=1,408$)		
	n	%	*p* value[a]	*n*	%	*p* value[a]	*n*	%	*p* value[a]	*n*	%	*p* value[a]
Age												
< 50 years	66	33.0	< 0.001	63	38.9	0.012	80	30.2	< 0.001	50	21.2	< 0.001
50–65 years	106	18.4		119	34.5		162	21.4		81	12.2	
≥ 65 years	65	12.8		40	24.1		94	15.8		39	7.7	
Social class												
Manual class	39	12.8	0.003	30	22.9	0.006	56	16.1	0.013	15	5.6	< 0.001
Non-manual class	194	20.3		188	35.4		277	22.3		153	13.8	
Missing	4	14.8		4	36.4		3	11.5		2	7.1	
Cohabitation												
Living alone	60	20.7	0.278	41	31.8	0.727	88	25.1	0.025	36	11.4	0.699
Cohabiting/married	177	17.9		181	33.4		247	19.6		133	12.2	
Missing	0	0.0		0	0.0		1	14.3		1	16.7	
Time since diagnosis (years)												
< 5 years	101	20.2	0.229	92	33.8	0.479	141	22.9	0.252	72	13.1	0.591
5–10 years	98	18.5		96	34.2		134	19.1		70	11.5	
> 10 years	37	15.0		33	28.2		58	20.2		27	11.1	
Missing	1	12.5		1	33.3		3	21.4		1	14.3	
Relapse												
No	197	17.8	0.441	176	30.9	0.014	271	19.5	0.009	137	11.3	0.014
Yes	24	20.7		31	45.6		42	28.6		23	18.9	
Missing	16	25.0		15	42.9		23	28.1		10	14.3	
Chemotherapy												
No	109	17.3	0.471	82	28.2	0.032	144	19.0	0.172	68	10.1	0.029
Yes	117	18.9		129	36.1		176	21.7		97	14.0	
Missing	11	29.7		11	44.0		16	32.7		5	12.5	
Total												
	237	18.4		222	33.0		336	20.8		170	12.1	

[a]Chi-squared test

Statistical significance: $p < 0.050$; missing items are not considered

Table 5 Association between improved consumption of major healthy food groups and socioeconomic and clinical variables

	Vegetables ($n=1,287$)		Fruit ($n=673$)		Nuts ($n=1,619$)		Legumes ($n=1,408$)	
	OR_{biv} (95% CI)	OR_{multi} (95% CI)	OR_{biv} (95% CI)	OR_{multi} (95% CI)	OR_{biv} (95% CI)	OR_{multi} (95% CI)	OR_{biv} (95% CI)	OR_{multi} (95% CI)
Age (years)								
< 50 years	3.4 (2.27–4.99)	3.4 (2.23–5.31)	2.0 (1.24–3.22)	1.80 (1.07–3.02)	2.3 (1.64–3.25)	2.3 (1.56–3.31)	3.2 (2.06–5.09)	2.9 (1.78–4.81)
50–65 years	1.5 (1.10–2.15)	1.6 (1.11–2.30)	1.7 (1.09–2.52)	1.53 (0.97–2.40)	1.5 (1.64–1.93)	1.5 (1.07–1.96)	1.7 (1.12–2.50)	1.5 (0.97–2.32)
≥ 65 years	1		1		1		1	
Social class								
Manual class	1		1		1		1	
Non-manual class	1.6 (1.05–2.25)	1.5 (1.05–2.30)	1.8 (1.11–2.74)	1.8 (1.12–2.81)	1.4 (1.01–1.91)	1.4 (1.01–1.96)	2.4 (1.41–4.25)	2.5 (1.38–4.36)
Cohabitation								
Living alone	1.5 (1.03–2.04)	1.5 (1.03–2.12)	1.0 (0.67–1.55)	0.9 (0.58–1.43)	1.6 (1.19–2.13)	1.6 (1.20–2.19)	1.1 (0.75–1.68)	1.03 (0.67–1.58)
Cohabiting/married	1		1		1		1	
Time since diagnosis (years)								
< 5 years	1.2 (0.76–1.76)	1.2 (0.72–1.82)	1.2 (0.76–1.98)	1.3 (0.75–2.11)	0.9 (0.69–1.41)	1.2 (0.79–1.73)	1.0 (0.59–1.55)	1.2 (0.67–1.98)
5–10 years	1.2 (0.75–1.75)	1.1 (0.69–1.68)	1.2 (0.72–1.92)	1.1 (0.69–1.90)	0.9 (0.61–1.22)	0.9 (0.65–1.38)	0.9 (0.57–1.49)	1.1 (0.66–1.86)
> 10 years	1		1		1		1	
Relapse								
No	1		1		1		1	
Yes	1.1 (0.70–1.84)	1.2 (0.69–1.91)	1.8 (1.08–3.03)	1.9 (1.10–3.24)	1.6 (1.09–2.37)	1.7 (1.11–2.54)	1.8 (1.10–2.96)	1.8 (1.03–2.96)
Chemotherapy								
No	1		1		1		1	
Yes	1.0 (0.78–1.40)	1.2 (0.85–1.57)	1.4 (1.01–1.98)	1.5 (1.05–2.11)	1.1 (0.88–1.46)	1.2 (0.91–1.52)	1.4 (0.97–1.90)	1.4 (1.00–2.00)

OR biv bivariate odds ratio, adjusted by age; OR multi multivariate odds ratio, adjusted by all variables. 95% CI confidence interval of 95%