



# Use of health services among long-term breast cancer survivors in Spain: longitudinal study based on real-world data

Anna Jansana<sup>1,2,3</sup> · Laia Domingo<sup>1,3</sup> · Berta Ibañez<sup>3,4</sup> · Alexandra Prados<sup>3,5</sup> · Isabel Del Cura<sup>3,6,7</sup> · Maria Padilla-Ruiz<sup>3,8</sup> · Teresa Sanz<sup>3,6</sup> · Beatriz Poblador<sup>3,5</sup> · Ibai Tamayo<sup>3,4</sup> · Antonio Gimeno<sup>3,4</sup> · Angel Alberquilla<sup>3,6</sup> · Mercè Abizanda<sup>9</sup> · Mercè Comas<sup>1,3</sup> · Manuela Lanzuela<sup>10</sup> · Rossana Burgui<sup>11</sup> · Antonio Diaz Holgado<sup>12</sup> · Talita Duarte-Salles<sup>13</sup> · Conchi Moreno<sup>3,11</sup> · Javier Louro<sup>1,3</sup> · Javier Baquedano<sup>3,14</sup> · Cristobal Molina<sup>8</sup> · Maria del Carmen Martinez<sup>8</sup> · Javier Gorricho<sup>3,15</sup> · Maximino Redondo<sup>8</sup> · Xavier Castells<sup>1,3,16</sup> · Maria Sala<sup>1,3</sup> 

Received: 30 November 2020 / Accepted: 17 February 2021

© The Author(s), under exclusive licence to Springer Science+Business Media, LLC, part of Springer Nature 2021

## Abstract

**Purpose** This study aimed to evaluate health service utilization in Spain among long-term breast cancer survivors and to compare it with that among women with no history of breast cancer.

**Methods** Study based on the SURBCAN cohort includes a sample of long-term breast cancer survivors and a sample of women without breast cancer from 5 Spanish regions. Healthcare utilization was assessed through primary care, hospital visits, and tests during the follow-up period (2012 to 2016) by using electronic health records. Annual contact rates to healthcare services were calculated, and crude and multivariate count models were fitted to estimate the adjusted relative risk of healthcare services use.

**Results** Data were obtained from 19,328 women, including 6512 long-term breast cancer survivors. Healthcare use was higher among breast cancer survivors (20.9 vs 16.6;  $p < 0.0001$ ) and decreased from >10 years of survival. Breast cancer survivors who underwent a mastectomy were more likely to have a primary care visit (RR = 3.10 95% CI 3.08–3.11). Five to ten years survivors were more likely to have hospital inpatient visits and imaging test compared to women without breast cancer (RRa = 1.35 95% CI 1.30–1.39 and RRa = 1.27 95% CI 1.25–1.29 respectively).

**Conclusion** This study shows higher use of health services in long-term breast cancer survivors than in women without breast cancer regardless of survival time.

**Implications for Cancer Survivors** These results help to estimate the health resources needed for the growing group of breast cancer survivors and to identify risk factors that drive higher use of health services.

**Keywords** Breast cancer · Health services research · Cancer survivors · Primary care · Survival care · Real-world data

## Introduction

Long-term breast cancer survivors (BCS) are those women who survive breast cancer for at least 5 years after diagnosis [1]. The number of BCS is gradually increasing [2–5], and trends suggest their number will continue to increase due to improvements in breast cancer screening, advances in diagnosis and treatment, and greater life expectancy [6]. In 2019, the 5- and 10-year relative survival rates for women with invasive breast cancer were 90% and 83%, respectively [7–10].

The significant improvements in breast cancer treatment and survival have led to new challenges to health organizations related to follow-up. The National Cancer Institute of the United States (US) as well as other international organizations highlights the importance of providing a collaborative and coordinated follow-up shared between primary and specialized care, with special attention on comorbidities. Breast cancer-related comorbidities can strongly impact the long-term health of BCS, which complicates disease management [11–15].

Both Spanish and international guidelines agree that regular follow-up for long-term BCS is recommended to be mainly managed by primary care practitioners (PCP) after the 5th year of survival, and in all cases after the 10th year in the absence of cancer recurrence. PCP can provide equivalent follow-up care to oncologists in long-term BCS with the support of specialists regarding cancer-related comorbidities management

✉ Maria Sala  
msalaserra@parcdesalutmar.cat

Extended author information available on the last page of the article

[13, 14, 16]. To date, few studies have evaluated the use of health services among long-term BCS even though it is essential to understand this use to aid the resource planning required. Within the European context, results on long-term BCS healthcare use have been controversial [17]. Some studies report underuse of recommended medical visits [18] specially of imaging tests, while others report overuse of resources [19–21], such as too many visits to oncology services. The few existing studies also reported the need to optimize resources, although the prevailing health systems are different from the present study [22–24]. So far, in the Spanish context, there are not studies that tackle this particular issue.

Describing the real use of healthcare services is the first step to identify women with potentially inadequate follow-up and to propose interventions to address this problem [11, 12]. Real-world data helps to describe standardized health outcome measurements of long-term BCS, enabling optimal monitoring and comparison of the quality of healthcare across different settings [25, 26].

This study was based on the SURBCAN cohort (SURvival Breast CANcer Cohort) and aims to evaluate health service utilization and its determinants by using real-world data in a cohort of long-term BCS and to compare this resource use to that among women without history of breast cancer (non-BC). In addition, among the group of long-term BCS, we assessed whether the time since diagnosis and other women's characteristics play a role in the use of healthcare services.

## Methods

### Study design and population

The SURBCAN cohort is an observational population-based retrospective cohort study that includes long-term BCS and a control group of non-BC, matched by age and administrative health area (AHA). It includes women from 5 Spanish areas within the Spanish National Health Service (SNHS) [27]. Three areas corresponded to the reference population of three university hospitals: Hospital del Mar from Barcelona (Catalonia) that covers a population of 350000 people, Hospital Costa del Sol in Malaga (Andalusia) that covers 387026 people, and Hospital 12 de Octubre in Madrid that covers 431325 people. The SURBCAN cohort includes also women from the Autonomous Community of Navarra (population of 660887 people) and from the EpiChron Cohort in Aragón (includes 1253292 individuals from Aragón) [28].

The SNHS is universal and has full coverage. It is organized in two levels: primary health care and specialist care. However, access to specialist attention is gained by referral from primary health care. The SURBCAN cohort was developed on the basis of the STROBE checklist (online resource 1).

All women  $\geq 18$  years old with a diagnosis of incident breast cancer between 2000 and 2006 and a survival period of at least 5 years after diagnosis were identified in each participating area and were followed-up from January 1, 2012 to December 31, 2016. Women were identified by means of cancer registries. To ensure a minimum 5-year survival period, all included women had to be alive at the beginning of the follow-up period. For long-term BCS, survival time was calculated from the time of diagnosis to the start of follow-up. Long-term BCS were divided into two groups: women surviving 5–10 years and those surviving more than 10 years. Women with unknown date of diagnosis were excluded. In addition, long-term BCS were only included if they had attended at least one visit to primary care health services during the follow-up. Non-BC women were identified through the primary care registries of each participating area, and the pairing with long-term BCS was made in each participating area. All personal data were anonymized.

### Variables and information sources

The SURBCAN cohort is based on real-world data from electronic health records (EHR) and from tumor registries. The variables collected in the SURBCAN cohort were drawn from patients' routine contacts with the primary care and specialized care.

The main study variable was the annual contact rate of healthcare services per woman during the follow-up period. Rates were calculated for each of the healthcare services analyzed. The total number of contacts to each healthcare service was used as the numerator and the total number of women—year of the entire cohort—as the denominator. They were calculated separately among the long-term BCS group, the non-BC group, and according to whether survival was 5–10 years or more than 10 years.

The healthcare services analyzed were (1) primary care: primary care physician, nurse, and other primary care professionals. The category “Other primary care professionals” includes the psychologists, physical and rehabilitation therapists, and other medical professionals who see patients in primary care settings; (2) hospital-based inpatient contacts: hospital emergency visits and admissions. Moreover, medical specialty was also analyzed; (3) diagnostic tests: laboratory tests, imaging tests, and other tests; (4) outpatient visits to specialized hospital care were calculated only for long-term BCS due to data availability. These contacts were on-site, although we cannot exclude sporadic contacts through phone calls.

Demographic variables and lifestyle characteristics included age, AHA, and health coverage (active or pensioner) at the beginning of the follow-up and vital status at the end of follow-up (alive or exitus). Clinical variables included survival time (5–10 years or  $\geq 10$  years), tumor behavior (in situ or

invasive tumor), breast cancer surgical treatment (conservative, mastectomy, or without surgery/unknown technique), the number of active diagnoses, and the Charlson Comorbidity Index (CCI). The CCI was calculated using the original diagnoses from the International Disease Classification (IDC-9, IDC-10) and from the International Classification of Primary Care (CIAP2). Breast cancer diagnoses were excluded from long-term BCS registries to obtain a comorbidity index that was comparable between groups [14, 29, 30].

## Statistical analysis

Differences in demographic and clinical variables between long-term BCS and those in the non-BC group were assessed using either the chi-square or Mann-Whitney test. Annual contact rates of healthcare services were calculated for both BCS (5–10 years,  $\geq 10$  years, and total) and non-BC.

First, we applied generalized linear models (GLM) to estimate the crude relative risks (RR) and the 95% confidence intervals (CI) of utilizing health services based on women's characteristics (age, health coverage, Charlson index, vital status) for both BCS and non-BC. Moreover, for BCS, we estimated crude RR based on the characteristics of the tumor as well (tumor behavior, breast cancer surgical treatment). Second, to estimate the adjusted RR of health services use based on whether women were long-term BCS or non-BC, we applied multivariate GLM. The exposure time (total follow-up time, considering possible censorship such as death or loss to follow-up due to other causes) was used as offset. Regarding the characteristics of the models, the CCI and the AHA were used as predictors and the age at the beginning of follow up as a covariate. AHA was used as a predictor due to possible variability between territories in breast cancer survivorship care. These variables were selected in order to include the maximum number of women in the models. A sensitivity analysis was performed including health coverage to examine its effect on the model (online resource 3). Negative binomial models were used based on the model goodness-of-fit and data over-dispersion. Statistical analyses were performed through the SPSS statistical package (version 23.0).

## Results

### Women's characteristics

The study population consisted of 19328 women, including 6512 long-term BCS and 12816 women in the non-BC group. The women's baseline characteristics are shown in Table 1. The mean age at the beginning of follow-up was 66 years in both groups. Vital status at the end of follow-up was deceased in 12.6% of long-term BCS and 7.5% in the non-BC group. Among long-term BCS, 25.2% had survived for more than 10

years, and 87.3% were diagnosed with an invasive breast cancer tumor.

### Healthcare service utilization

Table 2 shows the annual contact rates with primary care, hospital-based inpatient visits, and tests performed in long-term BCS (5–10 years survival,  $> 10$  years survival, and total) and in non-BC women. The annual contact rate for all healthcare services was 26.5 contacts for 5–10 years BCS ( $n = 544,338$  contacts for the whole period), 18.5 contacts for  $> 10$  years BCS ( $n = 195,049$  contacts for the whole period), and 16.6 contacts for women in the non-BC group ( $n = 916,237$  contacts for the whole period) ( $p$  value  $< 0.0001$ ).

The annual visit rates among overall BCS for primary care physicians, nurses, and other primary care professionals were 8.0, 5.0, and 5.2, respectively, whereas these figures for women in the non-BC group were 7.9, 4.7, and 2.9, and all of them statistically different and lower in non-BC ( $p$  value  $< 0.0001$ ), especially for visits to other primary care professionals, were the rate difference (RD) was the highest (RD = 2.3) ( $p$  value  $< 0.0001$ ).

Analysis of hospital-based inpatient contacts showed that the overall annual rate was 0.7 in BCS and 0.2 in the non-BC group ( $p$  value  $< 0.0001$ ). However, no statistically significant differences were observed according to inpatient type of visit or medical specialty between groups. According to diagnostic tests, the annual rates were 1.9 and 0.8 among both long-term BCS groups and in non-BC women ( $p$  value  $< 0.0001$ ).

As presented in Table 3, crude relative risk (RR) showed that older women were more likely to contact primary care (RR (BCS) = 1.40, 95% CI 1.37–1.41 and RR (non-BC) = 1.70, 95% CI 1.68–1.73). Regardless of age, BCS were as well more likely to undergo more diagnostic tests. Higher disease burden (Charlson Index  $\geq 2$ ) was also associated with greater use of primary care (RR (BCS) = 1.10, 95% CI 1.05–1.70 and RR (non-BC) = 1.19, 95% CI 1.19–1.20) and hospital (RR (BCS) = 1.26, 95% CI 1.21–1.31 and RR (non-BC) = 1.17, 95% CI 1.15–1.30) for both groups. Moreover, long-term BCS that were alive at the end of follow-up and diagnosed with an invasive tumor were more likely to contact hospital-based inpatient services (RR = 1.20, 95% CI 1.10–1.40) compared to BCS diagnosed with an in situ tumor (online resource 2). Results show that those BCS who underwent a mastectomy as a surgical treatment for the primary breast cancer tumor were more likely to contact both primary care (RR = 3.10, 95% CI 3.08–3.11) and hospital services (RR = 1.05, 95% CI 1.02–1.06). BCS who died during the follow-up were more likely to undergo tests (RR = 1.09, 95% CI 1.03–1.15) while among non-BC those who died were more likely to contact hospital-based services (RR = 1.11, 95% CI 1.03–1.54).

**Table 1** Women's baseline characteristics ( $N = 19,328$ )

Characteristics	Long-term BCS $N = 6,512$	non-BC $N = 12,816$	$p$ value
Age at the beginning of follow-up, mean (SD)	66.0 (12.5)	66.0 (12.6)	
Age groups, $n$ (%)			
25–49 years	611 (9.4)	1,203 (9.4)	
50–69 years	3,425 (52.6)	6,684 (52.1)	
$\geq 70$ years	2,476 (38.0)	4,929 (38.5)	
Health coverage, $n$ (%) <sup>*</sup>			
Active	1,096 (27.5)	2,542 (32.4)	<0.0001
Pensioner	2,888 (72.5)	5,302 (67.6)	
Number of diagnoses at the beginning of follow-up, mean (SD) <sup>a</sup>	6.4 (6.9)	5.2 (4.9)	<0.0001
Charlson Index score, $n$ (%) <sup>b</sup>			
0–1	2,961 (45.5)	10,807 (84.3)	<0.0001
$\geq 2$	3,551 (54.5)	2,039 (15.7)	
Tumor behavior, $n$ (%) <sup>c</sup>			
In situ	516 (12.7)	-	
Invasive	3,533 (87.3)	-	
Survival time at the beginning of follow-up, $n$ (%)			
5–10 years	4,719 (74.8)	-	
>10 years	1,590 (25.2)	-	
Breast cancer surgical treatment, $n$ (%)			
Conservative	2,056 (50.7)	-	
Mastectomy	869 (21.4)	-	
Without surgery and unknown surgical treatment	1,131 (27.9)	-	
Vital status at the end of follow-up, $n$ (%)			
Alive	5,662 (87.4)	11,759 (91.7)	<0.0001
Exitus	819 (12.6)	965 (7.5)	

BCS, breast cancer survivors; non-BC, women without history of breast cancer

<sup>\*</sup>Number of women with missing data within this variable = 2,528 BCS and 4972 non-BC<sup>a</sup>Diagnoses at the beginning of follow-up include the baseline breast cancer diagnosis for BCS group and all other cancer codes within the primary care information system at the beginning of follow-up for both groups<sup>b</sup>The Charlson Index was calculated using ICD9, ICD10, and ICPC-2 codes at the beginning of the follow-up using primary care databases and excluding breast cancer codes for BCS<sup>c</sup>Number of women with missing data within this variable = 2,463 BCS

Compared with the non-BC group, both long-term BCS groups were more likely to use primary care services, with RR (5–10 years survival) = 1.14, 95% CI 1.06–1.16, and RR (>10 years survival) = 1.05, 95% CI 1.04–1.09 (Figure 1). BCS with 5–10 years survival more frequently had hospital-based inpatient contacts (RR = 1.35, 95% CI 1.30–1.39) than non-BC women. BCS with more than 10 years survival had far fewer hospital-based inpatient contacts than BCS with 5–10 years survival, but still more than non-BC women (RR = 1.10, 95% CI 1.07–1.18). Regarding diagnostic tests, both BCS groups were more likely to undergo an imaging test (RR (5–10 years survival) = 1.27, 95% CI 1.25–1.29 and RR (>10 years survival) = 1.10, 95% CI 1.08–1.12)

compared with the non-BC group. No differences were observed in laboratory tests or in other tests.

## Discussion

To our knowledge, this is the first study reporting healthcare contact rates during the follow-up period of long-term BCS and focusing on the population of long-term BCS in Spain. Our findings show that although the group of non-BC includes women diagnosed with cancers other than breast cancer, long-term BCS still use health services more than non-BC women, receiving follow-up from both their specialist

**Table 2** Healthcare services use among long-term BCS and women without breast cancer (non-BC)

	Long-term BCS						non-BC ( <i>N</i> = 12,816)		<i>p</i> value <sup>α</sup>
	5-10 years survival* ( <i>N</i> = 4,719)		> 10 years survival* ( <i>N</i> = 1,590)		Total BCS ( <i>N</i> = 6,512)				
	Total contacts ( <i>n</i> )	Annual contact rates <sup>a</sup>	Total contacts ( <i>n</i> )	Annual contact rates <sup>b</sup>	Total contacts ( <i>n</i> )	Annual contact rates <sup>c</sup>	Total contacts ( <i>n</i> )	Annual contact rates <sup>c</sup>	
Contacts to healthcare services									
Primary care	376,725	18.4	141,401	13.4	519,557	18.2	859,668	15.5	<0.0001
Hospital inpatient	14,869	0.7	4,433	0.4	21,243	0.7	11,299	0.2 <sup>^</sup>	<0.0001
Tests	38,136	1.9	14,175	1.3	54,123	1.9	42,270	0.8	<0.0001
Total contacts	544,338	26.5	195,049	18.5	594,923	20.9	916,237	16.6	<0.0001
Primary Care									
Primary care physician	163,300	7.9	58,348	5.5	228,373	8.0	437,530	7.9	<0.0001
Nurse	100,890	4.9	37,513	3.6	142,768	5.0	261,436	4.7	<0.0001
Other professionals <sup>d</sup>	112,535	5.5	45,540	4.3	148,416	5.2	160,702	2.9	<0.0001
Hospital-based outpatient	114,608	5.6	35,040	3.3	155,469	5.4	-	-	0.17
Hospital-based inpatient									
Emergency	6,463	0.3	2,041	0.2	9,784	0.3	7,249	0.2 <sup>^</sup>	0.82
Admissions	7,972	0.4	2,202	0.1	11,459	0.4	4,050	0.1 <sup>^</sup>	0.71
Visited specialtiese									
Surgical specialties	13,954	0.7	4,954	0.5	18,908	0.7	977	0.02 <sup>^</sup>	0.78
Medical specialties	41,497	2.0	13,341	1.3	54,838	1.9	1,738	0.04 <sup>^</sup>	0.57
Tests									
Laboratory <sup>f</sup>	12,439	0.6	4,972	0.5	17,969	0.6	16,680	0.3	0.08
Imaging	21,562	1.1	7,754	0.7	30,527	1.1	23,596	0.4	0.12
Other <sup>g</sup>	4,135	0.2	1,449	0.1	5,627	0.2	4,994	0.1	0.19

BCS, breast cancer survivors; non-BC, women without history of breast cancer

\*203 BCS were excluded from this analysis because of the lack of survival time data

<sup>a</sup> Total follow-up time for 5–10 years BCS was 20,509.0 years<sup>b</sup> Total follow-up time for >10 years BCS was 10,550.0 years<sup>c</sup> Total follow-up time for overall BCS was 28,484.0 years. Total follow-up time for non-BC was 55,355.7 years<sup>d</sup> Other primary care professionals include psychologists, physical and rehabilitation therapists, and other medical professionals who see patients in primary care settings<sup>e</sup> Surgical specialties include orthopedic, traumatology, and ophthalmology, and medical specialties include internal medicine, medical oncology, radiation oncology, obstetrics, and gynecology <sup>f</sup> Laboratory test performed on the same date using the same vector (blood, urine, feces...) were counted as one test<sup>g</sup> Other tests include respiratory, cardiovascular, and digestive diagnostic tests as well as biopsies<sup>^</sup> Rates referring to hospital visits were calculated including only woman whose data was available. The total follow-up time used in hospital visits among non-BC was 45,877.3 years<sup>α</sup> Significant differences between long-term BCS and non-BC were studied with Mann Whitney U test

physician and their primary care physician. This use decreases from 10 years after diagnosis but it remains slightly higher than that of non-BC women.

Although few studies compare health services use between long-term BCS and non-BC, those published in Northern Europe, USA, and Canada agree to our findings regarding that

BCS have higher use of health services compared to non-BC during all periods assessed (up to 17 years of survival), but that this use decreases as survival time increases [19, 20, 31, 32]. As pointed in other previous studies, the probability of death due to breast cancer at 10 years survival has been reduced over the last decades in our context [33]. However,



**Table 3** Healthcare services use and crude relative risk (RR) among long-term BCS characteristics

	Long-term BCS (N = 6,512)			Non-BC (N = 12,816)		
	Primary Care RR (95% CI)	Hospital-based inpatient RR (95% CI)	Test RR (95% CI)	Primary Care RR (95% CI)	Hospital-based inpatient RR (95% CI)	Test RR (95% CI)
Age						
25–49	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.
50–69	1.08 (1.07–1.10)	1.02 (0.97–1.09)	1.10 (1.06–1.14)	1.24 (1.23–1.25)	0.68 (0.62–0.74)	1.04 (1.02–1.49)
≥70	1.40 (1.37–1.41)	1.07 (0.75–1.11)	1.24 (1.20–1.29)	1.70 (1.68–1.73)	0.83 (0.76–0.90)	1.03 (1.01–1.44)
Health coverage						
Active	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.
Pensioner	1.10 (1.04–1.23)	1.07 (1.03–1.17)	1.08 (1.03–1.15)	1.13 (1.08–1.53)	1.05 (0.75–1.11)	1.08 (0.98–1.23)
Charlson Index						
0–1	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.
≥2	1.10 (1.05–1.70)	1.26 (1.21–1.31)	1.19 (0.68–1.22)	1.19 (1.19–1.20)	1.17 (1.15–1.30)	1.10 (0.98–1.13)
Tumor behavior						
In situ	Ref.	Ref.	Ref.	-	-	-
Invasive	1.11 (1.09–1.12)	1.30 (1.24–1.36)	1.02 (0.99–1.05)			
Breast cancer surgical treatment						
Conservative	Ref.	Ref.	Ref.	-	-	-
Mastectomy	3.10 (3.08–3.11)	1.05 (1.02–1.06)	1.18 (0.97–1.25)			
Without surgery and unknown surgical treatment	0.72 (0.69–0.75)	0.95 (0.94–0.97)	0.94 (0.93–1.09)			
Vital status <sup>a</sup>						
Alive	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.
Exitus	0.87 (0.54–0.98)	1.14 (0.76–1.17)	1.09 (1.03–1.15)	1.01 (0.86–1.23)	1.11 (1.03–1.54)	1.05 (0.75–1.13)

<sup>a</sup> Vital status at the end of follow-up (31 December 2016)

unlike non-BC, long-term BCS still have long-term probability of dying from breast cancer than from other causes which drives follow-up guidelines and recommendations to surveil for cancer recurrences. As observed in previous studies, our results elucidate that invasive tumor and mastectomy, besides comorbidity burden and age, might be key factors that drive long-term BCS to seek health services attention [34, 35]. Differences in annual contact rates between long-term BCS and non-BC could be attributed to cancer follow-up routine visits and tests to surveil for cancer recurrences and shed light on the importance of identifying other risk factors as those mentioned above [36, 37].

The decline in overall health services use after 10 years survival among long-term BCS reflects that practice is globally adherent to follow-up care guidelines. Long-term BCS follow-up guidelines recommend a decrease of the intensity of follow-up in BCS with 10 or more years survival [11, 12]. However, the highest probability of having inpatient visits, taking into account Charlson comorbidity index, was observed among BCS with 5–10 years, suggesting an improvement of health status of longer survivors probably due to a survival bias [33, 38].

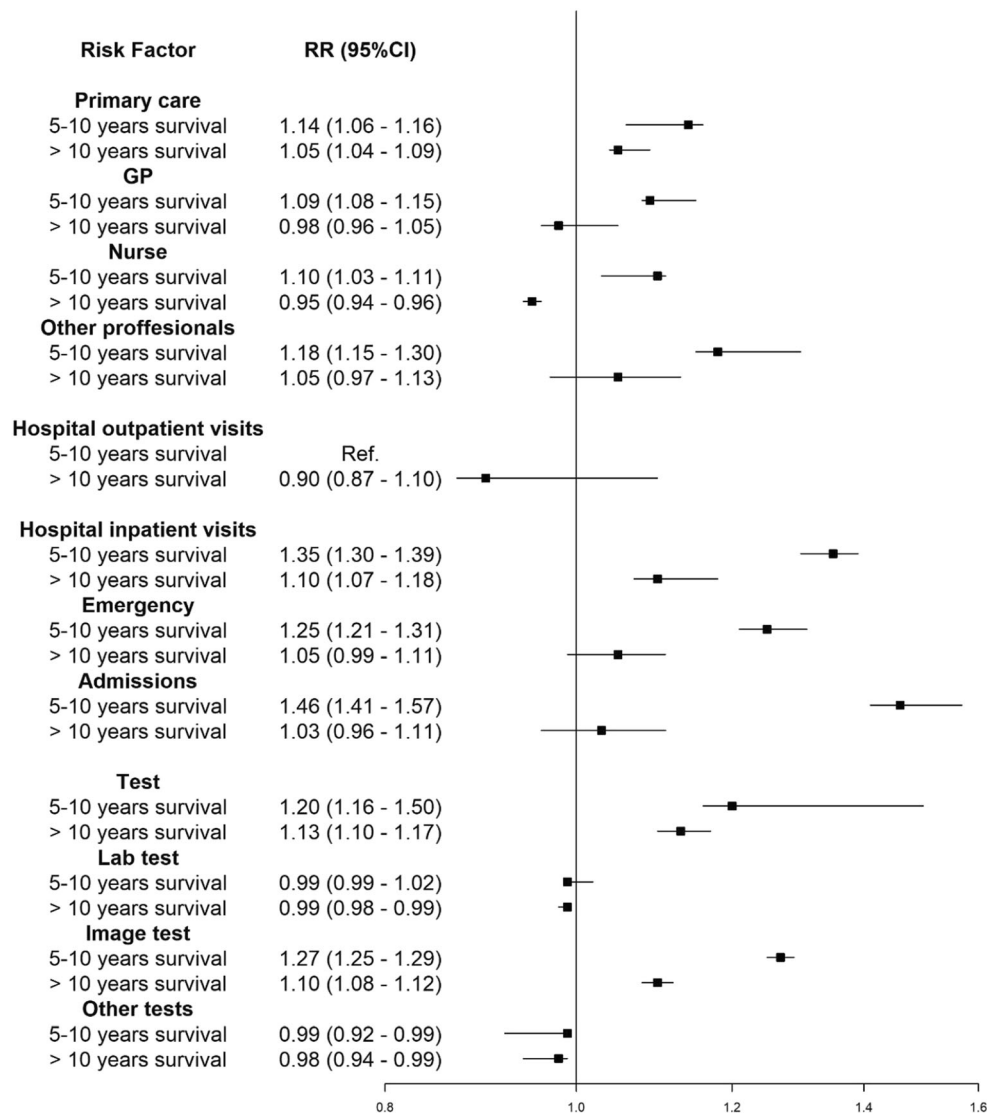
The greatest difference between BCS and non-BC was found in visits to primary care professionals who were neither the primary care physician nor the nurse. Similar results were found in a study conducted in The Netherlands reporting that younger BCS use more physical therapist and complementary caregivers [20]. This use of specialist within primary care

settings has been attributed to cancer-related comorbidities such as lymphedema, chronic pain, or mental health disorders [20–22]. It shows that although the transition from routine follow-up to primary care is recommended, it is also known that long-term BCS need the support of a range of professionals from various disciplines, not just medical attention, who can work together on the health and psychosocial problems that may arise from breast cancer in the medium and long-term and highlight the importance of including these professionals in the breast cancer survival care regardless of the setting in which they visit.

The most visited specialties were the non-surgical ones, being the annual rate greater than one visit. This has been supported by previous studies performed both in Europe and North America [32, 39, 40] that suggest that medical specialties, including oncology, may encompass breast cancer-related care as well as cancer comorbidities but may also reflect women's preferences [40–42]. Prolonged specialist follow-up care may represent inefficient use of specialist cancer resources and a worsening of health status.

Regarding diagnostic tests, our data revealed that both groups of long-term BCS were more likely to undergo an imaging test than non-BC. It is understandable for long-term BCS to be more likely to receive mammography because of their increased risk of recurrence [38, 41]. Annual mammography is recommended to long-term BCS while the European breast cancer screening guidelines recommend a biennial screening mammography until the age of 69–74 years in

**Figure 1** Adjusted relative risk (RR) of healthcare services use by long-term BCS and women without breast cancer (non-BC). Reference category is the non-BC group except for hospital outpatient visits. Models were adjusted by age, Charlson Index, administrative health area (AHA), and follow-up time. Other primary care professionals include psychologists, physical and rehabilitation therapists, and other medical professionals who see patients in primary care settings. Laboratory test performed on the same date using the same vector (blood, urine, feces...) was counted as one test. Other tests include this category includes respiratory, cardiovascular, and digestive diagnostic tests as well as biopsies.  $n$  (5–10 years survival) = 4719;  $n$  (> 10 years survival) = 1590.  $n$  = 203 BCS were excluded from this analysis because of lack of survival time data



non-BC women. Likewise, other studies have reported that around 54–80% of BCS undergo the recommended annual mammography [39, 42–44]. Nevertheless, a study from the UK showed that BCS were less likely to have a mammography than non-BC [41]. Indeed, BCS undergo other diagnostic and surveillance tests for breast cancer associated diseases and its treatment. For example, women treated with aromatase inhibitors are at increased risk of osteoporosis and should undergo annual densitometries [45].

This study provides an exhaustive characterization of the long-term BCS use of the SNHS compared to a non-BC group which has not been studied before in the Spanish population. Also, this study includes a sample of women with a survival of more than 10 years higher than other studies. Moreover, the quality of breast cancer diagnoses used has been validated before [46].

Nonetheless, this study has some limitations. Data were drawn from the SNHS and do not include private sector contacts. However, use of private sector for oncology processes is low in Spain [47]. Another limitation is that we were unable to differentiate among types of imaging tests, especially mammography, which could led to an overestimation of imaging test rates for surveillance purposes; however, this would have affected both the BCS group and the non-BC group. The same happens with identification of metastatic diseases and recurrences, which was not available for the entire cohort hampering deeper analysis. Of note, most of breast cancer recurrences occur before the 5 years after the diagnosis [48].

Finally, the existence of unknown values may have influenced the study and its results in some way.

However, we believe that performance of the pairing by AHA significantly minimized possible reporting bias.

## Conclusions

This study shows that long-term BCS use health services more than non-BC women, and that this use decreases after 10 years from the breast cancer diagnosis. In addition, BCS with invasive tumors and those who underwent mastectomy were more likely to contact health services. These results help to estimate the health resources needed for the growing group of BCS and to identify risk factors that drive higher use of health services.

Further quantitative and qualitative studies evaluating adherence to the existing survival follow-up recommendations are needed in order to identify gaps within follow-up and healthcare among long-term BCS care and to propose new strategies for long-term BCS follow-up.

**Supplementary Information** The online version contains supplementary material available at <https://doi.org/10.1007/s11764-021-01011-z>.

**Acknowledgments** Anna Jansana is a Ph.D. candidate at the Methodology of Biomedical Research and Public Health program, Universitat Autònoma de Barcelona (UAB), Barcelona, Spain (European Higher Education Area Doctoral Program in Methodology of Biomedical Research and Public Health in Department of Pediatrics, Obstetrics and Gynecology, Preventive Medicine and Public Health, Universitat Autònoma de Barcelona (UAB), Bellaterra, Barcelona, Spain).

The authors acknowledge the dedication and support of the SURBCAN Study Group (alphabetical order): IMIM (Hospital del Mar Medical Research Institute), Barcelona: Mercè Abizanda, Xavier Castells, Mercè Comas, Laia Domingo, Talita Duarte, Anna Jansana, Javier Louro, and María Sala. Hospital Costa del Sol, University of Malaga: María del Carmen Martínez, Cristóbal Molina, María del Carmen Padilla, and Maximino Redondo. Grupo EpiChron de Investigación en Enfermedades Crónicas, del Instituto Aragonés de Ciencias de la Salud, Aragón: Antonio Gimeno, Manuela Lanzuela, Beatriz Poblador, and Alexandra Prados. Primary Care Research Unit. Gerencia de Atención Primaria, Hospital Universitario 12 de Octubre, Madrid: Ángel Alberquilla, Isabel del Cura, Antonio Díaz, Teresa Sanz, Guillermo Pérez, Ana María Muñoz, Francisco Javier Salamanca, and Óscar Toldos. Grupo de investigación en servicios sanitarios y cronicidad de la Fundación Miguel Servet, Navarra: Javier Baquedano, Rossana Burgui, Javier Gorricho, Berta Ibáñez, Conchi Moreno, and Ibai Tamayo.

**Authors' contributions** MS, AJ, LD, BI, IDC, AP, and MR made substantial contributions to the design and conception of the study. AD, TS, and IDC took responsibility for the data acquisition of the Madrid sub-cohort; BP, AG, and ML for the Aragon sub-cohort; MP, MCM, and CM for the Costa del Sol sub-cohort; JG, JB, CM, and RB for the Navarre sub-cohort; and MS, AJ, JL, TDS, MC, LD, and MA for the Hospital del Mar sub-cohort. AJ took responsibility for data analysis, interpretation, and drafting the article.

MS, LD, MC, XC, BI, AP, MR, IDC provided advice for the study design, critical interpretation of the study, and gave final approval of the version to be published. All of the authors have read and approved the manuscript.

**Funding** This work was supported by Carlos III Health Institute [PI16/00244] and [PI19/00056] and by FEDER (European Regional Development Fund/European Social Fund) and by the Research Network on Health Services in Chronic Diseases [RD16/0001/0013].

**Data availability** Further details of the data analyzed in this work are available from the corresponding author on request.

## Declarations

**Ethics approval and consent to participate** This article does not contain any studies with human participants or animals performed by any of the authors. This project was accepted by the Clinical Research Ethics Committee of Parc de Salut Mar (n°2016/6835/I).

**Informed consent** For this type of study, formal consent is not required.

**Conflict of interest** The authors declare no conflict of interest.

## References

- Cardoso F, Harbeck N, Barrios C, Bergh J, Cortés J, El Saghir N, et al. Research needs in breast cancer. *Ann Oncol*. 2017;28(2):208–17.
- American Cancer Society. Cancer Facts & Figures 2019. Atlanta: American Cancer Society; 2019. <https://www.cancer.org/research/cancer-facts-statistics/>. Accessed 19 Feb 2020
- Bray F, Ferlay J, Soerjomataram I, Siegel RL, Torre LA, Jemal A. Global cancer statistics 2018: GLOBOCAN estimates of incidence and mortality worldwide for 36 cancers in 185 countries. *CA Cancer J Clin*. 2018;68(6):394–424. <https://doi.org/10.3322/caac.21492> Erratum in: *CA Cancer J Clin*. 2020 Jul;70(4):313.
- Stat Bite: Cancer Survivors In The United States. *J Natl Cancer Inst*. 2008;100(4):236. <https://doi.org/10.1093/jnci/djn018>.
- Hewitt M, Greenfield S, Stovall E. From cancer patient to cancer survivor: lost in transition. Washington, DC: National Academies Press; 2005.
- Erikson C, Salsberg E, Forte G, Bruinooge S, Goldstein M. Future simply and demand for oncologist: challenges to assuring access to oncology services. *J Oncol Pract*. 2007;3(2):79–86.
- Noone AM, Cronin KA, Altekruse SF, Howlander N, Lewis DR, Petkov VI, et al. Cancer incidence and survival trends by subtype using data from the surveillance epidemiology and end results program, 1992–2013. *Cancer Epidemiol Biomark Prev*. 2017;26(4):632–41. <https://doi.org/10.1158/1055-9965.EPI-16-0520>.
- Baeyens-Fernández JA, Molina-Portillo E, Pollán M, Rodríguez-Barranco M, del Moral R, Arribas-Mir L, et al. Trends in incidence, mortality and survival in women with breast cancer from 1985 to 2012 in Granada, Spain: a population-based study. *BMC Cancer*. 2018;18(1):781.
- Engholm G, Ferlay J, Christensen N, Bray F, Gjerstorff ML, Klint A, et al. NORDCAN—a Nordic tool for cancer information, planning, quality control and research. *Acta Oncol*. 2010;49(5):725–36.
- Cancer research UK. <https://www.cancerresearchuk.org/about-cancer/about-our-information/writers-guidelines>. Accessed 16 March 2020.
- Runowicz C, Leach C, Henry N, Henry K, MEckey H, Cowens-Alvarado R, et al. American Cancer Society/American Society of Clinical Oncology Breast Cancer Survivorship Care Guideline. *CA Cancer J Clin*. 2016;66(1):43–73.
- Alba E, Cruz J, Barón F, Rodríguez X, Blasco A, Escobar Y, et al. Monográfico SEOM de largos supervivientes en cáncer. Sociedad




- Española de Oncología Médica. Madrid: 2012. [https://seom.org/seomcms/images/stories/recursos/infopublico/publicaciones/MONOGRAFICO\\_SEOM\\_LARGOS\\_SUPERVIVIENTES\\_1.pdf](https://seom.org/seomcms/images/stories/recursos/infopublico/publicaciones/MONOGRAFICO_SEOM_LARGOS_SUPERVIVIENTES_1.pdf). Accessed 31 March 2020.
13. McBride ML, Groome PA, Decker K, et al. Adherence to quality breast cancer survivorship care in four Canadian provinces: a CanIMPACT retrospective cohort study. *BMC Cancer*. 2019;19(1):659. <https://doi.org/10.1186/s12885-019-5882-z>.
  14. Chen YY, Hsieh CI, Chung KP. Continuity of care, follow-up care, and outcomes among breast cancer survivors. *Int J Environ Res Public Health*. 2019;16(17):3050. <https://doi.org/10.3390/ijerph16173050>.
  15. Ong WL, Schouwenburg MG, van Bommel ACM, Stowell C, Allison KH, Benn KE, et al. A Standard Set of Value-Based Patient-Centered Outcomes for Breast Cancer: The International Consortium for Health Outcomes Measurement (ICHOM) Initiative. *JAMA Oncol*. 2017;3(5):677–85. <https://doi.org/10.1001/jamaoncol.2016.4851>.
  16. Rubinstein EB, Miller WL, Hudson SV, Howard J, O'Malley D, Tsui J, et al. Cancer survivorship care in advanced primary care practices: a qualitative study of challenges and opportunities. *JAMA Intern Med*. 2017;177(12):1726–32. <https://doi.org/10.1001/jamainternmed.2017.4747>.
  17. Jansana A, Posso M, Guerrero I, Prados-Torres A, Del Cura I, Castells X, et al. Health care services use among long-term breast cancer survivors: a systematic review. *J Cancer Surviv*. 2019;13:477–93.
  18. Khan N, Watson E, Rose P. Primary care consultation behaviors of long-term, adult survivors of cancer in the UK. *Br J Gen Pract*. 2011;61(584):197–9.
  19. Nord C, Mykletun A, Thorsen L, Bjørø T, Fosså SD. Self-reported health and use of health care services in long-term cancer survivors. *Int J Cancer*. 2005;114(2):307–16.
  20. Poll-Franse L, Mols F, Vingerhoets A, Voogd A, Roumen R, Coebergh J. Increased health care utilisation among 10-year breast cancer survivors. *Support Care Cancer*. 2005;14:436–43.
  21. Grunfeld E, Hodgson DC, Del Giudice ME, Moineddin R. Population-based longitudinal study of follow-up care for breast cancer survivors. *J Oncol Pract*. 2010;6(4):174–81. <https://doi.org/10.1200/JOP.200009>.
  22. Patnaik JL, Byers T, Diguseppi C, Denberg TD, Dabelea D. The influence of comorbidities on overall survival among older women diagnosed with breast cancer. *J Natl Cancer Inst*. 2011;103(14):1101–11.
  23. Miller K, Siegel R, Lin C, Mariotto A, Kramer J, Rowland J, et al. Cancer treatment and survivorship statistics, 2016. *CA Cancer J Clin*. 2016;66(4):271–89.
  24. Yan S, Kwan YH, Thumboo J, Low LL. Characteristics and health care utilization of different segments of a multiethnic Asian population in Singapore. *JAMA Netw Open*. 2019;2(9):e1910878. <https://doi.org/10.1001/jamanetworkopen.2019.10878>.
  25. Jutte D, Roos L, Brownell M. Administrative record linkage as a tool for public health research. *Annu Rev Public Health*. 2011;32(1):91–108.
  26. Birkhead GS. Successes and continued challenges of electronic health records for chronic disease surveillance. *Am J Public Health*. 2017;107(9):1365–7.
  27. Jansana A, Del Cura I, Prados-Torres A, Sanz Cuesta T, Poblador-Plou B, Gimeno Miguel A, et al. Use of real-world data to study health services utilisation and comorbidities in long-term breast cancer survivors (the SURBCAN study): study protocol for a longitudinal population-based cohort study. *BMJ Open*. 2020;10(9):e040253. <https://doi.org/10.1136/bmjopen-2020-040253>.
  28. Prados-Torres A, Poblador-Plou B, Gimeno-Miguel A, Calderón-Larrañaga A, Poncel-Falcó A, Gimeno-Feliú LA, et al. Cohort profile: the epidemiology of chronic diseases and multimorbidity. The EpiChron Cohort Study. *Int J Epidemiol*. 2018;47(2):382–384f. <https://doi.org/10.1093/ije/dyx259>.
  29. Bannay A, Chaignot C, Blotière PO, Basson M, Weill A, Ricordeau P, et al. The best use of the Charlson Comorbidity Index with electronic health care databases to predict mortality. *Med Care*. 2016;54(2):1881–194.
  30. Brusselaers N, Lagergren J. The Charlson comorbidity index in Registry-based research. *Methods Inf Med*. 2017;56(5):401–6.
  31. Snyder CF, Frick KD, Peairs KS, Kantsiper ME, Herbert RJ, Blackford A, et al. Comparing care for breast cancer survivors to non-cancer controls: a five-year longitudinal study. *J Gen Intern Med*. 2009;24:469–74.
  32. Kendell C, Decker KM, Groome PA, McBride ML, Jiang L, Krzyzanowska MK, et al. Use of physician services during the survivorship phase: a multi-province study of women diagnosed with breast cancer. *Curr Oncol*. 2017;24(2):81–9. <https://doi.org/10.3747/co.24.3454>.
  33. Cléries R, Ameijide A, Buxó M, Martínez JM, Marcos-Gragera R, Vilardell ML, et al. Long-term crude probabilities of death among breast cancer patients by age and stage: a population-based survival study in Northeastern Spain (Girona-Tarragona 1985-2004). *Clin Transl Oncol*. 2018;20:1252–60.
  34. Hofvind S, Holen, Aas T, Roman M, Sebuødegård S, Akslen LA. Women treated with breast conserving surgery do better than those with mastectomy independent of detection mode, prognostic and predictive tumor characteristics. *Eur J Surg Oncol*. 2015;41(10):1417–22.
  35. Miret C, Domingo L, Louro J, Barata T, Baré M, Ferrer J, et al. Factors associated with readmissions in women participating in screening programs and treated for breast cancer: a retrospective cohort study. *BMC Health Serv Res*. 2019;19(1):940.
  36. Cléries R, Buxó M, Yasui Y, Marcos-Gragera R, Martínez JM, Ameijide A, et al. Estimating long-term crude probability of death among young breast cancer patients: a Bayesian approach. *Tumori*. 2016;102(6):555–61.
  37. Dal Maso L, Guzzinati S, Buzzoni C, Capocaccia R, Serraino D, Caldarella A, et al. Long-term survival, prevalence, and cure of cancer: a population-based estimation for 818 902 Italian patients and 26 cancer types. *Ann Oncol*. 2014;25(11):2251–60.
  38. Virgo KS, Lerro CC, Klabunde CN, Earle C, Ganz PA. Barriers to breast and colorectal cancer survivorship care: perceptions of primary care physicians and medical oncologists in the United States. *J Clin Oncol*. 2013;31(18):2322–36.
  39. Baena-Cañada JM, Ramírez-Daffós P, Cortés-Carmona C, Rosado-Varela P, Nieto-Vera J, Benítez-Rodríguez E. Follow-up of long-term survivors of breast cancer in primary care versus specialist attention. *Fam Pract*. 2013;30(5):525–32.
  40. Urquhart R, Folkes A, Babineau J, Grunfeld E. Views of breast and colorectal cancer survivors on their routine follow-up care. *Curr Oncol*. 2012;19(6):294–301.
  41. Khan NF, Carpenter L, Watson E, Rose PW. Cancer screening and preventative care among long-term cancer survivors in the United Kingdom. *Br J Cancer*. 2010;102:1085–90.
  42. Grunfeld E, Julian JA, Pond G, Maunsell E, Coyle E, Folkes A, et al. Evaluating survivorship care plans: results of a randomized, clinical trial of patients with breast cancer. *J Clin Oncol*. 2011;29(36):4755–62.
  43. Jones T, Duquette D, Underhill M, Ming C, Menderlsohn-Victor K, Anderson B, et al. Surveillance for cancer recurrence in long-term young breast cancer survivors randomly selected from a statewide cancer registry. *Breast Cancer Res Treat*. 2018;169:141–52.
  44. Field TS, Doubeni C, Fox MP, Buist DSM, Wei F, Geiger AM, et al. Under Utilization of Surveillance Mammography among Older Breast Cancer Survivors. *J Gen Intern Med*. 2007;23:158–63.
  45. Bouvard B, Chatelais J, Soulié P, Hoppé E, Saulnier P, Capitain O, et al. Osteoporosis treatment and 10 years' oestrogen receptor+

- breast cancer outcome in postmenopausal women treated with aromatase inhibitors. *Eur J Cancer*. 2018;101:87–94. <https://doi.org/10.1016/j.ejca.2018.06.028>.
46. Recalde M, Manzano-Salgado CB, Díaz Y, Garcia-Gil MDM, Marcos-Gragera R, Ribes-Puig J. Validation of cáncer diagnoses in electronic health records: results from the Information System for Research in Primary Care (SIDIAP) in Northeast Spain. *Clin Epidemiol*. 2019;11:1015–24.
  47. Cantarero-Prieto D, Pascual-Sáez M, Gonzalez-Prieto N. Effect of having private health insurance on the use of health care services: the case of Spain. *BMC Health Serv Res*. 2017;17:716.
  48. Ferlay J, Steliarova-Foucher E, Lortet-Tieulent J, Rosso S, Coebergh JWW, Comber H, et al. Cancer incidence and mortality patterns in Europe: estimates for 40 countries in 2012. *Eur J Cancer*. 2013;49:1374–03.

**Publisher's note** Springer Nature remains neutral with regard to jurisdictional claims in published maps and institutional affiliations.

## Affiliations

**Anna Jansana**<sup>1,2,3</sup> · **Laia Domingo**<sup>1,3</sup> · **Berta Ibañez**<sup>3,4</sup> · **Alexandra Prados**<sup>3,5</sup> · **Isabel Del Cura**<sup>3,6,7</sup> · **Maria Padilla-Ruiz**<sup>3,8</sup> · **Teresa Sanz**<sup>3,6</sup> · **Beatriz Poblador**<sup>3,5</sup> · **Ibai Tamayo**<sup>3,4</sup> · **Antonio Gimeno**<sup>3,4</sup> · **Angel Alberquilla**<sup>3,6</sup> · **Mercè Abizanda**<sup>9</sup> · **Mercè Comas**<sup>1,3</sup> · **Manuela Lanzuela**<sup>10</sup> · **Rossana Burgui**<sup>11</sup> · **Antonio Diaz Holgado**<sup>12</sup> · **Talita Duarte-Salles**<sup>13</sup> · **Conchi Moreno**<sup>3,11</sup> · **Javier Louro**<sup>1,3</sup> · **Javier Baquedano**<sup>3,14</sup> · **Cristobal Molina**<sup>8</sup> · **Maria del Carmen Martinez**<sup>8</sup> · **Javier Gorricho**<sup>3,15</sup> · **Maximino Redondo**<sup>8</sup> · **Xavier Castells**<sup>1,3,16</sup> · **Maria Sala**<sup>1,3</sup> 

<sup>1</sup> Department of Epidemiology and Evaluation, IMIM (Hospital del Mar Medical Research Institute), Passeig Marítim, 25-29, 08003 Barcelona, Spain

<sup>2</sup> European Higher Education Area Doctoral Program in Methodology of Biomedical Research and Public Health in Department of Pediatrics, Obstetrics and Gynecology, Preventive Medicine and Public Health, Universitat Autònoma de Barcelona (UAB), Bellaterra, Barcelona, Spain

<sup>3</sup> Health Services Research on Chronic Patients Network (REDISSEC), Institute of Health Carlos III, Madrid, Spain

<sup>4</sup> Navarrabiomed-Complejo Hospitalario de Navarra-Universidad Pública de Navarra, IdiSNA, Irunlarrea, s/n, 31008 Pamplona, Spain

<sup>5</sup> IIS Aragon, Miguel Servet University Hospital, EpiChron Research Group, Aragon Health Sciences Institute (IACS), Zaragoza, Spain

<sup>6</sup> Madrid Health Service, Primary Care Research Unit, Calle San Martín de Porres, 6-5ª planta, 28035 Madrid, Spain

<sup>7</sup> Department of Preventive Medicine and Public Health, University Rey Juan Carlos, Avenida de Atenas, 28922 Alcorcón, Madrid, Spain

<sup>8</sup> Research Unit, Costa del Sol Hospital, University of Málaga, Instituto de Investigación Biomédica de Málaga (IBIMA), Marbella, Spain

<sup>9</sup> Department of Organization and Communication, Parc Sanitari Pere Virgili, Barcelona, Spain

<sup>10</sup> Radiotherapy Department, Miguel Servet University Hospital, Saragossa, Spain

<sup>11</sup> Instituto de Salud Pública y Laboral de Navarra (ISPLN), IdiSNA, Pamplona, Spain

<sup>12</sup> Madrid Health Service, Technical Direction of Sanitary Information System, Calle San Martín de Porres, 6- 5ª planta, 28035 Madrid, Spain

<sup>13</sup> Fundació Institut Universitari per a la recerca a l'Atenció Primària de Salut Jordi Gol i Gurina (IDIAPJGol), Barcelona, Spain

<sup>14</sup> Servicio Navarro de Salud-Osasunbidea, Gerencia de Atención Primaria, Pamplona, Spain

<sup>15</sup> Servicio de Evaluación y Difusión de resultados en Salud, Servicio Navarro de Salud-Osasunbidea, Pamplona, Spain

<sup>16</sup> Autonomous University of Barcelona (UAB), 08193 Bellaterra, Barcelona, Spain