



Original article

Changes in employment status up to 5 years after breast cancer diagnosis: A prospective cohort study



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ABSTRACT

Aim: To assess how sociodemographic, clinical and treatment characteristics impact employment status five-years following a breast cancer diagnosis, and to compare the incidence rate of changes with the general population.

Methods: A total of 462 women with incident breast cancer were evaluated before treatment and three- and five-years later. Adjusted odds ratios (ORs) with 95% confidence intervals (95%CI) were computed through multinomial logistic regression. Data for comparisons were retrieved from the SHARE Project. Incidence rate ratios (IRRs) with 95%CI were calculated using Poisson regression.

Results: Among the 242 employed women prior to diagnosis, 162 remained employed, 26 became unemployed, 27 entered early retirement, 14 entered normal retirement and 13 were on sick leave at five-years. Unemployment increased with age (≥ 55 vs < 55 years: OR = 4.49, 95%CI: 1.56–12.92; OR = 3.40, 95%CI: 1.05–10.97 at three- and five-years, respectively) and decreased with education (> 4 vs ≤ 4 years: OR = 0.36, 95%CI: 0.13–0.97; OR = 0.27, 95%CI: 0.10–0.71 at three- and five-years, respectively). Axillary surgery (unemployment at five-years: OR = 5.13, 95%CI: 1.30–20.27), hormonal therapy (unemployment at three-years: OR = 0.28, 95%CI: 0.10–0.83) and targeted therapy (sick leave at three-years: OR = 3.79, 95%CI: 1.14–12.63) also influenced employment status. Five-years post diagnosis, women with breast cancer had a lower incidence of unemployment (IRR = 0.51, 95%CI: 0.30–0.89) than the general population, while, among older women, there was a higher tendency to enter early retirement (IRR = 1.72, 95%CI: 0.82–3.61).

Conclusions: Although not all women may want to pursue or continue a professional life following their breast cancer experience; those who do may benefit from social and employer support when returning to work.

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1. Introduction

Breast cancer is the most frequent cancer among women, with nearly 2.1 million new cases diagnosed in 2018 [1]. Due to improved access to early diagnosis [2] and effective treatments, including new adjuvant drugs and less aggressive surgeries [3], breast cancer survival has increased over the last decades [4]; the most recent five-year net survival estimates surpass 80% in most developed

countries [5]. Additionally, almost two-thirds of newly diagnosed patients are under the age of 65 years [1], which further contributes to a growing number of survivors who return to their daily routine following a breast cancer diagnosis.

Returning to work can symbolize re-entering ordinary life and helps patients increase their self-esteem and quality of life [6]. However, several factors have been described to influence employment status following breast cancer treatment [7]. Older age [8] and a lower educational level [9] have been consistently associated with lower employment rates, whereas other factors, such as clinical characteristics and treatments, had heterogeneous results [10,11]. Furthermore, it seems that the factors influencing employment status change over time, while most reports focus on

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the role of clinical and treatment characteristics in the first three years; studies with longer follow-up times have demonstrated that sociodemographic and work-related factors have a more predominant role five to 10 years after diagnosis [12,13]. Additionally, most previous research has focused on the effect of sociodemographic, clinical and job characteristics on the return to work of breast cancer patients following diagnosis [8,9,14,15]. In this context, there are also other possible employment outcomes: it can be harder for some women to find a job after breast cancer diagnosis due to comorbidities, and for this reason may remain unemployed, retire early or remain on sick leave for longer periods of time [16–18].

Therefore, the aims of this study were to assess how socio-demographic, clinical and treatment characteristics at baseline impact employment status, namely changes to unemployment, early retirement and sick leave among breast cancer patients employed at baseline and followed prospectively for five years, and to compare the incidence rate of unemployment and early retirement between these patients and the general population.

2. Methods

2.1. Cohort of breast cancer patients

This is a prospective cohort study including women with newly diagnosed breast cancer admitted to the Breast Clinic of the Portuguese Institute of Oncology of Porto and followed for five years. The study methods have been described in detail elsewhere [19]. Briefly, study participants were consecutively recruited in 2012, among women aged 18 years or older, with histologically confirmed breast cancer, proposed for surgery, either as primary treatment or after neoadjuvant chemotherapy. The study included those who had not previously received any treatment for breast cancer, had not been submitted to a previous breast surgery, were never treated with chemotherapy and/or radiotherapy in the chest or axillary areas for other primary cancers, and who could understand the purposes of the study and were willing to collaborate.

A total of 506 participants underwent a baseline evaluation, before treatment, from whom 31 and 11 were lost to follow-up at the three- and five-year evaluations, respectively (Fig. 1). Further, two women with stage IV cancer were excluded. Therefore, data from 462 (91.3%) participants were available for the present analysis. The latter were not significantly different from those excluded or lost to follow-up, regarding age (median age at diagnosis: 54.9 vs. 54.2 years, respectively; $p = 0.630$), educational level (median

years: 7.7 vs. 6.9, respectively; $p = 0.197$), marital status (married or cohabitating: 69.9% vs. 68.2%, respectively; $p = 0.810$) or breast cancer stage (stages 0/I: 55.0% vs. 41.0%, stage II: 30.0% vs. 41.0%, stage III: 14.7% vs. 17.9%, respectively; $p = 0.237$).

Sociodemographic data were collected through face-to-face interviews using a structured questionnaire in all evaluations. Employment status before diagnosis and at three-, and five-years after diagnosis was assessed at the three- and five-year follow-up, respectively. Employment status was selected from eight categories: full-time job, part-time job, unpaid family worker, unemployed, student, retired or early retired, housewife, and other. The latter was specified through an open-ended question.

Information on cancer stage and treatment was collected from clinical records. Cancer stage was classified according to the seventh American Joint Committee on Cancer staging manual [20].

Anxiety and depression at baseline were evaluated using The Hospital Anxiety and Depression Scale (HADS) [21,22]. HADS classifies anxiety and depression in the past week using a score range from 0 to 21, in which a score greater than or equal to 11 for each of them was defined as indicative of clinically significant anxiety or depression.

The characteristics of patients are presented as counts and proportions for all categorical variables, and median and percentiles 25 and 75 (P25–P75) for continuous variables.

For statistical analysis, employment status was classified into five categories: employment (those working full- and part-time jobs, and unpaid family workers), unemployment (unemployed and housewives), early retirement (those who retired with less than 65 years – for women retiring during follow-up, age at retirement was estimated as the midpoint age between the nearest evaluations), normal retirement (those who retired with more than or equal to 65 years) and sick leave.

Adjusted odds ratios (ORs) and 95% confidence intervals (CIs) were computed using multinomial logistic regression, to quantify the relation between sociodemographic and clinical characteristics at baseline, and breast cancer treatments and employment status at three- and five-years after diagnosis, among women who were employed at baseline. For these analyses, the outcomes of interest were: unemployment, early retirement and sick leave. Each model included potential confounders, according to the scientific literature [23], as described in the footnotes of Fig. 3.

2.2. Comparison to the general population

A representative sample of the female adult Portuguese population assembled as part of the Fourth and Sixth Waves of the Survey of Health, Ageing and Retirement in Europe (SHARE), conducted in 2011 and 2015, respectively, was used as a source for the comparison group of the general population [24–26].

Participants were evaluated through computer-assisted face-to-face interviews, using a structured and *ex-ante* harmonized questionnaire. Employment status was selected from six categories: retired (semi-retired, partially retired, early retired and pre-retired), employed or self-employed (paid work, working for family business but unpaid and workers who are still employees of a firm though currently not paid), unemployed, permanently sick or disabled, homemaker, and other. For statistical analyses, three categories were used: employment, unemployment and early retirement (those who retired with less than 65 years – for women retiring during follow-up, age at retirement was estimated as the midpoint age between the nearest evaluations, and those who selected the option permanently sick or disabled).

A total of 862 Portuguese females aged between 38 and 89 were evaluated in both the Fourth and Sixth Waves. After excluding 68 women with a previous cancer diagnosis and those who were not

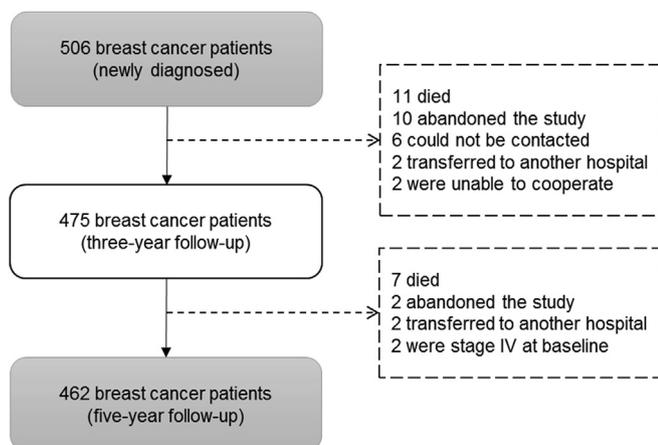


Fig. 1. Flowchart describing the number of breast cancer patients in each of the follow-up evaluations.

Table 1
Sociodemographic and clinical characteristics at baseline, and treatments of breast cancer patients.

Characteristics	N (%)
Age, years	
<55	232 (50.2)
≥55	230 (49.8)
Education, years	
≤4	194 (42.0)
>4	268 (58.0)
Marital status	
Married or cohabitating	323 (69.9)
Other ^a	139 (30.1)
Monthly income before diagnosis, euros^b	
≤500	250 (55.3)
>500	202 (44.7)
Place of residence	
Porto Metropolitan Area	160 (34.6)
Outside the Porto Metropolitan Area	302 (65.4)
Employment status before diagnosis	
Employed	242 (52.4)
Unemployed	103 (22.3)
Early retired	47 (10.2)
Normal retired	70 (15.1)
Anxiety^c	178 (38.5)
Depression^c	38 (8.2)
Cancer stage	
0/I	254 (55.0)
II/III	208 (45.0)
Breast surgery^d	
Breast-conserving	235 (50.9)
Mastectomy	227 (49.1)
Axillary surgery^e	
None/SLNB	309 (66.9)
ALND	153 (33.1)
Chemotherapy	277 (60.0)
Radiotherapy	339 (73.4)
Hormone therapy	356 (77.0)
Targeted therapy	48 (10.4)

ALND: Axillary lymph node dissection; SLNB: Sentinel lymph node biopsy.

^a Including single, widowed and divorced women.

^b N=452 due to 6 missing values and 4 participants that did not know/answer. Monthly income before diagnosis considered the patients' total monthly net income.

^c Anxiety and depression were defined as a score greater than or equal to 11 in the respective anxiety and depression subscales of the Hospital Anxiety and Depression Scale [21].

^d Patients who had both mastectomy and breast-conserving surgery are reported as mastectomy.

^e Patients who had both ALND and SLNB are reported as ALND.

employed at the Fourth Wave evaluation, 180 women were considered in the comparison group for the present study.

Adjusted incidence rate ratios (IRRs) with 95% CIs were calculated through Poisson regression to compare the incidence rates of employment changes between breast cancer patients and women from the general population. For these analyses, the outcomes of interest were unemployment and early retirement among those who were previously employed.

3. Results

3.1. Cohort of breast cancer patients

Participants' characteristics are shown in Table 1. At baseline, more than half of the women were less than 55 years old (50.2%) and had successfully completed more than four years of education (58.0%). Two-thirds were married or cohabitating with a partner (69.9%) and lived outside the Porto Metropolitan Area (65.4%), and approximately half were employed before diagnosis (52.4%) and had a monthly income of less than 500 euros (55.3%). At baseline, a total of 38.5% and 8.2% had anxiety and depression, respectively. Over half of the patients were diagnosed with stage 0/I cancer (55.0%) or performed a breast-conserving surgery (50.9%) and one-third were submitted to axillary surgery (33.1%). Most of the women underwent chemotherapy (60.0%), radiotherapy (73.4%) and hormone therapy (77.0%), whereas just over 10% received targeted therapy.

As depicted in Fig. 2, there was a decrease in the number of employed women before diagnosis to the five-year follow-up evaluation. Among the 242 women who were employed prior to breast cancer diagnosis, 170 (70.2%) were employed, 24 (9.9%) became unemployed, 19 (7.8%) entered early retirement, 8 (3.3%) entered normal retirement and 21 (8.7%) were on sick leave at three-years; the corresponding figures at five-years were 162 (66.9%), 26 (10.7%), 27 (11.2%), 14 (5.8%) and 13 (5.4%). The median (P25–P75) retirement age was similar at both follow-up evaluations: 57.8 (49.6–59.4) years at three-years and 55.4 (48.2–60.4) years at five-years for early retirement, and 65.7 (65.1–66.5) years at three-years and 66.1 (64.7–67.1) years at five-years for normal retirement.

Fig. 3 shows the association between sociodemographic and clinical characteristics, and treatment of breast cancer patients and

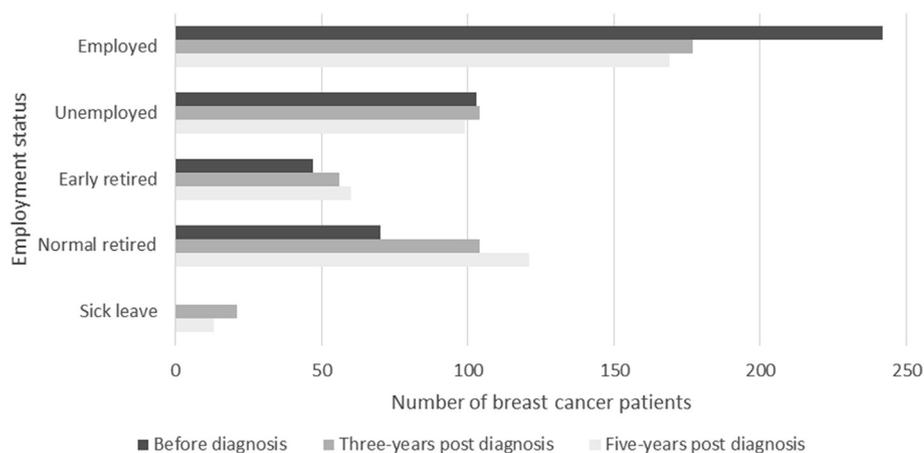


Fig. 2. Changes in employment status from before diagnosis to the three- and five-year follow-up evaluations in breast cancer patients.

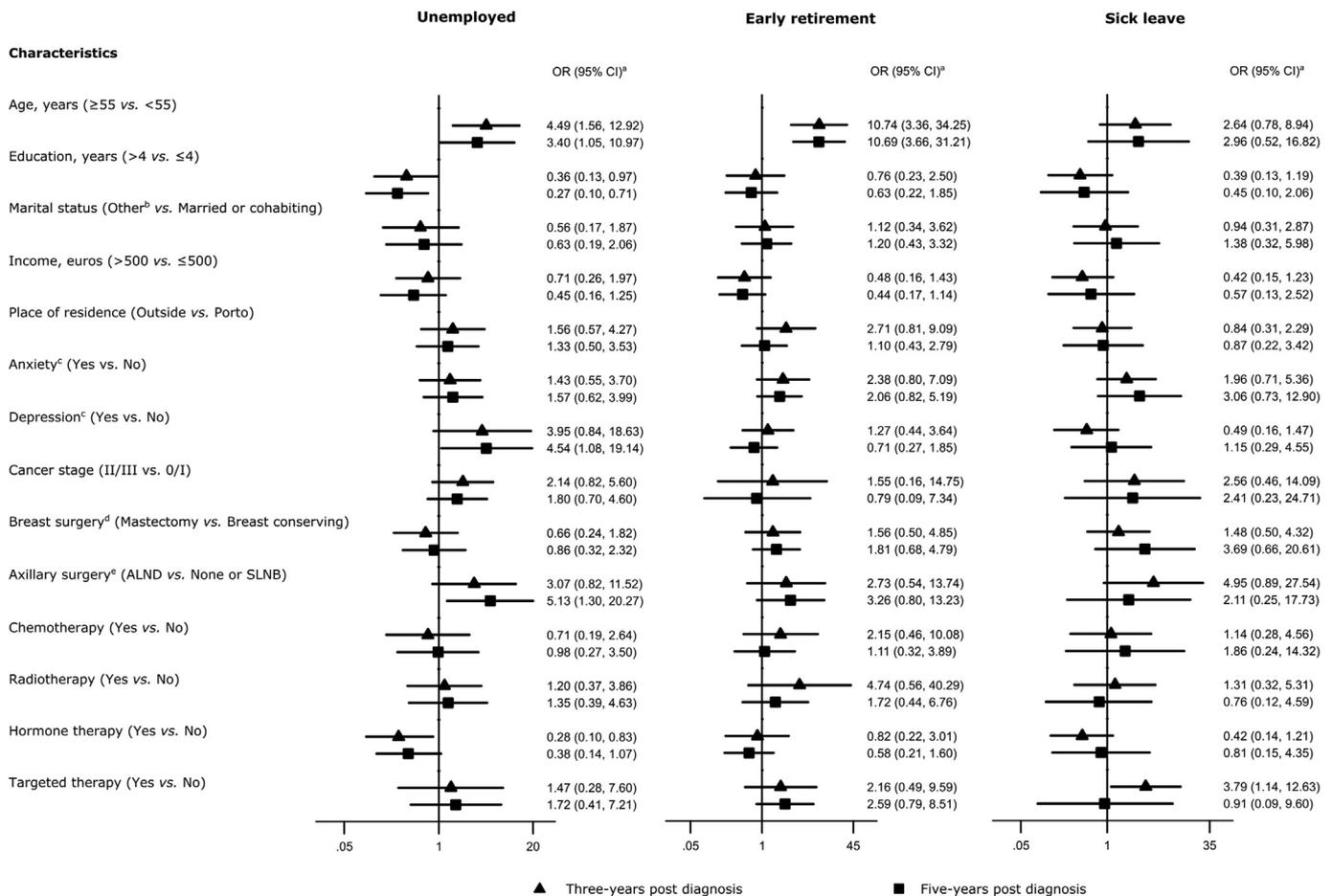


Fig. 3. Association between sociodemographic and clinical characteristics, and treatment of breast cancer patients and employment status three- and five-years after diagnosis among those employed before diagnosis. ALND: Axillary lymph node dissection; CI: confidence interval; SLNB: Sentinel lymph node biopsy. ^aAdjusted for age (continuous), education (≤4, 5–9, ≥10), marital status (married or cohabiting, and single, widowed and divorced women) and cancer stage at diagnosis (0/I, II, III), as applicable. ^bIncluding single, widowed and divorced women. ^cAnxiety and depression were defined as a score greater than or equal to 11 in the respective anxiety and depression subscales of the Hospital Anxiety and Depression Scale [21]. ^dPatients who had both mastectomy and breast-conserving surgery are reported as mastectomy. ^ePatients who had both ALND and SLNB are reported as ALND.

employment status. Among those employed prior to diagnosis, older women were significantly more likely to become unemployed (OR = 4.49, 95%CI: 1.56–12.92 and OR = 3.40, 95%CI: 1.05–10.97 at three- and five-years, respectively) or enter early retirement (OR = 10.74, 95%CI: 3.36–34.25 and OR = 10.69, 95%CI: 3.66–31.21 at three- and five-years, respectively). A higher educational level was negatively associated with unemployment (OR = 0.36, 95%CI: 0.13–0.97 and OR = 0.27, 95%CI: 0.10–0.71 at three- and five-years, respectively). Further, women with depression at baseline were at higher odds of being unemployed at five-years (OR = 4.54, 95%CI: 1.08–19.14). Women who underwent axillary surgery were more likely to be unemployed (OR = 5.13, 95%CI: 1.30–20.27 at five-years), those who received hormone therapy had a lower odds of being unemployed (OR = 0.28, 95%CI: 0.10–0.83 at three-years) and those who received targeted therapy were more likely to be on sick leave (OR = 3.79, 95%CI: 1.14–12.63 at three-years).

3.2. Comparison to the general population

Compared to the general population, women with breast cancer had a lower incidence of unemployment (IRR = 0.51, 95%CI: 0.30–0.89). Though no other statistically significant results were

observed, among older women, breast cancer patients had a higher tendency to enter early retirement when compared to the general population (IRR = 1.72, 95%CI: 0.82–3.61) (Table 2).

4. Discussion

The current study found that among breast cancer patients who were employed before diagnosis, approximately one-third were unemployed, retired or on sick leave five years later. Age and education were most strongly associated with employment status: older breast cancer patients were more likely to be unemployed, early retired or on sick leave, whereas those with a higher educational level had lower odds for those outcomes. Regarding treatment characteristics, axillary surgery and targeted therapy were negatively associated with being employed, while those who received hormone therapy were less likely to be unemployed. Compared to the general population, women with breast cancer had a significantly lower incidence of unemployment, though, among older women, there was a higher tendency for breast cancer patients to enter early retirement.

Table 2
Incidence rate ratios with 95% confidence intervals of unemployment and early retirement among employed breast cancer survivors and general population females.

	Unemployed				Early retired			
	N	O	PT ^a	IRR (95% CI) ^b	N	O	PT ^a	IRR (95% CI) ^b
TOTAL								
General population	159	38	609.16	1	142	21	544.82	1
Breast cancer patients	209	26	1024.16	0.51 (0.30–0.89)	216	33	1056.10	1.00 (0.56–1.78)
AGE, years								
<55								
General population	87	19	332.80	1	76	8	291.15	1
Breast cancer patients	167	18	816.24	0.65 (0.32–1.33)	164	15	801.55	0.53 (0.19–1.48)
≥55								
General population	72	19	276.36	1	66	13	253.67	1
Breast cancer patients	42	8	207.92	0.72 (0.31–1.68)	52	18	254.55	1.72 (0.82–3.61)
EDUCATION, years								
≤4								
General population	75	23	289.93	1	64	12	249.09	1
Breast cancer patients	48	11	234.42	0.52 (0.24–1.13)	47	10	228.28	0.98 (0.42–2.29)
>4								
General population	84	15	319.23	1	78	9	295.73	1
Breast cancer patients	161	15	789.74	0.49 (0.23–1.05)	169	23	827.82	1.07 (0.48–2.38)

CI: Confidence interval; IRR: Incidence rate ratio; N: Number of women employed at baseline; O: Number of women who became unemployed or entered early retirement; PT: Person-time in years.

^a Calculated for each individual considering the time between the two evaluation dates.

^b Adjusted for age (continuous), education (≤4, 5–9, ≥10) and marital status (married or cohabitating, and single, widowed and divorced women), as applicable.

4.1. Cohort of breast cancer patients

In this study, more than 65% of the women continued to be employed five years following breast cancer diagnosis. In particular, there were a greater number of women becoming unemployed, early retired or on sick leave in the first three years of follow-up. Previous studies in other developed countries have found higher estimates of employment among women with breast cancer than those observed in our study. A Canadian study showed that among 646 breast cancer survivors, 79% were working three years following diagnosis [27], while in a Norwegian study, 82% of non-disabled survivors continued to be employed, up to 14 years after diagnosis [28]. On the other hand, in an investigation among North American women with limited resources, less than 60% of patients returned to work within three years following a breast cancer diagnosis [14]. Nevertheless, direct comparisons are difficult due to differences across studies in the length of follow-up, as well as unemployment rates in the general population, which also vary with time.

We found that older patients were more likely to be unemployed, early retired or on sick leave over the study period, which is consistent with previous findings [8,10–12]. The significantly higher odds of unemployment in this group suggest that older women may encounter greater obstacles in re-joining the work force, either finding a new job or reintegrating in the previous one. On the other hand, previous research shows that women who live a cancer experience are more likely to revise their values and choose a life with less stress, more devoted to themselves and their family [9,29,30]. For this reason, they may be more prone to reduce their work effort or retire early. However, we did not have data available on work-related factors such as type of job, workload, environment, value attached to work or change of life priorities, so we cannot establish if these factors contributed to a greater employment abandonment.

Several studies have demonstrated that educational and income levels are closely associated with employment status after breast cancer diagnosis [9,18,31]. Similarly, our study showed that more educated women were less likely to be unemployed. The level of education is correlated to the type of job, with lower education being associated with more physically demanding work [7], and a less adaptable and supportive work environment [32], which does not encourage resuming work and makes less educated women particularly vulnerable to unemployment. We also observed that a

higher income tended to be a protective factor for unemployment, early retirement and sick leave, though results were not statistically significant. Generally, women with a higher income have more opportunities for career development, with more flexibility in their professional activity and work schedule, which may be a motivation to return to work [31].

Evidence regarding the contribution of clinical characteristics to employment status has been conflicting. Although some studies have reported that depression was associated with a less frequent return to work three years after diagnosis [31,33], in studies with longer follow-up times these characteristics did not generally impact work outcome [12,33]. In line with the latter, we found no significant results for clinical characteristics.

Likewise, breast cancer treatments have been shown to be associated with employment changes between breast cancer diagnosis and five-years post diagnosis but not in the long-term [7,8,18,33]. In the current study, we found that axillary surgery, hormonal and targeted therapy affected employment status. More specifically, women who underwent axillary surgery were more likely to be unemployed five-years after breast cancer diagnosis. This may be due to a higher morbidity being described following this type of treatment when compared with sentinel lymph node biopsy, with axillary surgery leading to decreased mobility and sensitivity [34]. However, a recent study showed that the association between lymph node biopsy and unemployment was no longer significant six years after diagnosis [33]. When considering hormone therapy, some studies found a negative association with being employed [9,31], while we observed that these women were less likely to be unemployed at three-years, though this effect disappeared at five years. Contrarily to our results, no association has been previously reported between employment and targeted therapy; however, future studies with stronger statistical power may be expected, due to the growing number of patients likely to be exposed to this treatment [35]. Overall, our results indicate that while some treatments may influence employment status in the first three-years post diagnosis; this impact eventually disappears at five-years. Therefore, further studies with longer follow-up times are necessary to assess the repercussion of treatments on employment status among women diagnosed with breast cancer.

4.2. Comparison to the general population

Employment comparisons between breast cancer patients and

women from the general population have yielded contradictory results. Some studies have found the risk of unemployment [18,27,36], of receiving disability pension or entering early retirement [28,37,38] to be higher among survivors when compared to individuals without cancer. On the contrary, a study from Norway found that non-disabled breast cancer patients had higher employment rates than non-disabled controls [28], while a study conducted in Canada observed no significant differences in early retirement between patients and cancer-free individuals [27]. Compared to the Portuguese general population, we found that breast cancer survivors had a lower incidence of unemployment, though, among older women, there was a higher tendency to enter early retirement. These differences may be due to variations in follow-up times and methodological options, for instance, most of the previous studies have included both employed and unemployed women in the analyses, while we restricted our analyses to employed women. In fact, one study performed stratified analyses among women who were employed at diagnosis only and found no significant differences in the number of employed days between patients and controls during follow-up [28].

Furthermore, it is possible that the number of women becoming unemployed and early retired during the study period may be a reflection of the country's economic situation at the time. In fact, Portugal was recovering from an economically challenging period, resorting to foreign financial assistance, which ended in 2014 [39]. Nevertheless, at five-years post diagnosis, we found that women with a breast cancer diagnosis had a significantly lower incidence of becoming unemployed compared to the general population during the same period. However, it is also possible that more women entered early retirement, as we observed that they had a higher incidence of this outcome.

4.3. Strengths and limitations

The prospective design with multiple and systematic evaluations of all patients is the major methodological strength of the present study. Additionally, its results reflect findings in usual practice, since all patients were treated according to the protocol of the oncological hospital, and this is one of the first studies evaluating different employment outcomes up to five-years after breast cancer diagnosis. However, some limitations should be noted. First, women with a stage IV diagnosis were excluded, because there were very few, which limits the generalization to those with more advanced disease, but this does not affect the internal validity. Second, data about employment status before diagnosis was collected at the three-year evaluation, which might cause recall bias as changes in employment status may occur after cancer diagnosis; however, it is not expected that women forget such an important personal characteristic. Likewise, we do not have employment information at specific periods (i.e. immediately post diagnosis and post treatment), as employment status was only evaluated at three- and five-years post diagnosis. As such, we cannot elucidate on the differences in temporal profile of re-entering employment following a breast cancer diagnosis. Third, a misclassification bias may have occurred as some women who are on sick leave might say that they are employed. Finally, a large proportion of women were not working prior to diagnosis, which limited the statistical power of our study; however, for exposures evenly distributed among the participants and OR estimates above 2.5, the sample available allowed for a power around 75% for an outcome occurring in approximately one out of 10 unexposed participants.

5. Conclusion

We found that axillary surgery was the only treatment associated with employment status, and older and less educated women were more likely to be unemployed five-years after breast cancer diagnosis. Although not all women may want to pursue or continue a professional life following their breast cancer experience as they may re-evaluate their life, those who do may benefit from social and employer support when returning to work. This may be promoted by political and legislative interventions aiming to increase schedule flexibility, the adaptation of work functions and legal protection, in order to reduce the burden of breast cancer in the long term.

Declarations of interest

None.

Ethical approval

The prospective cohort study including breast cancer patients was approved by the Ethics Committee of Portuguese Institute of Oncology of Porto (ref. CES 406/011, CES 99/014 and CES 290/014) and by the Portuguese Data Protection Authority (ref. 9469/2012 and 8601/2014). Informed consent was obtained from all breast cancer patients included in the study.

The SHARE project has been reviewed and approved by the Ethics Committee of the University of Mannheim (until 2011) and the Ethics Council of the Max-Planck-Society for the Advancement of Science (from 2011 to present). Additionally, whenever required, the implementation of SHARE in each country was approved by the respective ethics committees or institutional review boards.

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References

- [1] Ferlay J, Ervik M, Lam F, Colombet M, Mery L, Piñeros M, Znaor A, Soerjomataram I, Bray F. Global cancer observatory: cancer today. Lyon, France: International Agency for Research on Cancer; 2018. Available from: <https://gco.iarc.fr/today>. [Accessed 1 April 2019].
- [2] The benefits and harms of breast cancer screening: an independent review. *Lancet* 2012;380:1778–86.
- [3] Clarke M, Collins R, Darby S, Davies C, Elphinstone P, Evans V, et al. Effects of radiotherapy and of differences in the extent of surgery for early breast cancer on local recurrence and 15-year survival: an overview of the randomised trials. *Lancet* 2005;366:2087–106.
- [4] Crocetti E, Roche L, Buzzoni C, di Costanzo F, Molinier F, Caldarella A. Trends in net survival from breast cancer in six European Latin countries: results from the SUDCAN population-based study. *Eur J Cancer Prev* 2017;26:S85–s91.
- [5] Allemani C, Matsuda T, Di Carlo V, Harewood R, Matz M, Niksic M, et al. Global surveillance of trends in cancer survival 2000–14 (CONCORD-3): analysis of individual records for 37 513 025 patients diagnosed with one of 18 cancers from 322 population-based registries in 71 countries. *Lancet* 2018;391:1023–75.
- [6] Steiner JF, Cavender TA, Main DS, Bradley CJ. Assessing the impact of cancer on work outcomes: what are the research needs? *Cancer* 2004;101:1703–11.
- [7] Amir Z, Brocky J. Cancer survivorship and employment: epidemiology. *Occup Med* 2009;59:373–7.
- [8] Hassett MJ, O'Malley AJ, Keating NL. Factors influencing changes in employment among women with newly diagnosed breast cancer. *Cancer* 2009;115:2775–82.
- [9] Lee MK, Kang HS, Lee KS, Lee ES. Three-year prospective cohort study of factors associated with return to work after breast cancer diagnosis. *J Occup Rehabil* 2017;27:547–58.
- [10] Jaggi R, Hawley ST, Abrahamse P, Li Y, Janz NK, Griggs JJ, et al. Impact of adjuvant chemotherapy on long-term employment of survivors of early-stage breast cancer. *Cancer* 2014;120:1854–62.
- [11] Hoyer M, Nordin K, Ahlgren J, Bergkvist L, Lambe M, Johansson B, et al. Change in working time in a population-based cohort of patients with breast cancer. *J Clin Oncol* 2012;30:2853–60.
- [12] Tamminga SJ, Coenen P, Paalman C, de Boer A, Aaronson NK, Oldenburg HSA, et al. Factors associated with an adverse work outcome in breast cancer survivors 5–10 years after diagnosis: a cross-sectional study. *J Canc Surviv* 2019;13:108–16.
- [13] Drolet M, Maunsell E, Brisson J, Brisson C, Masse B, Deschenes L. Not working 3 years after breast cancer: predictors in a population-based study. *J Clin Oncol* 2005;23:8305–12.
- [14] Blinder VS, Patil S, Thind A, Diamant A, Hudis CA, Basch E, et al. Return to work in low-income Latina and non-Latina white breast cancer survivors: a 3-year longitudinal study. *Cancer* 2012;118:1664–74.
- [15] Heuser C, Halbach S, Kowalski C, Enders A, Pfaff H, Ernstmann N. Socio-demographic and disease-related determinants of return to work among women with breast cancer: a German longitudinal cohort study. *BMC Health Serv Res* 2018;18:1000.
- [16] Balak F, Roelen CA, Koopmans PC, Ten Berge EE, Groothoff JW. Return to work after early-stage breast cancer: a cohort study into the effects of treatment and cancer-related symptoms. *J Occup Rehabil* 2008;18:267–72.
- [17] Roelen CA, Koopmans PC, de Graaf JH, Balak F, Groothoff JW. Sickness absence and return to work rates in women with breast cancer. *Int Arch Occup Environ Health* 2009;82:543–6.
- [18] Grinshpun A, Rottenberg Y. Unemployment following breast cancer diagnosis: a population-based study. *Breast* 2019;44:24–8.
- [19] Pereira S, Fontes F, Sonin T, Dias T, Fragoso M, Castro-Lopes J, et al. Neurological complications of breast cancer: study protocol of a prospective cohort study. *BMJ Open* 2014;4:e006301.
- [20] Edge SB, Compton CC. The American Joint Committee on Cancer: the 7th edition of the AJCC cancer staging manual and the future of TNM. *Ann Surg Oncol* 2010;17:1471–4.
- [21] Zigmund AS, Snaith RP. The hospital anxiety and depression scale. *Acta Psychiatr Scand* 1983;67:361–70.
- [22] Pais-Ribeiro J, Silva I, Ferreira T, Martins A, Meneses R, Baltar M. Validation study of a Portuguese version of the hospital anxiety and depression scale. *Psychol Health Med* 2007;12:225–35. quiz 35–7.
- [23] Islam T, Dahlui M, Majid HA, Nahar AM, Mohd Taib NA, Su TT. Factors associated with return to work of breast cancer survivors: a systematic review. *BMC Public Health* 2014;14(Suppl 3):S8.
- [24] Börsch-Supan A. Survey of Health, Ageing and Retirement in Europe (SHARE) Wave 4. Release version: 7.0.0. SHARE-ERIC. Data set. 2019.
- [25] Börsch-Supan A. Survey of Health, Ageing and Retirement in Europe (SHARE) Wave 6. Release version: 7.0.0. SHARE-ERIC. Data set. 2019.
- [26] Börsch-Supan A, Brandt M, Hunkler C, Kneip T, Korbmayer J, Malter F, et al. Data resource profile: the Survey of Health, Ageing and Retirement in Europe (SHARE). *Int J Epidemiol* 2013;42:992–1001.
- [27] Maunsell E, Drolet M, Brisson J, Brisson C, Masse B, Deschenes L. Work situation after breast cancer: results from a population-based study. *J Natl Cancer Inst* 2004;96:1813–22.
- [28] Hauglann B, Benth JS, Fossa SD, Dahl AA. A cohort study of permanently reduced work ability in breast cancer patients. *J Canc Surviv* 2012;6:345–56.
- [29] Kennedy F, Haslam C, Munir F, Pryce J. Returning to work following cancer: a qualitative exploratory study into the experience of returning to work following cancer. *Eur J Cancer Care* 2007;16:17–25.
- [30] Marino P, Teyssier LS, Malavolti L, Le Corroller-Soriano AG. Sex differences in the return-to-work process of cancer survivors 2 years after diagnosis: results from a large French population-based sample. *J Clin Oncol* 2013;31:1277–84.
- [31] Landeiro LCG, Gagliato DM, Fede AB, Fraile NM, Lopez RM, da Fonseca LG, et al. Return to work after breast cancer diagnosis: an observational prospective study in Brazil. *Cancer* 2018;124:4700–10.
- [32] Bradley CJ, Brown KL, Haan M, Glasgow RE, Newman LS, Rabin B, et al. Cancer survivorship and employment: intersection of oral agents, changing workforce dynamics, and employers' perspectives. *J Natl Cancer Inst* 2018;110:1292–9.
- [33] Paalman CH, van Leeuwen FE, Aaronson NK, de Boer AG, van de Poll-Franse L, Oldenburg HS, et al. Employment and social benefits up to 10 years after breast cancer diagnosis: a population-based study. *Br J Canc* 2016;114:81–7.
- [34] Husted Madsen A, Haugaard K, Soerensen J, Bokmand S, Friis E, Holtveg H, et al. Arm morbidity following sentinel lymph node biopsy or axillary lymph node dissection: a study from the Danish Breast Cancer Cooperative Group. *Breast* 2008;17:138–47.
- [35] Masoud V, Pagès G. Targeted therapies in breast cancer: new challenges to fight against resistance. *World J Clin Oncol* 2017;8:120–34.
- [36] de Boer AG, Taskila T, Ojajarvi A, van Dijk FJ, Verbeek JH. Cancer survivors and unemployment: a meta-analysis and meta-regression. *J Am Med Assoc* 2009;301:753–62.
- [37] Short PF, Vasey JJ, Belue R. Work disability associated with cancer survivorship and other chronic conditions. *Psycho Oncol* 2008;17:91–7.
- [38] Eaker S, Wigertz A, Lambert PC, Bergkvist L, Ahlgren J, Lambe M. Breast cancer, sickness absence, income and marital status. A study on life situation 1 year prior diagnosis compared to 3 and 5 years after diagnosis. *PLoS One* 2011;6:e18040.
- [39] Banco de Portugal. Economic bulletin May 2018. Lisbon, Portugal: Banco de Portugal; 2018.