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# Perceived cognitive functioning in breast cancer patients treated with chemotherapy compared to matched healthy women: Evidence from a Portuguese study

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## Abstract

**Aim:** Cognitive concerns are one of the most frequently reported symptoms by breast cancer survivors. This study aimed to evaluate perceived cognitive functioning in Portuguese women with breast cancer treated with chemotherapy.

**Methods:** A cross-sectional study enrolling 146 women (73 with breast cancer and 73 healthy) was conducted from August to October 2017, invited to participate through online dissemination. Participants completed self-reported questionnaires to collect sociodemographic and clinical data and assess perceived cognitive functioning and psychological adjustment variables (anxiety and depression).

**Results:** Compared to healthy women, women with breast cancer showed significantly lower scores on the Functional Assessment of Cancer Therapy-Cognitive Function (FACT-Cog) subscales and higher levels of depression. Both groups showed significant negative correlations between perceived cognitive functioning and anxiety and depression. Health status and depression seem to better explain perceived cognitive functioning, with health status adding significantly more explained variance beyond sociodemographic and psychological adjustment variables.

**Conclusion:** The current findings provide evidence for the existence of more cognitive complaints among Portuguese women with breast cancer, compared to healthy individuals. Anxiety, depression, age and education also explain perceived cognitive functioning. Considering that health status and psychological adjustment seem to significantly explain perceived cognitive functioning, special attention should be given by health-care professionals, including nurses, to designing clinical interventions for breast cancer patients to help manage cognitive impairment.

KEYWORDS
anxiety, breast neoplasms, chemotherapy, cognitive dysfunction, cross-sectional, depression, nurses

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## Summary statement

What is already known about this topic?

- Cancer and associated treatments have diverse short- and long-term side effects. Deficits in cognitive functions are one of the most frequently reported for breast cancer specifically due to chemotherapy.
- Subjective assessment of cognitive function is often neglected, although it might be clinically very useful and an important indicator of the impact of cognitive impairment on daily functioning.
- There is currently no Portuguese data on perceived cognitive impairment in cancer.

What this paper adds?

- This Portuguese study shows that, compared to a matched healthy sample, breast cancer patients have significantly more cognitive complaints, as assessed by the FACT-Cog scale.
- Furthermore, our findings showed that higher levels of anxiety and depression are associated with worse perceived cognitive functioning.
- Cognitive complaints in breast cancer patients are predicted by a complexity of factors, such as psychological adjustment, age, and education.

The implications of this paper:

- Health-care professionals, including nurses, should recognize cognitive complaints as legitimate in breast cancer patients.
- Findings may deepen nurses' knowledge about cognitive concerns in breast cancer patients, in order to improve the quality of care provided to this population.
- The results of the study highlight the importance of tackling this problem with specifically designed clinical interventions that target both the cognitive deficits and the psychological adjustment of patients, especially depressive symptomatology.

## 1 | INTRODUCTION

Breast cancer is the most commonly diagnosed type of cancer and the leading cause of cancer mortality among women, both worldwide and in Portugal (Bray, Ferlay, et al., 2018; International Agency for Research on Cancer, 2021). Advances in treatment and early diagnosis have substantially increased the number of breast cancer survivors (Frank et al., 2015; Howlader et al., 2017). Cognitive complaints are one of the most frequent side effects reported by breast cancer survivors, mainly studied following chemotherapy (Bray, Dhillon, et al., 2018; Kim et al., 2020). Affecting from 21% to 90% of breast cancer survivors (Pullens et al., 2010), cognitive difficulties (e.g., short-term and working memory, attention and executive functions) can be long-lasting and have a negative impact on overall quality of life (QoL), including work-related outcomes (Bray, Dhillon, et al., 2018; Frank et al., 2015; Von Ah et al., 2013).

Perceived cognitive functioning (also referred to as subjective or self-reported cognitive functioning) (Bray, Dhillon, et al., 2018; Wagner et al., 2009) is an important outcome in research and clinical practice (Bray, Dhillon, et al., 2018). Subjective assessment, with the administration of self-report questionnaires, is often neglected but is stated to be an effective and valid approach to collect data representing patients' perceived cognitive functioning (Costa et al., 2018), as confirmed by objective evidence showed with neuroimaging (Sousa et al., 2020). Additionally, it may be clinically very useful to understand patient distress and perception of cognitive function and to identify patients with subtle deficits who may benefit from a neuropsychological evaluation or more frequent monitoring (Asher, 2011; Lai et al., 2009). Furthermore, it is an important indicator of the impact of cognitive impairment on daily functioning (e.g., work, social interactions and community integration) and QoL (Asher & Myers, 2015; Lycke et al., 2019; Shilling & Jenkins, 2007).

Although the biological and neuropsychological mechanisms that contribute to cognitive impairment are not fully known, it is assumed to be multifactorial: It may result from treatments (including chemotherapy), sociodemographical variables (e.g., age, education level) and/or psychological factors (Ahles et al., 2010; Lange et al., 2019; Ono et al., 2015; Stewart et al., 2008). Psychological factors, as anxiety and depression, are frequent in cancer patients and have been associated with cognitive complaints (Bray, Dhillon, et al., 2018; Lange et al., 2019). By using the Functional Assessment of Cancer Therapy-Cognitive Function (FACT-Cog)—version 3 (Wagner et al., 2009) scale,

a widely used instrument specifically developed to assess cognitive complaints in cancer patients, previous studies investigated the impact of cancer and chemotherapy on perceived cognitive functioning in women with breast cancer and identified the potentially interacting clinical and psychosocial factors. These studies found that perceived cognitive functioning was associated with depressive symptoms and anxiety (e.g., Cheung et al., 2012; Von Ah & Tallman, 2015) and that patients not receiving chemotherapy reported better perceived cognitive functioning than those who had received chemotherapy (e.g., Cheung et al., 2012). A better knowledge about the changes in perceived cognitive functioning due to chemotherapy and about its sociodemographic, clinical and psychosocial predictors is of major importance to help identify patients at risk of developing problems in this area and, consequently, at risk of a reduced QoL (Debess et al., 2009). Hence, these variables should be considered when assessing perceptions of cognitive function, because an early detection may allow interventions to address them and consequently improve cognitive complaints (Hutchinson et al., 2012; Pullens et al., 2010).

Studying cognitive changes related to breast cancer and its treatment and its impact on survivors' functioning is of great importance, as hundreds of thousands of patients are treated worldwide, and the number of long-term survivors that may deal with these changes is growing dramatically (Ahles et al., 2012; Feuerstein, 2007). Despite the high prevalence of cognitive complaints in breast cancer patients and the implications for QoL, few studies have assessed perceived cognitive functioning using a measure specifically developed to the context of cancer, such as the FACT-Cog (Bray, Dhillon, et al., 2018). Furthermore, few studies compared the reports of breast cancer patients with control groups (especially healthy individuals) using the FACT-Cog (Bray, Dhillon, et al., 2018). This is important to consider when making conclusions about the aetiology of cognitive impairment (Bernstein et al., 2017). To our knowledge, only Janelsins et al. (2017) addressed this variable with the breast cancer population and did not assess whether health status (i.e., breast cancer diagnosis vs. no disease) could be a predictor of perceived cognitive functioning. Other studies (Gregorowitsch et al., 2019) have compared breast cancer patients with a non-cancer population but using only more limited measures (e.g., cognitive functioning subscale of the European Organization for Research and Treatment of Cancer Quality of Life Questionnaire Core-30; EORTC QLQ-C30—version 3), which may not fully evaluate the extent of an individual's cognitive concerns.

Available data collected from Portuguese women are still lacking to better understand their self-reported cognitive functioning after cancer and cancer treatments. Although some studies have assessed cognitive functioning of cancer patients in Portugal, these are related to findings from neuropsychological evaluations (e.g., Bessa et al., 2020). Furthermore, some studies have found that cognitive impairment is lower compared to studies conducted in other countries (e.g., Ramalho et al., 2017). Hence, evidence from patients' perception could be useful to understand the impact that cognitive complaints might have, which objective evaluation may not detect. Considering differences in anxiety/depression reports between Portuguese women and other countries (Ramalho et al., 2017), it is also important to address these variables and explore its potential impact on perceived cognitive functioning.

## 2 | METHODS

### 2.1 | Aim

The primary aim of this study was to evaluate perceived cognitive functioning (assessed with the FACT-Cog scale) in Portuguese women with breast cancer, compared to matched healthy women. Furthermore, we also aimed to study the relationship between perceived cognitive functioning and other variables, such as age, education, anxiety and depression, and to investigate whether sociodemographic variables (age and education), emotional state (anxiety and depression) and health status (breast cancer or healthy) could explain perceived cognitive functioning.

### 2.2 | Study design

We conducted a cross-sectional study in a Portuguese sample of women with breast cancer who have received chemotherapy treatments to better understand the psychosocial impact of cancer treatments and their effects on perceived cognitive functioning. The study design is based on self-administered questionnaires.

### 2.3 | Participants

A convenience sample of 73 breast cancer survivors and 73 healthy women participated in this study. For both groups, the inclusion criteria were as follows: (1) being female, (2) age 18–65 years, (3) no history of brain injuries (e.g., stroke and traumatic brain injury) or of substance abuse, and (4) being able to read and understand Portuguese. Additionally, breast cancer survivors should have received and completed chemotherapy treatments for breast cancer at the time of participation (participation was possible if other treatments were undergone or ongoing) and had no central nervous system (CNS) and/or brain metastases. Healthy women should have no history of cancer or other serious illness affecting the CNS.

### 2.4 | Instruments

#### 2.4.1 | Sociodemographic and clinical questionnaire

Breast cancer participants completed a global questionnaire including sociodemographic (e.g., age, education level, marital status and occupation) and relevant medical clinical information (e.g., date of diagnosis, previous and forthcoming treatments, presence of metastases or brain injuries). For the healthy group, some changes were made to the questionnaire, not including specific questions regarding cancer or cancer treatments.

### 2.4.2 | Perceived cognitive functioning

The FACT-Cog—version 3 (Oliveira et al., 2021; Wagner et al., 2009) is a 37-item self-response measure to assess cognitive concerns of cancer patients. Considering that items do not mention cancer, this instrument is also appropriate for a non-cancer population (Costa et al., 2018). This scale consists of four subscales: For *Perceived Cognitive Impairments* (CogPCI) and *Comments from Others* (CogOth), the patient has to indicate how often the situation occurred during the last 7 days, on a 5-point Likert scale (0=*Never* to 4=*Several times a day*); and for *Perceived Cognitive Abilities* (CogPCA) and *Impact on Quality of Life* (CogQoL), participants should use a 5-point Likert scale (0=*Not at all* to 4=*Very much*) to indicate the severity of each situation during the last week. Higher scores indicate better perceived cognitive functioning. Good psychometric properties were found on the Portuguese validation study (Oliveira et al., 2021). In this study, FACT-Cog subscales presented high internal consistency, with Cronbach's alpha ranging from .88 to .96.

### 2.4.3 | Anxiety and depression

To evaluate depressive and anxious symptomatology, the Hospital Anxiety and Depression Scale (HADS) (Pais-Ribeiro et al., 2007; Zigmond & Snaith, 1983) was used. It is a 14-item self-response questionnaire, useful in recognizing emotional components associated with physical illness. It consists of two subscales: One measuring anxiety (HADS_A) and one measuring depression (HADS_D), each with seven items scored separately; these items are answered on a 4-point Likert scale from "0" to "3", choosing the option that better corresponds to the way they felt during the previous week. The higher the scores, the greater the presence of anxious and depressive symptoms. Good psychometric properties were found on the Portuguese validation study (Pais-Ribeiro et al., 2007). In this study, Cronbach's alpha was .86 for HADS_A and .83 for HADS_D.

## 2.5 | Procedure

Both breast cancer and healthy participants were recruited through online advertisement, using social media, forums, associations and support blogs. Data were collected through a self-report web-based survey designed for this study and programmed in an open-source tool hosted in the server of the University of Aveiro. The survey was opened for 3 months, between August and October 2017.

## 2.6 | Ethical considerations

This Portuguese cross-sectional study was approved by the Ethics Committee of the University of Aveiro. All participants received complete information about the study and consented to participate. Confidentiality and anonymity of the data were ensured. In this study, participants' ethical treatment was safeguarded, in accordance with the Declaration of Helsinki (World Medical Association, 2000) and the guidelines of the American Psychological Association (2010).

## 2.7 | Statistical analysis

All statistical analyses were performed using the software IBM SPSS Statistics version 21.0. Means (M), standard deviations (SD) and frequencies were calculated to describe the sample. Despite small deviations from normality in some of the variables, we opted for carrying out parametric statistics given the reasonably large sample size (*Note*: Nonparametric Mann–Whitney tests comparing the breast cancer and healthy groups revealed identical effects for all variables, as well as nonparametric Spearman correlations). The comparison between the two groups was conducted using *t*-tests for independent samples and the $\chi^2$/Fisher's exact test for categorical variables. To calculate the effect size, we used Cohen's *d* formula $d = \frac{(M1-M2)}{SD\ pooled}$ (with M1 = mean breast cancer group, M2 = mean healthy group and SD pooled = $\sqrt{\frac{SD1^2+SD2^2}{2}}$, with SD1 = SD breast cancer group and SD2 = SD healthy group), assuming the values .20, .50 and .80 as small, medium and large effect size, respectively (Cohen, 1988). Pearson's correlation coefficient was used to examine the associations between the four subscale scores of the FACT-Cog and age and education and anxiety and depression (HADS). To analyse whether age, education, anxiety, depression and health status are significant predictors of perceived cognitive functioning, hierarchical multiple regression analyses were performed, where age and years of education were entered as predictors in the first block; anxiety and depression were introduced in the second block; and health status was entered in the third block, with each of the FACT-Cog subscales as a criterion variable. Health status was coded as 0 = *healthy* and 1 = *breast cancer*. All significance tests were conducted using a significance level of $p < .05$.

# 3 | RESULTS

## 3.1 | Sample

A total of 146 women participated in this study, mean age of 43.64 years (SD = 8.93; range 29–64 years), 73 with breast cancer (Mean = 45.51 years; SD = 8.59) and 73 age and education-matched healthy women (Mean = 41.78 years; SD = 8.92). The breast cancer group did not differ significantly from the healthy group in age and education, which are two important variables concerning their influence on cognitive functioning. Sociodemographic and clinical characteristics of the sample are presented in Table 1.

## 3.2 | Group differences concerning perceived cognitive functioning, anxiety and depression

Table 2 shows the results from the *t*-tests for independent samples comparing the two groups in the FACT-Cog and HADS subscales.

**TABLE 1** Sociodemographic and clinical characteristics of the sample

| | Breast cancer group ($n = 73$) | | Healthy group ($n = 73$) | | | |
|---|---|---|---|---|---|---|
| | *n* | % | *n* | % | $\chi^2$ | *p* |
| Age (years) | | | | | 5.895 | .117 |
| 29–36 | 12 | 16.4 | 24 | 32.9 | | |
| 37–43 | 21 | 28.8 | 20 | 27.4 | | |
| 44–51 | 21 | 28.8 | 14 | 19.2 | | |
| 52–64 | 19 | 26.0 | 15 | 20.5 | | |
| Marital status | | | | | 3.010 | .556 |
| Single | 19 | 26.0 | 18 | 24.7 | | |
| Married | 37 | 50.7 | 42 | 57.5 | | |
| Cohabiting unmarried partners | 10 | 13.7 | 5 | 6.8 | | |
| Divorced or separated | 7 | 9.6 | 7 | 9.6 | | |
| Widowed | 0 | 0.0 | 1 | 1.4 | | |
| Education | | | | | 9.830 | .132 |
| 1st cycle (4th year complete) | 1 | 1.4 | 1 | 1.4 | | |
| 2nd cycle (6th year complete) | 4 | 5.5 | 4 | 5.5 | | |
| 3rd cycle (9th year complete) | 6 | 8.2 | 7 | 9.6 | | |
| Secondary education (12th year complete) | 20 | 27.4 | 14 | 19.2 | | |
| Higher education—Bachelor's degree | 36 | 49.3 | 28 | 38.4 | | |
| Higher education—Master's degree | 5 | 6.8 | 11 | 15.0 | | |
| Higher education—Doctoral degree | 1 | 1.4 | 8 | 10.9 | | |
| Occupation | | | | | 29.911 | <.001 |
| Working (part and full time) | 39 | 53.4 | 61 | 83.6 | | |
| Medical leave | 21 | 28.8 | 1 | 1.4 | | |
| Unemployed | 7 | 9.6 | 11 | 15.1 | | |
| Retired | 6 | 8.2 | 0 | 0.0 | | |
| Year of cancer diagnosis | | | | | - | - |
| ≤ 2000 | 1 | 1.4 | - | - | | |
| 2001–2005 | 2 | 2.7 | - | - | | |
| 2006–2010 | 6 | 8.3 | - | - | | |
| 2011–2017 | 64 | 87.6 | - | - | | |
| Previous treatments | | | | | - | - |
| None | 0 | 0.0 | - | - | | |
| Surgery | 67 | 91.8 | - | - | | |
| Radiation therapy | 51 | 69.9 | - | - | | |
| Chemotherapy | 73 | 100.0 | - | - | | |
| Hormone therapy | 47 | 64.4 | - | - | | |
| Immunotherapy | 5 | 6.8 | - | - | | |
| Other | 8 | 11.0 | - | - | | |
| Forthcoming treatments | | | | | - | - |
| None | 23 | 31.5 | - | - | | |
| Surgery | 5 | 6.8 | - | - | | |
| Radiation therapy | 7 | 9.6 | - | - | | |
| Chemotherapy | 0 | 0.0 | - | - | | |
| Hormone therapy | 42 | 57.5 | - | - | | |
| Immunotherapy | 0 | 0.0 | - | - | | |
| Other | 4 | 5.5 | - | - | | |

(Continues)

**TABLE 1** (Continued)

| | Breast cancer group ($n = 73$) | | Healthy group ($n = 73$) | | | |
|---|---|---|---|---|---|---|
| | *n* | % | *n* | % | $\chi^2$ | *p* |
| End of treatments (year) | | | | | - | - |
| ≤ 2000 | 0 | 0.0 | - | - | | |
| 2001–2005 | 2 | 2.8 | - | - | | |
| 2006–2010 | 4 | 5.6 | - | - | | |
| 2011–2017 | 49 | 66.9 | - | - | | |
| Not finished yet | 18 | 24.7 | - | - | | |

**TABLE 2** Group differences concerning perceived cognitive functioning, anxiety and depression

| | Breast cancer group ($n = 73$) M (SD) | Healthy group ($n = 73$) M (SD) | *t* | *df* | *p* | Cohen's *d* |
|---|---|---|---|---|---|---|
| Perceived cognitive functioning (FACT-Cog) | | | | | | |
| Perceived cognitive impairments (CogPCI) | 41.63 (17.68) | 58.74 (11.15) | −6.993 | 144 | <.001 | 1.16 |
| Impact on QoL (CogQOL) | 7.89 (5.27) | 13.01 (3.42) | −6.967 | 144 | <.001 | 0.58 |
| Comments from others (CogOth) | 13.79 (3.21) | 15.23 (1.48) | −3.474 | 144 | .001 | 0.89 |
| Perceived cognitive abilities (CogPCA) | 11.30 (6.07) | 16.68 (6.08) | −5.352 | 144 | <.001 | 1.15 |
| Anxiety and depression (HADS) | | | | | | |
| Anxiety (HADS_A) | 8.51 (4.61) | 7.25 (3.65) | 1.830 | 144 | .069 | 0.30 |
| Depression (HADS_D) | 6.32 (4.03) | 4.36 (3.39) | 3.175 | 144 | .002 | 0.53 |

Abbreviations: FACT-Cog, Functional Assessment of Cancer Therapy—Cognitive Function; HADS, Hospital Anxiety and Depression Scale.

#### 3.2.1 | Perceived cognitive functioning

The breast cancer group had significantly lower scores on the four FACT-Cog subscales compared to the healthy group. Thus, the breast cancer group reported significantly higher perceived cognitive deficits (CogPCI) than the healthy group, as well as CogOth. The breast cancer group also showed a significantly lower number of CogPCA compared to the healthy group, as well as a greater impact on QoL (CogQOL), all medium to large effect sizes.

#### 3.2.2 | Anxiety and depression

Concerning anxiety and depression symptoms, the breast cancer group only showed significantly higher levels of depression than the healthy group, corresponding to a medium effect size.

### 3.3 | Association between perceived cognitive functioning and age, education, anxiety and depression, in both groups

The results from the correlational analyses are presented in Table 3.

#### 3.3.1 | Perceived cognitive functioning, age and education

There were no statistically significant correlations in either group.

#### 3.3.2 | Perceived cognitive functioning, anxiety and depression

Anxiety and depression were significantly negatively correlated with all subscales of the FACT-Cog in both groups, suggesting generally lower levels of perceived cognitive performance with increasing levels of anxiety and depression, regardless of health status.

### 3.4 | Factors explaining perceived cognitive functioning

Table 4 presents the results from the regression analyses with the four FACT-Cog subscales, indicating the significant and nonsignificant predictors in each final model.

For the CogPCI subscale, a significant final model was obtained, $F(5,140) = 38.51$, $p < .001$, with the model only with age and education not being significant and explaining 2.6% of the variance

**TABLE 3** Association between perceived cognitive functioning and age, education, anxiety and depression, in both groups

| | | Breast cancer group ($n = 73$) Perceived cognitive functioning (FACT-Cog) | | | | Healthy group ($n = 73$) Perceived cognitive functioning (FACT-Cog) | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | **CogPCI** | **CogQOL** | **CogOth** | **CogPCA** | **CogPCI** | **CogQOL** | **CogOth** | **CogPCA** |
| Age (years) | *r* | −0.10 | 0.02 | −0.12 | −0.04 | −0.04 | 0.01 | −0.14 | −0.23 |
| | *p* | .418 | .895 | .329 | .761 | .725 | .941 | .254 | .052 |
| Education (years) | *r* | −0.23 | −0.12 | −0.03 | −0.10 | 0.05 | −0.00 | 0.23 | 0.04 |
| | *p* | .052 | .314 | .783 | .396 | .656 | .989 | .056 | .767 |
| Anxiety (HADS_A) | *r* | **−0.48** | **−0.60** | **−0.35** | **−0.57** | **−0.70** | **−0.63** | **−0.51** | **−0.42** |
| | *p* | <.001 | <.001 | .003 | <.001 | <.001 | <.001 | <.001 | <.001 |
| Depression (HADS_D) | *r* | **−0.59** | **−0.64** | **−0.38** | **−0.66** | **−0.66** | **−0.55** | **−0.54** | **−0.44** |
| | *p* | <.001 | <.001 | .001 | <.001 | <.001 | <.001 | <.001 | <.001 |

Abbreviations: CogPCA, perceived cognitive abilities; CogPCI, perceived cognitive impairments; CogOth, comments from others; CogQOL, impact on QoL; FACT-Cog, Functional Assessment of Cancer Therapy—Cognitive Function; HADS, Hospital Anxiety and Depression Scale.

**TABLE 4** Factors explaining perceived cognitive functioning

| | *B* | *SE B* | *β* | *p* |
|---|---|---|---|---|
| Perceived cognitive impairments (CogPCI) | | | | |
| Age (years) | −0.24 | 0.12 | −0.12 | .041 |
| Education (years) | −0.60 | 0.23 | −0.15 | .010 |
| Anxiety (HADS_A) | −0.94 | 0.31 | −0.23 | .003 |
| Depression (HADS_D) | −0.71 | 0.35 | −0.39 | <.001 |
| Health status | 12.26 | 1.97 | −0.36 | <.001 |
| Impact on QoL (CogQOL) | | | | |
| Age (years) | −0.02 | 0.03 | −0.03 | .649 |
| Education (years) | −0.10 | 0.07 | −0.09 | .150 |
| Anxiety (HADS_A) | −0.39 | 0.09 | −0.32 | <.001 |
| Depression (HADS_D) | −0.42 | 0.10 | −0.32 | <.001 |
| Health status | 3.84 | 0.59 | −0.38 | <.001 |
| Comments from others (CogOth) | | | | |
| Age (years) | −0.03 | 0.02 | −0.12 | .146 |
| Education (years) | −0.00 | 0.05 | −0.01 | .945 |
| Anxiety (HADS_A) | −0.12 | 0.06 | −0.19 | .062 |
| Depression (HADS_D) | −0.18 | 0.07 | −0.27 | .009 |
| Health status | 0.81 | 0.40 | −0.16 | .044 |
| Perceived cognitive abilities (CogPCA) | | | | |
| Age (years) | −0.12 | 0.05 | −0.17 | .015 |
| Education (years) | −0.16 | 0.10 | −0.10 | .126 |
| Anxiety (HADS_A) | −0.34 | 0.14 | −0.22 | .012 |
| Depression (HADS_D) | −0.65 | 0.15 | −0.37 | <.001 |
| Health status | 3.37 | 0.86 | −0.26 | <.001 |

Abbreviation: HADS, Hospital Anxiety and Depression Scale.

(explained variance based on *adjusted* $R^2$ will be reported for all models), the model including anxiety and depression explaining 44.7% of the variance, representing a significant increase and the model including health status explaining 56.4% of the variance; this increase being again significant. In the final model, all the variables were significant predictors of CogPCI, with depression being the variable with the greatest predictive power, closely followed by the health status.

In relation to the CogQOL subscale, a significant final model was obtained, $F$ (5,140) = 38.86, $p$ < .001, with the model only with age and education not being significant and explaining 0.3% of the variance; the model including anxiety and depression explaining 43.9% of the variance, representing a significant increase; and the model including health status explaining 56.6% of the variance; this increase being again significant. In the final model, only the variables anxiety, depression and health status were significant predictors of the impact of CogPCI on QoL, with health status being the variable with the greatest predictive power.

In relation to the CogOth subscale, a significant final model was obtained, $F$ (5,140) = 9.91, $p$ < .001, with the model only with age and education not being significant and explaining 1.4% of the variance; the model including anxiety and depression explaining 21.8% of the variance, representing a significant increase; and the model including health status explaining 23.5% of the variance; this increase being again significant. Only the variables depression and health status were significant predictors of other people's comments about CogPCI, with depression being the variable with the greatest predictive power.

In relation to the CogPCA subscale, a significant final model was obtained, $F$ (5,140) = 24.75, $p$ < .001, with the model only with age and education being significant and explaining 3.3% of the variance; the model including anxiety and depression explaining 39.4% of the variance, representing a significant increase; and the model including health status explaining 45.0% of the variance; this increase being again significant. Only the variables age, anxiety, depression and health status were significant predictors of CogPCA, with depression being the variable with the greatest predictive power, followed by health status.

## 4 | DISCUSSION

Women with breast cancer often report changes in their cognitive functioning as a consequence of cancer and its treatments, especially after chemotherapy, and these changes are associated with difficulties in their daily functioning, social impact, ability to work and QoL (Von Ah et al., 2013). The present study contributed new data in this area, exploring perceived cognitive functioning differences between this population and healthy women, in a Portuguese sample; investigating the relation between perceived cognitive functioning and age, education, anxiety and depression; and exploring possible predictors of perceived cognitive functioning.

Concerning group differences, the main result in this study is the perception of worse cognitive functioning in women with breast cancer (with lower scores on all FACT-Cog subscales), compared to healthy women, which is in line with previous findings (Janelsins et al., 2017). To our knowledge, Janelsins et al.'s (2017) study was the only study that evaluated perceived cognitive functioning in women with breast cancer submitted to chemotherapy in comparison to healthy women; other studies did not compare with another group (Von Ah & Tallman, 2015) or compared with women with breast cancer not receiving chemotherapy (Cheung et al., 2012). Still, these studies found that women with breast cancer who received chemotherapy reported worse perceived cognitive functioning, thus indicating that the amount of CogPCI and deficits observed or commented by others is higher in this group, also reporting less CogPCA and greater impact of CogPCI on QoL dimensions. Additionally, concerning emotional state, our results suggest that women with breast cancer present significantly higher levels of depression than healthy women, which corroborate previous studies (e.g., Moreira et al., 2008; Tsaras et al., 2018).

Regarding relationships among perceived cognitive functioning and sociodemographic and psychological adjustment variables, age and education did not appear to be related to perceived cognitive functioning. Although these individual characteristics are clinically relevant predictors/risk factors for cognitive deficits (Ahles et al., 2010; Stewart et al., 2008), these results support previous data also based on self-report assessment (e.g., Cheung et al., 2012). On the other hand, we verified that higher levels of anxiety and depression are associated with worse perceived cognitive functioning (lower scores in all FACT-Cog subscales), indicating perception of more cognitive complaints, a greater impact on QoL, more CogOth about cognitive deficits and lower CogPCA. These findings are in line with previous studies; for instance, Von Ah and Tallman's (2015) study verified that higher values on the scales that assessed anxiety (State-Trait Anxiety Inventory) and depression (Center for Epidemiologic Studies Depression Scale) also correlated negatively with all subscales of the FACT-Cog.

It was also our goal to explore which variables could explain the variance on dimensions of perceived cognitive functioning. Thus, based on the literature, the variables included in the hierarchical regression analyses were age and education (sociodemographic variables, on a first level) and anxiety and depression (emotional state variables, on a second level). On a third level, we additionally included health status (breast cancer or healthy) as a predictor, to explore if the disease itself could increase the amount of explained perceived cognitive functioning variance, significantly adding predictive value to the previous variables. Generally, for all four FACT-Cog subscales, when only age and education were entered in the models, the explained variance was low; introducing anxiety and depression substantially increased the amount of explained variance. Finally, when health status was entered in the third block, the percentage of explained variance still increased significantly, suggesting that being a breast cancer survivor treated with chemotherapy is a predictor of worse perceived cognitive functioning, beyond what is already explained by sociodemographic and emotional state variables.

Age was only significantly associated with the dimensions CogPCI and abilities of the FACT-Cog, so the results are in line with previous findings (Ahles et al., 2010; Janelsins et al., 2017). Education only seems to be a significant predictor of perceived cognitive functioning regarding the perception of cognitive deficits; indeed, some studies (e.g., Ahles et al., 2010) have pointed out that cognitive reserve/education is negatively associated with cognitive impairment. In terms of age and education, regression and correlational results may seem inconsistent. However, this might be related to the fact that in the regression analyses the variance of other variables is taken into account in the model.

Regarding emotional state, depression was a significant predictor of perceived cognitive functioning in all the dimensions, and anxiety only does not seem to be a predictor of comments about cognitive deficits from others, which confirms what the literature has shown (Jenkins et al., 2006; Reid & MacLullich, 2006). Finally, health status (being healthy or a breast cancer survivor) appears to be a significant predictor of perceived cognitive functioning in all its dimensions. To our knowledge, there are no previous studies reporting this variable as a significant predictor of perceived cognitive functioning, but this result is consistent with what is known about the potential risk factors for the development of cognitive impairment (e.g., Asher, 2011; Asher & Myers, 2015). These results alert to the need of considering both clinical and demographic factors as predictors of perceived cognitive functioning, in order to help professionals in clinical contexts to identify patients at risk of developing problems related to perceived cognitive functioning. This early identification could help in the prescription of specific treatments to improve cognitive function and reduce the impact on QoL.

### 4.1 | Limitations and future studies

Some limitations of the present study should be addressed when interpreting our results. Considering the more limited nature of cross-sectional designs to investigate CogPCI consequent to cancer treatments, future studies should attempt to use a longitudinal design to corroborate the present findings. We also need to be cautious in generalizing our results to the Portuguese breast cancer population,

because our sample was limited to breast cancer survivors with digital literacy. Furthermore, we did not recruit our sample from clinical services and so relied on self-report regarding medical information. Consequently, it was not possible to have access to the medical clinical records to gather more specific information about medical and treatment variables, such as the type and dose of chemotherapy and the stage of cancer. These are potentially important variables that should be explored in future studies, considering their possible influence on cognitive functioning. It would also be important to have another comparison group of breast cancer patients not submitted to chemotherapy treatments, who would be matched on the effects of the disease, confounding factors and distress associated with the diagnosis (Joly et al., 2015).

### 4.2 | Strengths

Notwithstanding these limitations, this study is one of the few to include a healthy control group in the investigation of the subjective assessment of cognitive deficits. The use of the FACT-Cog scale should also be highlighted, because it is specifically designed to assess perceived cognitive functioning in cancer patients (Lai et al., 2009; Wagner et al., 2009). Furthermore, we believe that the present study gives important contributions to the literature on the subjective assessment of cognitive impairments in breast cancer patients, providing not only pioneering data regarding the Portuguese breast cancer population but also evidence for the complexity of predictors and factors related to perceived cognitive functioning in women with breast cancer treated with chemotherapy.

## 5 | CONCLUSION

The results of this study highlight the need for health-care professionals, including nurses, to recognize subjective cognitive complaints as legitimate in breast cancer patients. Moreover, the present findings are relevant to nurses to deepen their knowledge about this side effect and to improve the quality of care delivered to breast cancer survivors, for instance, in developing or improving effective symptom management and supportive care interventions targeting cognitive functions, such as cognitive rehabilitation (Ercoli et al., 2015; Green et al., 2018; Poppelreuter et al., 2009; Vance et al., 2017). Additionally, nurses should not only help manage patients' cognitive complaints but also give special attention to depression and anxiety symptomatology, in order to contribute more effectively to ameliorate or even eliminate the negative consequences of this complex side effect of cancer and cancer treatments (McDougall et al., 2011; Sleight, 2016; Vance et al., 2017).

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### CONFLICT OF INTEREST

The authors declare no conflict of interest.

### AUTHORSHIP STATEMENT

Ana F. Oliveira, Ana Torres, Ricardo J. Teixeira, Sara Monteiro, Anabela Pereira and Isabel M. Santos designed the study. Ana F. Oliveira collected the data. Ana F. Oliveira, Ana Torres and Isabel M. Santos analysed the data. Ana F. Oliveira prepared the manuscript. All authors approved the final version for submission.

### DATA AVAILABILITY STATEMENT

The data that support the findings of this study are available from the corresponding author upon reasonable request.

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