

Pet ownership during the first 5 years after breast cancer diagnosis in the NEON-BC cohort

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Background: Although human–animal interactions (HAI) have been associated with health benefits, they have not been extensively studied among cancer patients nor which factors may influence HAI during cancer survivorship. Therefore, this study aims to describe pet ownership in a breast cancer cohort within 5 years post-diagnosis and to identify associated factors. **Methods:** Four hundred sixty-six patients from the NEON-BC cohort were evaluated. Four groups of pet ownership over the 5 years were defined: ‘never had’, ‘stopped having’, ‘started having’ and ‘always had’. Multinomial logistic regression was used to quantify the association between the patient characteristics and the groups defined (reference: ‘never had’). **Results:** 51.7% of patients had pets at diagnosis, which increased to 58.4% at 5 years; dogs and cats were the most common. Women presenting depressive symptoms and poor quality of life were more likely to stop having pets. Older and unpartnered women were less likely to start having pets. Those retired, living outside Porto, having diabetes or having owned animals during adulthood were more likely to start having pets. Women with higher education and unpartnered were less likely to always have pets. Those living in larger households, with other adults or having animals throughout life, were more likely to always have pets. Obese women had lower odds of stopping having dogs/cats. Women submitted to neoadjuvant chemotherapy and longer chemotherapy treatments were more likely to stop having dogs/cats. **Conclusions:** Pet ownership changed over the 5 years and is influenced by sociodemographic, clinical and treatment characteristics, patient-reported outcomes and past pet ownership, reflecting the importance of HAI during cancer survivorship.

Introduction

Globally, breast cancer is the most prevalent cancer among women accounting for nearly one-third of all 5-year prevalent cases of cancer.¹ In the last decades, advances in treatment and earlier diagnosis have led to an improvement in 5-year net survival that surpasses 80% in most countries.² This highlights the need for a comprehensive evaluation of the burden of disease among cancer survivors, and how it reflects on their short- and long-term quality of life. The wide range of symptoms associated with the disease may affect all domains of quality of life, emphasizing the need for the identification of determinants, and for an interdisciplinary approach to the care and management of cancer survivors.

Interacting with animals has been associated with physiological, physical and psychosocial benefits, including decreased cardiovascular risk, such as lower heart rate and blood pressure, increased physical activity levels, increased β -endorphin, dopamine and oxytocin, less frequent feelings of loneliness and depression and improved self-esteem.^{3–7} The importance and role of pets within families can make them important sources of emotional and social support,^{5,7} which are known to influence the ability of patients with cancer to cope with the disease, treatment and long-term survivorship.⁸

Among patients with cancer, previous studies on human–animal interactions have focused mainly on animal-assisted interventions.^{9,10} Additionally, those regarding stable relationships with animals, such as pet ownership, have a cross-sectional design, a small sample size, been conducted in population niches or use a

qualitative/mixed methodology.^{11–18} Nonetheless, in these patients, pet ownership was related with both higher and lower quality of life, whereas dog ownership, specifically, was associated with higher levels of light physical activity.^{11–13} For some patients, pets were associated with mental health benefits and may be a relevant source of emotional, social and functional support, bringing them comfort and humor.^{14–16} Furthermore, patients who were strongly attached to their pets presented fewer depressive symptoms after the end of cancer treatment, whereas during treatment the opposite was also true, which may be explained by challenges related to pet care, and anxieties and concerns for their pet’s future.^{17,18} Despite these results, pet ownership has not been extensively studied among patients with cancer, including which factors may influence it during the course of cancer survivorship. Moreover, it is estimated that more than half of households have pets in the general population,¹⁹ but the prevalence of pet ownership among patients with cancer has not been previously studied.

Therefore, the present study aims to describe pet ownership in a cohort of patients with breast cancer during the first 5 years after diagnosis and to identify associated factors, namely sociodemographic, clinical and treatment features, patient-reported outcomes and aspects of the interaction with pets before diagnosis.

Methods

Study design and participants

The present study is based on a prospective breast cancer cohort study (NEON-BC) aiming to estimate the incidence of neurological

complications of the disease and its treatments during the first years after diagnosis. The study protocol has been described in detail previously.²⁰ Briefly, the cohort comprises adult women consecutively admitted to the Breast Clinic of the Portuguese Institute of Oncology of Porto in 2012, with newly diagnosed breast cancer and proposed for surgery, either as primary treatment or after neoadjuvant chemotherapy. Women who had not been previously treated with chemotherapy and/or radiotherapy in the chest or axillary areas for other primary cancer diagnosed before, nor had been submitted to a previous breast surgery, nor had received any treatment for breast cancer before, and who could understand the purposes of the study and were willing to collaborate, were included.

In 2012, participants underwent a baseline evaluation before any cancer treatment ($n=506$) and were followed up to 1 ($n=503$, 99.4%), 3 ($n=475$, 93.9%) and 5 ($n=466$, 92.1%) years. From the 40 participants lost up to the 5-year evaluation, 18 died, 16 abandoned the study, 4 were transferred to another hospital and 2 were classified as unable to cooperate in subsequent evaluations by the neurologist. Therefore, the present study included 466 patients.

This study is in concordance with the STROBE guidelines for observational studies.²¹

Data collection

In all evaluations, data on sociodemographic, clinical and treatment characteristics of the participants and patient-reported outcomes (i.e. quality of life, anxiety and depression and sleep quality) were collected. Data regarding sociodemographic characteristics were obtained by face-to-face interviews using a structured questionnaire. Data on clinical and treatment characteristics were obtained from clinical records. Cancer stage was classified according to the seventh American Joint Committee on Cancer Staging Manual.²² The previous diagnosis of diabetes and hypertension was collected at baseline, while body mass index (BMI) was computed considering weight and height measured at baseline, and those presenting BMI equal or higher than 30.0 kg/m² were classified as obese.²³

Quality of life was assessed using the European Organization for Research and Treatment of Cancer Quality of Life Questionnaire Core 30,²⁴ which is a 30-item questionnaire. In NEON-BC,^{25,26} the score of all items was reversed, except for items 29 and 30, and the final score of the questionnaire was the sum of individual scores of the 30 items and was expressed as z-scores, with higher scores indicating better quality of life. For the purpose of the present study, the median of the z-score at baseline was used as the cut-off, with a z-score below the median indicating poor quality of life. Anxiety and depression were evaluated using the Hospital Anxiety and Depression Scale,²⁷ which is a 14-item questionnaire, with two seven-item subscales assessing each of the outcomes. The score of each subscale ranges between 0 and 21, with a score of 11 or more on either subscale being considered a 'case' of anxiety or depression (as applicable). Sleep quality was assessed using the Pittsburgh Sleep Quality Index,²⁸ which is a 19-item questionnaire and with a global score that ranges from 0 to 21. A score greater than five indicates poor sleep quality.

In the 5-year follow-up evaluation, participants were asked whether they have or ever had a pet. For those who answered 'yes', a structured questionnaire was used to collect more detailed information on pet ownership. Regarding the period before breast cancer diagnosis, participants were asked about the type and number of animals they lived with and at what stages of life (childhood, adolescence and adulthood). Furthermore, participants were asked about the number of animals they live or have lived with since breast cancer diagnosis, and, for each one, the type of animal and the moment when they started to live together and, for those who were no longer living with the pet in the 5-year evaluation, the moment when they stopped living together.

Statistical analysis

For statistical analysis, considering the information on the 5-year period since cancer diagnosis, which was collected retrospectively at the 5-year evaluation, participants were divided depending on whether they lived or not with any pet at baseline, 1-, 3- and 5-year evaluations. Then, the patients were grouped according to pet ownership since cancer diagnosis and were reclassified as follows: 'never had' (did not live with pets during the 5-year period), 'stopped having' (lived with pets at the baseline evaluation and no longer lived with one at one or more time points between the 1- and 5-year evaluations), 'started having' (did not live with pets at the baseline evaluation and started to live with one at one or more time points between the 1- and 5-year evaluations) and 'always had' (lived with pets during the entire 5-year period). Additionally, participants were divided depending on whether they lived or not with any dog, cat, bird, fish or other animal type at each time point, and the same four groups were created for each animal type. At each evaluation, the number of each animal type was also computed for each patient as well as the total number of pets that the patient had.

For the present analysis, symptoms of anxiety and depression, poor sleep quality and poor quality of life were considered present if the outcomes were identified in the baseline evaluation. The patients' characteristics are presented as counts and proportions for categorical variables, and median and percentiles 25 and 75 for continuous variables. McNemar's test was used to compare the proportions of women who lived with pets at the baseline and at the 5-year follow-up evaluation. Adjusted odds ratio (OR) and 95% confidence intervals (CIs) were computed using multinomial logistic regression to quantify the association between sociodemographic, clinical and treatment features, patient-reported outcomes and aspects of previous interaction with pets, and pet ownership during the first 5 years after breast cancer diagnosis. For this analysis, the outcomes of interest were as follows: 'stopped having', 'started having' and 'always had'; and the reference group was 'never had'. The same analyses were performed for dog and/or cat ownership. The estimates were adjusted for age (continuous) and education (≤ 4 , 5–9, ≥ 10). The sociodemographic characteristics considered in the models have been previously described to be associated with pet ownership.^{29–33} Furthermore, we studied the relationship between clinical characteristics, namely cancer stage and comorbidities, and patient-reported outcomes, and pet ownership, considering the following reasons: pets have also been associated with better cardiovascular outcomes, namely lower systolic and diastolic blood pressure, and lower incidence of overweight and obesity^{3,34}; pets may contribute to psychological and social domains by reducing anxiety and depression, giving a motivation for exercise and offering social support,^{4,5,35} which is a well-recognized predictor of adoption of behavior change and its maintenance, and for patients coping with cancer and other health problems. Some treatment characteristics, namely more aggressive surgery and longer chemotherapy regimens, were associated with short- and long-term side effects, such as immunosuppression and lymphedema, which may also influence interaction with pets.³⁶

A significance level of 5% was considered. Statistical analysis was conducted using Stata, version 15.1 (StataCorp, College Station, TX, USA).

Ethics

This study was approved by the Ethics Committee of the Portuguese Institute of Oncology of Porto (CES 406/011, CES 99/014, CES 290/014 and CES 198/016). All patients provided written informed consent.

Results

The main characteristics of the participants are presented in [Supplementary appendix S1](#). At baseline, nearly half of the women

were less than 55 years old (50.6%), were partnered (69.7%), lived with two or more persons (56.9%), were employed (52.4%) and lived outside the Porto Metropolitan Area (64.8%). A total of 86.3% and 27.0% of women lived with other adults and with children/adolescents at baseline, respectively.

Figure 1 depicts the variation in pet ownership in the first 5 years after cancer diagnosis. At baseline, more than half of the women (51.7%) lived with pets, and dogs and cats were the most frequently owned after cancer diagnosis. From baseline to the 5-year evaluation, there was an increase of 6.7 percentage points (pp) in pet ownership from 51.7% to 58.4% ($P=0.002$). While there were increases in the ownership of dogs (1.9pp, $P=0.286$), cats (8.8pp, $P<0.001$), birds (3.2pp, $P=0.003$) and fish (4.1pp, $P<0.001$) in that period, the opposite was observed for other pets (0.9pp decrease, $P=0.285$). Regarding the ownership of dogs, cats and other pets, more than two-thirds of patients lived with only one animal during the entire period. Additionally, in the same period, nearly half of women who had birds and around two-thirds of those who had fish lived with two or more animals. The maximum number of animals of any type

owned ranged between 11 for animal types other than dogs, cats, birds or fish, and 18 for fish.

The distribution of the patients in the groups according to pet ownership was the following: never had ($n=153$, 32.8%), stopped having ($n=43$, 9.2%), started having ($n=72$, 15.5%) and always had ($n=198$, 42.5%) (figure 2). Taking into account that dogs and cats were the animal types most frequently owned by patients with breast cancer, the distribution into the former groups considering the ownership of the two animal types, alone or together, was as follows: never had ($n=202$, 43.4%), stopped having ($n=38$, 8.2%), started having ($n=61$, 13.1%) and always had ($n=165$, 35.4%) (figure 2).

Figure 3 shows the association between sociodemographic, clinical and treatment features, patient-reported outcomes and aspects of past interaction with pets, and pet ownership in the first 5 years after breast cancer diagnosis. Among women who had at least one pet at cancer diagnosis, those who presented symptoms of depression (OR = 5.58, 95% CI: 1.94–16.09) and a poor quality of life (OR = 2.65, 95% CI: 1.30–5.41) were more likely to stop having a pet. Older women (OR = 0.47, 95% CI: 0.25–0.88) and those

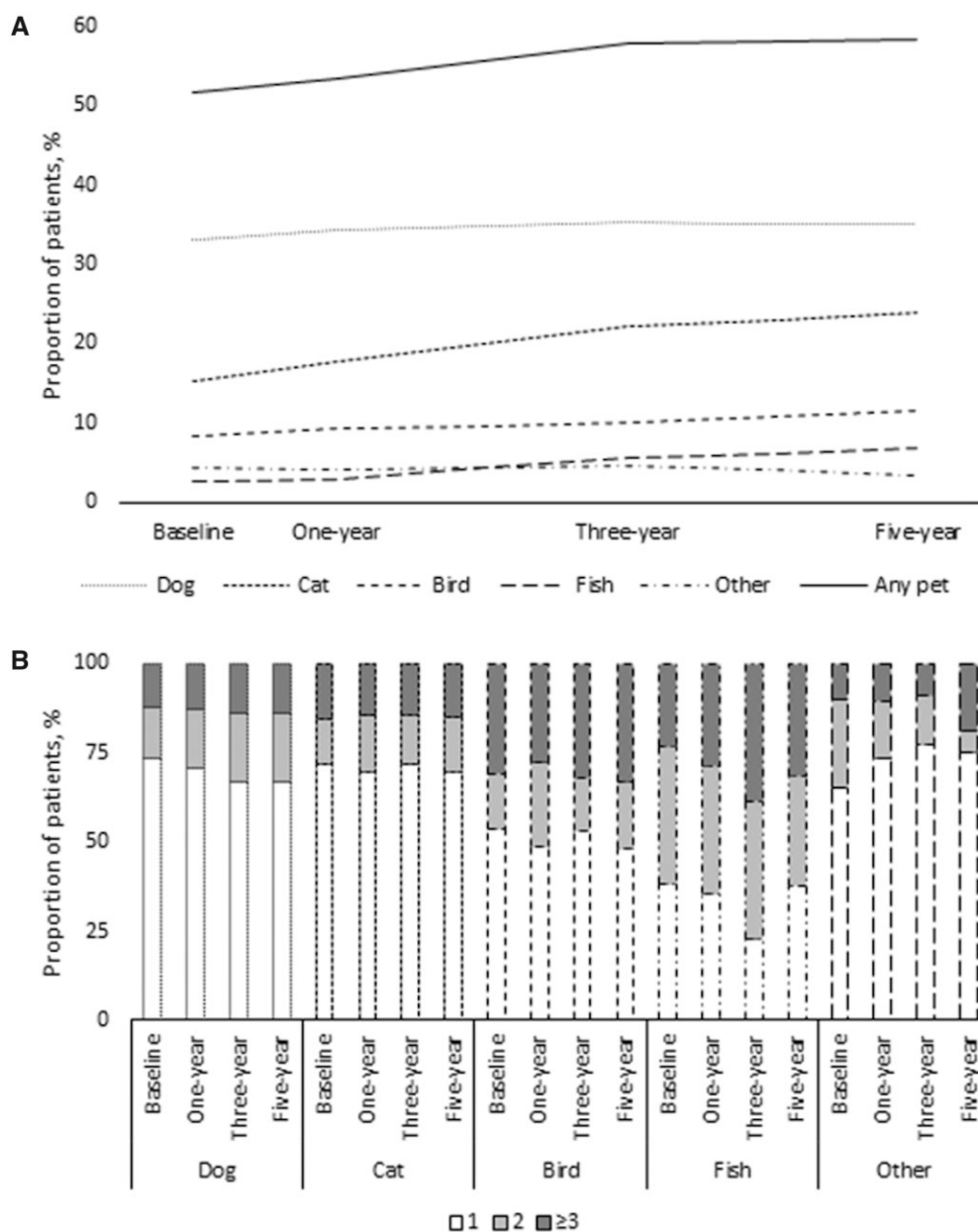


Figure 1 Pet ownership during the first 5 years after breast cancer diagnosis according to animal type (A) and number of animals by animal type (B).

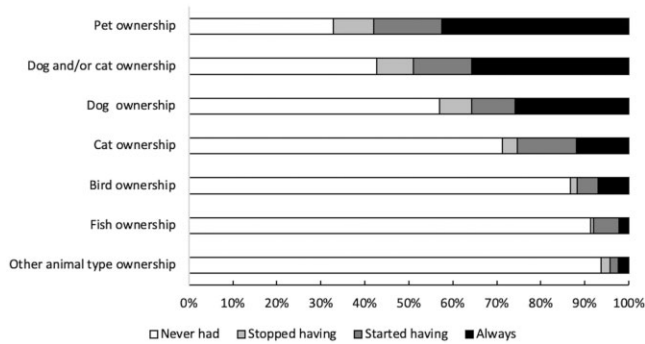


Figure 2 Pet ownership groups during the first five years after breast cancer diagnosis, overall and according to animal type.

unpartnered (OR = 0.45, 95% CI: 0.24–0.85) were less likely to start having a pet. Women who were retired (OR = 3.37, 95% CI: 1.32–8.59), those who lived outside the Porto Metropolitan Area (OR = 2.11, 95% CI: 1.11–4.00), those who had diabetes at baseline (OR = 2.61, 95% CI: 1.01–6.73) and those who had owned animals during adulthood (OR = 5.97, 95% CI: 2.19–16.29) were more likely to start having a pet. Women with a higher educational level (OR = 0.55, 95% CI: 0.32–0.97) and unpartnered (OR = 0.36, 95% CI: 0.23–0.58) were less likely to always having a pet. Further, women who lived in larger households (OR = 2.22, 95% CI: 1.37–3.62) and with other adults (OR = 2.93, 95% CI: 1.53–5.61), those who had animals during childhood/adolescence (OR = 2.19, 95% CI: 1.33–3.60) and adulthood (OR = 3.87, 95% CI: 2.09–7.17) were more likely to always having a pet since the diagnosis of breast cancer.

Among women who had at least one dog and/or a cat at cancer diagnosis, most of the reported associations were maintained, namely with age, marital status, number of people and presence of adults in the household, place of residence, presence of symptoms of depression and poor quality of life at diagnosis, and owning animals during childhood/adolescence and during adulthood (figure 4). Additionally, women who were obese at baseline (OR = 0.27, 95% CI: 0.08–0.92) had lower odds of stopping having a dog and/or a cat. Women who were submitted to neoadjuvant chemotherapy (OR = 3.33, 95% CI: 1.07–10.35) and longer time periods of this treatment type (OR = 3.53, 95% CI: 1.37–9.06) had higher odds of stopping having a dog and/or a cat. Further, women who lived outside the Porto Metropolitan Area (OR = 2.12, 95% CI: 1.34–3.35) had higher odds of always having a dog and/or a cat (figure 4).

Discussion

The present study showed that nearly half of the patients with breast cancer lived with pets at diagnosis, with dogs and cats being the animals with which the participants contacted more frequently in that moment and in the following 5 years. In that period, about one-third of women never had a pet, while more than two-fifths of women always had a pet. Age, education, marital status, presence of adults in and size of household, employment status and place of residence were associated with pet ownership during the 5-year period, as well as diabetes, symptoms of depression and quality of life at diagnosis and past experience with pets. Further associations were observed with dog and/or cat ownership during the 5-year period, namely obesity at diagnosis, and timing and duration of chemotherapy.

The frequency of pet ownership among patients with breast cancer was similar to that estimated in the general Portuguese population.¹⁹ At cancer diagnosis, nearly half of the women lived with pets and that proportion slightly increased in the following years, whereas in the country a variation of +7pp was observed during the same period. However, direct comparisons are difficult to interpret due to potential differences in population characteristics. Also, dogs

and cats were the animals with which the participants contacted more frequently at diagnosis and afterwards, which is consistent with estimated data in the general population.¹⁹ The proportion of women who started having a pet in the 5-year period is higher than those who stopped having one, and it was observed in all animal types studied. Although it is not possible to know the reasons for the women in our study to start or stop having animals, one possible explanation could be the fact that pets are usually associated with benefits for health and well-being, namely emotional and social support, companionship and reducing stress and anxiety,^{5,7,35} which may be particularly relevant after a cancer diagnosis.

Some sociodemographic characteristics associated with pet ownership among patients with breast cancer have been previously reported in the general population, including age, education, marital status, household size and structure and place of residence.^{29–33} In our study, most of these associations were also observed with dog and/or cat ownership. Contrarily, women who were retired had higher odds of starting having a pet. Previous studies found an association between employment status and pet ownership, with less retired people among pet owners, which is expected considering the younger age observed among pet owners.^{31,32} In our study, almost half of the women who started having a pet and who were retired had an early retirement, with their partners probably still working. Given that, it may be possible that they spend more time alone during the day, suggesting that a pet may be a source of companionship for these women. However, we did not have data available on partners' employment status to confirm this hypothesis. Also, women who had animals previously were more likely to start having a pet, and their experience may lead to the belief that pets may be important for their well-being. The latter may also be a possible explanation for women who presented diabetes at diagnosis having higher odds of belonging to that group, suggesting that pets may be sources of emotional and social support,^{5,7} which are well-recognized determinants for patients coping with cancer diagnosis and treatment, as well as with other health problems.

Besides the health benefits, interacting with pets may also pose some potential risks, namely zoonotic infections, which may be particularly pertinent among patients with cancer, specifically those immunocompromised and/or receiving immunosuppressive treatment, such as chemotherapy.³⁶ In fact, the infection susceptibility of patients with cancer may vary during their survivorship course. In this study, women submitted to longer time periods of chemotherapy had higher odds of stopping having a dog and/or a cat. The recommendations for immunocompromised patients refer to increase vigilance over maintaining their pets' health and to adopt husbandry and hygiene-related measures to mitigate the potential risk of zoonotic infections.^{37,38} Although it is advocated that healthcare professionals should not advise patients to part with their pets,³⁷ this possibility could not be excluded. Other possible explanations may be women's own fear to contact with pets or uncertainty of not being able to take care of them during cancer treatment.

Women who presented symptoms of depression and poor quality of life at baseline were more likely to stop having a pet. These associations were also observed with dog and/or cat ownership. Previous research shows an association between the bonds that patients with cancer established with their pets and symptoms of depression that may be partially dependent on treatment status; during treatment, a stronger bond is associated with higher depressive symptoms, while after treatment completion, the opposite is also true. It is possible that patients who were strongly attached with their pets may experience more distress due to challenges related to pet care, anxiety and concerns on the future of their pets.^{17,18} Therefore, some patients may not be able to deal with diagnosis and treatment and, at the same time, with the care of their pets care and may have to find ways to alleviate the associated burden, namely by giving them away. However, this option was not frequently reported.

In the current study, women who were obese at diagnosis were less likely to stop having a dog and/or a cat. Pet ownership, and dog

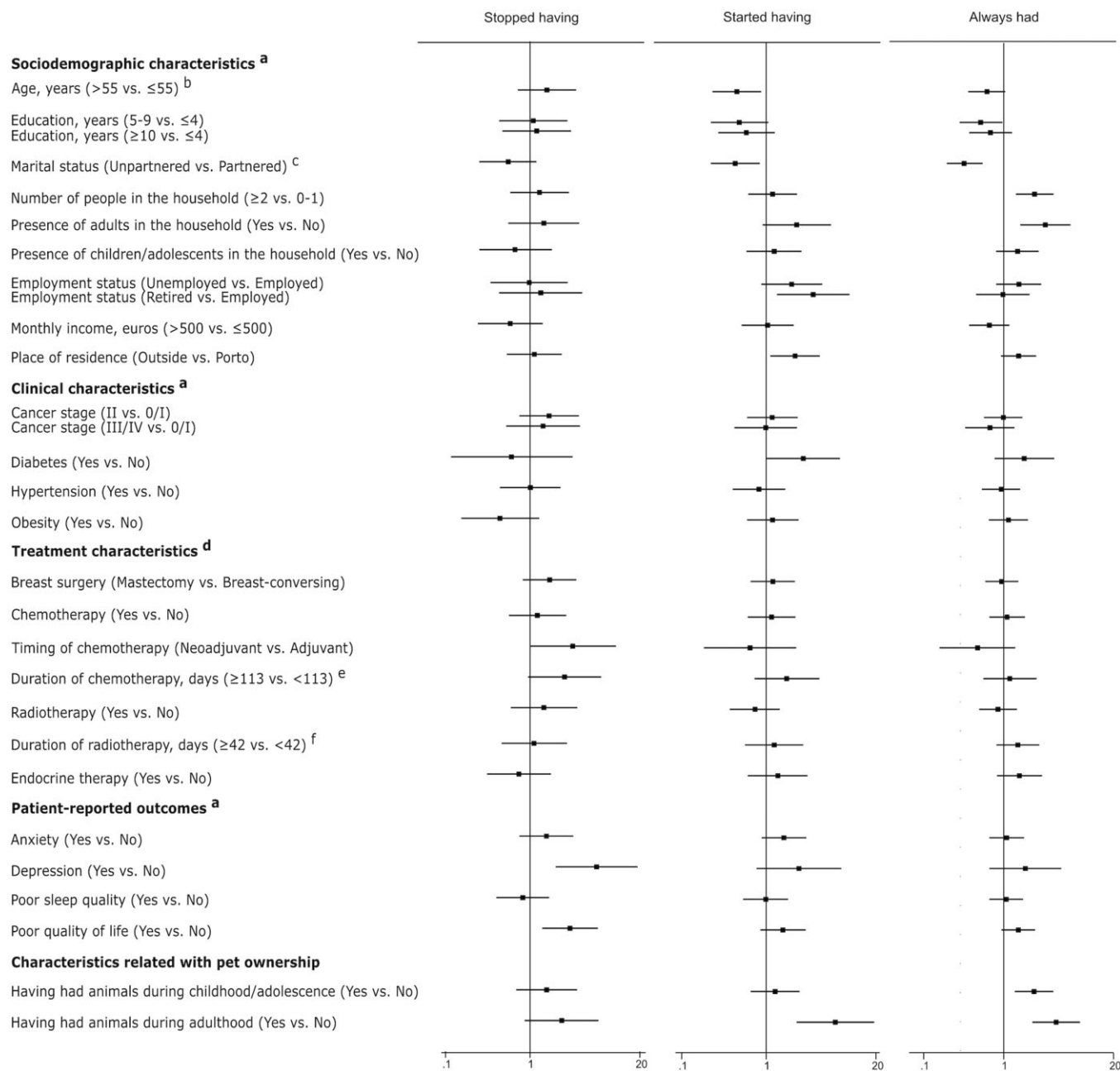


Figure 3 Association between sociodemographic, clinical and treatment features, patient-reported outcomes and other characteristics related with past experience with pets, and pet ownership during the first 5 years after breast cancer diagnosis, among women who had at least one pet since diagnosis (reference category: ‘never had’). ^aData referred to baseline evaluation; ^bThe median age of participants was 55 years; ^cThe ‘Partnered’ category included participants who were married or cohabitating with a partner, and the ‘Unpartnered’ category included single, divorced/separated and widowed participants; ^dTreatment characteristics referred to treatments performed during the first year after diagnosis; ^eThe percentile 75 of chemotherapy duration was 113 days, ^fThe percentile 75 of radiotherapy duration was 42 days.

ownership specifically, has been shown to be associated with increased physical activity levels and higher odds of meeting physical activity guidelines, which may explain the possible association between pet ownership and body weight.^{39,40} Pets may also give motivation for exercise. Moreover, pets may provide social support, which is one of the most important predictors of adoption of behavior change and its maintenance.

The major methodological strength of the present study is the prospective design of multiple and systematic evaluations of the entire cohort. Additionally, to the best of our knowledge, this is the first study describing pet ownership patterns in a cohort of women diagnosed with breast cancer during the first 5 years after diagnosis, while also identifying associated factors. However, some limitations

should be noted. This study only included women diagnosed with breast cancer, which limits the generalizability of the results to other patients with cancer. Studies addressing other cancer sites would help to understand if the effects of the characteristics studied on pet ownership are the same. Data about pet ownership were collected at the 5-year evaluation, which may have caused recall bias as changes in pet ownership may have occurred at any time after cancer diagnosis. Although it is not expected that women forget the moment when they started and stopped (as applicable) to live with a pet, such as a dog or a cat, this may be hindered when the number of animals increases or the animal type changes. Furthermore, the groups of patients who stopped and started having a pet in the 5-year period had a large within group heterogeneity, since only the starting point

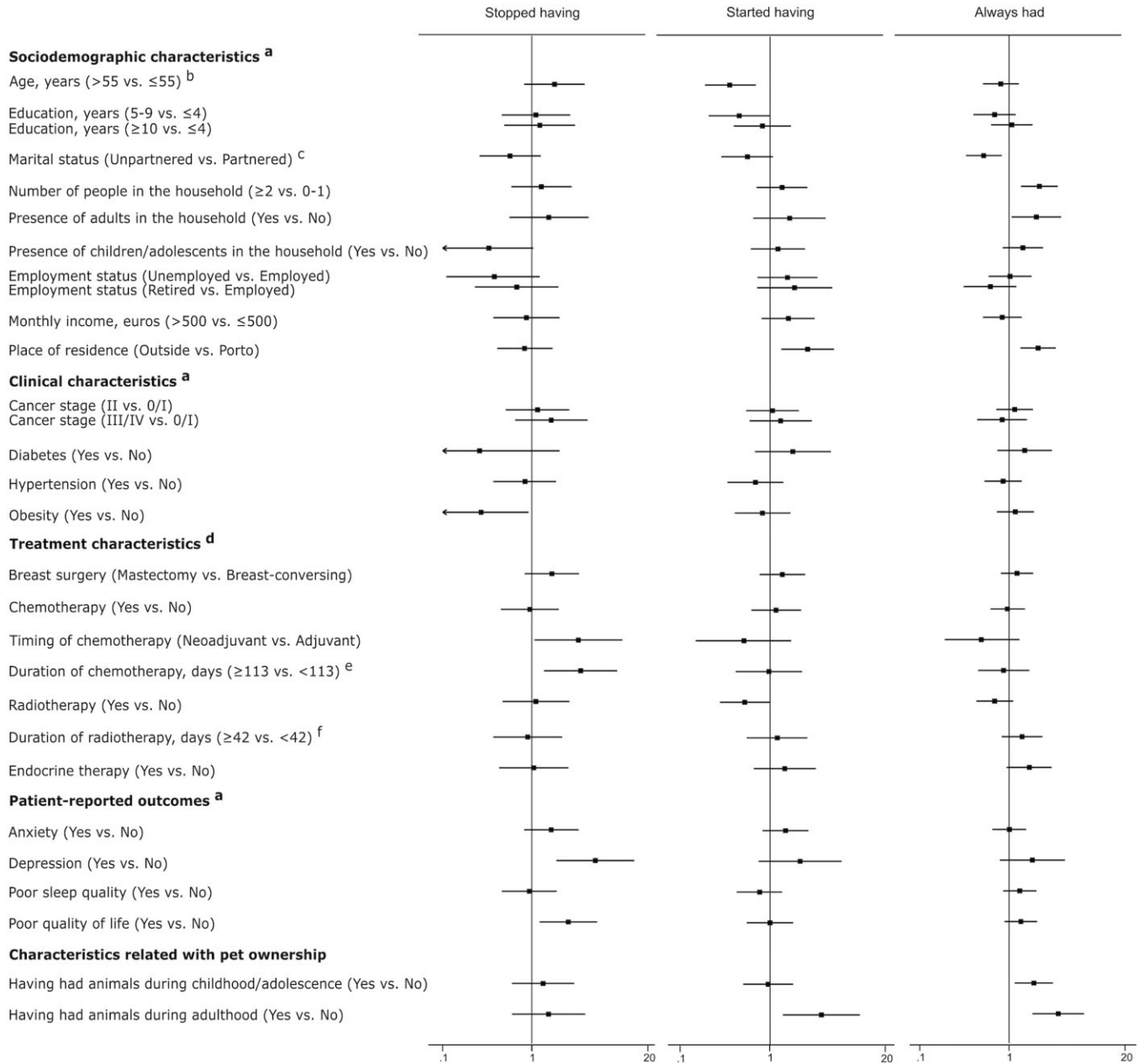


Figure 4 Association between sociodemographic, clinical and treatment features, patient-reported outcomes and other characteristics related with past experience with pets, and dog and/or cat ownership during the first 5 years after breast cancer diagnosis, among women who had at least one dog and/or cat since diagnosis (reference category: 'never had'). ^aData referred to baseline evaluation; ^bThe median age of participants was 55 years; ^cThe 'Partnered' category included participants who were married or cohabitating with a partner, and the 'Unpartnered' category included single, divorced/separated and widowed participants; ^dTreatment characteristics referred to treatments performed during the first year after diagnosis; ^eThe percentile 75 of chemotherapy duration was 113 days, ^fThe percentile 75 of radiotherapy duration was 42 days.

was constant among individuals of the same group. However, the small number of patients in every possible trajectory and the large number of possible trajectories within each group would invalidate the data analysis, while also making it difficult to summarize the results and to draw conclusions. Further studies with larger sample sizes would allow to better capture the differences within these groups. Additionally, a causal relationship between treatment characteristics and pet ownership may be difficult to establish due to the fact that treatments were performed during the first year. However, the treatment plan was defined at breast cancer diagnosis, which probably preceded any changes in pet ownership. Finally, the associations between age at diagnosis and pet ownership found in this study may not be due to the age-group to which each participant

belonged (age effect) but to the birth cohort to which she belonged (cohort effect); however, it was not possible to distinguish that in our analysis.

Nearly half of the women lived with pets at cancer diagnosis and that proportion slightly increased in the following 5 years. In that period, changes in pet ownership were found to be influenced by sociodemographic, clinical and treatment features, patient-reported outcomes and aspects of the interaction with pets before diagnosis. A cancer diagnosis is an overwhelming experience that may unsettle everyone. While for some patients a pet seems to be a source of emotional and social support that helps them to cope with diagnosis and treatment, for others a pet seems to be a source of distress, concern and anxiety. Therefore, it is important to highlight that in

both cases, efforts should be focused on reducing potential negative effects associated with pets, while also enhancing their potential benefits, by providing information and education to patients and promoting a safe, healthy and valuable contact between patients and their pets during the survivorship course.

Supplementary data

Supplementary data are available at *EURPUB* online.

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Conflicts of interest: None declared.

Data availability

The datasets generated during and/or analyzed during the current study are not publicly available due to the fact that the included participants did not provide their consent for public sharing of their data.

Key points

- Nearly half of the patients with breast cancer lived with pets at diagnosis and pet ownership increased in the first five years after diagnosis.
- Dogs and cats were the most frequently owned pets at cancer diagnosis and in the following five years.
- The proportion of women who started having a pet in the 5-year period was higher than that of those who stopped having one.
- Sociodemographic, clinical and treatment characteristics, patient-reported outcomes and past pet ownership of patients with cancer were associated differently with patterns of pet ownership during the survivorship course.
- The results highlight the importance of considering the interactions established with pets and their characteristics during the survivorship course as part of the social history of the patients.

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