Published in final edited form as:
Breast Cancer Res Treat. 2010 November ; 124(2): 487–495. doi:10.1007/s10549-010-0869-0.

Change in lifestyle behaviors and medication use after a diagnosis of ductal carcinoma in situ

Brian L. Sprague,
Department of Population Health Sciences, University of Wisconsin-Madison, Madison, WI 53726, USA. University of Wisconsin Carbone Comprehensive Cancer Center, 610 Walnut St., WARF Room 307, Madison, WI 53726, USA

Amy Trentham-Dietz,
Department of Population Health Sciences, University of Wisconsin-Madison, Madison, WI 53726, USA. University of Wisconsin Carbone Comprehensive Cancer Center, 610 Walnut St., WARF Room 307, Madison, WI 53726, USA

Hazel B. Nichols,
University of Wisconsin Carbone Comprehensive Cancer Center, 610 Walnut St., WARF Room 307, Madison, WI 53726, USA

John M. Hampton, and
University of Wisconsin Carbone Comprehensive Cancer Center, 610 Walnut St., WARF Room 307, Madison, WI 53726, USA

Polly A. Newcomb
University of Wisconsin Carbone Comprehensive Cancer Center, 610 Walnut St., WARF Room 307, Madison, WI 53726, USA. Cancer Prevention Program, Fred Hutchinson Cancer Research Center, Seattle, WA 98109, USA

Brian L. Sprague: bsprague@wisc.edu

Abstract

Women with ductal carcinoma in situ (DCIS) of the breast represent a growing cancer survivor population with a diagnosis of uncertain malignant potential. These survivors face an absence of scientific guidelines regarding lifestyle changes that can help to prevent a breast cancer recurrence. In this first report from the Wisconsin In Situ Cohort (WISC) study, we examine how women are currently changing their lifestyle behaviors and medication use following a diagnosis of DCIS. At study entry (1997–2006), 1,959 subjects (78% of eligible) with DCIS were identified from the Wisconsin cancer registry and administered an interview assessing behaviors prior to diagnosis. Follow-up interviews were completed every 2 years after the initial interview, beginning in 2003 and continuing through 2006. After adjusting for age and calendar year, women were 2.2 kg (95% CI 1.4, 3.0) heavier, 35% (95% CI 20, 47) less likely to be a smoker, 19% (95% CI −1, 43) more likely to use non-steroidal anti-inflammatory drugs, and 57% (95% CI 26, 95) more likely to use antidepressants after a DCIS diagnosis compared to 1 year prior to diagnosis. Use of postmenopausal hormones decreased sharply (OR = 0.06; 95% CI 0.04, 0.09) following a DCIS diagnosis. These findings indicate that women make substantial changes in their behaviors after a DCIS diagnosis. This cohort will be further monitored to evaluate the association between these behaviors and health outcomes following DCIS.

Correspondence to: Brian L. Sprague, bsprague@wisc.edu.

Keywords

Breast neoplasms; Ductal carcinoma in situ; Epidemiology; Cohort study; Health behaviors

Introduction

Breast carcinoma in situ is the earliest form of breast cancer, in which the malignant cells have not yet invaded the surrounding tissue [1]. Ductal carcinoma in situ (DCIS) is the most common form of breast carcinoma in situ, making up about 85% of new breast carcinoma in situ diagnoses and 15–20% of all new breast cancer diagnoses overall [2]. There are approximately 500,000 women in the United States living with a DCIS diagnosis [3].

DCIS is considered a precursor lesion to invasive breast cancer and is typically treated with surgery and radiation [4]. Women with DCIS suffer similar reductions in physical and mental quality of life following their diagnosis as women with localized invasive cancer [5]. By definition, DCIS is confined to the basement membrane and, if completely excised, should cause no further morbidity or mortality [6]. However, recurrences do occur and women diagnosed with DCIS are more than four times as likely to develop invasive breast cancer compared to the general population [7]. While <2% of women diagnosed with DCIS die from breast cancer within 10 years, this mortality rate is almost twice that of women in the general population [6].

While a number of tumor factors have been identified which are associated with an increased likelihood of recurrence [8–11], there is very little evidence upon which to base recommendations of lifestyle changes to reduce risk of recurrence. Women with DCIS are often advised to follow general healthy-lifestyle guidelines (e.g., increasing physical activity and maintaining a healthy weight) and to avoid behaviors known to be associated with risk of an initial breast cancer.

Relatively little population-based information is known describing the changes in lifestyle behaviors and medication use that women adopt following a breast cancer diagnosis [12]. There is a paucity of data examining DCIS specifically. As DCIS is associated with a very good prognosis, women with DCIS may not modify their behaviors as dramatically as those faced with an invasive breast cancer diagnosis. Alternatively, women with DCIS may overestimate their risk of a subsequent invasive breast cancer diagnosis and adopt substantial changes [5, 13,14].

Changes in lifestyle and medication use may have important implications for risk of future breast cancer diagnoses as well as for other health outcomes. The population-based Wisconsin In Situ Cohort (WISC) study was established to investigate risk of recurrence and quality of life among breast carcinoma in situ survivors. In this initial report, we describe the WISC cohort and examine patterns in lifestyle behaviors and medication use before and after a DCIS diagnosis. We focus on behaviors that are known or suspected to influence risk of an initial breast cancer diagnosis, recurrence, or other important health outcomes.

Methods

This study was approved by the University of Wisconsin Health Sciences Institutional Review Board. All subjects provided verbal informed consent.

Study population

The WISC is comprised of 1,037 incident breast carcinoma in situ cases (aged 20–74) who participated in a case–control study during 1997–2001 [15,16] and 1,244 additional incident breast carcinoma in situ cases (aged 20–69) recruited during 2002–2006. All participants were female residents of Wisconsin, with a new first primary diagnosis of breast carcinoma in situ reported to the Wisconsin Cancer Reporting System (the mandatory statewide tumor registry) during 1995–2006 and capable of granting a telephone interview. Eligibility was limited to cases with known dates of diagnosis and a listed telephone number. Cases recruited during 1997–2001 were also required to hold a Wisconsin driver's license for comparability with controls enrolled in a parallel case–control study [15,16]. Overall, 78% of eligible cases enrolled in the study.

Data collection

All study participants completed an initial telephone interview at study enrollment (1997–2006). This initial interview occurred on average 1.3 years (standard deviation, 0.44) after the breast carcinoma in situ diagnosis. Between 2003 and 2006, follow-up interviews were conducted at approximately 2-year interval. Of the 2,281 participants, 1,652 were enrolled by 2004 and therefore eligible for at least one re-contact interview before the end of data collection in December 2006. Of these 1,652 eligible, 78% (N = 1,281) completed the first re-contact interview. Of the 1,281 participants who completed the first re-contact interview, 734 completed it by 2004 and were eligible for a second re-contact interview. Of these 734 eligible, 86% (N = 634) completed the second re-contact interview.

Assessment of lifestyle behaviors and medication use—The initial post-diagnosis telephone interview elicited complete reproductive and menstrual histories, medical and family histories, cancer screening history, demographic information, and health-related behaviors. Subjects were asked to recall body weight, alcohol consumption, fruit and vegetable consumption (beginning in 2002), and smoking habits at 1 year prior to diagnosis. Specifically, participants were asked to recall the number of bottles or cans of beer, glasses of wine, and drinks of hard liquor consumed per day, week, or month; the number of servings of fruits and vegetables (separate items) consumed per day, week, or month; and whether they had smoked more than 100 cigarettes in their lifetime. Subjects who had smoked over 100 cigarettes were asked whether they were smoking at 1 year prior to diagnosis.

The initial interview additionally assessed pre-diagnosis use of postmenopausal hormones and (beginning in interviews conducted in 1999) non-steroidal anti-inflammatory drugs (NSAIDs) and antidepressants. Women were asked to recall if they had ever used hormones such as estrogen or progesterone for menopausal symptoms or osteoporosis for a total of 3 months or more. To assess NSAID use, the subjects were asked to recall if they had ever taken aspirin, ibuprofen, or any other anti-inflammatory medication to treat chronic pain or to prevent heart attack for six consecutive months. Study subjects were asked to recall if they had ever taken an antidepressant for at least three consecutive months. If a subject answered yes to any of these questions, the name of medication, frequency, start and stop dates for each formulation was recorded. For each medication, the start and end dates were used to classify use (yes vs. no) at a year prior to diagnosis.

At the re-contact interviews, subjects were asked to update their current body weight, alcohol consumption, fruit and vegetable consumption, smoking habits, and use of postmenopausal hormones, NSAIDs, and antidepressants. They were also asked to report any recurrence or new breast cancer diagnoses.

Assessing treatments received—Treatment information was obtained at the initial interview for all subjects recruited during 2002–2006, and updated during the follow-up interviews for all subjects. Collected information regarding treatment included surgical procedures, radiation therapy, and use of tamoxifen, aromatase inhibitors, and raloxifene. As treatment data was not collected during the initial interview for subjects enrolled prior to 2002, treatment information is missing for subjects enrolled during 1997–2001 who did not complete a follow-up interview.

Tumor histopathology—Under statutory mandate since 1976, the Wisconsin Cancer Reporting System receives standardized cancer diagnosis reports from physicians, hospitals, and clinics across the state. The Wisconsin Cancer Reporting System provided data on each breast carcinoma in situ diagnosis, including date of diagnosis and tumor histology. Subtypes were defined using the International Classification of Disease—Oncology codes [17] as ductal (codes 8201, 8230, 8500, 8501, 8503, 8507, 8521–8523, and 8543), lobular (code 8520), and other (all other codes). Estrogen receptor and progesterone receptor status is not currently available. Women with concomitant in situ and invasive breast cancer were excluded.

Reliability sub-studies

We have conducted a number of sub-studies to assess the reliability of the questionnaire items, as measured using Cohen's κ (categorical items) and the intraclass correlation coefficient (continuous items) [18]. A sample of Wisconsin women with and without breast cancer was re-interviewed using a short form of the questionnaire. With an average of 9.5 months (range 8.6, 11.1) between interviews, 112 (92% of eligible) women with invasive breast cancer and 76 (90% of eligible) women without breast cancer were re-interviewed. Among all re-interviewed subjects, the intraclass correlation coefficient for body weight was 0.89 (lower 95% confidence interval, 0.86).

In a separate sub-study [19], 147 selected controls (95% of eligible), 124 invasive cases (98% of eligible), and 26 in situ cases (93% of eligible) were successfully re-contacted and re-interviewed, with an average of 3.0 months (range 1.4, 4.7 months) between interviews. Among all women combined, κ was 0.59 (95% CI 0.49, 0.70) for current use of NSAIDs and 0.66 (95% CI 0.49, 0.83) for current use of antidepressants.

The reliability of the assessment of alcohol consumption, postmenopausal hormone use, and smoking was evaluated in a previous case–control study of invasive breast cancer which used the same format of questions [20]. After an average of 3.5 months (range 1.4, 5.6 months), 207 women with invasive breast cancer and 197 women without breast cancer were re-interviewed. The intraclass correlation coefficient among all subjects for drinks per week of alcohol was 0.76 (lower 95% confidence interval 0.73). κ was 0.91 (95% CI 0.85, 0.97) for current smoking status and 0.90 (95% CI 0.84, 0.96) for current postmenopausal hormone use (among postmenopausal women only). The reliability of the fruit and vegetable consumption items has not been evaluated. Overall, these statistics indicate good-to-excellent reliability of these questionnaire items on lifestyle behaviors and medication use.

Statistical analysis

This analysis was limited to women diagnosed with DCIS (N = 1,959; 926 with an initial interview only, 564 with an initial interview and one re-contact interview, and 469 with an initial interview and two re-contact interviews). Seventy-eight women with DCIS who reported a second breast cancer diagnosis (in situ or invasive) following their entry into the cohort were censored at the time of the second diagnosis.

All analyses were performed using SAS Statistical Software (Version 9; SAS Institute, Inc., Cary, North Carolina). Least squared means and 95% confidence intervals (CI) for body weight, alcohol consumption, and fruit and vegetable consumption were calculated using multivariable analysis of variance including covariates for age and calendar year corresponding to the date for which the health-behavior was assessed. A spatial power structure correlation matrix was used to account for repeated measurements on individuals [21]. Multivariable logistic regression models were used to calculate the odds ratios (OR) and 95% CIs of being a smoker or user of postmenopausal hormones, NSAIDs, and antidepressants as a function of time since the DCIS diagnosis. The logistic regression models were adjusted for age and calendar year. The alternating logistic regressions algorithm with the exchangeable log odds ratio regression structure was used to account for repeated measures [21]. Tests for interaction were conducted by the inclusion of cross-product terms in the models.

Results

Selected characteristics of the study subjects are shown in Table 1. The median age at diagnosis was 55.9 years. Though breast conserving surgery combined with radiation was the most common treatment (44%), a substantial fraction of women had a mastectomy (31%). Tamoxifen use was reported by 35% of the study sample. Over half of the study sample was overweight or obese at 1 year prior to diagnosis.

Of the subjects who completed the first follow-up interview (N = 1,033), 52% gained more than 2.3 kg (five pounds) since a year prior to their diagnosis, with 17% gaining more than 9 kg (20 lb). Among all subjects, body weight was significantly higher post-diagnosis than at 1 year prior to diagnosis after adjustment for age and calendar year (74.1 vs. 72.0 kg, $P < 0.001$; Table 2). The difference in body weight was not attributable to the weight gain associated with aging. Body weight was greater after diagnosis than that at 1 year prior to diagnosis in every age strata (Fig. 1).

Overall, the multivariable-adjusted difference in body weight before and after diagnosis was most pronounced among women who quit smoking (5.2 kg; 95% CI 1.0, 9.4), though a significant difference was also observed among women who refrained from smoking throughout the study period (2.2 kg; 95% CI 1.3, 3.0; $P_{\text{interaction}} = 0.01$). Weight gain after diagnosis was somewhat more pronounced among women who used tamoxifen (2.4 kg; 95% CI 1.1, 3.8; pre- vs. post-diagnosis) compared to those who had not (1.8 kg; 95% CI 0.8, 2.9; $P_{\text{interaction}} = 0.15$). Weight gain did not vary significantly according to history of postmenopausal hormone use ($P_{\text{interaction}} = 0.78$).

After adjusting for age and calendar year, no statistically significant differences in alcohol consumption or fruit and vegetable consumption were observed between DCIS cases before and after diagnosis (Table 2).

At 1 year prior to diagnosis, 14.5% of DCIS cases were smokers (Table 3). Among these smokers who completed the first follow-up interview, 38% had quit smoking after their diagnosis. Among DCIS cases who were non-smokers prior to diagnosis, 0.4% had begun smoking by the time of the first follow-up interview. Overall, DCIS cases were 35% less likely to be smoking after diagnosis than at 1 year prior to diagnosis (OR = 0.65; 95% CI 0.53, 0.80). The reduced odds of smoking post-diagnosis appeared to persist throughout the duration of follow-up.

Among postmenopausal women, use of hormones dropped sharply from 42.8 to 3.1% following a DCIS diagnosis (Table 4). After adjustment for age and calendar year, women were 94% (OR = 0.06; 95% CI 0.04, 0.09) less likely to use postmenopausal hormones after diagnosis than at a year prior to diagnosis. Survivors continued to avoid use of postmenopausal

hormones through the 11 years of follow-up. Hormone use among all subjects (before or after diagnosis) declined after the year 2002 when the adverse effects of hormone use were described in the Women's Health Initiative trial [22]. In analyses limited to dates after 2002, women were 91% (OR = 0.09; 95% CI 0.06, 0.14) less likely to report use of postmenopausal hormones after their DCIS diagnosis compared to 1 year prior to diagnosis.

In the 1 year prior to diagnosis, 29.2% of DCIS cases used NSAIDs, compared to 43.4% after diagnosis (Table 4). Some of this crude overall difference was attributable to the age difference between cases before and after diagnosis, as there was a strong positive association between age and NSAID use among the study population. After adjustment for age and calendar year, women were 19% (OR = 1.19; 95% CI 0.99, 1.43) more likely to use NSAIDs after diagnosis than at 1 year before diagnosis.

Following diagnosis, DCIS cases were 57% more likely to use antidepressants than at 1 year prior to diagnosis (OR = 1.57; 95% CI 1.26, 1.95; Table 4). This elevated use appeared to decline over the course of follow-up, and was no longer statistically significant after 6 years post-diagnosis. The increased use of antidepressants was similar among DCIS survivors regardless of history of postmenopausal hormone use ($P_{\text{interaction}} = 0.46$). However, the elevated odds of antidepressant use after diagnosis was most pronounced among users of tamoxifen (OR = 2.28; 95% CI 1.59, 3.26), whereas only a moderate increase in antidepressant use was observed among non-users of tamoxifen (OR = 1.22; 95% CI 0.90, 1.64; $P_{\text{interaction}} = 0.01$).

The differences between pre- and post-diagnosis body weight, smoking, postmenopausal hormone use, NSAID use, and antidepressant use did not appear to vary strongly by age, education, or surgical treatment (all $P_{\text{interaction}} > 0.05$; data not shown).

Discussion

In this first report of the WISC Study, we found that women tended to gain weight, quit smoking, increase use of NSAIDs and antidepressants, and dramatically decrease use of postmenopausal hormones following a DCIS diagnosis. Little difference in alcohol or fruit and vegetable consumption was detected after diagnosis.

Women tended to report a heavier body weight following their DCIS diagnosis than their recalled body weight at 1 year prior to diagnosis even after adjusting for the changes in weight associated with aging. The difference in weight was most pronounced within the first 4 years after diagnosis. These findings are similar to those reported by the Health, Eating, Activity, and Lifestyle (HEAL) study [23], in which breast carcinoma in situ survivors ($N = 127$) gained 1.3 kg on average between 1 and 3 years post-diagnosis. These results suggest that weight gain after a DCIS diagnosis may tend to be somewhat less than that previously reported for invasive breast cancer survivors [24,25]. This difference may be due to differences in the physiological or psychological impacts of in situ and invasive breast cancer diagnoses, as well as differences in the type of treatment received. In the Women's Healthy Eating and Living Study [25], invasive breast cancer survivors were more 1.65 times more likely to gain weight (≥5% of body weight) if they received chemotherapy. A smaller weight gain among DCIS survivors would thus be consistent with the rare use of chemotherapy in the treatment of DCIS (<1% in this population).

Tamoxifen has been associated with weight gain in some [26,27] but not all [28,29] controlled clinical trials in breast cancer survivors and high risk women. We observed somewhat greater weight gain following diagnosis among women who had used tamoxifen, though substantial weight gain was also observed in women who had not. The relative contributions of changes in metabolism rates, physical activity levels, and dietary intake to weight gain after a breast

cancer diagnosis remain unclear [30]. In the HEAL study [31], women with breast carcinoma in situ decreased their vigorous physical activity levels following their diagnosis. It has also been reported that survivors diagnosed with breast carcinoma in situ engage in lower levels of total physical activity after diagnosis than those with invasive breast cancer [32]. Ligibel et al. [33] recently reported that physical activity levels among 391 DCIS survivors were lower among women who underwent mastectomy and women who reported higher anxiety levels. Unfortunately we were unable to compare physical activity levels before and after a DCIS diagnosis in our study, as physical activity was assessed differently at the initial and follow-up interviews.

We observed little change in alcohol or fruit and vegetable consumption after a DCIS diagnosis. Thomson et al. [34] previously reported that 57% of women who consumed alcohol prior to an invasive breast cancer diagnosis reported decreasing their consumption following diagnosis. A few studies have reported that up to 70% of invasive breast cancer survivors report increasing their fruit and vegetable consumption after diagnosis [32,34,35]. In contrast, Wayne et al. [36] reported no change in mean intake of fruits and vegetables between 1 year prior and 2 years after a breast carcinoma in situ or invasive breast cancer diagnosis. Variation in the assessment of change in diet is likely to account for variation between studies [36].

We found a large fraction of women quit smoking after diagnosis, yet a substantial number (~8%) of DCIS survivors remained smokers. These results are generally similar to the reductions in smoking observed after an invasive breast cancer diagnosis [24,37].

Only 3% of DCIS survivors reported post-diagnosis use of postmenopausal hormones. Notably, use of postmenopausal hormones in the general population has declined since the publication in 2002 of the results of the Women's Health Initiative randomized trial [38]. However, the decline in hormone use following a DCIS diagnosis was independent of this secular trend. In analyses restricted to 2003–2006, postmenopausal hormone use was 91% lower among women after a DCIS diagnosis compared to pre-diagnosis reports during the same time period.

We observed elevated use of NSAIDs and antidepressants among women following a DCIS diagnosis compared to the recalled level of use pre-diagnosis. Both of these trends suggest that DCIS diagnosis and treatment may lead to health effects which require pharmacologic intervention. The LACE study has previously reported that 22.6% of invasive breast cancer survivors used NSAIDs after diagnosis [39] and the HEAL study found that 15% of breast cancer survivors (in situ and invasive combined) were taking antidepressants [40]. Chubak et al. [41] found that antidepressant use among invasive breast cancer survivors rose from 23% in 1990 to 36% in 1999, while only 14% of these survivors had used antidepressants in the year prior to their diagnosis. Elevated rates of depression have been observed among breast cancer survivors, with a reported prevalence ranging as high as 46% [42]. Some antidepressants (e.g., selective serotonin reuptake inhibitors) can also provide relief from menopausal symptoms, potentially explaining the particularly common use of antidepressants we observed among DCIS survivors treated with tamoxifen.

A number of limitations should be considered in the interpretation of this study. While participation in the initial and re-contact interviews was excellent (≥78% of eligible), it remains possible that women who participated had more healthy lifestyles or differed in other ways from those who refused to participate. Eligible women with DCIS who did not complete a follow-up interview were less likely to have a college diploma (20%) and more likely to be a smoker (20%) at the initial interview, but were similar to participants in regard to age, body weight, and family history of breast cancer.

We relied upon self reports of all health-related behaviors. In separate sub-studies we have found that reliability of this self-reported data is good. Among women who were re-interviewed, we found intraclass correlation coefficients >0.75 for body weight and alcohol consumption, and Cohen's κ ranging from 0.59 for NSAID use to 0.91 for smoking status (see "Methods" for further details). However, the validity of this self-reported data in our population has not been assessed. In addition, it is possible that women with DCIS may artificially alter their response to conform to an expected change in certain behaviors following diagnosis.

Health-related behaviors at 1 year prior to diagnosis were assessed in interviews conducted approximately 1 year after diagnosis. On average, this required subjects to recall behaviors from 2 years past. This reliance on recall likely contributed to measurement error in the pre-diagnosis behaviors. Beyond the typical measurement error inherent in recall over such a period of time, it is possible that the DCIS diagnosis may have clouded the subject's perception of their pre-diagnosis behaviors. Unfortunately, we have little evidence to assess the potential magnitude or direction of this bias. Finally, our assessment of dietary intake of alcohol and fruits and vegetables was not in the context of a full diet assessment (e.g., food frequency questionnaire) and may therefore be insensitive to true changes in dietary patterns.

Important strengths of the study include the large, population-based sample and the assessment of health-related behaviors for up to 11 years of follow-up after the initial diagnosis.

The influence of changes in health-related behaviors on risk of recurrence after a DCIS diagnosis is currently unknown. The limited data regarding risk of recurrence after an invasive breast cancer diagnosis suggests that post-diagnosis weight gain [43] and postmenopausal hormone use [44] increase risk of recurrence, while use of NSAIDs [39] may lower recurrence rates. Smoking has been associated with all-cause mortality among breast cancer survivors, though it has not been associated with breast cancer specific mortality or risk of recurrence [37]. Notably, some new antidepressants inhibit the cytochrome P450 enzyme CYP2D6, which metabolizes tamoxifen to its most active metabolite [45]. We observed that 26% of women treated with tamoxifen also reported post-diagnosis use of antidepressants. Fortunately, the limited evidence to date suggests no impact of antidepressant use on recurrence after a breast cancer diagnosis [41]. However, there remains a need for further studies with long follow-up periods to confirm this conclusion.

Women with DCIS represent a growing cancer survivor population with a long life expectancy following their diagnosis. Relative survival among DCIS cases approaches that of women without breast cancer [6], yet the psychological impact of a DCIS diagnosis appears similar to that of a localized invasive breast cancer diagnosis [5]. This may present a unique opportunity in which women are highly motivated to adopt lifestyle changes which could lower their risk of future breast cancer diagnoses and improve other health outcomes. This cohort will continue to be monitored to investigate the relation between health-related behaviors and risk of recurrence and other health outcomes after a DCIS diagnosis.

Acknowledgments

This work was supported by the National Institutes of Health (CA67264 and CA47147). Dr. Sprague is supported by a fellowship from the Prevent Cancer Foundation and the American Society of Preventive Oncology. We are grateful to Drs. Ronald Gangnon, Henry Anderson, Patrick L. Remington, Kathleen Egan, and Linda Titus-Ernstoff for study-related advice; Laura Stephenson and the staff of the Wisconsin Cancer Reporting System; and WISC study staff including Julie McGregor, Kathy Peck, Mary Pankratz, Linda Haskins, and Jerry Phipps, along with the study interviewers for assistance with data collection. We are especially grateful to the study participants, whose generosity made this research possible.

References

1. Silverstein, MJ.; Baril, NB. In situ carcinoma of the breast. In: Donegan, WL.; Spratt, JS., editors. Cancer of the breast. 5. Saunders; Philadelphia: 2002.
2. Sprague, BL.; Trentham-Dietz, A. In situ breast cancer. In: Li, CI., editor. Breast cancer epidemiology. Springer; New York: 2010. p. 47-72.
3. Sprague BL, Trentham-Dietz A. Prevalence of breast carcinoma in situ in the United States. JAMA 2009;302(8):846–848. [PubMed: 19706857]
4. Burstein HJ, Polyak K, Wong JS, Lester SC, Kaelin CM. Ductal carcinoma in situ of the breast. N Engl J Med 2004;350(14):1430–1441. [PubMed: 15070793]
5. Rakovitch E, Franssen E, Kim J, et al. A comparison of risk perception and psychological morbidity in women with ductal carcinoma in situ and early invasive breast cancer. Breast Cancer Res Treat 2003;77(3):285–293. [PubMed: 12602928]
6. Ernster VL, Barclay J, Kerlikowske K, Wilkie H, Ballard-Barbash R. Mortality among women with ductal carcinoma in situ of the breast in the population-based surveillance, epidemiology and end results program. Arch Intern Med 2000;160(7):953–958. [PubMed: 10761960]
7. Warnberg F, Yuen J, Holmberg L. Risk of subsequent invasive breast cancer after breast carcinoma in situ. Lancet 2000;355(9205):724–725. [PubMed: 10703809]
8. Boyages J, Delaney G, Taylor R. Predictors of local recurrence after treatment of ductal carcinoma in situ: a meta-analysis. Cancer 1999;85(3):616–628. [PubMed: 10091735]
9. Kerlikowske K, Molinaro A, Cha I, et al. Characteristics associated with recurrence among women with ductal carcinoma in situ treated by lumpectomy. J Natl Cancer Inst 2003;95(22):1692–1702. [PubMed: 14625260]
10. Li CI, Malone KE, Saltzman BS, Daling JR. Risk of invasive breast carcinoma among women diagnosed with ductal carcinoma in situ and lobular carcinoma in situ, 1988–2001. Cancer 2006;106 (10):2104–2112. [PubMed: 16604564]
11. Habel LA, Daling JR, Newcomb PA, et al. Risk of recurrence after ductal carcinoma in situ of the breast. Cancer Epidemiol Biomarkers Prev 1998;7(8):689–696. [PubMed: 9718221]
12. Norman SA, Potashnik SL, Galantino ML, et al. Modifiable risk factors for breast cancer recurrence: what can we tell survivors? J Womens Health (Larchmt) 2007;16(2):177–190. [PubMed: 17388734]
13. van Gestel YR, Voogd AC, Vingerhoets AJ, et al. A comparison of quality of life, disease impact and risk perception in women with invasive breast cancer and ductal carcinoma in situ. Eur J Cancer 2007;43(3):549–556. [PubMed: 17140788]
14. Partridge A, Adloff K, Blood E, et al. Risk perceptions and psychosocial outcomes of women with ductal carcinoma in situ: longitudinal results from a cohort study. J Natl Cancer Inst 2008;100(4): 243–251. [PubMed: 18270338]
15. Nichols HB, Trentham-Dietz A, Egan KM, et al. Oral contraceptive use and risk of breast carcinoma in situ. Cancer Epidemiol Biomarkers Prev 2007;16(11):2262–2268. [PubMed: 18006914]
16. Trentham-Dietz A, Nichols HB, Egan KM, et al. Cigarette smoking and risk of breast carcinoma in situ. Epidemiology 2007;18(5):629–638. [PubMed: 17700252]
17. Fritz, A.; Percy, C.; Jack, A., et al., editors. International classification of diseases for oncology. 3. World Health Organization; Geneva: 2000.
18. Armstrong, BK.; White, E.; Saracci, R. Principles of exposure measurement in epidemiology. Vol. 21. Oxford University Press; Oxford: 1992.
19. Sprague BL, Trentham-Dietz A, Newcomb PA, et al. Lifetime recreational and occupational physical activity and risk of in situ and invasive breast cancer. Cancer Epidemiol Biomarkers Prev 2007;16 (2):236–243. [PubMed: 17301255]
20. Newcomb PA, Titus-Ernstoff L, Egan KM, et al. Post-menopausal estrogen and progestin use in relation to breast cancer risk. Cancer Epidemiol Biomarkers Prev 2002;11(7):593–600. [PubMed: 12101105]
21. Palta, M. Quantitative methods in population health; extensions of ordinary regression. Wiley; Hoboken: 2003.

22. Rossouw JE, Anderson GL, Prentice RL, et al. Risks and benefits of estrogen plus progestin in healthy postmenopausal women: principal results from the Women's Health Initiative randomized controlled trial. JAMA 2002;288(3):321–333. [PubMed: 12117397]
23. Irwin ML, McTiernan A, Baumgartner RN, et al. Changes in body fat and weight after a breast cancer diagnosis: influence of demographic, prognostic, and lifestyle factors. J Clin Oncol 2005;23(4):774–782. [PubMed: 15681521]
24. Caan B, Sternfeld B, Gunderson E, et al. Life after cancer epidemiology (LACE) study: a cohort of early stage breast cancer survivors (United States). Cancer Causes Control 2005;16(5):545–556. [PubMed: 15986109]
25. Saquib N, Flatt SW, Natarajan L, et al. Weight gain and recovery of pre-cancer weight after breast cancer treatments: evidence from the women's healthy eating and living (WHEL) study. Breast Cancer Res Treat 2007;105(2):177–186. [PubMed: 17123151]
26. Hoskin PJ, Ashley S, Yarnold JR. Weight gain after primary surgery for breast cancer—effect of tamoxifen. Breast Cancer Res Treat 1992;22(2):129–132. [PubMed: 1391977]
27. Ingle JN, Twito DI, Schaid DJ, et al. Combination hormonal therapy with tamoxifen plus fluoxymesterone versus tamoxifen alone in postmenopausal women with metastatic breast cancer. An updated analysis. Cancer 1991;67(4):886–891. [PubMed: 1991261]
28. Fisher B, Costantino J, Redmond C, et al. A randomized clinical trial evaluating tamoxifen in the treatment of patients with node-negative breast cancer who have estrogen-receptor-positive tumors. N Engl J Med 1989;320(8):479–484. [PubMed: 2644532]
29. Grey AB, Stapleton JP, Evans MC, Reid IR. The effect of the anti-estrogen tamoxifen on cardiovascular risk factors in normal postmenopausal women. J Clin Endocrinol Metab 1995;80(11): 3191–3195. [PubMed: 7593425]
30. Demark-Wahnefried W, Rimer BK, Winer EP. Weight gain in women diagnosed with breast cancer. J Am Diet Assoc 1997;97(5):519–526. 529. quiz 527–518. [PubMed: 9145091]
31. Irwin ML, Crumley D, McTiernan A, et al. Physical activity levels before and after a diagnosis of breast carcinoma: the health, eating, activity, and lifestyle (HEAL) study. Cancer 2003;97(7):1746–1757. [PubMed: 12655532]
32. Patterson RE, Neuhouser ML, Hedderson MM, et al. Changes in diet, physical activity, and supplement use among adults diagnosed with cancer. J Am Diet Assoc 2003;103(3):323–328. [PubMed: 12616253]
33. Ligibel JA, Partridge A, Giobbie-Hurder A, et al. Physical activity behaviors in women with newly diagnosed ductal carcinoma-in situ. Ann Surg Oncol 2009;16(1):106–112. [PubMed: 18953612]
34. Thomson CA, Flatt SW, Rock CL, et al. Increased fruit, vegetable and fiber intake and lower fat intake reported among women previously treated for invasive breast cancer. J Am Diet Assoc 2002;102(6):801–808. [PubMed: 12067045]
35. Maunsell E, Drolet M, Brisson J, Robert J, Deschenes L. Dietary change after breast cancer: extent, predictors, and relation with psychological distress. J Clin Oncol 2002;20(4):1017–1025. [PubMed: 11844825]
36. Wayne SJ, Lopez ST, Butler LM, et al. Changes in dietary intake after diagnosis of breast cancer. J Am Diet Assoc 2004;104(10):1561–1568. [PubMed: 15389414]
37. Holmes MD, Murin S, Chen WY, et al. Smoking and survival after breast cancer diagnosis. Int J Cancer 2007;120(12):2672–2677. [PubMed: 17278091]
38. Hersh AL, Stefanick ML, Stafford RS. National use of postmenopausal hormone therapy: annual trends and response to recent evidence. JAMA 2004;291(1):47–53. [PubMed: 14709575]
39. Kwan ML, Habel LA, Slattery ML, Caan B. NSAIDs and breast cancer recurrence in a prospective cohort study. Cancer Causes Control 2007;18(6):613–620. [PubMed: 17404892]
40. Meeske K, Smith AW, Alfano CM, et al. Fatigue in breast cancer survivors two to five years post diagnosis: a HEAL study report. Qual Life Res 2007;16(6):947–960. [PubMed: 17457697]
41. Chubak J, Buist DS, Boudreau DM, et al. Breast cancer recurrence risk in relation to antidepressant use after diagnosis. Breast Cancer Res Treat 2008;112(1):123–132. [PubMed: 18058227]
42. Massie MJ. Prevalence of depression in patients with cancer. J Natl Cancer Inst Monogr 2004;32:57–71. [PubMed: 15263042]

43. Kroenke CH, Chen WY, Rosner B, Holmes MD. Weight, weight gain, and survival after breast cancer diagnosis. J Clin Oncol 2005;23(7):1370–1378. [PubMed: 15684320]

44. Holmberg L, Anderson H. HABITS (hormonal replacement therapy after breast cancer—is it safe?), a randomised comparison: trial stopped. Lancet 2004;363(9407):453–455. [PubMed: 14962527]

45. Loprinzi CL, Wolf SL, Barton DL, Laack NN. Symptom management in premenopausal patients with breast cancer. Lancet Oncol 2008;9(10):993–1001. [PubMed: 19071256]

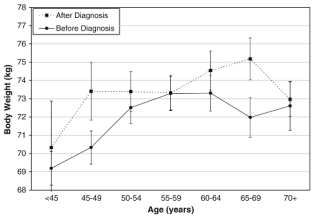

Fig. 1.

Mean body weight (adjusted for calendar year) by age among DCIS cases before and after diagnosis, Wisconsin, 1997–2006. Error bars represent standard error

Table 1

Characteristics of DCIS study subjects, Wisconsin, 1997–2006

	No. (*N* = 1,959)	%
Age at diagnosis (years)		
20–44	243	12.4
45–54	693	35.4
55–64	595	30.4
65–74	428	21.9
Menopausal status at 1 year prior to diagnosis		
Premenopausal	625	31.9
Postmenopausal	1,173	59.9
Unknown	161	8.2
Method of initial tumor detection		
Mammography	1,622	82.8
Self/partner/physician/unrelated medical procedure	273	13.9
Unknown	64	3.3
Treatment		
Ipsilateral mastectomy	526	26.9
Bilateral mastectomy	75	3.8
Breast conserving surgery and no radiation	181	9.2
Breast conserving surgery and radiation	861	44.0
Biopsy only	46	2.4
Unknown	270	13.8
Tamoxifen use		
Yes	682	34.8
No	983	50.2
Unknown	294	15.0
Education		
< High school diploma	93	4.8
High school diploma	750	38.3
Some college	525	26.8
College diploma	561	28.6
Unknown	30	1.5
First degree family history of breast cancer		
No	1,400	71.5
Yes	444	22.7
Unknown	115	5.9
Body mass index at 1 year prior to diagnosis (kg/m^2)		
< 18.5	24	1.2
18.5–24.9	887	45.3
25.0–29.9	616	31.4
≥30	398	20.3

	No. (*N* = 1,959)	%
Unknown	34	1.7

Table 2

Body weight, alcohol consumption, and fruit and vegetable consumption before and after a DCIS diagnosis, Wisconsin, 1997–2006

	Observations[a,b]	Mean value	Adjusted mean value[c]	95% CI[c]	Difference[c]	95% CI[c]	*P* value[c]
Body weight (kg)							
One year prior to diagnosis	1,932	71.8	72.0	71.2, 72.8	Ref	Ref	Ref
Post-diagnosis (all years)	1,466	73.8	74.1	73.2, 75.1	2.2	1.4, 3.0	< 0.001
Time since diagnosis							
2–4 years after	369	74.3	74.5	73.5, 75.6	2.5	1.5, 3.6	< 0.001
4–6 years after	396	73.9	73.4	72.2, 74.6	1.4	0.2, 2.5	0.02
6–8 years after	474	73.4	73.5	72.1, 74.9	1.5	0.0, 3.0	0.06
8–11 years after	227	73.4	73.4	71.4, 75.4	1.4	−0.8, 3.5	0.22
Alcohol consumption (drinks/week)							
One year prior to diagnosis	1,941	2.53	2.49	2.27, 2.70	Ref	Ref	Ref
Post-diagnosis	1,499	2.12	2.31	2.02, 2.59	−0.18	−0.51, 0.14	0.27
Time since diagnosis							
2–4 years after	377	2.20	2.33	1.92, 2.74	−0.16	−0.60, 0.29	0.50
4–6 years after	401	2.09	2.28	1.89, 2.67	−0.21	−0.61, 0.20	0.32
6–8 years after	487	1.98	2.31	1.90, 2.72	−0.17	−0.64, 0.29	0.46
8–11 years after	234	2.33	2.32	1.71, 2.93	−0.17	−0.85, 0.52	0.64
Fruit and vegetable consumption (servings/day)							
One year prior to diagnosis	1,083	3.32	3.36	3.23, 3.50	Ref	Ref	Ref
Post-diagnosis (all years)	1,482	3.36	3.29	3.18, 3.41	−0.08	−0.26, 0.09	0.34
Time since diagnosis							
2–4 years after	374	3.44	3.36	3.16, 3.56	0.00	−0.24, 0.23	0.98
4–6 years after	399	3.22	3.20	3.01, 3.38	−0.17	−0.38, 0.04	0.11
6–8 years after	479	3.44	3.41	3.24, 3.59	0.05	−0.17, 0.27	0.66
8–11 years after	230	3.31	3.20	2.93, 3.47	−0.16	−0.49, 0.17	0.34

DCIS ductal carcinoma in situ, *CI* confidence interval

[a]The number of observations varies according across lifestyle factors due to missing information. Since fruit and vegetable consumption was assessed beginning in 2002, no data is available from the initial interview for women who were enrolled prior to this date

[b] Follow-up interviews began in 2003 and continued through 2006. Thus, there is a large number of women contacted 6–8 years following diagnosis; this includes the both the first follow-up interview of many women diagnosed in 1995–1997 as well as the second follow-up interview of many women diagnosed in 1998–2000

[c] Adjusted for age and calendar year

Table 3

Smoking before and after a DCIS diagnosis, Wisconsin, 1997–2006

	Observations	%	OR[a]	95% CI[a]
Smoking				
One year prior to diagnosis	1,941	14.5	1	Ref
Post-diagnosis (all years)	1,499	8.3	0.65	0.53, 0.80
Time since diagnosis				
2–4 years after	377	8.5	0.49	0.35, 0.69
4–6 years after	401	9.2	0.80	0.64, 1.01
6–8 years after	487	7.6	0.70	0.51, 0.94
8–11 years after	234	7.7	0.61	0.40, 0.94

DCIS ductal carcinoma in situ, *CI* confidence interval, *OR* odds ratio

[a] Adjusted for age and calendar year

Table 4

Medication use before and after a DCIS diagnosis, Wisconsin, 1997–2006

	Observations	%	OR[a]	95% CI[a]
Postmenopausal hormone use[b]				
One year pre-diagnosis	1,158	42.8	1	Ref
Post-diagnosis (all years)	1,218	3.1	0.06	0.04, 0.09
Time since diagnosis				
2–4 years after	295	1.7	0.04	0.01, 0.11
4–6 years after	313	3.2	0.06	0.03, 0.11
6–8 years after	408	3.4	0.07	0.04, 0.12
8–11 years after	202	4.5	0.13	0.06, 0.29
NSAID use[c]				
One year pre-diagnosis	1,659	29.2	1	Ref
Post-diagnosis (all years)	1,474	43.4	1.19	0.99, 1.43
Time since diagnosis				
2–4 years after	372	44.9	1.31	1.00, 1.71
4–6 years after	395	38.7	1.08	0.86, 1.36
6–8 years after	479	44.7	1.25	0.98, 1.60
8–11 years after	228	46.1	1.18	0.82, 1.70
Antidepressant use[c]				
One year pre-diagnosis	1,652	13.8	1	Ref
Post-diagnosis (all years)	1,488	19.4	1.57	1.26, 1.95
Time since diagnosis				
2–4 years after	374	24.6	1.67	1.24, 2.25
4–6 years after	397	19.7	1.58	1.21, 2.05
6–8 years after	484	16.1	1.20	0.88, 1.64
8–11 years after	233	17.6	1.31	0.84, 2.04

DCIS ductal carcinoma in situ, *CI* confidence interval, *NSAID* non-steroidal anti-inflammatory drug, *OR* odds ratio

[a] Adjusted for age and calendar year

[b] Postmenopausal women only

[c] Use of NSAIDS and antidepressants was assessed beginning in 1999