Published in final edited form as:
J Am Coll Surg. 2009 March ; 208(3): 341–347. doi:10.1016/j.jamcollsurg.2008.12.001.

Elevated Breast Cancer Mortality in Young Women (<40 Years) Compared with Older Women Is Attributed to Poorer Survival in Early Stage Disease

Jennifer L Gnerlich, MD[1], **Anjali D Deshpande, PhD, MPH**[2], **Donna B Jeffe, PhD**[2], **Allison Sweet, MPH**[3], **Nick White, MPH**[2], and **Julie A Margenthaler, MD, FACS**[1]

[1]Department of Surgery, Washington University School of Medicine, St. Louis MO

[2]Department of Medicine, Washington University School of Medicine, St. Louis MO

[3]American Cancer Society-Metro East Region, Maryville, IL

Abstract

Background—We investigated differences in breast cancer mortality between younger (<40 yrs) and older (≥40 yrs) women by stage at diagnosis to identify patient and tumor characteristics accounting for disparities.

Study Design—We conducted a retrospective study of women diagnosed with breast cancer in the 1988-2003 Surveillance, Epidemiology, and End Results (SEER) Program data. Multivariate Cox regression models calculated adjusted hazard ratios (aHR) and 95% confidence intervals (CI) to compare overall and stage-specific breast cancer mortality in women <40 yrs and women ≥40 yrs, controlling for potential confounding variables identified in univariate tests.

Results—Of 243,012 breast cancer patients, 6.4% were <40 yrs, while 93.6% were ≥40 yrs. Compared with older women, younger women were more likely to be Black, single, diagnosed at later stages, and treated by mastectomy. Younger women had tumors that were more likely to be higher grade, larger size, ER/PR negative, and lymph-node positive (p<0.001). Younger women were more likely to die from breast cancer compared with older women (cHR 1.39, CI 1.34-1.45). Controlling for confounders, younger women were more likely to die compared with older women if diagnosed with Stage I (aHR 1.44, CI 1.27-1.64) or Stage II (aHR 1.09, CI 1.03-1.15) disease and less likely to die if diagnosed with Stage IV disease (aHR 0.85, CI 0.76-0.95).

Conclusions—Higher breast cancer mortality in younger women was attributed to poorer outcomes with early stage disease. Further studies should focus on specific tumor biology contributing to the increased mortality of younger women with early stage breast cancer.

Keywords

Breast cancer; Young women; SEER data; Survival

Address correspondence to: Julie A. Margenthaler, MD, 660 S. Euclid, Campus Box 8109, St. Louis, MO 63110, Telephone: 314-362-7534, Fax: 314-454-5509, margenthalerj@wudosis.wustl.edu.

Disclosure Information: Nothing to disclose.

Abstract presented at the American College of Surgeons 94th Annual Clinical Congress, Surgical Forum, San Francisco, CA, October 2008.

INTRODUCTION

Although breast cancer risk increases with age, it is estimated that 5-7% of breast carcinomas are diagnosed in women who are younger than 40 years of age (1). Previous studies have shown that breast cancer in this younger population is more aggressive, with higher mortality and recurrence rates compared with older women (2-6). Chung et al. (3) reviewed 5-year cancer specific survival by decades of age in 3,722 women who were diagnosed with invasive breast cancer and found that women 40 years of age and younger had the worst 5-year cancer specific survival (69.7%) compared with all older age groups. This study showed that women 40 and younger also had a poor 5-year disease-free survival of 60.8%, second only to women older than 80 years of age. Swanson et al. (7) also observed that mortality was greater in younger women after controlling for race, stage, and treatment in a cohort study using the National Cancer Institute's Surveillance, Epidemiology, and End Results (SEER) Program data from 1983 to 1989.

In addition to survival disparities, young age also appears to be an important prognostic factor for poor local control. Local recurrence in women younger than 45 years of age was found to be four times higher than in patients older than 65 years of age (8). In another retrospective study (9), the local recurrence rate was 38% at 10 years, and the relative risk of loco-regional recurrence increased by 7% for every decreasing year of age in women younger than 40 years of age who were treated with primary breast conserving surgery followed by adjuvant radiation with or without chemotherapy. In that study, young age was the only prognostic factor for loco-regional recurrence.

It is not completely clear why women <40 years of age appear to have worse survival and recurrence rates than older age groups. Many studies suggest that breast cancer in younger women is more advanced and more aggressive than breast cancers in older women (4, 10-14). Clinically, younger women are more likely to present with a palpable mass, have larger tumor sizes, more invasive cancers, and more positive lymph nodes than older women (4, 10-11). Studies have shown that breast tumors in younger women were more likely to be higher grade, hormone receptor negative, poorly differentiated, and aneuploid, and to have high S-phase fraction, abnormal expression of p53, greater extent of lymphovascular invasion, and overexpression of human epidermal growth factor receptor 2 (HER-2) than breast tumors in older women (11-14). Recently, Anders et al. (14) used genomic expression analysis to explore biologically relevant gene sets that significantly distinguish breast cancers arising in young women. Their study suggests that breast cancer in younger women may be characterized by less hormone sensitivity and higher HER-2 and epidermal growth factor receptor (EGFR) expression.

These studies all suggest that breast cancer in younger women is a unique disease entity that may need a different treatment strategy than what may be efficacious for older women with breast cancer. Since breast cancer is typically a disease of older women, the majority of breast cancer studies have concentrated on older women and few studies have focused on age as the primary exposure. The studies that have been published were limited by a small sample size or limited to a single institution. Therefore, we conducted a large-scale study utilizing the SEER Program data (15) to investigate differences in breast cancer mortality and all-cause mortality by stage at diagnosis for women <40 years old and women ≥40 years old.

PATIENTS AND METHODS

We conducted a retrospective, population-based cohort study of women with a first primary diagnosis of breast cancer who were recorded in the Surveillance, Epidemiology, and End Results (SEER) Program public use database with a date of diagnosis between January 1, 1988 and December 31, 2003. Nine SEER registries were included – San Francisco-Oakland, Connecticut, Metropolitan Detroit, Hawaii, Iowa, New Mexico, Seattle (Puget Sound), Utah, and Metropolitan Atlanta. We only included women with a single primary cancer in their lifetime (sequence number=00 in the SEER dataset). We excluded all women with more than one record as well as "death-certificate only" or "autopsy-only" cases. Several updated extent of disease schemas have been utilized and collected by SEER to document stage of disease at diagnosis. The "SEER historic stage A" scheme was only utilized for data prior to 1988 and did not impact our analysis. We included the staging criteria "SEER modified AJCC stage 3rd edition (1988+)" and "SEER summary stage 2000 (1998+)" which represent the current AJCC staging system.

Demographic information included age, race, and marital status. Age was dichotomized (<40 years and ≥40 years of age). Younger women <40 years of age were grouped together as they represent a special high-risk population for whom routine screening is not recommended. Tumor characteristics were classified by stage (*in situ*, I, II, III, IV, or unstaged), tumor size in cm (<2, 2-5, >5-10, >10-25, diffuse, or unknown), tumor grade (1, 2, 3, 4, or unknown), estrogen receptor (ER) and progesterone receptor (PR) status (positive, negative, or unknown), laterality, and number of nodes involved (none, 1-3, >3, or unknown). This nodal segregation of patients was selected in order to group patients who are less likely (0-3 positive nodes) or more likely (>3 positive nodes) to undergo axillary nodal radiation.

Patients were categorized by receipt of surgery and receipt of radiation therapy. The SEER dataset contains separate variables for surgeries that occurred before 1998 and during or after 1998. Two SEER variables, "site-specific surgery" (for 1983-1997 records) and "surgery of the primary site" (for 1998-2003 records), were recoded to form a single variable categorizing women by receipt of surgery (none, lumpectomy, mastectomy, other/unknown). Patients who received any type of surgical resection of the primary breast tumor (*e.g.*, a mastectomy or lumpectomy) were categorized as having had surgery. Patients who did not receive any formal resection of their primary tumor or who only underwent breast biopsies for tissue diagnosis were categorized as not having surgery. Women whose surgery status was not recorded were categorized as "unknown." Patients also were categorized as either having received radiation (including external-beam radiation, radioisotopes, radioactive implants, or other forms of radiation) or not having received radiation therapy (received, did not receive, or unknown). Margin status after primary tumor resection, location of and surgery on metastatic disease sites, and use of any systemic therapy (chemotherapy or hormonal therapy) are not recorded in the public use SEER database.

The two outcomes of interest in this study were all-cause mortality and breast cancer-specific mortality. Vital status was present in the SEER dataset as "dead" or "alive." We calculated survival time (in months) for each woman using the "Completed Months of Follow-up" variable in the SEER dataset. We also determined whether observed deaths were due to breast cancer or to other causes using the "Cause of Death" recode variable in the SEER dataset. All-cause mortality was determined by comparing women who had died with women who were alive at the end of the study period or who had been lost-to-follow-up during the study period. Breast cancer-specific mortality was determined by comparing women whose cause of death was recorded as due to breast cancer with women who had

died of other causes or who were alive at their last follow-up or at the end of the study period.

Chi-square tests were used to compare the distribution of patient demographics, tumor characteristics, and treatment-related characteristics between younger (<40 years) and older women (≥40 years). Cox regression models were generated to describe the relationship between age and risk of death among women overall and within each stage at diagnosis. These models were used to calculate the hazard ratios (HRs) and 95% confidence intervals (CIs) in order to compare overall and stage-specific breast cancer mortality in women <40 and women ≥40 years of age. Death during the study period was the event of interest, and persons who were lost to follow-up during the study period or who were still alive at the end of the study period (December 31, 2003) were considered censored. Separate models were generated for the outcomes of breast cancer-specific mortality and all-cause mortality. Both crude (cHR) and adjusted hazard ratios (aHR) are reported, the latter controlling for potential confounders of the relationship between age and survival. Two-tailed p-values <0.05 were considered to be statistically significant. All analyses were conducted using SPSS 16.0™ statistical software.

RESULTS

A total of 245,289 active follow-up cases (excluding “autopsy only” or “death certificate only” cases) diagnosed from 1988-2003 were identified. We further excluded 2277 women with two or more primaries. Of the remaining 243,012 women in the 1988-2003 SEER dataset who were diagnosed with a first primary breast cancer, 15,548 (6.4%) were <40 and 227,464 (93.6%) were ≥40 years of age at time of diagnosis. The median age at diagnosis in the younger women was 36 years (range 11-39) compared to a median age of 61 years in the older women (range 40-108).

Univariate analyses identified significant differences between age groups in several patient and tumor characteristics. Compared with older women, younger women were more likely to have been Black, single, and diagnosed at advanced stages (each $p<0.001$). The biological characteristics of the tumors in younger women also were significantly different from tumor characteristics in older women. Younger women had tumors that were more likely to be higher grade (3 and 4), larger size (≥2cm), ER negative, PR negative, and have greater number of nodes involved (each $p<0.001$). Finally, treatment differed between younger and older women, with younger women receiving significantly more mastectomies than their older female counterparts ($p<0.001$). While differences in laterality and receipt of radiation also differed significantly between younger and older women, the absolute differences were small and unlikely to be clinically significant. Patient, tumor, and treatment characteristics of the two groups are summarized in Table 1.

A total of 59,555 women (24.5% of total sample) died of any cause, and 30,470 women (12.5% of total sample) died of breast cancer during the study period. Women <40 years of age were significantly more likely to die of breast cancer than women ≥40 years of age (18.3% vs. 12.1%; $p<0.001$). However, older women were more likely to die overall compared with younger women (24.8% vs. 20.4%, $p<0.001$). Breast cancer was the cause of death for 90% of younger women who died during the study, whereas breast cancer was the cause of death for only 49% of older women who died during the study.

Mortality due to breast cancer specifically and mortality due to other causes were analyzed for the study population overall by age group and stage at diagnosis and summarized in Table 2. As expected, the table shows that a lower percentage of women with more advanced stages of disease were still alive at the end of the study period for both younger

and older women and that the risk of death due to breast cancer was greater for women with more advanced breast cancer for both younger and older women. Interestingly, the percentage of women dying from other causes seemed to increase by stage at diagnosis for women < 40 years of age (Stage I-IV, range from 1.1-6.2%), but was fairly stable across all breast cancer stages (Stage I-IV, range 13.0-13.6%) for women >40 years of age.

Multivariate Cox regression models were generated to describe the association between age and mortality by stage as shown in Table 3. Separate models were fit for all-cause mortality and breast cancer-specific mortality at each stage of diagnosis comparing younger women with older women (reference group). Overall, younger women were more likely to die from breast cancer compared with older women (cHR 1.39, CI 1.34-1.45). Controlling for potential confounders, younger women were more likely to die from their breast cancer compared with older women if diagnosed with Stage I (aHR 1.44, CI 1.27-1.64) or Stage II (aHR 1.09, CI 1.03-1.15) disease, but younger women were less likely to die from their breast cancer compared with older women if diagnosed with Stage IV disease (aHR 0.85, CI 0.76-0.95). Differences in mortality due to breast cancer between the two age groups were not significant for *in situ* (aHR 1.12, CI 0.6-2.10), Stage III (aHR 1.01, CI 0.92-1.11), or unstaged patients (aHR 0.95, CI 0.82-1.11).

DISCUSSION

The current study, like other previously published studies (2-6), showed a significantly higher breast cancer-specific mortality rate overall among women <40 years of age compared with women ≥40 years of age. In fact, 90% of women <40 years old who died during the study period, died due to their breast cancer, compared with only 49% of women ≥40 years old who died during the study period. By doing an age-group comparison for each stage at diagnosis, we found that the higher breast cancer mortality in younger women was attributed predominantly to poorer outcomes with early stage disease. Specifically, women <40 years of age were significantly more likely to die from breast cancer compared with women ≥40 years of age if diagnosed with Stage I or Stage II disease.

The younger women in our study were more likely to be diagnosed at more advanced stages of disease (II and III) compared with older women. For example, 45.1% of women <40 years old were diagnosed with Stage II disease while only 30.9% of women ≥40 years old were diagnosed with Stage II disease (see Table 1). Given the lack of routine screening mammography guidelines for women <40 years of age, it is not surprising that women in this younger age group are more likely to present with a palpable mass and that their tumors tend to be larger and have more nodal involvement than breast cancers detected by screening (9-10,16). Even if younger women undergo mammography screening, the imaging is less sensitive than breast imaging in postmenopausal women because the dense breast tissue in young women can obscure radiological features of early breast cancer (17). Finally, there may be a greater likelihood for both patient and physician to contribute palpable masses to fibrocystic changes or other benign breast diseases in younger women. However, the increased breast cancer-specific mortality in younger women was not solely a result of advanced stage of disease at diagnosis, as evidenced by the significantly poorer outcomes in women <40 years of age with early stages of disease. In addition, greater breast cancer mortality in younger women also has been observed after controlling for tumor stage (3,8).

The younger women in our study had tumors that were distinctly different from older women and were characterized by unfavorable biological parameters. This finding likely accounts for the significant within-stage disparity that we observed between the younger and older women. Younger women had tumors that were more likely to be higher grade, ER negative, and PR negative. All of these characteristics are associated with a more aggressive

tumors and poorer prognosis. That there may be distinctly different breast cancer subtypes, with varying prognostic implications, has been reported previously (12-14, 18-19). Gene expression analysis has identified several breast cancer subtypes including basal-like, human epidermal growth factor receptor-2 positive/estrogen receptor negative (HER-2+/ER-), luminal A, and luminal B (18). These subtypes of breast carcinoma differ in various ways, including the surface markers expressed, proliferative capacity, and ability to respond to certain therapies. The basal-like subtype has been associated with poor clinical outcome, possibly attributed to its high proliferative capacity, lack of estrogen receptors, and overexpression of HER-2, while luminal A subtype has been shown to have the best prognosis (19). Recently, Anders et al (14) performed a large-scale genomic analysis on breast cancers in young women and found 367 gene sets differentially expressed in young women's tumors, whereas tumors arising in older patients did not share any common gene sets. His analysis also found that tumors in young women have lower ER positivity, higher HER-2/EGFR expression, and a trend toward inferior disease-free survival. All of these studies support the concept that tumors developing in younger women are biologically different from tumors in older women and tend to be more aggressive with unfavorable biological markers, which portend a poor prognosis.

While younger women were more likely to be diagnosed with late stage disease, our study is unique in that it demonstrated that significant survival disparities occur in younger women with Stage I and II disease compared with older women. Thus, the most significant within-stage disparities are not found in patients with late stage breast cancer. There are some possible explanations for this observation. The biological variability described previously is likely to be the main contributing factor responsible for the mortality disparities we observed, whereby younger women have tumors that have unfavorable features. Such biological variability would have the greatest impact in early stage, lymph node-negative disease. It is also possible that younger women with late stage disease (Stages III and IV) may be undergoing more aggressive treatment than older women diagnosed at these stages because of their younger age and presumed lack of comorbidities. Receipt of more aggressive treatment among younger breast cancer patients diagnosed with late stage disease might be the reason for the lack of a significant difference by age group in breast cancer-specific mortality in women with Stage III disease and a lower likelihood of death due to breast cancer in women with Stage IV disease. Because the SEER dataset does not include systemic therapy approaches or co-morbidity information, we cannot verify this hypothesis. Finally, when locally advanced disease is present, as with Stage III disease, the aggressiveness of the disease (and the presence of lymph node involvement) may be outweighed by any influence of younger age.

There are several limitations to our study, which are inherent to any retrospective cohort study. One limitation is the inability to control for selection bias. Younger women in our study were more likely than older women to have had mastectomies. Why this treatment was performed instead of breast-conserving surgery is unclear. Perhaps more mastectomies were performed on younger women due to the more advanced nature of their breast cancer, more nodal involvement, or even larger tumor size. Also, younger women may have had fewer comorbidities compared with older women and therefore were treated more aggressively, surgically or otherwise. Unfortunately, the public use SEER database does not contain information about comorbidities or other cancer treatments, such as chemotherapy and endocrine therapy. Types of systemic regimen, completion of the expected number of cycles, and delay in receiving the expected number of cycles could potentially account for the observed age disparities in survival. However, we are unable to determine whether younger patients were treated more aggressively than older women in this cohort. Socioeconomic status and access to health care, both of which could affect treatment options, are not available in the SEER data. Other data that might be associated with

survival but are unavailable in the SEER data include genetic risk factors, such as BRCA 1 or BRCA 2 mutations and family history of breast cancer, as well as behavioral risk factors (e.g., physical activity, smoking, alcohol consumption, and use of hormone replacement therapy).

Despite the lack of some potentially relevant information, the SEER database provides high quality population-based data (20), which makes for an effective large-scale cohort study. Our multivariate analyses, which controlled for potential confounders associated with survival, demonstrated significantly poorer survival in early stage disease (I and II) for women <40 years of age compared with women ≥40 years of age. Thus, advanced stage at diagnosis cannot solely explain the higher breast cancer mortality in younger women. However, the aggressive and unfavorable biological characteristics of the tumor subtypes seen in both histological and gene expression analysis suggests that younger women tend to have tumors with poor prognostic features. Therefore, further studies should focus on the specific tumor biology contributing to the increased mortality of young women with early stage breast cancer in order to determine more efficacious treatment strategies in this younger population.

Acknowledgments

We thank the Alvin J. Siteman Cancer Center at Barnes-Jewish Hospital and Washington University School of Medicine in St. Louis, Missouri, for the use of the Health Behavior and Outreach Core, especially James Struthers for data management and statistical services. The Siteman Cancer Center is supported in part by a National Cancer Institute Cancer Center Support Grant (#P30 CA91842).

REFERENCES

1. Bland KI, Menck HR, Scott-Conner CE, et al. The National Cancer Database 10-year survey of breast carcinoma treatment at hospitals in the United States. Cancer. 1998; 83:1262–1273. [PubMed: 9740094]
2. Adami HO, Malker B, Holmberg L, et al. The relation between survival and age at diagnosis and breast cancer. N Engl J Med. 1986; 315:559–563. [PubMed: 3736639]
3. Chung M, Chang HR, Bland KI, et al. Younger women with breast carcinoma have a poorer prognosis than older women. Cancer. 1996; 77:97–103. [PubMed: 8630946]
4. El Saghir NS, Seoud M, Khalil MK, et al. Effects of young age at presentation on survival in breast cancer. BMC Cancer. 2006; 6:194. [PubMed: 16857060]
5. Nixon AJ, Neuburg D, Hayes DF, et al. Relationship of patient age to pathologic features of the tumor and prognosis for patients with stage I and stage II breast cancer. J Clin Oncol. 1994; 12:888–894. [PubMed: 8164038]
6. de la Rochefordiere A, Campana F, Fenton J, et al. Age as a prognostic factor in premenopausal breast cancer. Lancet. 1993; 341:1039–1043. [PubMed: 8096955]
7. Swanson GM, Lin CS. Survival patterns among younger women with breast cancer: the effects of age, race, stage, and treatment. J Natl Cancer Inst Monogr. 1994; 16:69–77. [PubMed: 7999472]
8. Elkhuizen PH, van de Vijver MJ, Hermans J, et al. Local recurrence after breast-conserving therapy for invasive breast cancer: high incidence in young patients and association with poor survival. Int J Radiat Oncol Biol Phys. 1998; 40:859–867. [PubMed: 9531371]
9. Bollet MA, Sigal-Zafrani B, Mazeau V, et al. Age remains the first prognostic factor for loco-regional breast cancer recurrence in young (<40 years) women treated with breast conserving surgery first. Radiother Oncol. 2007; 82:272–280. [PubMed: 17287037]
10. Gajdos A, Tartter PI, Bleiweiss IJ, et al. Stage 0-III breast cancer in young women. J Am Coll Surg. 2000; 190:523–529. [PubMed: 10801018]
11. Albain KS, Allred DC, Clark GM. Breast cancer outcome and predictor of outcome: are there age differentials? J Natl Cancer Inst Monogr. 1994; 16:35–42. [PubMed: 7999467]

12. Kollias J, Elston CW, Ellis IO, et al. Early-onset breast cancer-histopathological and prognostic considerations. Br J Cancer. 1997; 75:1318–1323. [PubMed: 9155052]
13. Shannon C, Smith IE. Breast cancer in adolescents and young women. Eur J Cancer. 2003; 39:2632–2642. [PubMed: 14642925]
14. Anders CK, Hsu DS, Broadwater G, et al. Young age at diagnosis correlates with worse prognosis and defines a subset of breast cancers with shared patterns of gene expression. J Clin Oncol. 2006; 26:3324–3330. [PubMed: 18612148]
15. National Cancer Institute. [accessed February 1, 2007] Surveillance, Epidemiology, and End Results. Overview of the SEER Program. Available: http://seer.cancer.gov/about/
16. Winchester DP, Osteen RT, Menk HR. The National Cancer Data Base report on breast carcinoma characteristics and outcome in relation in age. Cancer. 1996; 78:1838–1843. [PubMed: 8859200]
17. Boyd NF, Martin LJ, Sun L, et al. Body size, mammographic density, and breast cancer risk. Cancer Epidemiol Biomarkers Prev. 2006; 15:2086–2092. [PubMed: 17119032]
18. Sorlie T, Perou CM, Tibshirani R, et al. Gene expression patterns of breast carcinomas distinguish tumor subclasses with clinical implications. Proc Natl Acad Sci USA. 2001; 98:10869–10873. [PubMed: 11553815]
19. Sotiriou C, Neo SY, McShane LM, et al. Breast cancer classification and prognosis based on gene expression profiles from a population based study. Proc Natl Acad Sci USA. 2003; 100:10393–10398. [PubMed: 12917485]
20. Merrill RM, Dearden KA. How representative are the surveillance, epidemiology, and end results (SEER) program cancer data of the United States. Cancer Cause Control. 2004; 15:1027–1034.

Table 1

Characteristics of the Study Population, SEER 1988-2003, Women with a Single Primary Breast Cancer Occurrence

Characteristic	Young women n=15,548 (%)	Older women n=227,464 (%)	Chi-square p-value
Demographic characteristics			
Race			< 0.001
Caucasian	75.6	84.7	
African	14.1	8.0	
American			
Other specified	9.4	6.7	
Other unspecified	0.2	0.1	
Unknown	0.8	0.5	
Marital Status			< 0.001
Single	22.3	10.0	
Married	64.0	54.8	
Separated	0.9	0.6	
Divorced	7.6	9.2	
Widowed	0.6	20.5	
Unknown	4.7	4.9	
Tumor characteristics			
Stage			< 0.001
In Situ	11.6	15.6	
I	25.9	38.7	
II	45.1	30.9	
III	8.3	5.3	
IV	3.5	4.2	
Unstaged	5.5	5.3	
Tumor size, cm			< 0.001
<2	38.6	51.8	
2-5	40.2	29.8	
>5-10	6.9	4.1	
>10-25	0.7	0.5	
Diffuse	1.7	1.1	
Unknown	12.0	12.7	
Grade			< 0.001
1	5.0	13.0	
2	23.2	30.1	
3	42.6	25.9	
4	4.2	3.2	
Unknown	25.0	27.9	
ER status			< 0.001
Positive	39.1	50.1	

Characteristic	Young women n=15,548 (%)	Older women n=227,464 (%)	Chi-square p-value
Negative	28.0	14.2	
Unknown	32.8	35.7	
PR status			< 0.001
Positive	36.2	42.5	
Negative	30.1	20.4	
Unknown	33.7	37.1	
Nodes involved			< 0.001
None	54.6	66.4	
1-3	10.3	7.1	
>3	28.9	18.1	
Unknown	6.2	8.3	
Laterality			0.003
Right	49.3	48.5	
Left	50.1	50.7	
One, unspecified	0.1	0.2	
Bilateral	0.1	0.1	
Treatment characteristics			
Radiation			< 0.001
Yes	42.7	41.4	
No	53.9	55.8	
Unknown	3.4	2.8	
Surgery			< 0.001
None	4.1	5.5	
Lumpectomy	42.2	48.3	
Mastectomy	53.4	45.9	
Other/Unknown	0.3	0.3	
Outcomes			
Breast cancer death			< 0.001
Yes	18.3	12.1	
No	81.7	87.9	
Vital status			< 0.001
Alive	79.6	75.2	
Dead	20.4	24.8	

Percentages shown are for column totals.

Table 2

Vital Status Outcomes for the Study Population by Age and Stage at Diagnosis, SEER 1988-2003, Women with a Single Primary Breast Cancer Occurrence

Stage	n	Alive (%)	Death because of breast cancer (%)	Death because of other cause (%)
Young women (< 40 y)				
In Situ	1806	98.2	0.6	1.2
I	4028	92.1	6.8	1.1
II	7016	77.4	20.3	2.3
III	1292	53.1	43.7	3.3
IV	551	27.4	66.4	6.2
Unstaged	855	72.7	23.3	4.0
Overall	15,548	79.6	18.3	2.2
Older women (≥ 40 y)				
In Situ	35,504	93.0	0.5	6.6
I	88,092	83.4	3.6	13.0
II	70,328	71.2	15.2	13.6
III	11,967	47.9	38.4	13.6
IV	9440	18.9	67.8	13.2
Unstaged	12,133	57.6	21.5	20.8
Overall	227,464	75.2	12.1	12.6

Percentages are of row totals in second column.

Table 3

Crude and Adjusted Hazard Ratios for Breast Cancer-specific and All-Cause Mortality by Stage at Diagnosis Comparing Younger Women to Older Women

	Breast cancer-specific mortality*		All-cause mortality†	
Stage	**cHR‡ (95%CI)**	**aHR§ (95%CI)**	**cHR (95%CI)**	**aHR (95% CI)**
0	1.04 (0.56-1.91)	1.13 (0.61-2.11)	0.19 (0.14-0.27)	0.28 (0.19-0.39)
I	1.64 (1.45-1.86)	1.44 (1.27-1.63)	0.40 (0.36-0.45)	0.54 (0.48-0.60)
II	1.24 (1.18-1.31)	1.08 (1.02-1.14)	0.73 (0.69-0.76)	0.80 (0.76-0.84)
III	1.05 (0.96-1.14)	1.00 (0.91-1.09)	0.82 (0.76-0.90)	0.86 (0.79-0.93)
IV	0.84 (0.76-0.94)	0.86 (0.77-0.96)	0.77 (0.70-0.85)	0.82 (0.74-0.91)
Unstaged	0.95 (0.82-1.10)	0.91 (0.78-1.05)	0.56 (0.49-0.64)	0.64 (0.56-0.74)
Overall	1.39 (1.34-1.45)		0.75 (0.72-0.78)	

Reference group for each model was women ≥40 y of age.

*Breast cancer-specific mortality compared women who died of breast cancer with women who were either alive at the end of followup or died of another cause.

†All-cause mortality compared women who died of any cause by the end of follow-up to women who were alive at the end of followup.

‡cHR=crude Hazard Ratio.

§aHR=adjusted Hazard Ratio; adjusted for race, marital status at diagnosis, tumor size, nodal involvement, grade, estrogen receptor status, progesterone receptor status, surgical treatment received, and radiation treatment received.