Weighing the Benefits and Burdens of Mammography Screening Among Women Age 80 Years or Older

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The Appendix is included in the full-text version of this article, available online at www.jco.org. It is not included in the PDF version (via Adobe® Reader®).

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ABSTRACT

Purpose

To examine outcomes of mammography screening among women ≥ 80 years to inform decision making.

Patients and Methods

We conducted a cohort study of 2,011 women without a history of breast cancer who were age ≥ 80 years between 1994 and 2004 and who received care at one academic primary care clinic or two community health centers in Boston, MA. Medical record data were abstracted on all screening and diagnostic mammograms, breast ultrasounds and biopsies performed, all breast cancers diagnosed through December 31, 2006, and on sociodemographics. Date and cause of death were confirmed using the National Death Index.

Results

The majority of patients (78.6%) were non-Hispanic white and 51.4% ($n = 1,034$) had been screened with mammography since age 80 years. Among women who were screened, eight were diagnosed with ductal carcinoma in situ, 16 with early stage disease (1.5%), two with late stage disease, and one died as a result of breast cancer. Many (110; 11%) experienced a false-positive screening mammogram that led to 19 benign breast biopsies, eight refused work-up, and three experienced a false-negative screening mammogram; 97 were screened within 2 years of their death from other causes. There were no significant differences in the rate, stage, recurrence rate, or deaths due to breast cancer between women who were screened and those who were not screened.

Conclusion

The majority of women ≥ 80 years are screened with mammography yet few benefit. Meanwhile, 12.5% experience a burden from screening. The data from this study can be used to inform elderly women's decision making and potentially lead to more rational use of screening.

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INTRODUCTION

Although the population of women age 80 years or older is increasing rapidly, there is little information on the benefits and burdens of mammography screening to guide their decision making. None of the eight randomized controlled trials evaluating mammography screening included these women.¹ In the absence of clinical trial data, guidelines generally recommend stopping screening for women with fewer than 5 years life expectancy.¹⁻³ Despite these recommendations, many older women with limited life expectancies are screened.⁴⁻⁶

Mammography screening may benefit some women age 80 years or older while causing burden to others. Three observational studies demonstrated a possible breast cancer mortality benefit for healthy

women age 80 years or older regularly screened with mammography.⁷⁻¹⁰ Other studies found that elderly women who do not get regularly screened are more likely to be diagnosed with larger tumors and later stage disease.⁸⁻¹¹

In contrast, due to more indolent tumors and competing causes of death, many of the breast cancers found in women age 80 years or older may represent overdiagnosis (tumors that would not have become clinically important in their lifetime).¹ Only one third of cases of ductal carcinoma in situ (DCIS), a noninvasive form of breast cancer, are thought to progress to invasive breast cancer over 10 to 20 years, which is greater than most women age 80 years or older's life expectancy.^{12,13} In these cases, elderly women are exposed to the burdens of treatment and anxiety of living with a cancer diagnosis without the benefit of

improving quality or quantity of life. Other risks of screening include false-positive and false-negative tests. False-positive tests may cause older women and their families unnecessary anxiety and false-negative tests leave women with a sense of false reassurance.

The purpose of this study was to perform a cohort study in a clinical population to determine outcomes of mammography screening or of not being screened among women age 80 years or older to inform decision-making.

PATIENTS AND METHODS

Sample Population

We performed a cohort study using the computerized online medical record (OMR) at Beth Israel Deaconess Medical Center's (BIDMC) hospital-based primary care practice, Healthcare Associates (HCA) as well as two community affiliates, Medical Care Center North in Chelsea, MA (Chelsea) and Bowdoin Street Health Center in Dorchester, MA (Bowdoin). HCA consists of approximately 50 faculty internists and more than 100 internal medicine residents that provide care to approximately 34,000 patients of which 74% are white, 23% African American, 3% Hispanic, and 4% Asian. Chelsea and Bowdoin each consist of approximately six primary care physicians (PCPs) that provide care to approximately 10,000 patients each. Chelsea has a 30% Hispanic population and Bowdoin has a 75% black population. The OMR used by these diverse practices contains notes from all office visits and telephone contacts, a detailed list and description of patients' medical problems, patient demographics, and a preventive health flow-sheet that tracks screening.^{14,15} To identify patients for this study, in April 2005 Information Services at BIDMC generated a list of all women age 80 years or older who had ever been seen at HCA, Chelsea, or Bowdoin since each of these sites began regularly using the OMR (1993, 1999, 1997, respectively). Since we planned to follow women through December 31, 2006, and we wanted at least 2 years of follow-up for each woman, we included all women who were age 80 years or older between 1994 and 2004 and who received their primary care at one of these sites (which we defined as having at least two clinic notes from one PCP in the medical record). To focus on women with whom a discussion about the benefits and burdens of screening would be most appropriate, we excluded women with a history of breast cancer.

Data Collection

We created two different medical record review instruments to obtain data. The first instrument was used by trained research assistants (RAs) and collected data on patient date of birth, first and last note in medical record, date of death (if available), insurance, race, ZIP code, and on date and result of each mammogram. The RAs reviewed all mammography reports including reasons each mammogram was ordered, preventive health flow sheets (to capture mammograms performed outside the hospital), and problem lists to identify patients with breast abnormalities since age 78 and/or those with a history of breast cancer. If there were any breast abnormalities listed on a mammogram report or in the problem list or if there was a breast ultrasound or if there was a breast biopsy reported since the patient turned 78, the record was designated for further review. Of note, if a bilateral diagnostic mammogram was done for screening purposes it was coded as screening. Each medical record was reviewed by two different RAs; discrepancies were resolved by medical record review by M.A.S.

Medical records designated for further review were reviewed by a physician (M.A.S. or one of four trained medical residents) using a second instrument. This instrument collected data on all mammograms, breast ultrasounds, and biopsies performed and all breast cancers diagnosed on patients after age 80 years. We abstracted data to determine stage of breast cancer at diagnosis (tumor size, positive lymph nodes, or metastatic disease) and we defined early-stage disease as stage I to IIA.^{7,8} We also collected comorbidity data using the Charlson Comorbidity Index¹⁶ and we noted whether any breast cancer treatment was received (mastectomy or breast conserving therapy, radiation, hormone therapy, and/or chemotherapy). Each of these medical records was

reviewed at least twice by different physicians and discrepancies were resolved by additional review of medical records by M.A.S.

Outcomes

We considered women to have experienced a false-positive screening mammogram if they underwent additional procedures or tests but were not diagnosed with breast cancer.¹⁷ We did not consider screening mammograms that were read as "mammogram not complete or further imaging necessary" that were followed by a normal diagnostic mammogram performed on the same day, as a false positive since patients would have received the results of both tests at or near the same time resulting in little burden.¹⁸ We considered women to have experienced a false-negative screening mammogram if they were diagnosed with breast cancer within 2 years of their last screening mammogram that was read as normal. We defined true-positive mammograms as those where an abnormal screening mammogram resulted in a diagnosis of DCIS or invasive breast cancer. We defined a true-negative mammogram as one where the mammogram was read as negative and the woman was not diagnosed with breast cancer within 2 years. Finally, we examined how many women underwent screening mammography within 2 years of their death to assess how well screening mammograms are being targeted to older women by life expectancy.

Follow-Up

We obtained data on date and cause of death for all patients using the National Death Index (NDI), a central computerized index of death record information on file in the state vital statistics offices established by the National Center for Health Statistics. The patients in our study were matched to those in the NDI based on name, maiden name, date of birth, and social security number. The NDI also provided cause of death as listed on patients' death certificates. If date and/or cause of death in the OMR did not match NDI data or was not available in the NDI we used data from the OMR. We reviewed all NDI matches and excluded any where there was a kept appointment after the date of death. We considered patients to be alive as of December 31, 2006 if there was documentation of contact with the patient after this date. We considered patients alive but unconfirmed if they did not match in the NDI and their last OMR contact was before December 31, 2006. Follow-up time was defined as time from when the patient turned age 80 years or the date of their first OMR note if it was after the patient turned age 80 years until the patient's death, December 31, 2006, or last kept appointment when vital status was unconfirmed.

Statistical Analysis

Using χ^2 tests, *t* tests, or Fisher's exact tests when appropriate, we compared the prevalence of diagnostic mammograms, breast ultrasounds, and biopsies among women who were screened in their 80s with those who were not screened after age 80 years. We also compared the prevalence of benign breast biopsies, atypical ductal hyperplasia, lobular carcinoma in situ (LCIS), DCIS, breast cancer, breast cancer treatments, recurrence, and cause of death among these women. Finally, we compared race, insurance, clinic site, income, and education between the two groups. We used United States' census data on median household income and high-school graduation rates for residents age 65 years or older by ZIP code as a proxy for income and education. We also compared receipt of breast cancer diagnostic tests and breast cancer diagnoses between the two groups of women using multivariable logistic regression. We adjusted for insurance status, race, clinic, and our proxies for income and education in these analyses. All statistical analyses were performed using SAS statistical software, version 9.1 (SAS Institute, Cary, NC). The Committee on Clinical Investigations at BIDMC approved this study.

RESULTS

Our initial search identified 2,602 women; 417 did not have two notes from one PCP or were not age 80 years before 2005 and 171 had a history of breast cancer. We excluded three women for whom it was not clear from their chart whether their breast cancer had been detected by screening mammography who reportedly died as a result of

Table 1. Patient Demographics by Receipt of Mammography Screening After Age 80 Years

Demographic	%			P
	Overall	Mammography Screening Since Age 80 Years (n = 1,034)	No Mammography Screening Since Age 80 Years (n = 977)	
Race				
Non-Hispanic white	78.6	79.7	77.4	< .0001
Non-Hispanic black	14.8	16.7	12.9	
Other	6.6	3.4	9.7	
Clinic				
HCA	68.9	76.4	60.9	< .0001
Chelsea	7.6	3.0	12.5	
Bowdoin	23.5	20.6	26.6	
Insurance				
Private insurance/medicare	64.1	63.4	64.8	.50
Medicaid/free care/no coverage	35.9	36.7	35.2	
Median follow-up time, years	5.2	6.2	4.2	< .0001
Median age at end of follow-up, years	87.4	87.9	86.8	< .0001
Median proportion who graduated high school by ZIP code	64.0	66.1	62.5	.0001
Median household income by ZIP code < \$20,000	54.1	54.9	53.4	.52

Abbreviation: HCA, Healthcare Associates.

the disease (online-only Appendix). Therefore, our final sample included 2,011 women, of whom 51.4% (n = 1,034) had been screened with mammography since age 80 years. The majority of the total sample was non-Hispanic white (78.6%), had private insurance or

Medicare coverage (64.0%), and received care in HCA (68.9%). Approximately one half (54.1%) lived in a ZIP code where the median household income for adults age 65 years or older was lower than \$20K and the median proportion who completed high school was

Table 2. Breast Cancer Outcomes Among Women Who Were Screened After Age 80 Years Compared With Those Who Were Not Screened

Parameter	Mammography Screening Since Age 80 Years (n = 1,034)	No Mammography Screening Since Age 80 Years (n = 977)	P*
Total screening mammograms since age 80 years	2,501	0	< .0001
No. of screening mammograms since age 80 years			
One	388		
Two	279		
Three or more	367		
Abnormal screening mammograms since 80 years	143	0	< .0001
Diagnostic mammograms	144	51	< .0001
Breast ultrasounds	56	29	.01
Breast biopsies	46	25	.02
Benign breast biopsies	16	3	.004
Atypical ductal hyperplasia	2	1	.60
Lobular carcinoma in situ	1	0	.33
Ductal carcinoma in situ	8	0	.005
Invasive breast tumors by stage	20	20	.85
I	13	15	.67 (TOT)†
II	6	4	
III	0	0	
IV	1	1	
Surgical treatment for stage I or II			
Mastectomy	1	2	.72
Breast conserving treatment			
With radiation	9	8	
Without radiation	7	6	
None	2	3	
Hormone therapy	16	15	.71
Chemotherapy, any stage	0	0	
Recurrence, alive at end of study	0	1	.30
Death as a result of breast cancer	1	2	.67

Abbreviation: TOT, test of trend.

*The P value is from χ^2 tests or Fisher exact tests when the sample size in the cells was < 5.

†The Mantel-Haenszel TOT was used for breast cancer stage.

64.0%. The median age at end of follow-up was 87.4 years. Table 1 demonstrates differences in demographic characteristics by receipt of mammography screening. Those who were screened were more likely to be non-Hispanic white or black, receive care at HCA, live longer, and reside in an area where a larger proportion of older adults graduated high school.

Table 2 compares differences in receipt of diagnostic testing and outcomes of breast cancer among women who were screened with those who were not screened. Women who were screened were more likely to undergo diagnostic testing for breast cancer including: diagnostic mammograms (adjusted odds ratio [aOR], 3.3; 95% CI, 2.3 to 4.7), breast ultrasounds (aOR, 2.0; 95% CI, 1.2 to 3.1), and biopsies (aOR, 1.9; 95% CI, 1.1 to 3.3). They were also more likely to experience a benign breast biopsy (aOR, 4.5; 95% CI, 1.3 to 15.6) and be diagnosed with DCIS. Women who were screened were as likely to develop invasive breast cancer as women who were not screened and there were no significant differences in stage at diagnosis, treatments received, breast cancer recurrence, or death as a result of breast cancer.

Figure 1 demonstrates outcomes of mammography screening and of not being screened. Among 1,034 women who underwent mammography screening after age 80 years, 110 (10.6%) experienced a false-positive screening mammogram (19 of which resulted in breast biopsy), three experienced a false-negative mammogram (two who were later found to have invasive breast cancer and one who was later found to have DCIS), eight refused any work-up after an abnormal mammogram, and seven women were diagnosed with DCIS. Sixteen women (1.5%) were diagnosed with early stage disease through mam-

mography screening, received treatment, and lived at least 2 years after diagnosis. Two women were diagnosed with late stage disease and one died as a result of breast cancer within 6 months of her most recent screening mammogram. She had a screening mammogram 2 years before that was abnormal, but a follow-up breast biopsy was negative. Nearly all women who had a normal mammogram had a true-negative test and 17.5% (25 of 143) had a true-positive test. Of the 977 women who were not screened, 15 (15 of 977, 1.5%) were diagnosed with early-stage disease and lived at least 2 years after diagnosis (one woman did not accept any treatment). One woman who was not screened experienced a breast cancer recurrence within 2 years of diagnosis. Her hormone therapy was changed and she was alive at the end of the study 4 years after diagnosis. Two women who were not screened were diagnosed with late stage breast cancer and died as a result of the disease. Both women had refused screening mammograms since at least their early 70s (when their record data begin). Finally, 97 women were screened within 2 years of their death as a result of causes other than breast cancer. Table 3 provides causes of death for all the women who died during the study period (n = 965).

DISCUSSION

Although the majority of women (51%) age 80 years or older were screened with mammography, fewer than 2% potentially benefited. Moreover, potentially benefitted was liberally defined as any women who was diagnosed with early-stage disease, accepted treatment, and

Fig 1. Outcomes of breast cancer screening among women age 80 years or older. (*)Potential benefits of screening denoted by italics and underline. Potential burdens of screening denoted with bold letters. Potential harms of not being screened denoted by capital bold letters and italics. DCIS, ductal carcinoma in situ. (*)The patient diagnosed with DCIS had a normal screening mammogram 9 months before. One of the patients who developed breast cancer had a normal screening mammogram 10 months before. The other patient had an abnormal screening mammogram 2 years before but 6-month follow-up mammogram was normal.

Table 3. Follow-Up Data on Women Who Were Screened After Age 80 Years Compared With Those Who Were Not Screened

Characteristic	Mammography Screening Since Age 80 Years (n = 1,034)		No Mammography Screening Since Age 80 Years (n = 977)	
	No.	%	No.	%
Developed breast cancer including DCIS	28		20	
Mean Charlson Comorbidity Score for those who were diagnosed with breast cancer	1.5		1.9	
Alive after December 31, 2006	16; 4 with DCIS	57	7	35
Alive but unconfirmed	0		1*	
Total deaths	12; 4 with DCIS	43	12	60
Death as a result of breast cancer	1		2	
Death as a result of other causes†	11		10	
Cardiovascular disease	5		2	
Cancer (non-breast)	0		3	
Infections	1		0	
CNS disorders (including dementia)	2		0	
Pulmonary disease	0		1	
Stroke			1	
Gastrointestinal disease	1		1	
Metabolic (including diabetes)	1		0	
Unknown	0		0	
Did not develop breast cancer or DCIS	1,006		957	
Alive after December 31, 2006	450	45	279	29
Alive but unconfirmed	135	13	159	17
Death as a result of cause other than breast cancer	421	42	519	54
Cause of death	421		519	
Cardiovascular disease	147	35	171	33
Cancer other than breast	67	16	88	17
Infections	47	11	53	10
CNS disorders (including dementia)	48	11	54	10
Pulmonary disease	28	7	38	7
Stroke	24	6	44	8
Gastrointestinal disease	16	4	24	5
Renal disease	17	4	16	3
Metabolic (including diabetes)	12	3	17	3
Other	13	3	12	2
Unknown	2	0.5	2	0.4

Abbreviation: DCIS, ductal carcinoma in situ.

*The last note in the medical record was from May 2006 from a hospitalization when the patient had pneumonia and there was no mention of breast cancer recurrence.

†For women diagnosed with breast cancer we confirmed cause of death listed in the National Death Index data with medical record data. Because more women in the non-screened group died as a result of cancer other than breast than did women in the screened group, we present their data here: none had breast cancer recurrence; one died as a result of bladder tumor, one as a result of colon cancer, and one as a result of non-Hodgkin's lymphoma (National Death Index and medical record data agreed in all three cases).

lived 2 years after diagnosis (Fig 1). Many women (12.5%) experienced burdens from screening including additional tests (n = 110), false reassurance from false-negative mammograms (n = 3), or refusal of work-up after an abnormal mammogram (n = 8). Eight women who were screened were diagnosed with DCIS and were subject to the anxiety of being diagnosed and burdened with decision-making around treatment for a disease that is unlikely to progress during their lifetime. In contrast, three women (0.3%) who were not screened may have been harmed from not being screened since they experienced a recurrence or were diagnosed with late-stage disease and died as a result of breast cancer. Women age 80 years or older and their clinicians can use these data to decide whether the potential benefits of mammography screening outweigh the burdens and potential harms of not being screened.

Despite the uncertainty of a mortality benefit from mammography screening for women age 80 years and older, some experts argue

that these women should be screened to prevent large tumors that may require more aggressive therapy and may be more likely to recur than smaller tumors.^{7,19} We did not find a significant difference in stage at diagnosis or in breast cancer recurrence or treatments received between women who were screened and those who were not screened. However, this was an observational study and it may be that the women who were screened were at greater risk of breast cancer. It may also be that many of the women in our study who were not being screened with mammography were receiving clinical breast examinations (CBEs). Nearly one half of the women who were diagnosed with breast cancer in the unscreened group had their tumors detected by clinical exam. Perhaps regular CBEs after age 80 years detect tumors early enough to avoid significant morbidity without detecting as much clinically insignificant disease as mammography screening.²⁰

We and others have found that very few women age 80 years or older die of breast cancer. Woloshin et al²¹ found using population

data that lower than 2% of these women die of breast cancer. This is higher than our rate of 0.2%. Woloshin et al²¹ did not exclude women with a history of breast cancer before age 80 years, suggesting that the majority of women dying of breast cancer in their 80s are those who have a history of the disease by age 80 years.

Some women in our study may have benefitted from screening due to the reassurance they experienced after a negative test.²² However, there are likely more cost-effective ways to offer older women reassurance about their health, especially since many effective preventive health measures are underutilized among these women (eg, immunizations, exercise).²³ Most cost-effective analyses have found that the positive effects of mammography screening balance with the negative effects around age 80 years.^{24,25}

Our findings also suggest overuse of mammography screening among elderly women since nearly 10% of those who were screened were screened within 2 years of their death. One reason for overscreening may be due to the fact that Medicare pays for annual mammography for all women age 80 years or older regardless of their health. The American Geriatrics Society offers a more thoughtful approach to screening.²⁶ They encourage clinicians to offer screening to women age 85 years or younger with at least 5 years life expectancy after an individualized review of the potential benefits and risks of screening and a discussion of patient preferences. The American Geriatrics Society recommends that mammography be reserved for women older than 85 in excellent health and functional status or those who strongly believe that they will benefit either through piece of mind or improved quality of life. The data from our study can be used to help women age 80 years or older understand the potential benefits and burdens of screening and what would likely occur if they chose not to be screened to allow for informed, preference based decision making.

There are several important limitations to this study. Since this study is a retrospective medical record review, some missing data are inevitable. We were unable to confirm that 295 women (15%) were alive at the end of the study since they had left the practice. However, there was no report of their death in the NDI.

The study is not powered to detect a significant difference in breast cancer mortality between screened and unscreened women. However, even large database studies have been unable to detect a mortality difference for breast cancer screening among women age 80 years or older with comorbidity.^{8,9} We only have comorbidity data or receipt of CBEs on a subset of women. Finally, our results may not be generalizable to older women outside of MA. However, our study did include a large number of women age 80 years or older from both academic and community primary care sites that were ethnically diverse. Also, our false positive rate is within the range (5% to 23%) reported by other studies that included women of all ages.^{17,27-29}

The majority of women age 80 years or older are screened with mammography yet few benefit. Meanwhile, 12.5% experience a burden from screening. The data from this study can be used to inform elderly women's decision making and potentially lead to more rational use of screening.

AUTHORS' DISCLOSURES OF POTENTIAL CONFLICTS OF INTEREST

The author(s) indicated no potential conflicts of interest.

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