CLINICAL RESEARCH STUDY

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Mammography Screening Among the Elderly: A Research Challenge

Maureen Sanderson, PhD,[a] Robert S. Levine, MD,[a] Mary K. Fadden, MPH,[a] Barbara Kilbourne, PhD,[a] Maria Pisu, PhD,[b] Van Cain, MS,[c] Baqar A. Husaini, PhD,[c] Michael Langston, PhD,[d] Lisa Gittner, PhD,[e] Roger Zoorob, MD, MPH,[a,1] George S. Rust, MD, MPH,[f] Charles H. Hennekens, MD, DrPH[a,g]

[a]Department of Family and Community Medicine, Meharry Medical College, Nashville, Tenn; [b]Division of Preventive Medicine, University of Alabama at Birmingham, Birmingham; [c]Center for Health Research, Tennessee State University, Nashville; [d]Department of Electrical Engineering and Computer Science, University of Tennessee, Knoxville; [e]Department of Political Science, Texas Tech University, Lubbock; [f]Morehouse School of Medicine, National Center for Primary Care, Atlanta, Ga; [g]Charles E. Schmidt College of Medicine, Florida Atlantic University, Boca Raton.

ABSTRACT

BACKGROUND: Randomized trials demonstrate clear benefits of mammography screening in women through age 74 years. We explored age- and race-specific rates of mammography screening and breast cancer mortality among women aged 69 to 84 years.

METHODS: We analyzed Medicare claims data for women residing within Surveillance, Epidemiology and End Results geographic areas from 1995 to 2009 from 64,384 non-Hispanic women (4886 black and 59,498 white) and ascertained all primary breast cancer cases diagnosed between ages 69 and 84 years. The exposure was annual or biennial screening mammography during the 4 years immediately preceding diagnosis. The outcome was breast cancer mortality during the 10 years immediately after diagnosis.

RESULTS: After adjustment for stage at diagnosis, radiation therapy, chemotherapy, comorbid conditions, and contextual socioeconomic status, hazard ratios (and 95% confidence intervals) for breast cancer mortality relative to no/irregular mammography at 10 years for women aged 69 to 84 years at diagnosis were 0.31 (0.29-0.33) for annual mammography and 0.47 (0.44-0.51) for biennial mammography among whites and 0.36 (0.29-0.44) for annual mammography and 0.47 (0.37-0.58) for biennial mammography among blacks. Trends were similar at 5 years overall and stratified by ages 69 to 74 years, 75 to 78 years, and 79 to 84 years.

CONCLUSIONS: In these Medicare claims and Surveillance, Epidemiology and End Results data, elderly non-Hispanic women who self-selected for annual mammography had lower 10-year breast cancer mortality than corresponding women who self-selected for biennial or no/irregular mammography. These findings were similar among black and white women. The data highlight the evidentiary limitations of data used for current screening mammography recommendations.

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KEYWORDS: Breast cancer screening; Geographic disparities; Mortality; Racial disparity

Randomized trials demonstrate clear benefits of mammography screening in women up to age 74 years.[1] After age 74 years, there are no cogent data from randomized trials.[1] Data from minority populations are especially sparse. The Surveillance, Epidemiology, and End Results (SEER) program file linked to the Medicare administrative claims file allows us to identify screening mammography use.[2] These linked files also permit exploration of breast cancer

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Requests for reprints should be addressed to Maureen Sanderson, PhD, Department of Family and Community Medicine, Meharry Medical College, 1005 Dr DB Todd Jr Blvd, Nashville, TN 37208.

E-mail address: msanderson@mmc.edu

[1]Current affiliation: Department of Family and Community Medicine, Baylor College of Medicine, Houston, Tex.

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mortality differences between elderly black or white women who self-selected for regular annual or biennial mammography screening.

MATERIALS AND METHODS

Detailed methods of the SEER-Medicare linked file have been published.[2] The SEER program, composed of 17 highly qualified cancer registries reflecting 26% of the US population, includes diagnostic information for up to 10 diagnosed cancer cases per person. Medicare is a health insurance program that enrolls approximately 93% of noninstitutionalized US men and women aged 65 years and older.[3] The SEER-Medicare linked file consists of SEER data that were linked successfully to the Medicare enrollment file for 94% of persons appearing in SEER registries. Information on socioeconomic status indicators at the census tract level from the US Census Bureau is included in the database.[2,4]

All primary female breast cancer cases diagnosed between the ages of 69 and 84 years from 1995 to 2009 according to Medicare claims information[4] were eligible for inclusion. Age 69 years was chosen because Medicare coverage of the general population begins at age 65 years, and the exposure of interest was regular mammography screening in the 4 years immediately preceding diagnosis. Three mutually exclusive exposure categories were defined: (a) no or irregular mammography screening; (b) biennial mammography; and (c) annual mammography. Eligibility criteria included female, non-Hispanic white or black race, and complete consecutive months of Medicare Parts A and B coverage with no health maintenance organization coverage (because health maintenance organization data are not provided to Medicare) during the 4-year period before primary breast cancer diagnosis. Hispanics were not included because Hispanic whites have substantially lower mortality than non-Hispanic whites, and the number of Hispanic blacks is small.[5] Algorithms developed by Smith-Bindman et al[6] and Fenton et al[7] were used to differentiate screening from diagnostic mammograms.

The women were categorized into 3 mutually exclusive age groups at breast cancer diagnosis: Group 1 included women ages 69 to 74 years, because the American Cancer Society (ACS)[8] and the United States Preventive Services Task Force (USPSTF)[1] recommend regular mammography for women aged 65 to 74 years. Group 2 included women aged 75 to 78 years, because they did not fit in the other 2 age categories. Group 3 included women aged 79 to 84 years, because the ACS and USPSTF mammography recommendations are for case-by-case decisions in the group aged 75 to 84 years.

The SEER-Medicare case file was used to determine breast cancer mortality among women diagnosed with primary nonmetastatic breast cancer. The initial sample included all persons with a history of breast cancer identified from SEER between 1991 and 2009 (n = 552,948). Exclusions included male cases (n = 4344); non-white, non-black cases (n = 67,483); women with diagnoses before 1995 (n = 83,838); women with nonprimary breast cancer (n = 14,711); cases diagnosed by autopsy or death certificate alone (n = 2630); women with American Joint Committee on Cancer (AJCC) stage IV cancer (n = 7278); women with less than 45 months of Medicare claims before diagnosis (n = 234,972); women with a previous diagnosis of cancer (n = 17,618); women with a breast cancer diagnosis before 2006 (to allow for the possibility of detecting at least 5-year postdiagnosis survival) (n = 38,454); and women who were not aged 65 to 74 years or 75 to 84 years during the 4 years before breast cancer diagnosis (n = 17,236), leaving 64,384 for the analyses (group 1, 69-74 years, n = 26,862; group 2, 75-78 years, n = 17,897; group 3, 79-84 years, n = 19,625). Cox proportional hazards regression was used to estimate the risk of breast cancer mortality at 5 years (in 3 age groups separately) and 10 years (all women aged 69-84 years combined) postdiagnosis associated with screening mammography rates 4 years prediagnosis while stratifying by race and controlling for confounding factors.[9] Cause of death was available from the SEER file. Survival time was calculated in months from the date of diagnosis to the date of death or the date of last follow-up (December 31, 2010, indicated in the Medicare file). Cases lost to follow-up, those still alive at the end of the follow-up period, or those who died of causes other than breast cancer were censored. No assumptions were made about the nature or shape of the hazard function. Survival curves were generated using the Kaplan-Meier procedure and compared using the log-rank test.

Because stage at diagnosis and treatment may modify the effect of mammography screening on breast cancer mortality, we added interaction terms between mammography screening rates and AJCC stage (coded as 0/I or II/III), radiation therapy, and chemotherapy to proportional hazards models and performed likelihood ratio tests in order to examine effect modification.[10] There was no evidence of effect modification, so AJCC stage and treatment were then assessed as confounders. Variables examined and excluded as confounders were age at diagnosis, diagnosis year, urban/rural residence, and type of surgery as categorized in Tables 1 and 2. Comorbid conditions, ascertained from Medicare inpatient, outpatient, and carrier claims through diagnoses made or procedures undergone 1 year before the diagnosis of breast cancer as described previously,[11-14] were classified as 0, 1, ≥2, or unknown. To measure contextual socioeconomic status, we calculated quartiles of a composite variable consisting of census tract-level

CLINICAL SIGNIFICANCE

- Black and white women aged 75 to 84 years who had an annual mammography had lower 10-year breast cancer mortality than corresponding women who had biennial or no/irregular mammography.

Table 1 Demographic Characteristics of White Women Aged 69 to 74 Years Diagnosed with Primary Nonmetastatic Breast Cancer Who Did and Did Not Die of Breast Cancer by Time Period

	Dead (n = 2407)		Alive or Censored (n = 22,289)	
Characteristic	n	%	n	%
Age (y)				
66-69	359	14.9	3515	15.9
70-74	2048	85.1	18,774	84.1
Diagnosis year				
1995-1997	614	25.5	4297	19.3
1998-2000	642	26.7	5550	24.9
2001-2003	672	27.9	7592	34.1
2004-2005	479	19.9	4850	21.7
Urban/rural				
Big metro	1261	52.4	11,575	51.9
Metro	705	29.3	6568	29.5
Urban/less urban/rural	441	18.3	4145	18.6
AJCC stage				
In situ/I	454	18.9	11,779	52.9
II	962	40.0	4523	20.3
III	354	14.7	430	1.9
Unstaged/missing	637	26.4	5557	24.9
Surgery				
Yes	2077	86.3	21,731	97.5
No/unknown	330	13.7	558	2.5
Radiation therapy				
Yes	959	39.8	10,644	47.7
No	1357	56.4	11,096	49.8
Unknown	91	3.8	549	2.5
Chemotherapy				
Yes	1030	42.8	3840	17.2
No	1248	51.8	17,548	78.7
Unknown/missing	129	5.4	901	4.0
Charlson index score				
0	1472	61.1	15,243	68.4
1	406	16.9	3895	17.5
≥2	217	9.0	1641	7.3
Unknown/missing	312	13.0	1510	6.8
Contextual socioeconomic status				
Quartile 1 (lowest)/missing	506	21.0	5861	26.3
Quartile 2	588	24.4	5522	24.8
Quartile 3	606	25.2	5504	24.7
Quartile 4 (highest)	707	29.4	5402	24.2

AJCC = American Joint Committee on Cancer.

Table 2 Demographic Characteristics of Black Women Aged 69 to 74 Years Diagnosed with Primary Nonmetastatic Breast Cancer Who Did and Did Not Die of Breast Cancer

	Dead (n = 335)		Alive or Censored (n = 1831)	
Characteristic	n	%	n	%
Age (y)				
66-69	63	18.8	314	17.1
70-74	272	81.2	1517	82.9
Diagnosis year				
1995-1997	57	17.0	292	16.0
1998-2000	80	23.9	407	22.2
2001-2003	104	31.0	658	35.9
2004-2005	94	28.1	474	25.9
Urban/rural				
Big metro	223	66.6	1233	67.3
Metro	77	23.0	410	22.4
Urban/less urban/rural	35	10.4	188	10.3
AJCC stage				
In situ/I	35	10.5	820	44.8
II	111	33.1	417	22.8
III	61	18.2	61	3.3
Unstaged/missing	128	38.2	533	29.1
Surgery				
Yes	266	79.4	1745	95.3
No/unknown	69	20.6	86	4.7
Radiation therapy				
Yes	109	32.5	727	39.7
No	211	63.0	1051	57.4
Unknown	15	4.5	53	2.9
Chemotherapy				
Yes	133	39.7	369	20.2
No	187	55.8	1379	75.3
Unknown/missing	15	4.5	83	4.5
Charlson index score				
0	146	43.6	921	50.3
1	66	19.7	471	25.7
≥2	70	20.9	310	16.9
Unknown/missing	53	15.8	129	7.1
Contextual socioeconomic status				
Quartile 1 (lowest)/missing	81	24.2	471	25.7
Quartile 2	83	24.8	455	24.8
Quartile 3	77	23.0	459	25.1
Quartile 4 (highest)	94	28.0	446	24.4

AJCC = American Joint Committee on Cancer.

information for median household income, the percent of persons living below the poverty level, and the percent of persons with less than a high school education for white and black women separately.[15] On the basis of a 10% change between crude and adjusted hazard ratios, AJCC stage, radiation therapy, and chemotherapy confounded the association between mammography screening rates and mortality from breast cancer. Comorbidity and contextual socioeconomic status were retained for confounding adjustment to conform to other analyses.

RESULTS

Tables 1 and 2 compare the demographic characteristics of non-Hispanic white and black women who died of breast cancer with those who were alive or censored at 5 years postdiagnosis among women aged 69 to 74 years. White women (Table 1) who had died tended to be older, to have a later stage at diagnosis, to have received chemotherapy, and to have a higher contextual socioeconomic status. White women who died were less likely to have undergone surgery and receive radiation therapy. Similar

Table 3 Hazard Ratios of 5-Year Breast Cancer Mortality Associated with Mammography Screening Among Non-Hispanic White Women Aged (a) 69 to 74 Years, (b) 75 to 78 Years, and (c) 79 to 84 Years

	Dead (n = 1569)		Alive or Censored (n = 23,127)			
(a) 69-74 y (Group 1)	n	%	N	%	HR*	95% CI†
Mammography screening						
No/irregular	1061	67.6	8876	38.4	1.00	(referent)
Biennial	209	13.3	4179	18.1	0.50	(0.43-0.58)
Annual	299	19.1	10,072	43.5	0.29	(0.25-0.33)
P value for trend						<.0001
	Dead (n = 1245)		Alive or Censored (n = 15,304)			
(b) 75-78 y (Group 2)	N	%	n	%	HR*	95% CI†
Mammography screening						
No/irregular	891	71.6	6415	41.9	1.00	(referent)
Biennial	150	12.1	2797	18.3	0.46	(0.39-0.55)
Annual	204	16.4	6092	39.8	0.28	(0.24-0.32)
P value for trend						<.0001
	Dead (n = 1823)		Alive or Censored (n = 16,430)			
(c) 79-84 y (Group 3)	N	%	n	%	HR*	95% CI†
Mammography screening						
No/irregular	1402	76.9	8189	49.9	1.00	(referent)
Biennial	168	9.2	2863	17.4	0.39	(0.33-0.45)
Annual	253	13.9	5378	32.7	0.29	(0.25-0.33)
P value for trend						<.0001

CI = confidence interval; HR = hazard ratio.
*HRs adjusted for AJCC stage, radiation therapy, chemotherapy, comorbid conditions, and contextual socioeconomic status.
†95% CI.

characteristics were seen in black women (Table 2) as in white women. Age- and race-specific demographic results among the 2 older age groups (not shown) did not substantially alter the conclusions.

Tables 3-5 present the hazard ratios and 95% confidence intervals for 5-year and 10-year breast cancer mortality associated with mammography screening adjusted for AJCC stage, radiation therapy, chemotherapy, comorbid conditions, and contextual socioeconomic status. Women who received no or irregular mammography screening were the referent group. After adjustment, hazard ratios (and 95% confidence intervals) for 5-year breast cancer mortality relative to no/irregular mammography at ages 69 to 74 years, 75 to 78 years, and 79 to 84 years among whites (Table 3) were 0.29 (0.25-0.33), 0.28 (0.24-0.32), and 0.29 (0.25-0.33) for annual screening and 0.50 (0.43-0.58), 0.46 (0.39-0.55), and 0.39 (0.33-0.45) for biennial screening, respectively; among blacks (Table 4), they were 0.41 (0.29-0.57), 0.23 (0.14-0.38), and 0.34 (0.20-0.56) for annual screening and 0.44 (0.29-0.66), 0.47 (0.30-0.72), and 0.45 (0.28-0.72) for biennial screening, respectively. Tests for trend (no/irregular, biennial, and annual screening) were highly significant ($P < .0001$) throughout. As shown in Table 5, corresponding 10-year values for women aged 69 to 84 years were 0.31 (0.29-0.33) for annual mammography and 0.47 (0.44-0.51) for biennial mammography among whites and 0.36 (0.29-0.44) for annual mammography and 0.47 (0.37-0.58) for biennial mammography among blacks. Tests for trend were again highly significant.

DISCUSSION

In these data, 69- to 84-year-old women receiving regular annual screening mammography during the 4 years immediately preceding breast cancer diagnosis had consistently lower 5-year and 10-year risks of breast cancer mortality than women with no or irregular screening regardless of race. Ten-year risks were 3.3-fold higher among whites and 2.2-fold higher among blacks aged 69 to 84 years with no or irregular screening compared with annual screening. The associations with screening in these data were independent from AJCC stage, radiation therapy, chemotherapy, comorbid conditions, and contextual socioeconomic status.

Two US organizations, the ACS[8] and the USPSTF,[1] offer widely recognized guidelines for screening mammography among women aged 65 years or more. Both organizations agree that in the general population, women between the ages of 65 and 74 years should have regular screening; however, the ACS recommends annual testing[8] and the

Table 4 Hazard Ratios of 5-Year Breast Cancer Mortality Associated with Mammography Screening among Non-Hispanic Black Women Aged (a) 69 to 74 Years (b) 75 to 78 Years, and (c) 79 to 84 Years

	Dead (n = 258)		Alive or Censored (n = 1908)		N	%
(a) 69-74 y (Group 1)	n	%	n	%	HR*	95% CI†
Mammography screening						
No/irregular	192	74.4	968	50.7	1.00	(referent)
Biennial	27	10.5	396	20.8	0.44	(0.29-0.66)
Annual	39	15.1	544	28.5	0.41	(0.29-0.57)
P value for trend						<.0001
	Dead (n = 188)		Alive or Censored (n = 1160)		n	%
(b) 75-78 y (Group 2)	N	%	n	%	HR*	95% CI†
Mammography screening						
No/irregular	148	78.7	635	54.8	1.00	(referent)
Biennial	23	12.2	215	18.5	0.47	(0.30-0.72)
Annual	17	9.0	310	26.7	0.23	(0.14-0.38)
P value for trend						<.0001
	Dead (n = 218)		Alive or Censored (n = 1154)		n	%
(c) 79-84 y (Group 3)	N	%	n	%	HR*	95% CI†
Mammography screening						
No/irregular	182	83.5	753	65.2	1.00	(referent)
Biennial	19	8.7	181	15.7	0.45	(0.28-0.72)
Annual	17	7.8	220	19.1	0.34	(0.20-0.56)
P value for trend						<.0001

CI = confidence interval; HR = hazard ratio.
*HRs adjusted for AJCC stage, radiation therapy, chemotherapy, comorbid conditions, and contextual socioeconomic status.
†95% CI.

USPSTF favors a biennial schedule.[1] The ACS states that decisions about screening after age 74 years should be individualized.[16] The USPSTF states that there is insufficient evidence for a recommendation after age 74 years, but adds that if screening is done, a biennial schedule is preferred.[16] The evidence base for both ACS and

Table 5 Hazard Ratios of 10-Year Breast Cancer Mortality Associated with Mammography Screening Among Non-Hispanic White Women and Black Women Aged 69 to 84 Years

	Dead (n = 6303)		Alive or Censored (n = 53,195)			
White Women	n	%	n	%	HR*	95% CI†
Mammography screening						
No/irregular	4358	69.1	22,476	42.3	1.00	(referent)
Biennial	782	12.4	9584	18.0	0.47	(0.44-0.51)
Annual	1163	18.5	21,135	39.7	0.31	(0.29-0.33)
P value for trend						<.0001
	Dead (n = 824)		Alive or Censored (n = 4062)			
Black Women	n	%	n	%	HR*	95% CI†
Mammography screening						
No/irregular	633	76.8	2245	55.2	1.00	(referent)
Biennial	91	11.0	770	19.0	0.47	(0.37-0.58)
Annual	100	12.2	1047	25.8	0.36	(0.29-0.44)
P value for trend						<.0001

CI = confidence interval; HR = hazard ratio.
*HRs adjusted for AJCC stage, radiation therapy, chemotherapy, comorbid conditions, and contextual socioeconomic status.
†95% CI.

USPSTF recommendations is sparse. None of the randomized trials for screening mammography included women aged more than 74 years, and none could address annual mammography because none included women at intervals less than 18 months.[16] Additional observational evidence specific to the elderly is also limited.[17]

The ACS recommendations for annual screening are based, in part, on data from 2 studies of ongoing mammography screening programs operated by single health care institutions (the University of Michigan[18] and a 6-county mobile van program at the University of California San Francisco[19]). Neither is representative of the United States. Also, in each study, the end points focused on tumor size at detection,[18,19] which may lead to more conservative estimates (ie, underestimates) of benefit.[20] In the University of Michigan study,[18] a retrospective record review of women aged 65 years or more (1988-1995), the proportion of patients who presented with a palpable mass was significantly greater in the group with the longer inter-screening interval (48%) than in the group with the smaller inter-screening interval (15%) ($P < .0001$). The proportion of patients with ductal carcinoma in situ without invasion was greater in the group with the shorter screening interval (22% vs 7%). The University of California San Francisco study (1985-1997)[19] included asymptomatic participants aged 40 to 79 years. Tumor size was 27% smaller in diameter for annual vs biennial screening ($P = .04$). Annual mammography was associated with a 30% decrease in recall rate ($P < .0001$), meaning that false-positives were reduced, and a 28% reduction in biopsies ($P = .06$), making for less frequent anxiety and lower biopsy costs. There was no statistically significant difference in detection rate (19% less in the annual group, $P = .49$). Both studies were subject to the biases potentially introduced by use of tumor characteristics rather than death as the primary end point[20] and selection based on attendance at institutions with little basis for national representation.[21] In addition, and in contrast to the present data, classification as to annual and biennial mammography was determined by a single inter-screening interval, leaving doubt about whether mammography had been regular before the observation period.

The USPSTF[1] and subsequent studies and reviews[16,17,22-24] have noted the paucity of data among older populations, particularly those aged 75 years and older. Rather than relying on observational studies, the USPSTF placed greater reliance on multiple predictive models whose primary end point was breast cancer mortality. Limitations of the predictive models include reliance on self-reported mammography and national cohorts. Specifically, mammography self-report overestimates use[25] and underestimates disparities,[25,26] whereas the use of national cohorts[23,27] may obscure variations in potential benefit among demographic and geographic subpopulations. For example, differences in mortality according to geographic area of residence and among Hispanics and non-Hispanics[5] raise questions about the utility of any model that considers the general US population as a homogenous group.

Aside from evidence cited by the USPSTF and the ACS, additional inquiries pertaining to frequency of mammography include a study evaluating the impact of changing from annual to biennial screening in British Columbia, Canada,[28] and results from a randomized trial in the United Kingdom.[29] Neither supported the value of annual mammography. However, the former study[28] compared results from women with an average of 2.9 screens over a median 13-month interval for annual screening (covering ∼38 months) with results from women averaging 2.4 screens over a median 24-month interval for biennial screening (covering ∼58 months). In contrast, the present results pertain to 48 months of screening coverage for both annual and biennial screening. The latter study[29] compared annual with triennial screening. In a comment to that study, Andersson[30] expressed concerns about the possibility of beta error and suggested that greater clarity might have been achieved had more baseline data been available.

As a measure of potential harm from mammography screening, we calculated the percentage of women aged 65 to 84 years without breast cancer categorized as having no or irregular biennial and annual screening mammography in the most recent 4-year period (2002-2005) available who received breast biopsies despite being breast cancer free (false-positives). Among whites, there were 288 biopsies among the 11,452 women receiving annual mammography (2.5%) that would not have occurred with biennial screening. Among blacks, there were 35 biopsies among the 1277 women receiving annual mammography (2.7%) that would not have occurred with biennial screening. The net increase for annual screening was 323 biopsies among the 54,213 women receiving annual or biennial mammography (0.6%).

A strength of the present data is its use of SEER[2,4] data linked to administrative claims data from the Medicare program to provide a reliable means to assess screening mammography use among women aged 65 years and older.[6] The Medicare program initiated reimbursement for biennial screening on January 1, 1991, and expanded the reimbursement benefit to include annual screening for women on January 1, 1998.[31] Although Medicare administrative claims data can be used to determine variations in screening mammography in geographic areas across the United States, it is unable to assess the impact that treatment and follow-up have on these screening rates. Linking the SEER program file to the Medicare file partly overcomes this problem. These data also are strengthened by use of regular mammography (as recommended by the ACS[8] and USPSTF[1]) as the exposure of interest rather than the interval between diagnosis and the most recent mammogram or the most recent inter-screening interval.

Study Limitations

Limitations of the present data include a geographic basis within SEER that underestimates the breast cancer mortality among non-Hispanic black and white elderly persons for the United States. SEER representation declined from approximately 70% of US mortality levels for data available since 1992 to approximately 50% of US levels for data available since 2000.[32,33] Also, better outcomes in these data among those with regular mammography may be, in part, overestimates due to biases such as lead time (disease is detected earlier, but survival is not prolonged), length time (screening may tend to detect less aggressive tumors), and selection (women accessing regular screening may be healthier and may have a variety of social advantages).[3] Further, it has been estimated that the lag time between the start of screening and the onset of mortality benefits may be at least 10 years.[17] Nonetheless, the better 10-year survival associated with annual mammography in these data lessens the probability that observed benefits are solely due to lead time bias. Likewise, the observation of benefits independent of AJCC stage, radiation therapy, and chemotherapy lessens the probability that observed benefits reflect less advanced disease at the time of diagnosis or treatment advantages. In addition, the observation that benefits are independent from comorbidity means that the results are less likely to reflect selection bias due to the fact that healthy women may be more likely to be referred for screening. Moreover, adjustment for contextual socioeconomic status makes it less likely that observed benefits reflect better education and other social advantages in the community structure of counties where these beneficiaries resided. Although these data do not address individual socioeconomic status, SEER-linked individual socioeconomic data have, to date, yielded results that are consistent with observations based on area measures.[34] In sum, although the present data are promising, the results are not conclusive.

CONCLUSIONS

In 2010, there were 19,201,270 women aged 65 to 84 years residing in the United States, and they accounted for 41% (16,863 of 40,996) of all US breast cancer deaths during that year.[35] We believe the current evidence about potential benefits and harms from screening mammography in this population is insufficient for clinical or policy decisions.[36,37] The need for better data is reflected by the magnitude of breast cancer as a cause of death among the elderly, the likelihood of greater numbers of women living to advanced age, and the projections indicating that racial and ethnic minorities will comprise 28% of the US elderly population aged 65 years or more by the year 2030.[3] Although a large-scale randomized trial comparing the risks and benefits of annual vs biennial mammography would be hampered by high costs and feasibility issues, this design strategy would provide the most reliable means to assess the most plausible way to discriminate small to moderate differences. In the interim, the present results highlight the evidentiary limitations of data used for current screening mammography recommendations.

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