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O'Meara, Ellen S
Zhu, Weiwei
Hubbard, Rebecca A
et al.

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Mammographic Screening Interval in Relation to Tumor Characteristics and False-positive Risk by Race/Ethnicity and Age

Ellen S. O'Meara, PhD[1], **Weiwei Zhu, MS**[1], **Rebecca A. Hubbard, PhD**[1,2], **Dejana Braithwaite, PhD**[3], **Karla Kerlikowske, MD**[3,4], **Kim L. Dittus, MD, PhD**[5], **Berta Geller, EdD**[5,6], **Karen J. Wernli, PhD**[1], and **Diana L. Miglioretti, PhD**[1,7]

[1]Group Health Research Institute, Seattle, WA

[2]Department of Biostatistics, University of Washington, Seattle

[3]Department of Epidemiology and Biostatistics, University of California, San Francisco

[4]General Internal Medicine Section, Department of Veterans Affairs, University of California, San Francisco

[5]Department of Hematology/Oncology, University of Vermont College of Medicine, Burlington

[6]Departments of Family Medicine and Radiology, University of Vermont College of Medicine, Burlington

[7]Division of Biostatistics, Department of Public Health Sciences, School of Medicine, University of California, Davis

Abstract

Background—Biennial screening mammography retains most benefits of annual breast cancer screening with reduced harms. Whether screening guidelines based on race/ethnicity and age would be more effective than age-based guidelines is unknown.

Methods—Mammography data from the Breast Cancer Surveillance Consortium were linked to pathology and tumor databases. We identified 40-74 year-old women who had annual, biennial, or triennial screening mammography during 1994-2008. We used logistic regression to estimate adjusted odds ratios (OR) and 95% confidence intervals (CI) of adverse tumor characteristics among 14,396 incident breast cancer cases and 10-year cumulative risks of false positive recall and biopsy recommendation among 1,276,312 noncases.

Results—We found no increased risk of adverse tumor characteristics associated with biennial versus annual screening in white women, black women, 40-49 year-old Hispanic women, or 50-74 year-old Asian women. Hispanic women aged 50-74 who screened biennially versus annually had increased risk of late stage (OR 1.6, 95% CI 1.0-2.5) and large (OR 1.6, 95% CI 1.1-2.4) tumors. Asian women aged 40-49 who screened biennially had elevated risk of positive lymph nodes (OR 3.1, 95% CI 1.3-7.1). No elevated risks were associated with triennial versus biennial screening. Cumulative false-positive risks decreased markedly with longer screening interval.

Conclusion—We found limited evidence of elevated risk of adverse tumor characteristics with biennial versus annual screening, while cumulative false-positive risks were lower. However,

Correspondence: Ellen O'Meara, Group Health Research Institute, 1730 Minor Ave, Suite 1600, Seattle, WA 98101. Phone: 206-287-2938, Fax: 206-287-2871, omeara.e@ghc.org.

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elevated risks of late stage disease in Hispanic women and node-positive disease in younger Asian women who screened less often than annually warrant consideration and replication.

Keywords

breast cancer; screening; mammography; race; ethnicity

Introduction

Evidence from published studies [1-5] consistently shows that biennial compared to annual mammographic screening for women aged 50-74 years retains most of the benefit of screening with reduced harms. Harms of annual screening include more false-positive results, unnecessary biopsies, and a greater chance of overdiagnosis [5]. For these reasons, the U.S. Preventive Services Task Force recommends biennial screening mammography at ages 50-74 [6,7]. Because of inconclusive evidence, routine screening is not recommended at ages 40-49 [6,7]. Screening recommendations based on factors beyond age could potentially reduce adverse outcomes [8].

Whether screening guidelines based on race/ethnicity and age would be more effective than guidelines based on age alone is unknown. When diagnosed with breast cancer, black and Hispanic women are more likely than non-Hispanic white and Asian women to have adverse tumor characteristics and worse survival [9]. Black and Hispanic women may therefore benefit from more frequent screening. In the population overall, breast cancer mortality rates are higher in black women, and lower in Hispanic and Asian women, than white women [10]. Despite declining breast cancer mortality in recent decades, the black-white mortality disparity has grown [11,12]. Further, black women tend to present with breast cancer at younger ages than white women [9], when the mortality difference is greatest [10,12], so that more frequent screening of women in their forties may be especially beneficial in black women [13].

To inform the development of risk-based breast cancer screening guidelines, we estimated risks of adverse tumor characteristics and cumulative false-positive probabilities associated with annual, biennial, and triennial screening mammography within racial/ethnic and age groups in the Breast Cancer Surveillance Consortium (BCSC), a prospective cohort study of mammography in U.S. communities.

Methods

Study Setting and Data

BCSC mammography registries (http://breastscreening.cancer.gov) [14] provided patient and clinical information from community radiology facilities. Radiologist assessments and recommendations were based on the American College of Radiology's Breast Imaging Reporting and Data System (BI-RADS®) [15]. Breast cancer diagnoses and tumor characteristics were obtained by linkage to pathology databases and regional Surveillance, Epidemiology, and End Results (SEER) programs or state tumor registries. Data were pooled at a Statistical Coordinating Center. Registries and the Coordinating Center received Institutional Review Board approval for active or passive consenting processes or a waiver of consent to enroll participants, link data, and perform analysis and a Federal Certificate of Confidentiality and other protections for the identities of women, physicians, and facilities. All procedures were Health Insurance Portability and Accountability Act compliant.

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Participants

Analyses of tumor characteristics included 40-74 year-old women diagnosed with incident invasive breast cancer or ductal carcinoma in situ (DCIS) during 1996-2008 and who had at least two prior screening mammograms (Figure 1). Screening intervals were defined by the time between the most recent screening mammogram before diagnosis (index mammogram) and the previous mammogram as either annual (9-18 months), biennial (>18-30 months), or triennial (>30-42 months) (Figure 2). We also restricted analyses to breast cancers diagnosed within a specified follow-up period after the index mammogram: one year for annual, two years for biennial, and three years for triennial intervals (Figure 2), as would be done in a randomized trial [3]. Screen-detected and interval cancers were included. For adequate follow-up, we included only index mammograms that occurred at least one year before the end of complete cancer data collection for annual intervals, at least two years for biennial intervals, and at least three years for triennial intervals.

Analyses of cumulative false-positive probabilities included screening mammograms from 1994-2008 for 40-74 year-old women without prior breast cancer (Figure 1). We censored women at breast cancer diagnosis and excluded the prior screening mammogram if it occurred within one year before diagnosis. We also censored women if self-reported time since the last examination differed from that in the database by more than six months.

Measures and definitions

Breast cancers were classified according to the American Joint Committee on Cancer (AJCC) staging system, 6^{th} edition [16]. We defined late stage as AJCC stages IIB, III, or IV and large tumors as >20 mm. For 3.1% of invasive cancers lacking complete AJCC stage data, we classified late stage using tumor size, extension, nodal status, metastasis, or SEER summary stage. For 1.2% of invasive cancers lacking detailed size data, we classified large tumors using summary data on size.

Mammograms were classified as screening based on the indication reported by the radiologist. To avoid misclassifying diagnostic mammograms as screening, we excluded mammograms that were unilateral or obtained within nine months after another breast imaging examination.

A mammogram was considered positive for recall if the initial BI-RADS assessment was 0 (needs additional imaging evaluation), 4 (suspicious abnormality), 5 (highly suggestive of malignancy), or 3 (probably benign finding) with a recommendation for immediate evaluation. A mammogram was considered positive for biopsy recommendation if the final BI-RADS assessment (after all imaging workup and within 90 days after screening) was 4 or 5—or was 0 or 3 with a recommendation for biopsy, fine needle aspiration, or surgical consult. Examinations were excluded from the biopsy recommendation analysis if the final assessment was BI-RADS 0 with recommendation for additional imaging, non-specified workup, or missing a recommendation. A false-positive result was defined as a positive mammogram without breast cancer diagnosis within one year after the screening examination or before the next screening mammogram, whichever occurred first.

Self-administered patient questionnaires were given at each mammogram. We used self-reported race and Hispanic ethnicity to categorize women as non-Hispanic white, black, or Asian/Pacific Islander, or Hispanic,. Due to small sample sizes, we excluded non-Hispanic women who reported mixed or other races and women missing race/ethnicity data (6.7% of otherwise eligible women). For analyses of tumor characteristics, we used cancer registry data to fill-in missing race/ethnicity for 4.4% of cases. Age was based on self-reported birth date. Body mass index (kg/m^2) was based on self-reported weight and height. Women were defined as postmenopausal if they reported natural menopause, removal of both ovaries, or

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were age 55 or older. Women reported current use of postmenopausal hormone therapy and family history of breast cancer in a first-degree relative. Mammographic breast density was classified using the BI-RADS scale [15].

Statistical Analysis

We describe the distribution of risk factors among women with and without incident breast cancer. Among cases, we show the proportion with invasive cancer versus DCIS by screening interval, race/ethnicity, and age (40-49 or 50-74 years). Among invasive cancer cases, we show proportions of tumor stage, size, and nodal status at diagnosis by interval, race/ethnicity, and age. We used logistic regression to estimate odds ratios (ORs) and 95% confidence intervals (CIs) of adverse (versus more favorable) tumor characteristics associated with screening interval by race/ethnicity and age. Models included indicator variables for screening and were adjusted for continuous age (years) and BCSC registry. In sensitivity analyses, models were further adjusted for family history, breast density, or body mass index.

We estimated the probability of a false-positive first mammogram using logistic regression stratified by age (40-49 or 50-74 years), with screening interval and race/ethnicity in a model adjusted for registry. The registry distribution was standardized across estimates using indirect standardization. We modeled the cumulative probability of at least one false-positive result after 10 years of subsequent screening using a discrete time survival approach developed for this purpose [17]. We report fitted values from the model by screening interval, race/ethnicity, and age.

Analyses of tumor characteristics were performed using SAS® Version 9.2 (SAS Institute, Cary, NC) and cumulative false-positive probabilities using R 2.10.1 (R Foundation for Statistical Computing, Vienna, Austria).

Results

Risk of adverse tumor characteristics at diagnosis

The analysis of tumor characteristics included 14,396 women with breast cancer, of whom 62 % were annual, 30% biennial, and 9% triennial screeners (Table 1). Annual versus biennial or triennial screeners were more likely to be over age 50, white, non-obese (body mass index <30), postmenopausal, hormone therapy users, and have a family history of breast cancer.

The proportion of cancers diagnosed as invasive (versus DCIS) among white women was highest in triennial screeners, and lower at age 40-49 than 50-74 (Table 2). These patterns were not seen consistently in the other racial/ethnic groups. Among invasive breast cancers, late stage diagnosis tended to be more common at 40-49 than 50-74. The proportion of white women with late stage disease varied little by screening interval. The proportion of black women with late stage was highest with annual screening at age 40-49 and triennial screening at 50-74. Late stage disease was more common with increasing interval in Hispanic and Asian women. Large tumor size was less common with annual versus less frequent screening among white women and 50-74 year-old Hispanic women. In black women, large tumors were more common with annual screening at 40-49 and triennial screening at 50-74. Positive lymph nodes were more common at age 40-49 than 50-74, and more common in biennial and triennial than annual screeners among white, Hispanic, and Asian women; no notable increases were seen with increasing interval in black women.

We did not observe frequent or consistent patterns of significantly worse tumor characteristics associated with screening less often than annually after adjusting for age and

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registry (Table 3). Hispanic women aged 50-74 who screened biennially versus annually had increased risk of late stage (OR 1.59, 95% CI 1.03-2.46) and large size (OR 1.60, 95% CI 1.08-2.37) tumors; the pattern for late stage was similar but nonsignificant at age 40-49. Asian women in their forties had increased risk of node-positive disease with biennial versus annual screening (OR 3.08, 95% CI 1.33-7.12) while their risk of late stage disease was nonsignificantly elevated (OR 2.14, 95% CI 0.76-5.98). We found no significantly increased risk of adverse tumor characteristics associated with biennial versus annual screening in 40-49 year-old white, black, or Hispanic women or 50-74 year-old white, black, or Asian women. We also found no elevated risks associated with triennial versus biennial screening, however the number of events was small in non-white triennial screeners. Further adjustment for family history, breast density, or body mass index resulted in little change in odds ratios (data not shown), although these analyses were limited by missing data.

False-positive risks

The analysis of false-positive risks included 1,276,312 women without breast cancer at baseline (Table 1). Estimates are based on 3,815,729 (for risk at first mammography) and 3,728,759 (for cumulative risk) mammograms from these women. At the first screening mammogram, estimated false-positive probabilities ranged from 12.2% to 17.7% for recall and 2.3% to 3.5% for biopsy recommendation (Table 4). Cumulative false-positive risks—the probability of having at least one false-positive result after 10 years of subsequent mammography—decreased sharply with longer screening interval. The cumulative risk of false-positive recall was highest in black and white women at age 40-49 (65% of annual, 41% of biennial, and 29% of triennial screeners in both groups) and lowest in Asian women at 50-74 (47%, 29%, and 20%). The cumulative risk of false-positive biopsy recommendation was highest in 40-49 year-old black women (13.8%, 7.2%, and 4.7%) and lowest in 50-74 year-old Asian women (6.4%, 3.5%, and 2.5%).

Discussion

This study examined risks associated with mammographic screening intervals by race/ethnicity and age—the first such study to our knowledge. We found some evidence of elevated risk for biennial compared to annual screening: of large size and late stage tumors in 50-74 year-old Hispanic women, and of positive lymph nodes in Asian women in their forties. No increased risk was associated with biennial compared to annual screening in 40-49 year-old Hispanic women, 50-74 year-old Asian women, or black or white women in either age group. We did not observe higher risks associated with triennial compared to biennial screening in any group. Cumulative false-positive risks decreased with longer screening interval. In general, our findings fit with earlier work showing that biennial versus annual screening at 50-74 years retains most of the benefits while reducing harms [1-5]. We also found that positive lymph nodes and late stage disease were more common at age 40-49 than 50-74, within all subgroups defined by race/ethnicity and screening interval. Yet—although we cannot rule out chance findings given the large number of comparisons—the elevated risks observed warrant further study.

Despite the high risk of poor-prognosis breast cancer in black women [9,10], we found no elevated risk of late stage, large size, or node-positive tumors in black women who screened biennially versus annually. High breast cancer mortality in black women has been attributed to disparities in access and quality of care, socioeconomic factors, tumor biology, and genetics [18]. According to statistical modeling evidence, most of the black-white disparity in breast cancer mortality is due to variation in natural history and undetermined factors, and to a lesser extent treatment differences, while mammographic screening uptake (age at initiation and interval) explains only 7-8% of the mortality difference [19]. The idea that

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more frequent screening in black women, especially in their forties, might be more beneficial than in the other racial/ethnic groups under study was not supported by our data.

Hispanic women who screened biennially versus annually had higher risk of late stage disease, which was significant at age 50-74 but not 40-49. Hispanic women aged 50-74 who screened biennially also had increased risk of large tumors, a pattern not seen at 40-49. While Hispanic women are more likely to have large and late stage tumors than white women [9,20], an earlier BCSC study found that Hispanic women had similar or more favorable tumor characteristics than white women after accounting for time since the previous screen [21]. It is not clear why screening interval would affect risk only in Hispanic women. But if confirmed, this finding may lead 50-74 year-old Hispanic women to consider annual screening despite higher cumulative false-positive risks.

Asian women aged 40-49 who screened biennially versus annually had increased risk of positive lymph nodes, while their risk of late stage disease was nonsignificantly elevated. These patterns were not seen at age 50-74. Asian compared to white women are more likely to have human epidermal growth factor receptor 2 positive tumors [22], which tend to grow rapidly. In our data, however, the association between interval and nodal status was seen only in the younger Asian women. Because few 40-49 year-old Asian women in our study had breast cancer (15 cases among annual screeners and 25 cases among biennial screeners), this finding needs confirmation.

Our findings echo previous BCSC findings that cumulative false positive risks decrease with longer screening intervals [5]—not unexpected given fewer screening rounds. Like others [23], we observed relatively low false-positive risks in Asian women. Studies from the Carolina Mammography Registry, part of BCSC, reported that black compared to white women had similar specificity on screening mammography [24] but lower specificity on diagnostic mammography, hence more false-positive biopsy recommendations [25]—consistent with our findings of similar cumulative risk of false-positive recall yet higher cumulative risk of false-positive biopsy recommendation in black versus white women. Moreover, studies of BCSC facilities that serve medically vulnerable populations, including racial/ethnic minorities, found that false-positive rates were lower for screening mammography [26] and higher for diagnostic mammography to evaluate breast problems [27] compared to facilities serving nonvulnerable populations. Perceptions that medically vulnerable women are less likely to return for follow-up or more likely to have breast cancer may result in false-positive biopsy recommendations [27,28]. But false positive results can lead to anxiety, unneccesary procedures, and overdiagnosis [5-7].

The BCSC includes a large, population-based, geographically diverse sample of U.S. women seen in community practice. Still, our data are limited by the few breast cancer cases in black, Hispanic, and Asian women who are in their forties or triennial screeners. We examined multiple tumor characteristics by screening interval, race/ethnicity, and age and expect some significant results by chance. Women at high versus low risk of poor-prognosis breast cancer may screen more frequently, which could spuriously inflate rates of adverse tumor characteristics among annual screeners; to avoid this potential bias, we evaluated the proportion of cases with adverse tumor characteristics. Although we would ideally measure benefit by reduced breast cancer mortality, late stage at diagnosis strongly predicts breast cancer mortality [29]. Our study design, in which follow-up time corresponds to the screening interval, and which requires at least two mammograms before diagnosis, reduces possible length bias [30]. Our study includes mostly film-screen mammography, while digital is becoming standard —but accuracy is similar for both [31]. Because we include only women with multiple screening mammograms, this study cannot address outcome disparities related to infrequent or lack of screening.

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Conclusion

Mammographic screening every two or even three years was infrequently associated with worse tumor characteristics compared to annual screening, and had lower cumulative false-positive risks. However, the elevated risks of late stage disease in 50-74 year-old Hispanic women and node-positive disease in 40-49 year-old Asian women screened less often than annually warrant consideration and replication.

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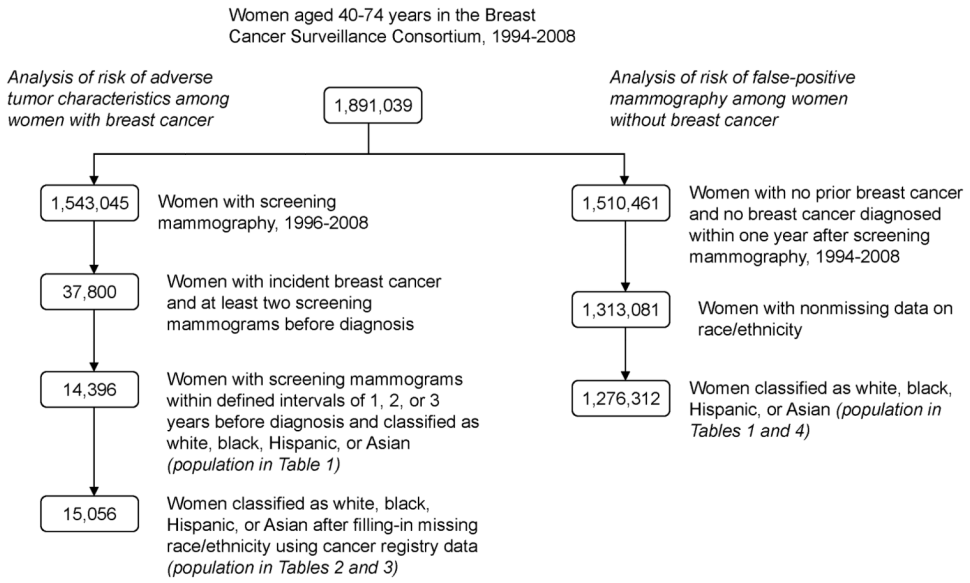

Fig. 1. Study populations

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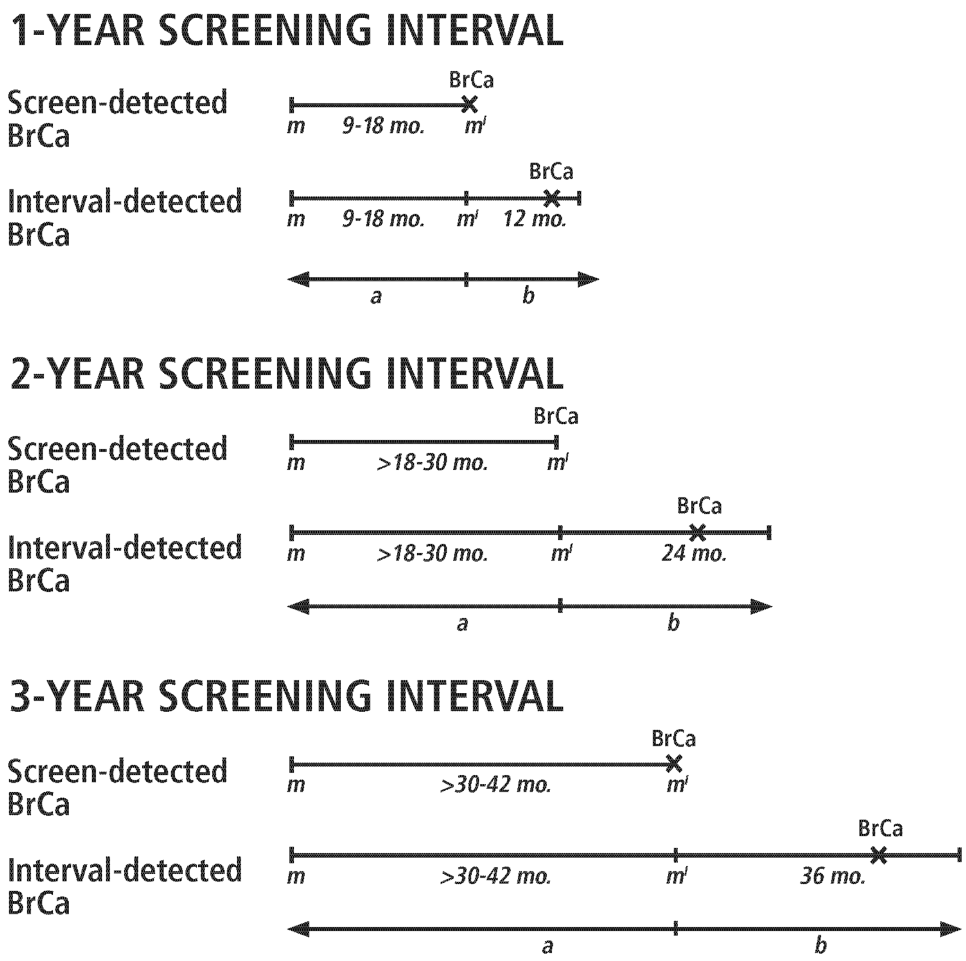

Fig. 2. Overview of study design

Legend: BrCa = breast cancer, m = screening mammogram, m^1 = index mammogram, a = screening interval, b = follow-up period for cancer ascertainment, mo. = months

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Table 1

Characteristics of women with and without breast cancer who underwent screening mammography, 1994-2008

Characteristic	Study population for analysis of tumor characteristics at diagnosis			Study population for analysis of false-positive risk
	Screening interval			Screening interval
	1 year	2 years	3 years	1, 2, or 3 years
	Breast cancer[a,d] (n = 8,876) %[f]	Breast cancer[b,d] (n = 4,265) %[f]	Breast cancer[c,d] (n = 1,255) %[f]	No breast cancer[e] (n = 1,276,312) %[f]
Age, years				
40-49	16.7	23.3	30.3	36.1
50-74	83.3	76.7	69.7	63.9
Race/ethnicity				
White	84.3	80.8	79.6	76.7
Black	4.5	5.5	6.3	6.6
Hispanic	6.4	7.5	9.5	10.3
Asian/Pacific Islander	4.8	6.1	4.6	6.5
Breast density				
Almost entirely fat	3.3	3.5	4.4	8.3
Scattered fibroglandular densities	39.9	38.5	39.6	43.4
Heterogeneously dense	47.8	47.3	46.3	39.4
Extremely dense	8.9	10.6	9.7	8.9
Missing[g]	30.5	27.9	33.4	32.3
Body mass index, kg/m^2				
<25	48.4	45.3	47.4	48.3
25 to <30	31.9	29.6	30.3	29.2
≥30	19.7	25.1	22.3	22.5
Missing[g]	49.2	39.4	42.9	52.3
Postmenopausal	82.6	77.3	72.6	64.8
Missing[g]	14.4	15.8	22.2	19.7
Current hormone therapy	37.7	33.2	27.9	25.2
Missing[g]	15.8	16.4	17.5	19.9
First degree family history	23.4	19.1	17.6	12.5
Missing[g]	18.4	19.8	22.9	24.4

[a] Cancer diagnosed within 12 months after screening mammogram

[b] Cancer diagnosed within 24 months after screening mammogram

[c] Cancer diagnosed within 36 months after screening mammogram

[d] Data from the most recent screening mammogram before diagnosis

[e] Data from the woman's earliest screening mammogram in the Breast Cancer Surveillance Consortium

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[f] Percentage among nonmissings unless otherwise specified

[g] Percentage among all women

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Table 2

Breast tumor characteristics by race/ethnicity, age, and mammographic screening interval

		White			Black			Hispanic			Asian		
		Screening interval			Screening interval			Screening interval			Screening interval		
Age	**Tumor characteristic**	**1 year**	**2 years**	**3 years**	**1 year**	**2 years**	**3 years**	**1 year**	**2 years**	**3 years**	**1 year**	**2 years**	**3 years**
		***N* %**	***N* %**	***N* %**	***N* %**	***N* %**	***N* %**	***N* %**	***N* %**	***N* %**	***N* %**	***N* %**	***N* %**
40-49	All cancers (n = 2,998)	*1,288*	*828*	*313*	*68*	*59*	*23*	*103*	*83*	*43*	*97*	*76*	*17*
	Invasive (versus DCIS)	75.2	75.8	81.2	83.8	86.4	69.6	77.7	75.9	72.1	68.0	68.4	64.7
	Invasive only (n = 2,278)	*969*	*628*	*254*	*57*	*51*	*16*	*80*	*63*	*31*	*66*	*52*	*11*
	Late stage (IIB-IV)	22.2	25.1	20.8	27.8	25.5	21.4	19.5	25.8	41.9	12.1	25.5	27.3
	Large size (>20 mm)	29.5	32.7	32.1	47.3	37.5	42.9	36.5	32.2	46.7	21.5	33.3	20.0
	Lymph node positive	32.7	36.9	36.5	41.8	39.2	40.0	33.3	39.7	48.4	22.7	49.0	36.4
50-74	All cancers (n = 12,058)	*6,604*	*2763*	*736*	*341*	*183*	*61*	*474*	*240*	*81*	*343*	*191*	*41*
	Invasive (versus DCIS)	79.2	81.5	85.6	76.8	84.7	77.0	76.2	85.4	81.5	66.5	75.4	61.0
	Invasive only (n = 9,609)	*5233*	*2253*	*630*	*262*	*155*	*47*	*361*	*205*	*66*	*228*	*144*	*25*
	Late stage (IIB-IV)	16.7	16.6	14.9	18.3	15.2	22.2	16.5	24.4	26.2	12.8	14.0	24.0
	Large size (>20 mm)	23.2	24.5	28.1	27.0	27.7	40.0	25.4	34.7	36.5	23.0	22.4	28.0
	Lymph node positive	25.1	25.7	25.8	32.9	32.0	26.7	28.1	28.8	30.3	22.0	24.5	36.0

Abbreviation: DCIS, ductal carcinoma in situ

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Table 3

Odds ratios (95% confidence intervals) of adverse invasive breast cancer characteristics associated with mammographic screening interval by race/ethnicity and age, adjusted for age in years and Breast Cancer Surveillance Consortium registry

	White		Black		Hispanic		Asian	
	2 vs. 1 year	3 vs. 2 years	2 vs. 1 year	3 vs. 2 years	2 vs. 1 year	3 vs. 2 years	2 vs. 1 year	3 vs. 2 years
40-49 years								
Late stage (IIB-IV)	1.14 (0.89, 1.46)	0.78 (0.54, 1.11)	0.91 (0.37, 2.22)	0.77 (0.18, 3.35)	1.64 (0.71, 3.81)	1.79 (0.70, 4.60)	2.14 (0.76, 5.98)	1.57 (0.29, 8.49)
Large size (>20 mm)	1.14 (0.91, 1.43)	0.96 (0.70, 1.32)	0.67 (0.30, 1.51)	1.29 (0.37, 4.46)	0.92 (0.43, 1.95)	1.68 (0.66, 4.26)	1.92 (0.75, 4.89)	0.13 (0.01, 1.93)
Node positive	1.19 (0.95, 1.48)	0.97 (0.71, 1.32)	0.93 (0.42, 2.06)	0.93 (0.28, 3.12)	1.32 (0.64, 2.73)	1.35 (0.55, 3.33)	3.08 (1.33, 7.12)	1.01 (0.21, 4.78)
50-74 years								
Late stage (IIB-IV)	1.03 (0.89, 1.19)	0.83 (0.65, 1.07)	0.78 (0.44, 1.38)	1.56 (0.67, 3.66)	1.59 (1.03, 2.46)	1.17 (0.61, 2.26)	1.05 (0.54, 2.03)	2.15 (0.74, 6.22)
Large size (>20 mm)	1.12 (0.99, 1.27)	1.15 (0.93, 1.41)	1.11 (0.70, 1.77)	1.73 (0.85, 3.55)	1.60 (1.08, 2.37)	1.03 (0.56, 1.90)	0.84 (0.49, 1.45)	1.48 (0.55, 3.97)
Node positive	1.04 (0.92, 1.18)	0.98 (0.80, 1.21)	0.98 (0.63, 1.53)	0.74 (0.35, 1.59)	0.96 (0.65, 1.42)	1.16 (0.62, 2.15)	1.08 (0.64, 1.83)	1.79 (0.72, 4.49)

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Table 4

Percentage (95% confidence interval) of false-positive results at first mammography and percentage (95% confidence interval) of women with at least one false-positive result after 10 years of subsequent mammography by race/ethnicity, adjusted for Breast Cancer Surveillance Consortium registry.[a]

Result	Age	Screening interval	White	Black	Hispanic	Asian
False-positive recall						
	40-49	First mammography	16.3 (16.1, 16.6)	17.7 (16.9, 18.6)	15.0 (14.4, 15.7)	14.3 (13.6, 15.0)
		1 year	64.5 (63.5, 65.4)	64.7 (63.3, 66.0)	63.0 (61.8, 64.2)	56.1 (54.7, 57.6)
		2 years	41.1 (40.7, 41.6)	41.3 (40.5, 42.2)	39.9 (39.2, 40.6)	34.3 (33.4, 35.2)
		3 years	29.2 (28.8, 29.6)	29.4 (28.8, 30.0)	28.3 (27.8, 28.8)	24.0 (23.4, 24.5)
	50-74	First mammography	16.8 (16.4, 17.3)	16.4 (15.3, 17.5)	13.7 (12.9, 14.6)	12.2 (11.4, 13.2)
		1 year	55.2 (54.8, 55.7)	52.3 (51.4, 53.1)	52.4 (51.7, 53.1)	46.7 (45.8, 47.6)
		2 years	35.4 (35.0, 35.7)	33.0 (32.5, 33.6)	33.2 (32.7, 33.6)	28.9 (28.3, 29.5)
		3 years	24.8 (24.5, 25.2)	23.1 (22.6, 23.5)	23.2 (22.8, 23.5)	20.0 (19.6, 20.4)
False-positive biopsy recommendation						
	40-49	First mammography	2.3 (2.2, 2.4)	2.3 (2.2, 2.4)	2.3 (2.2, 2.4)	2.3 (2.2, 2.4)
		1 year	11.4 (10.5, 12.4)	13.8 (12.4, 15.3)	11.3 (10.2, 12.5)	8.6 (7.6, 9.7)
		2 years	5.9 (5.6, 6.2)	7.2 (6.7, 7.7)	5.8 (5.4, 6.3)	4.4 (4.0, 4.8)
		3 years	3.9 (3.7, 4.1)	4.7 (4.4, 5.0)	3.8 (3.6, 4.1)	2.9 (2.7, 3.1)
	50-74	First mammography	3.1 (2.9, 3.3)	3.5 (3.0, 4.1)	2.9 (2.5, 3.4)	2.7 (2.2, 3.3)
		1 year	9.7 (9.3, 10.1)	10.8 (10.1, 11.5)	9.6 (9.1, 10.2)	6.4 (5.9, 7.0)
		2 years	5.4 (5.2, 5.6)	6.0 (5.7, 6.3)	5.3 (5.1, 5.6)	3.5 (3.3, 3.8)
		3 years	3.7 (3.6, 3.9)	4.2 (4.0, 4.4)	3.7 (3.5, 3.9)	2.5 (2.3, 2.6)

[a]First mammography refers to examinations in women with no prior mammogram in the BCSC database or by self-report, and no indication of comparison films. Subsequent mammography refers to examinations performed after a first screening mammogram.