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A prospective assessment of racial/ethnic differences in future mammography behavior among women who had early mammography

Julie M. Kapp[1], **Rod Walker**[2], **Sebastien Haneuse**[2], and **Bonnie C. Yankaskas**[3]

[1]Department of Family and Community Medicine, University of Missouri, Columbia, MO

[2]Group Health Research Institute, Seattle, WA

[3]Department of Radiology, University of North Carolina at Chapel Hill, Chapel Hill, NC

Abstract

BACKGROUND—29% of women aged 30-39 report having had a mammogram though sensitivity and specificity are low. We investigate racial/ethnic differences in future mammography behavior among women who had a baseline screening mammogram prior to age 40.

METHODS—Using 1994-2008 data from the Breast Cancer Surveillance Consortium (BCSC), we identified 29,390 women ages 35-39 with a baseline screening mammogram. We followed this cohort for two outcomes: (1) future BCSC mammography between ages 40-45; and (2) among those, delay in screening mammography until ages 43-45 compared to 40-42. Using adjusted log-linear models, we estimated the relative risk (RR) of these outcomes by race/ethnicity, while also considering the impact of false positive/true negative (FP/TN) baseline mammography results on these outcomes.

RESULTS—Relative to non-Hispanic white women, Hispanic women had an increased risk of no future BCSC mammography (RR: 1.21, 95% confidence interval (CI): 1.13-1.30); Asian women had a decreased risk (RR: 0.67, 95% CI: 0.61-0.74). Women with a FP, compared to TN, had a decreased risk of no future BCSC mammography (RR: 0.89, 95% CI: 0.85-0.95). Among those with future BCSC screening mammography, African American women were more likely to delay the timing (RR: 1.26, 95% CI: 1.09-1.45). The interaction between race/ethnicity and FP/TN baseline results was not significant.

CONCLUSIONS—Race/ethnicity is differentially associated with future BCSC mammography and the timing of screening mammography after age 40.

IMPACT—These findings introduce the need for research that examines disparities in lifetime mammography use patterns from the initiation of mammography screening.

Keywords

mammography; false positive reactions; ethnic groups; health behavior; cohort studies

Corresponding Author/Reprint Requests: Julie M. Kapp, Deptartment of Family and Community Medicine, University of Missouri, MA306 Medical Sciences Bldg, 1 Hospital Drive, Columbia, MO 65212, kappj@health.missouri.edu.

INTRODUCTION

Guidelines for the age at which to begin breast cancer screening have evolved over the last few decades and have at times conflicted across major organizations. In 1989, the U.S. Preventive Services Task Force (USPSTF) recommended mammography for women beginning at age 50.(1) They discouraged “baseline” mammograms before 50; however, suggested it may be prudent to begin regular mammography earlier (e.g. age 35) for women at high risk because of family history.(1) In 1996, the USPSTF suggested insufficient evidence for or against mammography screening for women under age 50.(2) In 2002, their guidelines recommended mammography screening every 1-2 years beginning at age 40.(3) Most recently,(4) the USPSTF suggested that beginning regular, biennial screening mammography before 50 is an individual decision. In contrast, the American Cancer Society (ACS) guidelines have recommended a baseline mammogram for women between ages 35-39,(5) and since 1992, have recommended regular screening begin at age 40.(5,6)

Yet in 2005 when the age at which to begin routine screening was generally recommended as 40, one population-based study estimated 29% of U.S. women ages 30-39 reported having had a mammogram; this percentage was even higher among non-Hispanic African American (AA) women (34%).(7) Among women younger than 40 (which we refer to here as “younger women”) who had a mammogram, 74% were reported to be for screening purposes; of those, only 13% reported a family history.(8) Among AA women, 40% reported the age at their first mammogram as <40 years,(9) and AA women were more likely than white women to report multiple mammograms before age 40.(7)

In contrast, after age 40 AA and Asian women are less likely to receive adequate mammography screening(10). Racial/ethnic variation in mammography use patterns before and after age 40 may reflect different subgroups of women. Alternatively, it is as yet unknown whether racial/ethnic variation exists in longitudinal mammography use patterns when following a cohort of women between early and later mammography use.

One important consideration in addressing screening mammography for younger women is the implications of poor mammography performance. A recent study estimated that a population of 10,000 women ages 35-39 undergoing a first screening mammogram would produce 1,266 further work-ups, detect 16 cancers, and produce 1,250 false positive (FP) results.(11) A related study of women with first mammograms younger than 40 reported one FP result for every eight screening mammograms, and that AA women were more likely than white women to be recommended for additional workup.(8) In a sample of women of all ages who underwent mammography, only 80% of AA and 71% of Hispanic women reported being likely or very likely to continue screening mammography after receiving FP results, compared to 93% of white women;(12) however, responses in the latter study were based on hypothetical questions, and not actual screening behaviors. Reports of the impact of FP mammograms suggest an increase in patients’ anxiety or psychological difficulty, but not a decreased adherence to further screening.(13-18) However, a common limitation among these studies is that they did not examine the impact by race/ethnicity.

The data available to longitudinally examine the association between race/ethnicity and later (after age 40) mammography, among women with early (younger than age 40) mammography, while incorporating mammography type (screening versus diagnostic) and outcomes (e.g. FP results) is extremely limited. The National Cancer Institute’s Breast Cancer Surveillance Consortium(19) (BCSC) data are rich in their racial/ethnic diversity and ability to prospectively follow women over time. Using a defined cohort of women who had a first screening mammogram between ages 35-39 (referred to here as a “baseline mammogram”), our objective was to examine the relationship between race/ethnicity and

mammography use after age 40. Our primary hypothesis is that race/ethnicity will be differentially associated with future mammography use among women who had a baseline screening mammogram before age 40. Our secondary hypothesis is that these results will be modified by FP baseline mammography results.

METHODS

Data Sources

Data were pooled from the National Cancer Institute's Breast Cancer Surveillance Consortium (BCSC), a collaborative network of community-based mammography registries created for the purpose of assessing the delivery and quality of breast cancer mammography utilization and outcomes in the United States. The seven registries are located across the U.S. in North Carolina, Washington, New Hampshire, New Mexico, California, Colorado, and Vermont. A Statistical Coordinating Center (SCC) oversees the coordination, pooling, and cleaning of data from the seven sites. Each registry and the SCC have received Institutional Review Board (IRB) approval for either active or passive consenting processes or a waiver of consent to enroll participants, link data, and perform analytic studies. All procedures are Health Insurance Portability and Accountability Act (HIPAA) compliant and all registries and the SCC have received a Federal Certificate of Confidentiality and other protection for the identities of women, physicians, and facilities who are subjects of this research. The University of Missouri's Health Sciences IRB approved this study as exempt.

The BCSC data are collected prospectively at the time of each screening visit, from the patient, technologists and radiologists. Participating radiology practices gather information from women at each breast imaging visit via a patient history form, including: age; race; ethnicity; education; history of breast procedures; and personal and first degree family history of breast cancer. The radiologists and/or technologists record information on the imaging studies, including mammography indication (screening or diagnostic). Each registry annually links to a state tumor registry or regional Surveillance, Epidemiology, and End Results program that collects population-based cancer data; some registries also link to pathology databases. The BCSC registries are described in greater detail elsewhere.(19)

Study Sample

As noted earlier, in 2002 both the USPSTF and ACS were recommending mammography screening begin at age 40. Therefore, we identified 32,670 women ages 35-39 with early mammography, whose first mammogram was for screening and was captured in the BCSC data between the years 1994-2002 (see Figure 1). As our study required sufficient follow-up time to have the ability to observe these women returning to a BCSC facility for future mammography between ages 40-45, we chose years 1994-2002 in order to only include women who would have had the potential to turn age 45 before the end of our observation time in the BCSC data. The end of our observation time was based on mammography completeness dates for each of the BCSC registries, which was through 2008. Additional eligibility criteria for our analysis included no personal history of breast cancer, breast mastectomy, or breast augmentation.

Self-reported information was used to create mutually exclusive categories of race/ethnicity: non-Hispanic African American, non-Hispanic white, Asian, and Hispanic. For brevity, we refer to these as AA, white, Asian, and Hispanic. We excluded 3,205 (9.8%) women who were either missing self-reported race/ethnicity or reported a race/ethnicity not in the above four categories due to the difficulty in deriving a meaningful interpretation from this heterogeneous group. We additionally excluded 75 women who received a cancer diagnosis

within the year following their baseline screening examination. The final study sample consisted of 29,390 women.

Measurements and Definitions

The BCSC has previously addressed complex issues of variable definitions,(20,21) which we adopt here together with standard definitions based on the Breast Imaging Reporting and Data System® (BI-RADS).(22) We defined a screening mammogram as a mammography examination with bilateral routine views taken with no other radiologic breast imaging within the prior nine months, and where the radiologist or technologist indicated the mammogram was for screening purposes. Radiologists interpreted the screening mammograms according to the ACR BI-RADS coding system, assigning a 0 or 1-6 to each breast, and provided a recommendation for follow-up action. Based on the most severe assessment and the follow-up recommendations, we defined a positive assessment as BI-RADS category 4, 5, 0, or 3 with a recommendation for immediate follow-up. We defined a negative assessment as BI-RADS category 1, 2, or 3 with no recommendation for immediate follow-up. A woman was considered to have breast cancer if she was diagnosed with invasive carcinoma or ductal carcinoma in situ within the 12 months following the screening mammogram and before her next screening exam. For women who did not receive a breast cancer diagnosis, a screening mammogram was considered a TN if the radiologist provided a negative assessment, and a FP if the radiologist provided a positive assessment.(21)

For this study, we defined a “baseline” screening mammogram as a woman’s first screening mammogram between ages 35-39. To qualify as a baseline mammogram, the BCSC database could have no record of prior mammography, no indication of comparison films, and no self-report of prior mammography from the woman. We considered baseline mammography outcomes for our secondary hypothesis because health behaviors and perspectives would not be contaminated by previous mammography outcomes at that time.

Rural or urban status was based on a classification scheme using a woman’s reported zipcode at the time of her baseline mammogram, the standard Bureau of Census Urbanized Area and Urban Clusters definitions, and the 2000 Census work commuting information.(23)

We examined two outcomes by race/ethnicity. First, among the 29,390 women in our study sample, we examined whether or not a woman returned to one of the BCSC facilities for any type of mammogram (screening, diagnostic, or unknown) between ages 40-45 (defined as “future BCSC mammography”) (Figure 1). Second, among the 20,192 women who had future BCSC mammography, we assessed delay in the timing of the first “future screening mammogram” between ages 40-45. This was not necessarily her next screening mammogram after baseline; she may have had additional mammography between baseline and age 40 (see Statistical Analyses). We defined a delay as having a routine screening mammogram between ages 43-45 compared to 40-42, given the recommended interval of 1-2 years. Women whose first mammogram between ages 40-45 was for diagnostic or unknown purposes were excluded from this second outcome, as were 78 women who developed breast cancer between baseline and their first age 40-45 mammogram, leaving a total of 18,047 women for the second analysis.

Statistical Analyses

We characterize our sample at the time of the baseline mammogram using frequencies and percentages, overall and by whether the women had future BCSC mammography between ages 40-45. We further describe the sample of women with future BCSC mammography, by race/ethnicity and FP/TN baseline results.

We fit a series of log-linear models to estimate the relative risk (RR) of each of our two outcomes with race/ethnicity and the baseline mammogram result (FP or TN). Next, we added, in sequence, each of the following covariables as potential mediators to observe any changes in our RR's of interest: mammography registry, age at baseline screening mammogram, rural/urban residential status at the time of baseline screening, and additional screening mammography prior to age 40.

We examined education and first-degree family history (yes versus other) as potential mediating factors; however, given the large percentage of missing data for those covariables, we considered this a sensitivity analysis (and reported it as such) and thus did not include those terms in the final presented model.

We considered effect modification between race/ethnicity and outcome of the baseline mammogram (FP or TN) by including interaction terms into each of the log-linear models. All analyses were run using SAS V9.2 (Cary, NC).

RESULTS

Overall, 22.1% of the 29,390 women in our study sample were non-white (Table 1). The largest proportion (44.6%) of our study sample was college educated, most (70.1%) resided in an urban area, and 45.2% had a baseline screening mammogram between ages 35-37 (mean age at baseline=37.5). Only 9.9% reported a first-degree family history of breast cancer. At this baseline screen, 11.4% had a FP result; 21.2% had more than one mammogram before age 40 [subjects with additional screening beyond baseline (n=3,712) or diagnostic beyond baseline (n=3,079) but before 40].

Overall, 31.3% did not have future BCSC mammography between ages 40-45. Compared to women who did, women who did not have future BCSC mammography were more likely at their baseline mammogram to be: younger, AA, live in an urban area, and have a TN baseline result. Women who did not have future BCSC mammography were more likely to have only had one mammogram (their baseline mammogram) at a BCSC facility prior to age 40. Conversely, a greater percentage of women with future BCSC mammography between ages 40-45 tended to be Asian and college educated.

Characteristics of the women with future BCSC mammography between ages 40-45 are presented in Table 2. Overall, there was a mean of 40.6 months between the baseline and follow up mammograms, with 13.1% of the women having had their first post-40 follow up screening mammogram delayed, i.e. ages 43-45; this was higher among AA (15.1%) and Hispanic (17.2%) women compared to white (12.6%) and Asian (13.3%) women. AA and Hispanic women in this sample were much less likely to be college graduates. Hispanic women were more likely to be older at baseline (ages 38-39) and less likely to have additional screens prior to age 40. AA women were more likely to have a breast cancer family history. Asian women were much more likely to reside in Urban areas, be older at baseline, and were much less likely to have additional screens prior to age 40. When considering baseline mammography results, the proportion of women having had their first post-40 follow up screening mammogram delayed was lower among those with a FP (10.6%) compared to TN (13.4%). Women with a FP were more likely to have a breast cancer family history and were more likely to have undergone additional screening between baseline and age 40. Overall, 25.1% of the sample had two or more mammograms (of any type) before age 40; this was significantly higher for women with a baseline FP (68.1%) as would be expected.

In our log-linear models for both not having future BCSC mammography between ages 40-45, and delayed age among those who did, the interactions between race/ethnicity and

baseline mammography outcome were not significant (p>0.1 for all models). Therefore, we report the main effects models in Table 3, adjusting for mammography registry, age at baseline screening mammogram, rural/urban residential status at the time of baseline screening, and additional screening mammography prior to age 40.

After adjusting for the above covariables, Hispanic women, compared to white women, were at increased risk (RR=1.21; 95% CI: 1.13-1.30) of not having future BCSC mammography. The risk was significantly decreased for Asian women (RR=0.67; 95% CI: 0.61-0.74), and there was no significant difference for AA compared to white women (RR=1.04; 95% CI: 0.98-1.09). The risk of not having future BCSC mammography was significantly decreased for having a baseline mammography result of FP compared to TN (RR=0.89; 95% CI: 0.85-0.95). The point estimates in our models did not vary substantially with the addition of each potentially mediating covariable; with the exception of the model with education. Adding education to our main model moderately attenuated the RRs comparing Asian and Hispanics to white women [(RR: 0.79, 95% CI: 0.70-0.89) for Asian women; (RR: 1.17, 95% CI: 1.06-1.28) for Hispanic women].

Among those having future BCSC mammography specifically for screening mammography between ages 40-45, we modeled the risk of delay in the timing of the first future screening mammogram between ages 40-45. After adjusting for covariates, the risk of having delayed future screening was not significantly different for Asian or Hispanic women compared to white women. AA compared to white women had a significantly increased risk of delay (ages 43-45 compared to 40-42) in the age of their future screening mammogram (RR=1.26; 95% CI: 1.09-1.45). There was no significant difference found for a FP compared to TN baseline result (RR: 0.97, 95% CI: 0.85-1.10). The point estimates in our model of delay in the timing of future screening did not vary substantially with the addition of each covariable, with the exception of the model with education [(RR: 0.79, 95% CI: 0.66-0.96) for Asian women; (RR: 1.03, 95% CI: 0.83-1.26) for Hispanic women].

DISCUSSION

Our study has important findings related to racial/ethnic disparities among women who begin mammography screening before age 40. About a third of our sample did not return to a BCSC facility for mammography between ages 40-45. Risk of not having future BCSC mammography was greater among Hispanic women, while Asian women were more likely to return to a BCSC facility.

Others have reported that non-white group members are less likely than non-Hispanic whites to have a regular site of care,(24) and certain Latino subgroups are less likely to have a usual source of care than non-Latino whites.(25) Women with both a usual place of care and usual provider have almost five times the odds of having had a mammogram in the past year compared with women who had no usual place;(26) not having a physician recommendation is one of the strongest reasons women do not undergo testing.(27) Therefore, it is possible that the Hispanic women in our sample were less likely to have a usual provider, although we cannot determine that directly from these data. As our data only include women who have had a mammogram, this suggests some means of access to health care. Further investigation of access, such as examination of insurance information, is unfortunately limited and inconsistent in these data. A post-hoc examination of our data revealed that of the 9,198 women who did not have future BCSC mammography, 4,692 (51.0%) of these women had their baseline mammogram at a facility that stopped participating in data collection efforts prior to the woman turning age 45. This did not appear to vary differentially by race/ethnicity (Hispanic 52.5%, white 51.9%, AA 53.7%) except for Asian women (27.1%). We note, too, that women within BCSC registries can attend multiple

facilities, so the closing of one facility does not necessarily mean the woman is lost to future observation within a BCSC registry. We examined this issue by assigning mammography facilities to “clusters”, i.e. groups of facilities that appear to cover similar catchment areas. To do this we first identified women in the broader BCSC data who visit multiple different facilities for screening mammography over a relatively short window of time (5 years). We then assumed that multiple facilities being attended by a single woman likely cover overlapping areas and thus might reasonably be able to serve common sets of women. Considering ‘clusters’ of facilities that a woman may reasonably attend within each of the given BCSC registries, only approximately 2% of the aforementioned 4,692 women had their cluster of facilities end participation prior to their turning age 45.

AA race/ethnicity was associated with an increased risk of delayed age at first routine screening mammography between ages 40-45. That we did not find an interaction in our model suggests there is no significant racial/ethnic variability in the effect of the baseline result on the timing of future mammography among women who return to a BCSC facility for future screening between ages 40-45. We cannot know from these data *why* AA women were at greater risk for a delay in the age of their future mammogram. However, it is important to note the presence of such disparities so early in the screening lifetime. In women 40 and older, the proportion and rates of advanced-stage cancer are similar across racial and ethnic groups after accounting for variations in mammography screening.(10) Improved adherence to recommended screening intervals may reduce the prevalence of advanced-stage disease and resulting mortality rates.(10) Therefore, these findings generate important avenues for future disparities work, including: examination of life-long mammography use patterns; whether delays in mammography timing increase between screening intervals; and the implications of an individualized, tailored approach to decision-making at mammography initiation in consistency of care.

While ours is the first known study to examine the impact of racial/ethnic and baseline result differences on subsequent mammography use, these findings should be considered in the context of limitations. First, of the 31% who did not have future BCSC mammography between ages 40-45, we do not know whether those women had a mammogram outside our data capture area or if they simply did not have future mammography. Earlier in the discussion we noted that approximately half of those who did not have future BCSC mammography had their baseline mammogram at a facility that stopped participating in data collection efforts prior to the woman turning age 45. Even though those women had opportunity to attend other facilities within their registries, this does not preclude the possibility that the association seen for our first outcome of interest might be explained by differences across racial/ethnic groups in women’s interest or ability in attending different BCSC mammography facilities. We recognize this as an important limitation of our study. To provide some estimate of migration, if we examine the 20,192 women in our sample who did have future BCSC mammography, 74.9% were seen for a mammogram after age 40 at the same facility as their baseline mammogram; this percentage varied minimally across racial/ethnic groups and FP/TN results (72.2-75.8%) with the exception of Hispanic women (64.9%). Further research is needed to understand whether Hispanic women tend to have different patient behaviors, live in more isolated areas and therefore depend on certain clinics, or are more transient. Second, while we did not find a significant interaction between race/ethnicity and baseline mammography results in either of our models, the possibility of inadequate statistical power to detect these interactions should be considered. While these data are among the best available for this purpose, by nature of the research question the cell sizes become rather modest when examining these interactions, particularly among the non-white FP groups. Related to this point, women who had a baseline mammogram at age 39 who had a diagnostic mammogram after age 40 would not have been included in our second analysis of delay in timing of future screening, and so may be underrepresented. We

encourage additional work to confirm a non-significant interaction between race/ethnicity and baseline results on future mammography behaviors. Third, because of the percentage of missing data for education, we had limited ability to interpret its potential role as a mediator on our main associations, i.e. where, with the addition of education in the model, Asian women were at significantly decreased risk of delaying the age of their future screening mammogram. Fourth, to adequately address the research question of the impact of baseline mammography outcomes on long-term mammography use would require a defined cohort followed for decades, and include multifaceted, detailed information on physician recommendations, women's screening preferences, migration, and risk. In the absence of this, these data are perhaps the closest proxy, being rich in their ability to: describe mammography use by race/ethnicity, distinguish screening from diagnostic mammography, use clinical records as opposed to strictly self-report, and then follow women longitudinally.

CONCLUSIONS

Using the 1994-2008 Breast Cancer Surveillance Consortium data, we found that race/ethnicity is differentially associated with having future BCSC mammography and the timing of future mammography screening after age 40. Risk of not returning to one of our facilities for mammography was greater among Hispanic women than non-Hispanic whites. Among those who returned, African American race was associated with an increased risk of delayed age at first screening mammography between ages 40-45 compared to non-Hispanic whites. Neither of these results was modified by the baseline mammography result of FP/TN. These findings introduce the need for research that examines disparities in lifetime mammography use patterns from the initiation of mammography screening and what factors impact long-term mammography use.

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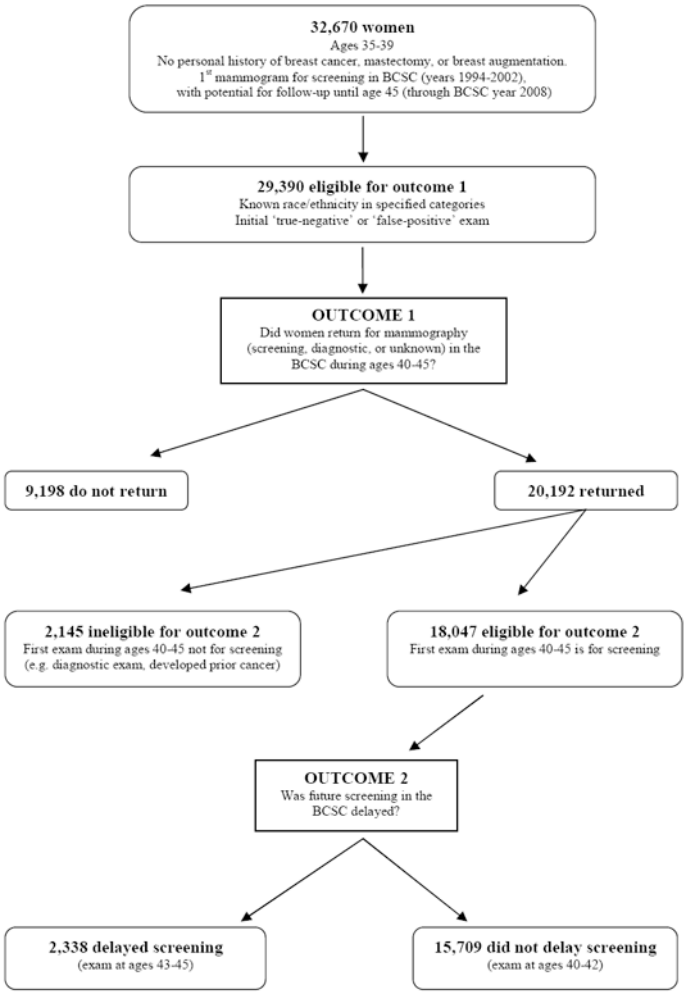

Figure 1.
Flow chart of study population, Breast Cancer Surveillance Consortium (BCSC) Data

Table 1

Characteristics of study participants at their baseline screening mammogram ages 35-39, overall and by whether they returned to a BCSC facility for future mammography ages 40-45*

	Overall		Had future mammography ages 40-45 as captured in the BCSC		Did not have future mammography ages 40-45 as captured in the BCSC	
	n	%†	n	%	n	%
TOTAL	29,390		20,192		9,198	
Age at baseline mammogram						
35	3,294	11.2	2,095	10.4	1,199	13.0
36	4,291	14.6	2,701	13.4	1,590	17.3
37	5,712	19.4	3,835	19.0	1,877	20.4
38	6,737	22.9	4,751	23.5	1,986	21.6
39	9,356	31.8	6,810	33.7	2,546	27.7
Race / ethnicity						
white	22,888	77.9	15,794	78.2	7,094	77.1
AA	2,609	8.9	1,585	7.8	1,024	11.1
Asian	2,002	6.8	1,581	7.8	421	4.6
Hispanic	1,891	6.4	1,232	6.1	659	7.2
Education level						
< High school graduate	1,057	4.5	681	4.1	376	5.7
High school graduate/GED	5,307	22.8	3,759	22.5	1,548	23.5
Some college/tech. school	6,526	28.0	4,559	27.3	1,967	29.9
College graduate	10,388	44.6	7,700	46.1	2,688	40.9
Unknown	6,112		3,493		2,619	
Rural / urban status						
Urban Focused	20,461	70.1	13,296	66.3	7,165	78.7
Large Rural	4,178	14.3	3,232	16.1	946	10.4
Small/Isolated Rural	4,536	15.6	3,538	17.7	998	11.0
Unknown	215		126		89	

	Overall		Had future mammography ages 40-45 as captured in the BCSC		Did not have future mammography ages 40-45 as captured in the BCSC	
	n	%†	n	%	n	%
First-degree family history of breast cancer						
No	18,294	90.1	13,200	90.2	5,094	89.8
Yes	2,009	9.9	1,430	9.8	579	10.2
Unknown	9,087		5,562		3,525	
Baseline mammography outcome						
False Positive	3,357	11.4	2,445	12.1	912	9.9
True Negative	26,033	88.6	17,747	87.9	8,286	90.1
Additional screening prior to age 40						
No	25,678	87.4	17,062	84.5	8,616	93.7
Yes	3,712	12.6	3,130	15.5	582	6.3
Number of mammograms (any type) prior to age 40						
Baseline mammogram only	23,146	78.8	15,124	74.9	8,022	87.2
2	4,411	15.0	3,522	17.4	889	9.7
3+	1,833	6.2	1,546	7.7	287	3.1

*BCSC: Breast Cancer Surveillance Consortium. Data years: 1994-2008

†Column percentages are calculated among the non-missing values

Table 2

Characteristics of 20,192 women in our study sample* with follow-up, by race/ethnicity and false positive or true negative baseline mammography results

	Total 20,192		White 15,794		AA 1,585		Asian 1,581		Hispanic 1,232	
	n	%†	n	%	n	%	n	%	n	%
FP	2,445	12.1	1,955	12.4	201	12.7	128	8.1	161	13.1
TN	17,747	87.9	13,839	87.6	1,384	87.3	1,453	91.9	1,071	86.9
Mean (SD) months between baseline and future mammogram	40.6 (20.5)		40.8 (20.6)		41.8 (21.1)		37.9 (18.9)		40.2 (20.9)	
Age at first (baseline) mammogram										
35	2,095	10.4	1,750	11.1	171	10.8	96	6.1	78	6.3
36	2,701	13.4	2,168	13.7	213	13.4	181	11.4	139	11.3
37	3,835	19.0	3,027	19.2	302	19.1	273	17.3	233	18.9
38	4,751	23.5	3,686	23.3	379	23.9	379	24.0	307	24.9
39	6,810	33.7	5,163	32.7	520	32.8	652	41.2	475	38.6
Education level										
< High school graduate	681	4.1	334	2.5	105	8.5	156	11.4	86	13.5
High school graduate/GED	3,759	22.5	2,958	22.0	374	30.1	272	19.9	155	24.4
Some college/tech. school	4,559	27.3	3,693	27.4	382	30.8	294	21.5	190	29.9
College graduate	7,700	46.1	6,470	48.1	381	30.7	644	47.1	205	32.2
Unknown	3,493		2,339		343		215		596	
First-degree family history of breast cancer										
No	13,200	90.2	10,516	90.0	337	87.8	1,309	93.0	1,038	90.2
Yes	1,430	9.8	1,171	10.0	47	12.2	99	7.0	113	9.8
Unknown	5,562		4,107		1,201		173		81	
Rural / urban status										
Urban Focused	13,296	66.3	9,592	61.1	1,131	71.7	1,528	97.8	1,045	85.7
Large Rural	3,232	16.1	2,900	18.5	212	13.4	19	1.2	101	8.3
Small / Isolated Rural	3,538	17.7	3,216	20.5	234	14.8	15	1.0	73	6.0
Unknown	126		86		8		19		13	

	Total 20,192		White 15,794		AA 1,585		Asian 1,581		Hispanic 1,232	
	n	%†	n	%	n	%	n	%	n	%
Additional screening prior to age 40										
No	17,062	84.5	13,252	83.9	1,336	84.3	1,395	88.2	1,079	87.6
Yes	3,130	15.5	2,542	16.1	249	15.7	186	11.8	153	12.4
Number of mammograms (any type) prior to age 40										
Baseline	15,124	74.9	11,706	74.1	1,160	73.2	1,297	82.0	961	78.0
2	3,522	17.4	2,826	17.9	298	18.8	204	12.9	194	15.7
3+	1,546	7.7	1,262	8.0	127	8.0	80	5.1	77	6.3

*Study sample defined as women who had a baseline screening mammogram ages 35-39 in the Breast Cancer Surveillance Consortium data in years 1994-2002 and followed to ages 40-45 at the time of their first post-40 mammogram

†Percentages are calculated among the non-missing values.

Table 3

Log-Linear Model to Estimate the Association of Not Returning for Future Mammography and Age of Future Screening Mammogram between 40-45

	Not Returning for Future Mammography RR (95% CI)*,†,‡	**Delayed Age of Future Mammography RR (95% CI)*,†,§**
Race/ethnicity		
NH AA	1.04 (0.98, 1.09)	**1.26 (1.09, 1.45)**
Asian	**0.67 (0.61, 0.74)**	0.92 (0.78, 1.09)
Hispanic	**1.21 (1.13, 1.30)**	1.17 (1.00, 1.36)
NH white	Referent	Referent
Outcome of baseline mammogram		
FP	**0.89 (0.85, 0.95)**	0.97 (0.85, 1.10)
TN	Referent	Referent
Model n	29,175	17,935

*RR: relative risk; CI: confidence interval; NH: non-Hispanic; AA: African American

†Adjusted for mammography registry site, age at baseline screening mammogram ages 35-39, rural/urban status at baseline, and whether additional screening occurred before age 40

‡Defined as not having a mammogram, compared to having one, captured in the BCSC data between ages 40-45, including screening, diagnostic, or unknown mammograms

§Defined as the first future screening mammogram between ages 40-45 among women who returned to a BCSC facility for mammography; ages 43-45 compared to 40-42