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Are there racial/ethnic disparities among women younger than 40 undergoing mammography?

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Abstract

While the probability of a woman developing invasive breast cancer at age <40 is low (<1%), mammography use reported among younger women (age <40) is substantial, and varies by race/ethnicity. Little detail is known about mammography use among women aged <40, particularly by race/ethnicity. We describe racial/ethnic differences in: (1) mammography indication after considering underlying risk factors (breast symptoms and family history); (2) follow-up recommendations, and (3) mammography outcomes for first mammograms in women aged <40. These 1996–2005 Breast Cancer Surveillance Consortium data are prospectively pooled from seven U.S. mammography registries. Our community-based sample included 99,615 women aged 18–39 who self-reported race/ethnicity and presented for a first mammogram (screening or diagnostic) with no history of breast cancer. Multivariable analyses controlled for registry site, age, family history of breast cancer, symptoms, and exam year. Overall, 73.6% of the women in our sample were seen for a screening mammogram. Following screening mammography, African American (AA) women were more likely than white women to be recommended for additional workup [relative risk (RR): 1.15 (95% CI: 1.07–1.23)]. Following diagnostic mammography, AA [RR: 1.30 (95% CI: 1.17–1.44)] and Asian [RR: 1.44 (95% CI: 1.26–1.64)] women were more likely to be recommended for biopsy, fine-needle aspiration, or surgical consultation. Depending on race/ethnicity, and considering the rate of true positive to total first screening mammograms of younger women, a women has a likelihood of a true positive of 1 in 363–1,122; she has a likelihood of a false positive of 1 in 7–10. This study of community-based practice found racial/ethnic variability in mammography indication, recommendations, and outcomes among women undergoing first mammography before 40. These findings highlight important areas for future research to understand the motivating factors for these practice patterns and the implications of early mammography use.

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Keywords

Mammography; Breast neoplasms; Risk factors; Health services accessibility; Healthcare disparities

Introduction

Breast cancers that occur in women aged less than 40 ("younger women") have poorer prognostic characteristics [1], higher recurrence rates and higher relative mortality than women ≥40 [2]. Younger women and African American (AA) women are more likely to have tumors that are triple negative (for receptors for estrogen, progesterone, and human epidermal growth factor 2), a distinct molecular tumor subtype, basal-like, and high grade [3]. Among younger women, AA women have a higher age-specific breast cancer incidence than white women in the age range somewhere between 35 [4] and 40 [5,6], beyond which white women have higher breast cancer incidence [4–6]. Hispanic, Asian, and Pacific Islander women tend to have lower incidence rates of breast cancer than white women [6].

Although the probability of a woman aged <40 developing invasive breast cancer is low (<1%), the use of mammography among younger women is reported to be substantial, and varies by race/ethnicity [7]. According to a population-based study, 34% of non-Hispanic (NH) AA women, 30% of NH white women, and 22% of Hispanic women aged 30–39 self-reported ever having had a mammogram [8]. In another sample, 40% of AA women self-reported the age of their first mammogram as <40 [9]. Even among younger women estimated to be at average risk, AA women had a greater odds of self-reporting multiple mammograms compared to white women [8]. Further, once younger women begin mammography, they may likely be recommended to continue mammography, irrespective of risk factors [10]. Yet the continuation of mammography recommendations may not mean continued adherence to recommended intervals. Younger AA women were significantly more likely to self-report having a mammogram than white women until age 34 [11]; however, among women ≥40, AA and Asian women are less likely to receive adequate mammography screening [12].

Our knowledge from the literature of mammography use in younger women by race/ethnicity has relied heavily on self-reported data, and often fails to distinguish screening from diagnostic indications. This article is the first to prospectively describe mammography use in younger women by race/ethnicity; specifically: (1) mammography indication after considering underlying risk factors (breast symptoms and family history); (2) follow-up recommendations after each indication, and (3) mammography outcomes. We use the National Cancer Institute's (NCI) Breast Cancer Surveillance Consortium [13] (BCSC) data which are rich in their prospective design, racial/ethnic diversity, description of breast symptoms, large sample size, and ability to distinguish mammography indications (screening and diagnostic). Describing first mammograms in younger women by race and ethnicity is a step toward understanding patterns of mammography use in younger women, the motivations for this use, and ultimately the implications of very early mammography.

Methods

Data sources

The pooled BCSC data used in this study are drawn from a collaborative network of mammography registries in North Carolina, Washington, New Hampshire, New Mexico, California, Colorado, and Vermont. The BCSC was created to assess the performance characteristics, delivery, and quality of breast cancer mammography utilization and outcomes across the United States [13,14]. A Statistical Coordinating Center (SCC) oversees the coordination, pooling, and cleaning of data from the registry sites. Each registry and the SCC

receives ongoing IRB approval for either active or passive consenting processes or a waiver of consent to enroll participants, link data, and perform analytic studies. All the procedures are Health Insurance Portability and Accountability Act-compliant, and all the registries and the SCC have received a US Public Health Service 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 Institutional Review Board approved this study as exempt.

Registry overview

The BCSC registries are described in greater detail elsewhere [13]. In brief, the participating radiology practices prospectively gather information from women at each visit for breast imaging using a self-administered patient survey. The type of information collected by site includes: date of birth; race; ethnicity; education; history of breast procedures; personal and first-degree family history of breast cancer; and breast symptoms. The radiologists and/or technologists record information on the imaging studies including mammography indication (screening or diagnostic); Breast Imaging Reporting and Data System® (BI-RADS) [15] breast density, imaging assessments and recommendations for follow-up; prior mammography; and use of same-day ultrasound. Each registry annually links to a state tumor registry or regional Surveillance, Epidemiology, and End Results program that collects population-based cancer data; some also link to pathology databases.

Subjects

We initially identified 114,317 women aged 18–39 having had a first mammogram during 1996–2005 and with no personal history of breast cancer. We excluded 1,403 (1.2%) mammograms with unknown indication. We categorized race/ethnicity into mutually exclusive categories of non-Hispanic AA, non-Hispanic white, Asian, and Hispanic. For brevity, we will refer to these categories as AA, white, Asian, and Hispanic. We excluded 11,151 (9.9%) women missing information of self-reported race or ethnicity, and 2,148 (1.9%) women reporting a race/ethnicity not falling in any of the above categories, as the relatively small sample size precluded further analyses. Thus, our final sample overall consisted of 99,615 women.

Measurements and definitions

We used standard BCSC definitions for classifying type of mammogram [13]. A routine-view, bilateral mammography examination indicated for screening was considered a screening mammogram, i.e., performed to detect unsuspected breast cancer in asymptomatic women [16]. A mammogram indication for the evaluation of a breast problem was considered a diagnostic mammogram, i.e., appropriate for a specific focus of clinical concern or when direct involvement of the radiologist is required [16]. If the radiology report indicated a screening mammogram, but the woman self-reported symptoms on the patient survey, then we a priori chose to retain the screening classification to be consistent with community-based practice.

Patient-reported breast symptoms were categorized as the presence of a lump, discharge, pain, symptoms not otherwise specified (NOS), or no symptoms. Patients could report more than one symptom. BI-RADS recommendations for follow-up were classified as normal- or short-interval; or "additional workup" [defined here as additional imaging; clinical exam; biopsy, fine-needle aspiration (FNA) or surgical consultation; or other workup NOS]. For screening mammography, the recommendation based on the initial screening views was used. For diagnostic mammography, the recommendation was based on the end of diagnostic workup. For descriptive analyses, we divided age into two groups, 18–34 and 35–39, based on historical ACS recommendations for a baseline mammogram [17].

Statistical analysis

We describe the distribution of patient characteristics and mammography outcomes in this sample by race/ethnicity separately for diagnostic and screening mammograms. The primary aims of this article are descriptive and hypothesis generating, with formal tests of significance primarily limited to a priori-specified hypotheses regarding racial/ethnic differences in the follow-up recommendations of screening and diagnostic mammography.

In order to identify racial/ethnic differences in the follow-up recommendations, we modeled recommendations separately for each mammography indication, adjusting for registry site, age (using a cubic b-spline with three knots to allow flexibility in adjusting for the age association), examination year, first-degree family history of breast cancer, and the presence of symptoms. We a priori chose to exclude breast density from the multivariable models due to missing data; this was included post-hoc. We obtained estimates via estimating equations, with standard errors calculated using the robust "sandwich estimator" [18] to produce consistent estimates of the covariance matrix and, thus, provide valid inference. For screening exams, we used a log-linear model to compute the relative risk of an initial recommendation for additional workup between the racial and ethnic groups, compared with normal- or short-interval follow-up. For diagnostic examinations, we calculated the relative risk of a final recommendation for "invasive workup" (biopsy, FNA, or surgical consultation) compared with normal- or short-interval follow-up; we excluded recommendations for additional imaging, clinical exam, or other workup NOS. We tested for an interaction between race and ethnicity and both symptom types (lump/symptoms other than lump/none) and presence of symptoms.

Standard definitions for true positive (TP), false positive (FP), true negative (TN), and false negative (FN) were calculated using the 12-month follow-up period [19]. All the analyses were run using SAS V9.1 (Cary, NC).

Results

Our sample included 73,353 (73.6%) women seen for a first screening mammogram and 26,262 (26.4%) for a first diagnostic mammogram; the majority of first mammograms were for screening across all racial/ethnic groups (69% for AA, 71% for Hispanic, 74% for white, and 81% for Asian women). Overall, the women who first underwent screening mammography tended to be older (aged 35–39), college educated, and reported a first-degree family history of breast cancer, compared to the women who first underwent diagnostic mammography.

First screening mammograms

African American and Hispanic women were more likely to be <35 years and less frequently reported a college degree than white and Asian women (Table 1). AA women were least likely to report a family history of breast cancer.

Overall, 11.3% of women undergoing a first screening mammogram reported symptoms, most commonly a lump (5.3%). AA and Hispanic women reported symptoms more frequently than did white and Asian women. Asian women were much more likely to be classified with extremely dense breasts than other women.

Recommendations for additional workup ranged from 10.8% for Asian to 15.7% for AA women. There was no interaction between race and ethnicity, or presence or type of symptoms for the recommendations models for screening mammograms, and so only the main-effects models are shown (Table 3). After a first screening mammogram, AA women were more likely than white women to have an initial recommendation for additional workup compared to normal- or short-interval follow-up [relative risk: 1.15 (95% CI: 1.07–1.23)]. Results remained significant after post-hoc inclusion of breast density in the model.

Over a 10-year period, 152 (<1%) of the women in our study were diagnosed with breast cancer after a first screening mammogram, 26% of which were ductal carcinoma in situ. The percent FP reflect variability across racial/ethnic groups, ranging from 10.4 to 14.1% (Table 4). Considering the rate of TP to total first screening mammograms of younger women, a woman has a likelihood of true positive of 1 in 363–1,122, depending on her race/ethnicity; she has a likelihood of a FP of 1 in 7–10.

First diagnostic mammograms

African American and Hispanic women were less likely to report a college degree at the first diagnostic mammogram than white and Asian women (Table 2). White and Hispanic women reported a breast cancer family history more frequently than AA and Asian women.

Overall, 91.0% of the women reported symptoms. White women were more likely (71.8%) than other women (57.7–63.6%) to report a lump; Asian women were less likely to report any symptoms (77.4 vs. 89.9–91.9%). Asian women were much more likely to be classified with extremely dense breasts than other women.

Recommendations for invasive workup ranged from 11.8% for white and Hispanic women to 20.2% for Asian women. There was no interaction between race and ethnicity, or presence, or type of symptoms for the recommendations models for diagnostic mammograms, and so only the main-effects models are shown (Table 3). After a first diagnostic mammogram, Asian [relative risk: 1.44 (95% CI: 1.26–1.64)] and AA [relative risk: 1.30 (95% CI: 1.17–1.44)] women were more likely than white women to be recommended for invasive workup. Results remained significant after post-hoc inclusion of breast density in the model.

For first diagnostic mammograms of younger women, the overall TP was 1.5%, and slightly higher for AA women at 2.3% (Table 4). The percent FP was substantively higher for Asian women (18.2%) than other women (8.7–11.3%).

Discussion

Ours is the first study to prospectively describe mammography use in women younger than 40 by race/ethnicity. We interpret our results in the context of the literature, and formulate hypotheses for future research based on our findings.

First screening mammograms

In our study, AA women are more likely to be recommended for further testing with no clinically significant difference in TP results. This is consistent with a finding for women ≥40, that a greater percentage of AA women than white women were recommended for biopsy after a positive screening mammogram [20]. In our study, AA women have a TP to total screening mammography rate of 1 in 363, about twice the rate as white women, and a FP rate of 1 in 7. While our FP results did not vary substantially by race/ethnicity, their impact might. Among AA women ≥40, abnormal or inconclusive results may be less effectively communicated than normal results [21]. 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 [22]. Women who begin mammography screening prior to 40 face potential harms from these first exams, but also from the cumulative risk of FP results from ongoing regular mammography [23,24]. Therefore, future research should examine whether early mammography use contributes to a differential impact on mammography use after 40 by race/ethnicity given potential variation in the impact of FP results and recommendations for additional invasive testing.

Overall, 74% of these first mammograms were for screening purposes. Most women in our sample seen for a first mammogram<40 had normal mammograms and were recommended for normal interval follow-up. In addition to the potential harms associated with FP results, other important harms to be considered in screening younger women include an increase in radiation exposure. One study estimated the risk of radiation-induced breast cancer from early mammography screening, finding no net benefit from annual mammography screening at ages 25–29, zero or small benefit at ages 30–34, and some benefit at ≥35 for BRCA mutation carriers [25]. Another study estimated that a decade of annual screening mammography before age 40 for *all women* would result in a net increase in radiation-induced breast cancer deaths [26].

First diagnostic mammograms

In diagnostic mammograms, AA and Asian women are having 4.8–8.1% more recommendations for invasive workup than white and Hispanic women, with an absolute difference of a TP of <1%. Fibroadenomas are more common in younger AA women [27, 28]. Asian women are more likely to have extremely dense breasts. That women with dense breasts tend to have lower mammography specificity [2] may partly explain why Asian women in particular had a much higher percentage of diagnostic FP. Our overall diagnostic FP results of 9.6% are twice that of the 4.9% for women aged<40 in another study [29], which may be explained by the disparity in sample selections. The above-cited study sample included radiologists from three mammography registries who responded to a survey, while our study sample was derived from the records of women seen for first mammograms among seven registries.

Women with breast problems

In our study, 91% of women at diagnostic and 11% at screening mammograms reported symptoms. As breast problems at a screening mammogram are contrary to standard definitions, we conducted a post-hoc analysis to examine racial/ethnic differences in mammography indication (diagnostic compared to screening), adjusting for registry site, age (using a cubic b-spline with 3 knots), examination year, and first-degree family history of breast cancer (yes/no/unknown). We fitted a single model for indication, and included an interaction term for race/ethnicity and the presence of symptoms (yes/no), which was significant ($P < 0.001$). Therefore, we report the model results stratified by the presence of symptoms. We later examined the stratified model with adjustment for education; this did not substantively alter the results.

Among the women reporting symptoms, minority women were slightly less likely than white women to have a diagnostic rather than screening indication [Hispanic: relative risk (RR) = 0.94 (95% CI: 0.92–0.97); Asian: RR = 0.95 (95% CI: 0.91–0.99); and AA: RR = 0.96 (95% CI: 0.94–0.98)]. Women who report symptoms at a screening mammogram may have different patterns of mammography access, such as self-referral, not receiving adequate pre-mammography breast examinations, or may be more likely to access care through a program for disadvantaged women. For example, the National Breast and Cervical Cancer Early Detection Program (NBCCEDP) is an avenue for low-income and uninsured U.S. women to access breast and cervical cancer screening [30]. From 1995 to 2002, the NBCCEDP sponsored 28,965 first mammograms for women aged <40 in the United States [30]. Similar to our study, in their analysis of women aged ≥40, these authors' report included initial mammograms as screening, even when symptomatic. An important avenue for future research would be to better understand the circumstances surrounding women arriving for a screening mammogram with reported symptoms.

Among the women not reporting symptoms, Hispanic and AA women were significantly more likely than white women to have a diagnostic indication [Hispanic: RR = 1.37 (95% CI: 1.20–

1.57); Asian: RR = 1.15 (95% CI: 1.00–1.31); AA: RR = 1.33 (95% CI: 1.16–1.53)]. We considered three explanations for these findings. First, a woman at the time of a diagnostic mammogram may have symptoms but not report them. This is consistent with the literature on low health literacy being associated with poor communication between patients and providers [31], and being higher on average among white and Asian than among AA and Hispanic adults [31]. Second, these women may have healthcare disparities, where mammography access was facilitated by the referring physician, such as (a) for third-party payment [32,33], given that insurance providers cover diagnostic but not screening mammography in younger women, or (b) in order to increase patient compliance, although diagnostic testing is often completed the same day, screening mammography may require later follow-up testing. Third, these women may have been evaluated with a clinical breast examination, where the provider found something of concern but the woman did not exhibit symptoms.

Strengths and limitations

These BCSC data are rich in their racial/ethnic diversity, geographical variation, general representation of the U.S. population [34], and prospective collection of community-based practice data. However, a number of limitations warrant mention. First, these BCSC data cannot finely define breast cancer risk, such as identifying women with BRCA1/BRCA2 mutations or evaluation of risk based on a comprehensive family history pedigree [35]. However, collecting breast cancer history on second degree relatives or the age at diagnosis of affected relatives may not substantially improve the ability to assess which individuals are at high risk for breast cancer, at least among women ≥40 [36]. One previous study suggests only about 3% of first primary breast cancers detected in younger women were among asymptomatic women with a positive family history [37]. In another study of younger women, all cancers found were in symptomatic women with no family history of breast cancer [38]. Second, while these data are supported by a rigorous, ongoing quality control practice in addition to the strong collaboration and expertise within the BCSC, the potential for some variation in data capture exists by site. Therefore, we report the percentage of missing data for consideration in interpreting our results. For example, given high amounts of missing data for reported pain and discharge symptoms, it is difficult to derive a meaningful understanding of these symptoms by race/ethnicity. Third, we consider these findings somewhat exploratory and they deserve confirmation in other studies with other community-based practices. Finally, we were unable to distinguish women coming in early (e.g. age 39) for their 40-year screening mammogram from those receiving early mammography for other reasons; however, our findings reflect clinical practice.

Conclusions

This study is the first to prospectively describe first mammography use in women younger than 40 by race/ethnicity, using data from a nationally representative sample of 99,615 women from community-based practice. Our findings suggest racial/ethnic variation at multiple points of care over the course of an early first mammogram, such as at indication, recommendations, and outcomes, the implications of which warrant further investigation. The fact that 74% of these first mammograms were indicated for screening purposes highlights avenues for additional study of motivating factors for these practice patterns and understanding of the implications of early mammography use.

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Table 1

Descriptive characteristics of an index screening mammogram among women aged <40, BCSC data 1996–2005

	Total		White		AA		Asian		Hispanic	
	n	%	*n*	%	*n*	%	*n*	%	*n*	%
	73,353	**73.6%**	**55,469**	**75.6%**	**5,800**	**7.9%**	**5,354**	**7.3%**	**6,730**	**9.2%**
Age at first mammogram (years)										
18–34	11,273	15.4	8,291	14.9	1,061	18.3	671	12.5	1,250	18.6
35–39	62,080	84.6	47,178	85.1	4,739	81.7	4,683	87.5	5,480	81.4
Education level										
< High school graduate	2,415	4.3	1,120	2.5	344	8.4	379	8.6	572	14.7
High school graduate/GED	11,018	19.5	8,253	18.7	1,179	28.7	624	14.1	962	24.7
Some college/tech. school	15,672	27.7	12,148	27.6	1,408	34.2	924	20.9	1,192	30.6
College graduate	27,426	48.5	22,566	51.2	1,184	28.8	2,504	56.5	1,172	30.1
Unknown	16,822	22.9	11,382	20.5	1,685	29.1	923	17.2	2,832	42.1
First-degree family history of breast cancer										
No	57,005	87.5	43,120	86.9	4,102	91.6	4,183	89.5	5,600	88.1
Yes	8,125	12.5	6,497	13.1	376	8.4	492	10.5	760	12.0
Unknown	8,223	11.2	5,852	10.6	1,322	22.8	679	12.7	370	5.5
Symptoms or breast change reported										
Type[a]										
Lump (yes)	3,750	5.3	2,675	5.0	356	6.2	311	5.9	408	6.4
Discharge (yes)	1,029	1.5	706	1.4	111	2.0	71	1.6	141	2.3
Pain (yes)	2,470	9.5	1,707	8.7	178	22.8	153	7.8	432	11.5
Symptoms, not otherwise specified (yes)	2,136	3.4	1,541	3.2	268	4.8	112	2.8	215	4.6
Number										
Any	8,118	11.3	5,696	10.5	802	13.9	579	10.9	1,041	15.9
None	63,895	88.7	48,673	89.5	4,980	86.1	4,749	89.1	5,493	84.1
Unknown	1,340	1.8	1,100	2.0	18	0.3	26	0.5	196	2.9
BI-RADS breast density										
1: Almost entirely fat	2,489	4.9	1,910	4.7	298	6.1	13	1.0	268	6.9
2: Scattered fibroglandular tissue	17,276	34.0	13,837	33.9	1,738	35.7	224	17.7	1,477	38.0
3: Heterogeneously dense	23,431	46.1	18,866	46.2	2,276	46.8	632	50.0	1,657	42.6

	Total		White		AA		Asian		Hispanic	
	n	%	*n*	%	*n*	%	*n*	%	*n*	%
	73,353	**73.6%**	**55,469**	**75.6%**	**5,800**	**7.9%**	**5,354**	**7.3%**	**6,730**	**9.2%**
4: Extremely dense	7,633	15.0	6,199	15.2	551	11.3	395	31.3	488	12.5
Unknown	22,524	30.7	14,657	26.4	937	16.2	4,090	76.4	2,840	42.2
Same day ultrasound performed										
No	68,930	98.2	52,519	98.2	5,447	97.0	4,670	99.4	6,294	98.1
Yes	1,291	1.8	970	1.8	168	3.0	30	0.6	123	1.9
Unknown	3,132	4.3	1,980	3.6	185	3.2	654	12.2	313	4.7
Initial recommendation										
Normal interval follow-up	59,828	83.2	45,075	83.0	4,627	80.6	4,694	88.1	5,432	83.2
Short interval follow-up	1,785	2.5	1,395	2.6	217	3.8	54	1.0	119	1.8
Other workup, not otherwise specified	251	0.4	191	0.4	38	0.7	6	0.1	16	0.3
Additional imaging	9,311	13.0	7,082	13.0	779	13.6	544	10.2	906	13.9
Clinical exam	438	0.6	370	0.7	26	0.5	12	0.2	30	0.5
Biopsy/FNA/Surgical consultation	301	0.4	209	0.4	52	0.9	16	0.3	24	0.4
Unknown	1,439	2.0	1,147	2.1	61	1.1	28	0.5	203	3.0

Percentages are calculated among the non-missing data

Racial/ethnic categories are mutually exclusive representations of non-Hispanic African American, non-Hispanic white, Asian, and Hispanic *BCSC* Breast Cancer Surveillance Consortium

[a]Percentage missing for individual symptoms: lump 3.0%; discharge 7.5%; pain 64.4%; symptoms not otherwise specified 14.1%

Table 2

Descriptive characteristics of an index diagnostic mammogram among women aged <40, BCSC data 1996–2005

	Total		White		AA		Asian		Hispanic	
	n	%	*n*	%	*n*	%	*n*	%	*n*	%
	26,262	**26.4%**	**19,756**	**75.2%**	**2,547**	**9.7%**	**1,241**	**4.7%**	**2,718**	**10.4%**
Age at first mammogram (years)										
18–34	14,490	55.2	10,831	54.8	1,544	60.6	643	51.8	1,472	54.2
35–39	11,772	44.8	8,925	45.2	1,003	39.4	598	48.2	1,246	45.8
Education level										
< High school graduate	1,311	6.1	675	4.0	224	12.0	79	7.0	333	18.8
High school graduate/GED	4,705	21.9	3,551	21.2	524	28.2	135	12.0	495	27.9
Some college/tech. school	6,321	29.4	4,917	29.4	656	35.3	241	21.4	507	28.6
College graduate	9,176	42.7	7,608	45.4	457	24.6	672	59.6	439	24.8
Unknown	4,749	18.1	3,005	15.2	686	26.9	114	9.2	944	34.7
First-degree family history of breast cancer										
No	21,444	92.6	16,207	92.4	1,795	94.9	1,084	94.0	2,358	91.6
Yes	1,714	7.4	1,332	7.6	96	5.1	69	6.0	217	8.4
Unknown	3,104	11.8	2,217	11.2	656	25.8	88	7.1	143	5.3
Symptoms or breast change reported										
Type[a]										
Lump (yes)	17,125	69.0	13,293	71.8	1,603	63.6	731	61.0	1,498	57.7
Discharge (yes)	2,392	11.1	1,786	11.3	297	12.1	72	7.6	237	9.9
Pain (yes)	4,256	37.2	3,347	38.0	262	35.3	135	34.4	512	33.9
Symptoms, not otherwise specified (yes)	3,656	18.5	2,733	18.5	562	24.5	101	12.4	260	13.9
Number										
Any	23,463	91.0	17,801	91.9	2,316	91.3	948	77.4	2,398	89.9
None	2,329	9.0	1,563	8.1	220	8.7	277	22.6	269	10.1
Unknown	470	1.8	392	2.0	11	0.4	16	1.3	51	1.9
BI-RADS breast density										
1: Almost entirely fat	788	4.1	549	3.7	132	6.1	12	2.2	95	6.1
2: Scattered fibroglandular tissue	5,523	28.7	4,304	28.7	660	30.5	61	11.1	498	31.9
3: Heterogeneously dense	8,973	46.6	7,067	47.2	974	45.0	253	45.9	679	43.6

	Total		White		AA		Asian		Hispanic	
	n	%	*n*	%	*n*	%	*n*	%	*n*	%
	26,262	**26.4%**	**19,756**	**75.2%**	**2,547**	**9.7%**	**1,241**	**4.7%**	**2,718**	**10.4%**
4: Extremely dense	3,965	20.6	3,056	20.4	397	18.4	225	40.8	287	18.4
Unknown	7,013	26.7	4,780	24.2	384	15.1	690	55.6	1,159	42.6
Same day ultrasound performed										
No	14,136	54.7	10556	54.4	1,518	59.7	450	36.6	1,612	60.0
Yes	11,725	45.3	8847	45.6	1,023	40.3	781	63.4	1,074	40.0
Unknown	401	1.5	353	1.8	6	0.2	10	0.8	32	1.2
Final recommendation										
Normal interval follow-up	15,006	60.8	11,299	60.8	1,524	61.7	668	57.3	1,515	61.1
Short interval follow-up	1,925	7.8	1,429	7.7	213	8.6	127	10.9	156	6.3
Other workup, not otherwise specified	99	0.4	76	0.4	13	0.5	2	0.2	8	0.3
Additional imaging	1,513	6.1	1,092	5.9	139	5.6	34	2.9	248	10.0
Clinical exam	3,031	12.3	2,501	13.5	170	6.9	99	8.5	261	10.5
Biopsy/FNA/surgical consultation	3,125	12.7	2,186	11.8	410	16.6	236	20.2	293	11.8
Unknown	1,563	6.0	1,173	5.9	78	3.1	75	6.0	237	8.7

Percentages are calculated among the non-missing data

Racial/ethnic categories are mutually exclusive representations of non-Hispanic African American (AA), non-Hispanic white, Asian, and Hispanic

BCSC Breast Cancer Surveillance Consortium

[a]Percentage missing for individual symptoms: lump 5.5%; discharge 17.9%; pain 56.4%; symptoms not otherwise specified 24.6%

Table 3

Risk of recommendation for additional workup or biopsy/FNA/surgical consultation compared to normal/short-interval follow-up at the first mammogram for women aged <40, BCSC data 1996–2005

	First screening mammogram[a,b] **RR (95% CI)**	**First diagnostic mammogram[a,b]** **RR (95% CI)**
Race/ethnicity		
Hispanic	1.06 (0.99–1.13)	1.12 (0.99–1.27)
Asian	0.91 (0.83–1.00)	1.44 (1.26–1.64)
AA	1.15 (1.07–1.23)	1.30 (1.17–1.44)
White	Referent	Referent
Model *n*	70,709	19,711

Racial/ethnic categories are mutually exclusive representations of non-Hispanic African American (AA), non-Hispanic white, Asian, and Hispanic

BCSC Breast Cancer Surveillance Consortium, *RR* relative risk, *CI* confidence interval

[a] Initial recommendation for additional workup (additional imaging, clinical exam, biopsy/FNA/surgical consultation, other workup NOS) of screening mammograms; final recommendation for biopsy/FNA/surgical consultation for diagnostic mammograms

[b] Adjusted for registry site, age (using a cubic b-spline with 3 knots), first-degree family history of breast cancer (yes/no/unknown), examination year, and self-reported breast symptoms (yes/no)

Table 4

Outcomes of first mammograms in women aged <40 by race/ethnicity, BCSC data 1996–2005

	TP		FP		TN		FN		TP: Total	FP: Total
	n	%	*n*	%	*n*	%	*n*	%	Ratio	Ratio
Race/ethnicity: index screening mammogram age < 40[a]	118	0.2	9,647	13.2	63,210	86.6	34	0.1	1:622	1:8
AA	16	0.3	817	14.1	4,955	85.5	6	0.1	1:363	1:7
Asian	7	0.1	556	10.4	4,780	89.4	3	0.1	1:765	1:10
Hispanic	6	0.1	928	13.9	5,752	86.0	3	0.0	1:1122	1:7
NH white	89	0.2	7,346	13.3	47,723	86.5	22	0.0	1:623	1:8
Race/ethnicity: index diagnostic mammogram age < 40[b]	385	1.5	2,396	9.6	22,168	88.6	62	0.3	1:68	1:11
AA	58	2.3	280	11.3	2,124	85.8	13	0.5	1:44	1:9
Asian	19	1.6	212	18.2	930	80.0	2	0.2	1:65	1:6
Hispanic	28	1.1	260	10.3	2,243	88.5	4	0.2	1:97	1:10
NH white	280	1.5	1,644	8.7	16,871	89.6	43	0.2	1:71	1:12

Row percentages: Percentages are calculated among the non-missing data

Racial/ethnic categories are mutually exclusive representations of non-Hispanic African American (AA), non-Hispanic white, Asian, and Hispanic

BCSC Breast Cancer Surveillance Consortium

[a] 344 (0.5%) unknown outcome (289 white, 6 AA, 8 Asian, 41 Hispanic)

[b] 1,251 (4.8%) unknown outcome (918 white, 72 AA, 78 Asian, 183 Hispanic)