



Racial/ethnic differences in supplemental imaging for breast cancer screening in women with dense breasts

Charlotte Ezratty¹ · Suzanne Vang² · Jordonna Brown³ · Laurie R. Margolies⁴ · Lina Jandorf² · Jenny J. Lin¹

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Abstract

Background Mammography is limited when analyzing dense breasts for 2 reasons: (1) breast density masks underlying cancers and (2) breast density is an independent risk factor for cancer. We undertook this study to assess whether there is a racial/ethnic difference in supplemental image ordering for women with dense breasts.

Methods We conducted a retrospective, observational cohort study of women aged 50–75 from an academic medical center who had completed a screening mammogram between 2014 and 2016 that was read as BI-RADS 1 with heterogeneously or extremely dense breasts or BI-RADS 2 with extremely dense breasts. Data were abstracted on type, timing and frequency of supplemental imaging tests ordered within two years of an initial screening mammogram. Patient characteristics (age, race/ethnicity, insurance, and comorbidities) were also abstracted. We used bivariate and multivariate logistic regression to assess for differences in supplemental imaging ordered by race/ethnicity.

Results Three hundred twenty-six women met inclusion criteria. Mean age was 58 years: 25% were non-Hispanic white, 30% were non-Hispanic black, 27% were Hispanic, 6% were Asian and 14% unknown. Seventy-nine (24%) women were ordered a supplemental breast ultrasound after the initial screening mammogram. Non-Hispanic black and Hispanic women were less likely to have supplemental imaging ordered compared to non-Hispanic white women (15% and 10%, respectively, vs. 45%, $p < 0.0001$). After controlling for patient age, ordering physician specialty, insurance, BI-RADS score, breast density, and family history of breast cancer, non-Hispanic black and Hispanic women remained less likely to be ordered supplemental imaging (OR 0.38 [95% CI 0.17–0.85] and OR 0.24 [95% CI 0.10–0.61], respectively, $p < 0.0001$).

Conclusion Minority women with dense breasts are less likely to be ordered supplemental breast imaging. Further research should investigate physician and patient behaviors to determine barriers in supplemental imaging. Understanding these differences may help reduce disparities in breast cancer care and mortality.

Keywords Cancer screening · Race and ethnicity · Women's health

Introduction

Breast cancer is the most common non-skin cancer among women in the United States (US) and has the second highest cancer-related mortality rate [1]. Mammograms have allowed for early detection of breast cancer, and biennial screening mammograms for women between the ages of 50 and 74 (as recommended by the US Preventive Services Task Force) has resulted in a steady decrease in breast cancer mortality by 20–30% since the 1990s [2]. However, this decrease in mortality is not universal among all women: non-Hispanic black and Hispanic women are still being diagnosed with more advanced stage cancer and consequently suffer higher mortality rates [3]. Part of this disparity may

✉ Charlotte Ezratty
charlotte.ezratty@icahn.mssm.edu

¹ Division of General Internal Medicine, Icahn School of Medicine at Mount Sinai, New York, NY, USA

² Department of Population Health Science and Policy, Icahn School of Medicine at Mount Sinai, New York, NY, USA

³ Graduate Program in Public Health, Icahn School of Medicine at Mount Sinai, New York, NY, USA

⁴ Department of Diagnostic, Molecular, and Interventional Radiology, Icahn School of Medicine at Mount Sinai, New York, NY, USA

be due to lower participation in screening mammograms among these minority groups [1].

Although an integral component of breast cancer screening, mammograms are limited in detecting cancer in women with dense breasts [4]. This is due to primarily two reasons: (1) dense breast tissue masks underlying cancers and (2) breast density has been found to be an independent risk factor for breast cancer [5]. Women with dense breasts thus experience higher rates of interval cancers that manifest within a year of a normal mammogram [6]. As of 2019, legislation in 38 states has mandated patient notification of breast density to identify women who may benefit from supplemental imaging following screening mammography [7]. With documented racial/ethnic disparities in breast cancer mortality, some studies have investigated whether there is a corresponding difference in breast density by race; many of these studies have concluded that breast density does not vary by race [8]. We undertook this study to assess whether there is a racial/ethnic difference in supplemental image ordering for breast cancer screening in women with dense breasts.

Methods

We conducted a retrospective, observational cohort study of women aged 50–75 from an urban academic medical center who completed a screening mammogram between 2014 and 2016 that was read as BI-RADS 1 and either heterogeneously or extremely dense breasts or BI-RADS 2 and extremely dense breasts. Data were abstracted from the electronic health record on sociodemographic characteristics (age, race/ethnicity, insurance and family history of breast cancer) of women who met inclusion criteria and type and ordering provider for any supplemental imaging tests ordered. Women who reported being of Hispanic ethnicity were classified as Hispanic, regardless of race [9]. We categorized ordering provider type as either primary care (physicians from general internal medicine, family medicine, or geriatrics) or specialty care (physicians from obstetrics/gynecology or surgery). Insurance was dichotomized as public (e.g., Medicaid and/or Medicare) or private (e.g., commercial insurance, self-pay). The outcome variable, supplemental image ordering, was determined by whether there was a physician's order for a supplementing imaging within 12 months after screening mammogram. The institutional review board at Icahn School of Medicine at Mount Sinai approved this study.

Data analysis

Univariate analyses were conducted to compare baseline sociodemographic characteristics of the study cohort.

Chi-square or *t*-test analyses were used, as appropriate, to assess for differences by race/ethnicity in age, insurance, ordering physician type, BI-RADS category, breast density, family history of breast cancer, and supplemental imaging ordered. Multiple logistic regression was performed to assess whether race/ethnicity was associated with ordering of supplemental imaging, controlling for patient age, ordering physician type, insurance, BI-RADS score, breast density, and family history of breast cancer. We report odds ratios (OR) and 95% confidence intervals (CI) significant at two-tailed, $p < 0.05$. All statistical analyses were conducted using SAS 9.4.

Results

Three hundred twenty-six women met inclusion criteria (Table 1). Mean age was 58 years: 25% were non-Hispanic white, 30% were non-Hispanic black, 27% were Hispanic, 6% were Asian and 14% unknown. One hundred forty-nine patients (46%) had private insurance and 177 (54%) had public insurance. Overall, 222 (68%) mammograms were read as BI-RADS 1 and 104 (32%) were BI-RADS 2. Of those

Table 1 Characteristics of study cohort ($n = 326$)

	<i>N</i> (%)
Demographics	
Age (years), mean (SD)	57.9 (7.1)
Race	
Non-Hispanic White	80 (24.5)
Non-Hispanic Black	97 (29.8)
Hispanic	86 (26.4)
Asian	19 (5.8)
Other	44 (13.5)
Clinical factors	
BI-RADS score	
1	222 (68.1)
2	104 (31.9)
Breast density	
Extremely dense	136 (41.7)
Heterogeneously dense	190 (58.3)
Family history of breast cancer	111 (34.1)
Health system factors	
Insurance type	
Private	149 (45.7)
Public	177 (54.3)
Ordering physician	
Primary care	244 (74.9)
Specialty care	82 (25.2)
Outcome variable	
Supplemental imaging ordered	79 (24.2)

which were read as BI-RADS 1, 136 (42%) mammograms were read as extremely dense and 190 (58%) as heterogeneously dense. One hundred eleven (34%) women had a family history of breast cancer.

There were several differences in demographic and clinical characteristics by race/ethnicity (Table 2). Non-Hispanic white women were more likely to have their initial screening mammogram ordered by a physician in specialty care (44% vs. 16% for non-Hispanic blacks and 14% for Hispanics [$p < 0.0001$]). Thirty percent of non-Hispanic white women had public insurance, compared to 64% of non-Hispanic blacks, 42% of Asians, and 76% of Hispanics ($p < 0.0001$). Forty-eight (60%) non-Hispanic whites were noted to have extremely dense breasts, compared to 31% of non-Hispanic black women, 58% of Asian women, and 31% of Hispanic women ($p < 0.001$) (Table 3).

Seventy-nine (24%) women were ordered a supplemental breast ultrasound after the initial screening mammogram. Non-Hispanic black and Hispanic women were less likely to have supplemental imaging ordered compared to non-Hispanic white women (15% and 10%, respectively, vs. 45%, $p < 0.0001$). After controlling for patient age, ordering physician specialty, insurance, BI-RADS score, breast density, and family history of breast cancer, non-Hispanic black and Hispanic women remained less likely to be ordered supplemental imaging (OR 0.38 [95% CI 0.17–0.85] and OR 0.24 [95% CI 0.10–0.61], respectively, $p < 0.0001$).

Discussion

We found that among women with findings of dense breasts on screening mammography, there was a racial/ethnic difference in rates of supplemental image ordering. Compared to non-Hispanic white women, non-Hispanic black and Hispanic women were a third and a quarter less likely to have had supplemental ultrasound ordered. Understanding factors that may explain this difference in breast cancer screening practices is critical for ensuring equal care for all women.

Table 3 Factors associated with ordering of supplemental imaging

Variables	O.R	C.I	
Age	0.99	0.94	1.03
Race (reference = white)			
Non-Hispanic Black	0.38	0.17	0.85*
Hispanic	0.24	0.10	0.61**
Asian	0.57	0.17	1.90
Other	0.72	0.31	1.70
Private insurance	1.00	0.51	1.96
BI-RADS 2	2.64	1.02	6.84*
Extremely dense	1.60	0.61	4.21
Family history of breast cancer	1.57	0.86	2.85
Ordering physician is specialist	2.23	1.18	4.18*

* $p < 0.05$, ** $p < 0.01$

Racial/ethnic disparities in breast cancer diagnoses and treatment have been widely documented. Ahmed et al., in meta-analysis of 39 studies, determined that non-Hispanic black and Hispanic women exhibited significantly lower utilization of screening mammography compared to white women.¹ Furthermore, Elmore et al. found that non-Hispanic black women were half as likely to use screening mammography for cancer detection and more likely to have longer delays between diagnosis and treatment compared to white women (23 days compared to 18 days) [10]. Hoppe et al. also showed that compared to white women, non-Hispanic black women had longer times to first treatment, surgery, chemotherapy, radiation, and endocrine therapy [11]. Due to decreased use of screening mammography and delays in treatment after diagnosis, it is not surprising that non-Hispanic black [12] and Hispanic women [13] experience increased rates of aggressive, later stage diagnoses and poorer prognoses. Overall, though age-standardized incidence rates of breast cancer are lower among non-Hispanic black and Hispanic women compared to non-Hispanic white women, minority women continue to experience higher mortality rates, even when controlling for disease stage and

Table 2 Characteristics of the study cohort by race/ethnicity

Characteristic, N (%)	Non-Hispanic White (N=80)	Non-Hispanic Black (N=97)	Hispanic (N=86)	Asian (N=19)	Other (N=44)	Total (N=326)
Age, mean (SD)	58	57	57	59	44	56
Private insurance	56 (70.0)	35 (36.1)	21 (24.4)	11 (57.9)	26 (59.1)	149 (45.7)****
BI-RADS 2	37 (46.3)	23 (23.7)	20 (23.3)	8 (42.1)	16 (36.4)	104 (31.9)**
Extremely dense breasts	48 (60.0)	30 (30.9)	27 (31.4)	11 (57.9)	20 (45.5)	136 (41.7)***
Family history of breast cancer	38 (47.5)	29 (29.9)	25 (29.1)	5 (26.3)	14 (31.8)	111 (34.1)
Ordering physician is specialist	35 (43.8)	15 (15.5)	12 (13.9)	4 (21.1)	16 (4.91)	82 (25.2)****
Supplemental imaging completed	36 (45.0)	15 (15.5)	9 (10.5)	5 (26.3)	14 (31.8)	79 (24.2)****

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$, **** $p < 0.0001$

tumor characteristics [12]. Our findings similarly demonstrate there is less aggressive screening for minority women with dense breasts.

The long-term and mortality benefits of supplemental imaging for women with dense breasts are still being studied. There is evidence that supports the benefits of supplemental imaging, particularly in terms of detection of small node-negative invasive cancers and reducing interval cancers in women with dense breasts [14]. For example, ultrasound has been found to be helpful in detecting node-negative invasive cancers not seen on mammography [15], and magnetic resonance imaging (MRI) in detecting ductal carcinoma in situ as well as reducing late stage disease and metastases [14]. Berg et al. investigated outcomes following supplemental ultrasound or MRI to annual mammograms for 2662 women with dense breasts; supplemental imaging in this population was found to increase both cancer detection yield as well as false-positive results [16]. This trade-off of improved cancer detection with increased false-positive rates was further highlighted in the ASTOUND trial, which used adjunct screening with tomosynthesis or ultrasound in 5300 women with mammography-negative dense breasts; adjunct screening detected 29 additional tumors, mostly invasive node-negative cancers, however, caused 64 false-positive screens [17]. Thus, although the benefits and risks of supplemental imaging are still being evaluated, our study highlights the racial/ethnic difference in supplemental screening among women with dense breasts.

There are several factors that may explain our findings. First, it is well understood that systemic factors, such as lower socioeconomic status and lack of health insurance, are often barriers to care and may ultimately lead to both lower utilization of screening mammography as well as use of supplemental imaging [18]. However, even after we controlled for insurance and assessed for supplemental imaging tests that were ordered but not completed, racial/ethnic differences in supplemental imaging remained. Second, it is possible that specialists are more likely to order more tests. We found that specialty physicians were more likely to order supplemental imaging as compared to their generalist counterparts, and in our cohort, non-Hispanic white women were more likely to have specialist physicians order their initial screening mammogram. This may have partially explained the increased supplemental imaging for non-Hispanic white women. However, even after controlling for physician specialty, we found that non-Hispanic black and Hispanic women were still less likely to be ordered supplemental imaging. Third, patient health literacy and care seeking behaviors could have accounted for the observed differences. Though breast density notification laws are becoming more widespread, patient lack of understanding about breast density and subsequent increased risk for breast cancer could contribute to decreased seeking of medical care by the non-Hispanic black and Hispanic populations in our

study [7]. Studies have further found that patient pain and embarrassment may lead to generally decreased utilization of screening mammography [18]. Lastly, physicians' personal biases and prejudices should be considered as well to possibly explain our findings.

Our study has a few limitations. The data were collected from a single urban academic institution so our results may not be generalizable to other institutions or other settings. Furthermore, we were not able to capture whether supplemental images were ordered by physicians outside of our institution, although given that the initial screening mammogram was ordered by physicians within our institution, it is likely that these physicians would be the ones who would order any supplemental imaging. We were also not able to assess whether physicians ordered supplemental imaging for other facilities outside our institution. Finally, we were unable to ascertain whether patients declined further testing after being recommended supplemental imaging by their physicians, as we were only able to capture whether supplemental imaging was ordered.

In conclusion, we found that non-Hispanic black and Hispanic women with dense breasts were less likely to be ordered supplemental imaging after screening mammogram. While we were not able to determine whether this difference was due to a system-level, physician and/or patient-level cause, some of the difference may be due to the lack of current recommendations or guidelines for supplemental imaging for women with dense breasts. Further research should investigate physician and patient behaviors to determine barriers in supplemental imaging for non-Hispanic black and Hispanic women with dense breasts. Understanding these differences may allow for the development of interventions in policy and health care access, physician clinical training, and patient education. These initiatives may ultimately help reduce disparities in breast cancer care and mortality.

Compliance with ethical standards

Conflict of interest We have no conflicts of interest to disclose and confirm that this manuscript has not been published elsewhere, nor is it under consideration by another journal. This manuscript has also not been previously submitted to Breast Cancer Research and Treatment. All authors have contributed to, reviewed, and approved the enclosed manuscript. Dr. Lin was supported by a National Cancer Institute Cancer Prevention and Control Career Development Award (1K07CA166462-01). The institutional review board at Icahn School of Medicine at Mount Sinai approved this study.

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