

# What Do Women Know About Breast Density? Results From a Population Survey of Virginia Women

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## Abstract

**Purpose:** Breast density reduces the sensitivity of mammography and is a moderate independent risk factor for breast cancer. Virginia is one of 24 states that currently require notification of patients when they have dense breasts. However, little is known about what women in the general population know about breast density. This survey study assessed knowledge about breast density and about its impact on mammography and breast cancer risk.

**Methods:** A random sample of 1024 Virginia women between ages 35 and 70 years without breast cancer, reached by landline and cell phone, who completed a 24-minute interview. Bivariate and multivariate analysis was performed.

**Results:** Thirty-six percent of respondents had been informed about their breast density. These women were more likely to be familiar with the term “breast density.” Seventy-five percent of respondents reported being either somewhat or very familiar with risk factors for breast cancer, but <1% spontaneously listed breast density as a risk factor. About half of women who had a mammogram in the last year were aware of their breast density. Overall, only one in five women were aware that density reduces the sensitivity of mammography and only one in eight were aware that density increases breast cancer risk. Very few respondents (5.3%) were able to correctly answer three density knowledge questions. Lower-education, African-American, and Jewish women were less knowledgeable about breast density.

**Conclusions:** Although women are becoming aware of the term “breast density,” they may not understand its relationship to cancer detection on mammography and, especially, its relationship to breast cancer risk.

**Key Words:** Breast density, mammography, breast cancer knowledge, breast cancer risk, population studies

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## INTRODUCTION

Breast density is a moderate independent risk factor for breast cancer [1] and reduces the sensitivity of mammography [2], yet women may not know or understand the implications of their personal breast density on cancer risk or detection. Women in at least 27 states are subject to “breast density notification laws” that require radiologists to inform women of their

mammographic breast density, and federal bills have been proposed in the last three congressional sessions that would set a minimum federal standard for dense breast tissue notification [3]. The assumption underlying these laws is that women will use this information to inform and guide decisions about breast cancer screening they make with their health care providers. Specifically, women with dense breast tissue

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may benefit from additional screening with ultrasound or other modalities owing to the reduced sensitivity for breast cancer for women with dense breast tissue [4,5].

Breast density is currently classified by the radiologist into one of four categories: almost entirely fatty, scattered fibroglandular densities, heterogeneously dense, or extremely dense [6,7]. Approximately half of all women screened will fall into one of the two high-density categories [8,9]. In the United States, this means that approximately 19 million women will be notified that they have dense breasts this year [10]. But many, if not most, will be unclear about its meaning for their personal breast health [11,12].

The current body of research on women's knowledge of breast density is limited. Smaller studies have found that when women were provided with information on breast density, they were able to identify density as a risk factor for breast cancer, but knowing that information did not alter their screening behaviors [11]. One large-scale study [13] surveyed participants in a prerecruited, online access panel and did not directly survey the general population.

The Virginia "Breast Density" notification law went into effect on July 1, 2012, and was the third breast density notification law in the United States, after Connecticut and Texas. Our study sought to explore what women in Virginia know about breast density and its risks for cancer detection, diagnosis, and recommendations.

## METHODS

This study was reviewed and approved by the University of Virginia Institutional Review Board for Social and Behavioral Sciences.

The Virginia "Breast Density" notification law went into effect on July 1, 2012. The law requires that patients be informed if they have heterogeneous or extremely dense breast tissue on mammography by inclusion of a specific statement in their result letter [14] (Appendix 1). A second law updated the language to specifically state that women with dense tissue may benefit from additional screening and was effective July 1, 2013 (Appendix 1). The Virginia Survey on Breast Cancer Screening was conducted via telephone by the University of Virginia Center for Survey Research during the summer and early fall of 2013.

### Questionnaire Development

Before the questionnaire was drafted, a total of four focus groups were conducted. The first focus group included

breast cancer survivors and the second included women who had never had breast cancer. Two breast cancer advocates, who were active members of the study team, helped to conduct the focus group sessions. Results from these focus group sessions assisted in development of the language and content of the survey.

A second set of two focus group sessions were then assembled: one in Charlottesville, Virginia, and a second in Richmond, Virginia, an area with a more racially and ethnically diverse population. These second focus group sessions were designed as group self-administered surveys followed by a group debriefing, after which the survey was modified based on feedback. A live telephone pretest of the survey was conducted in May 2013, yielding 26 completed interviews. This allowed final revisions to the survey instrument to clarify questions.

The survey questionnaire included questions about breast cancer screening adapted from the Mayo Clinic Long Term Follow-up Study [15] as well as a number of new questions developed expressly for this study. The final questionnaire, in English and Spanish, covered a number of topics in sequence: the respondent's family experience with breast cancer, her current breast cancer screening practices, her assessment of her own risk for breast cancer, understanding of breast density, understanding of current screening guidelines, willingness to change screening practices, sources of information about breast cancer screening, and demographics.

### Sample

The survey used a triple-frame telephone sample of Virginia phone numbers, combining a conventional random-digit landline telephone sample, a sample of directory-listed landline telephone numbers, and a random-digit cell phone sample with active numbers identified. The survey instrument included an initial screen that asked for women aged 35 to 70 and screened out women with a prior diagnosis of breast cancer and those not residing in Virginia. For households reached via landline, respondents were asked to say how many women in the household met the eligibility criteria, and then a random selection procedure [16] was used to select one of these women as the respondent. For cell phone interviews, the person answering the phone was simply screened for eligibility.

### Interviewing

All interviews were conducted by trained, female interviewers from June through October 2013. Spanish speakers who preferred native language were called back

by bilingual interviewers from specifically trained staff. Response rates were calculated using American Association of Public Opinion Research standards for Response Rate 4. Response Rate 4 includes usable partial interviews in the numerator and allows the denominator to be adjusted downward by subtracting an estimate of the proportion of cases of unknown eligibility that is actually not eligible for the survey [17].

### Statistical Analysis

The survey data were weighted to match the distributions of age, race, ethnicity, marital status, home ownership, and education among Virginia women aged 35 to 70, based on the 2011 American Community Survey (Integrated Public Use Microdata Series, Version 5.0, University of Minnesota, Minneapolis, Minnesota). Using iterative raking (also known as raking), final survey results were weighted for these demographic characteristics, region of the state, and telephone service type. Because the prevalence of cell phone–only status among Virginia women aged 35 to 70 is not known, a bootstrap method was used to estimate the population percentages in each phone segment, resulting in a weighted 23.6% of respondents having cell phone service only. The weighted sample was intended to closely reflect the demographic characteristics of all Virginia women aged 35 to 70, their regional distribution, and their telephone status. All analyses reported here use the complex sampling facility of SPSS 21 to obtain ordinary least squares regressions with significance tests that take into account the design effect from weighting.

Three indicators were used to evaluate women's knowledge of and familiarity with breast density: a woman's self-rated familiarity with the term "breast density," her report of whether or not she had heard anything about the relationship of breast density to breast cancer risk, and her score on a four-point scale of accuracy of breast density knowledge questions. The accuracy of breast density knowledge questions were designed to assess whether women knew about methods to identify breast density, if they knew about breast cancer risk in relation to breast density, and whether or not it was harder to read a mammogram with high breast density. To summarize the accuracy of women's knowledge, each respondent was assigned a point score ranging from 0 to 4. One point was assigned for choosing a correct answer on each of the three knowledge questions, and an additional point was assigned to those who chose the correct answer on the question about breast density detection and *did not* also choose any of the incorrect alternatives.

To evaluate influence of personal and social factors, Pearson correlations were performed using a bivariate analysis with sample weighting as above. A *P* level of less than .05 was considered significant. A multivariate analysis was also performed to assess which factors were predictors of breast density knowledge.

### RESULTS

The average interview length was 24 minutes and 1,024 interviews were fully completed, with an additional 27 usable partial interviews. Response rate varied by sampling frame, but the overall response rate to the survey was 24.5%, which compares favorably with other well-designed telephone surveys in the current era of low survey response rates [18,19]. The overall design effect from weighting was 1.8, yielding a margin of error of  $\pm 4.1\%$  at the 95% level of confidence.

Table 1 summarizes demographic and personal history information for the weighted sample of survey respondents. About 12% of the weighted sample had been diagnosed with cancer of any kind, and roughly 40% of respondents had one or more blood relatives who had been diagnosed with breast cancer.

### Screening and Risk

More than 90% of women in this study said they had done something in the last 5 years to check themselves for breast cancer. Three-fourths of these women had a mammogram in the last 5 years. More than 50% did breast self-examinations, and 40% have had some type of clinical breast examination. For those who have had a mammogram, more than 40% have received abnormal results at some time.

To understand what women think about their own risk for breast cancer, respondents were asked to estimate their chance of getting breast cancer in the future. About half of the women said their risk of getting breast cancer is the same as any other woman. Thirteen percent said that their risk of getting breast cancer is more than the average woman, whereas nearly one-third said their risk is less.

When asked how familiar they were with the risk factors for breast cancer, 9 out of 10 said they were at least slightly familiar. One-third of the women said they were very familiar with breast cancer risk factors. Women were then asked to list any factors they knew that affected a woman's risk of developing breast cancer, either increasing or decreasing the risk (Fig. 1). This was an open-ended, unprompted question. Breast density was mentioned as a risk factor by only 0.8% of the respondents, ranking twenty-second by frequency of mention.

Table 1. Demographics and personal history of respondents (N = 1,051)

		N	%
Age	35-39 years	125	13.3%
	40-49 years	299	31.6%
	50-59 years	289	30.6%
	60-70 years	231	24.5%
Education	Some high school	41	4.2%
	High school diploma	263	26.9%
	GED	11	1.1%
	Some college	168	17.2%
	2-year degree	114	11.7%
	Technical or trade school	8	0.9%
	Bachelor's degree	209	21.4%
	Graduate or professional school	146	14.9%
Income	\$10,000-\$14,999	31	3.8%
	\$15,000-\$19,999	32	3.9%
	\$20,000-\$29,999	63	7.9%
	\$30,000-\$49,999	166	20.6%
	\$50,000-\$74,999	144	17.9%
	\$75,000-\$99,999	130	16.1%
	\$100,000-\$149,999	120	14.8%
	\$150,000+	92	11.4%
Race/ethnicity	Hispanic	53	5.5%
	Ashkenazi Jewish	23	2.4%
	White only	751	76.8%
	Black or African American only	148	15%
	Asian only	22	2.3%
	Other or multiple race	57	5.9%
Marital status	Married	623	63.0%
	Widowed	56	5.7%
	Divorced	160	16.4%
	Separated	34	3.5%
	Never married	104	10.6%
Employment status	Working full-time	502	54%
	Working part-time	100	10.7%
	Unemployed	59	6.3%
	Temporarily not at work	13	1.4%
	Retired	157	16.9%
	Student	4	0.4%
	Homemaker/stay-at-home mom	85	9.1%
Cancer	Yes	121	11.6%
	Have you ever been diagnosed with cancer of any kind?	No	920
Family cancer history: How many of your blood relatives have ever been diagnosed with breast cancer?	None	632	61.4%
	1	247	24%
	2	104	10.1%
	3	30	2.9%
	4	9	.9%
	5 or more	7	.7%
Parental status: Have you given birth to any children?	Yes	842	85.1%
	No	148	14.9%
Tobacco use: Have you ever used tobacco products, either now or in the past?	Current smoker or tobacco user	186	19.1%
	Smoked in the past	219	41.7%
	Never smoked	566	58.4%

Note: GED = General Educational Development.

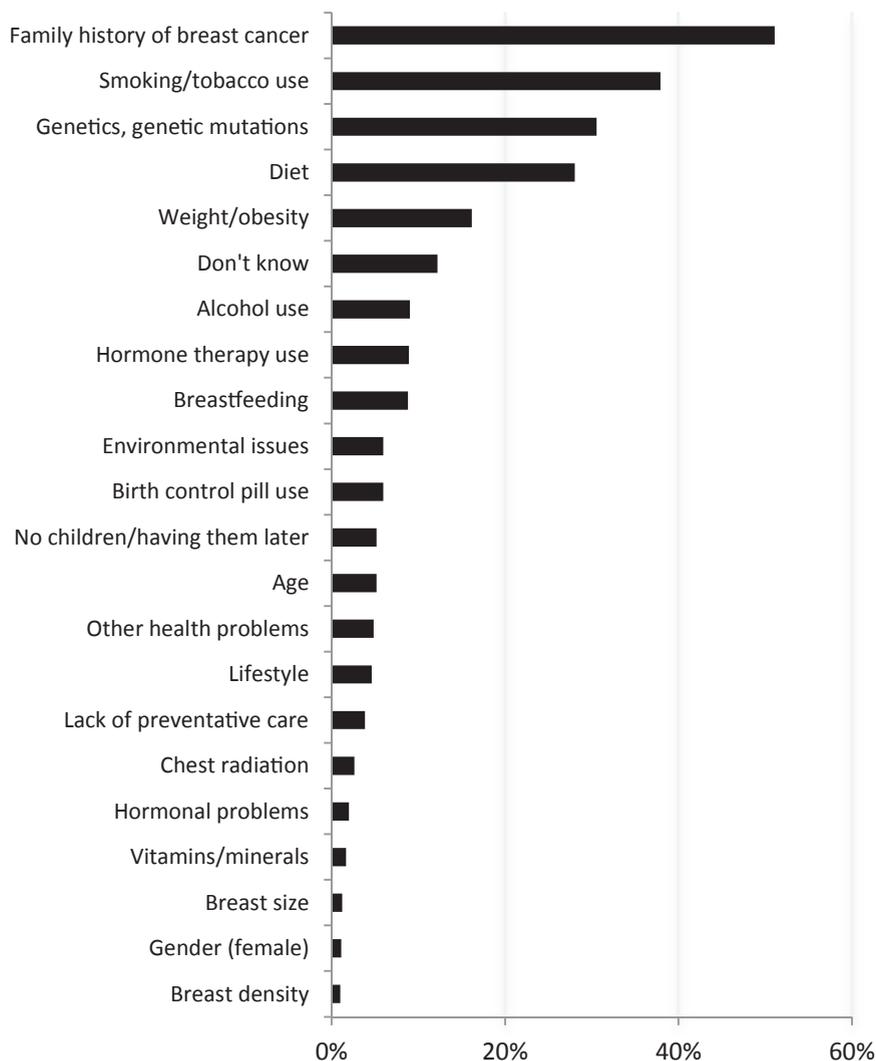


Fig 1. Risk factors for breast cancer. Results of an open-ended, unprompted question asking women to list any factors that affected a woman's risk of developing breast cancer, either increasing or decreasing risk (N = 2,066 responses from 765 women).

### Breast Density Familiarity and Being Informed of Density

When asked how familiar they are with breast density, fewer than one out of five women said they were very familiar. Four out of 10 reported being somewhat or slightly familiar, and one-third said they were not familiar with breast density.

About 39% of the women surveyed said their health care provider had informed them about the density of their breasts. Women who have had mammograms were more likely to have been informed (Table 2). In fact, over half of women who had a mammogram in the last year report that they had been informed about the density of their breasts. Nevertheless, one-third of the women who have had mammograms said they were not familiar

with the concept of breast density at all. And among women who had been informed about the density of their breasts, 53% said they had never heard anything about the relationship of breast density to the risk of breast cancer.

### Breast Density Knowledge

Only 25% of the women in the study said they had heard anything about the relationship between breast density and breast cancer risk. Of those who had heard of the relationship of density and breast cancer risk, 85% knew that it would be harder to detect tumors in a woman with dense breasts; this represents 20% of all women in the total sample. Fifty-four percent knew that a woman with dense breasts would have a higher risk of

**Table 2.** Relationship of personal knowledge of breast density and date of last mammogram

Time of Last Mammogram	Less than 1 year ago	1-2 years ago	3-4 years ago	5 or more years ago	Never had a mammogram	All women
Percent Ever Informed by Doctor About Density of Their Breasts	51.8%	33.7%	25.7%	24.0%	13.0%	38.8%

breast cancer, which represents just 13% of the total sample. The results thus indicate that the relationship between breast density and lower sensitivity of mammography is more familiar to women than the link between density and cancer risk, but the great majority of women are unfamiliar with (or unclear on) either relationship.

Those who said they had some familiarity with breast density were asked which methods can be used to identify breast density. Nine out of 10 of these women correctly said that breast imaging can be used to identify breast density. However, 20% also said that the size and shape of the breasts can be used; one-third said a breast self-examination can be used; and nearly half said that a breast examination by a medical professional can be used to identify breast density.

Regarding accuracy of women's knowledge of breast density (one point for each correct answer on the three knowledge questions, and an additional point for giving no incorrect answer on the question about breast density detection), only about 5% of women with some knowledge of breast density had all three questions fully correct (Fig. 2).

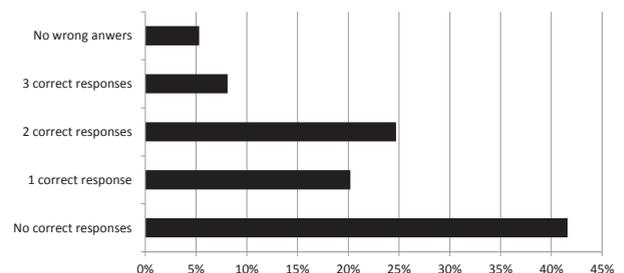
### Correlates and Predictors of Breast Density Knowledge

Familiarity with the concept of breast density and knowledge of its relationship to breast cancer detection and breast cancer risk were correlated with a variety of personal and social factors (Table 3).

The strongest single correlate of familiarity of breast density and knowledge was whether or not the woman's health care provider had informed her about the density of her breasts. Each of the three knowledge indicators (1: familiarity with breast density; 2: awareness of relationship between breast density and breast cancer risk; and 3: score on accuracy questions) was also strongly correlated with indicators of more general knowledge and awareness about breast cancer: familiarity with the risk factors for breast cancer, and familiarity with current recommendations for breast cancer screening. Women who see themselves as being at higher than

average risk for breast cancer scored significantly higher on all three knowledge indicators. The strongest social and demographic correlates are related to socioeconomic status: breast cancer familiarity and knowledge are higher for more educated women, those with higher household incomes, and those who own their own homes. Older women are significantly more familiar with breast density and more accurate in their knowledge of its effects. In addition, African-American ( $n = 148$ ) women score lower on all three knowledge indicators, current smokers score lower on two of the knowledge indicators, and women who self-identify as Ashkenazi Jewish ( $n = 23$ ) are less likely to have heard about the density–cancer link.

To better understand the underlying factors creating disparities in familiarity and knowledge, a multivariate analysis was conducted (Table 4). As the bivariate correlations suggest, one strong predictor for all three indicators is whether a woman has been informed of her breast density by her health care provider. Level of education is a predictor for all three indicators, but (with these and other factors and covariates controlled) the other indicators of socioeconomic status (including current smoking) are generally no longer significant as predictors. Age is no longer significant with other variables controlled. For two of the three indicators,



**Fig 2.** Accuracy of breast density knowledge. Women were asked three questions regarding breast density knowledge ( $n = 833$ ). One point was assigned for choosing a correct answer on each of the three knowledge questions, and an additional point was assigned to those who chose the correct answer on the question about breast density detection and did not also choose any of the incorrect alternatives.

**Table 3.** Bivariate correlations with three indicators of breast density knowledge

Variable	Familiarity With Breast Density ("How Familiar Are You With the Concept of Breast Density?") (1-4 Scale) (N = 934)	Heard of Relationship Between Breast Density and Breast Cancer ("Have You Ever Heard Anything About the Relationship Between Breast Density and Breast Cancer Risk?") (N = 910)	Accuracy Score of Knowledge About Breast Density (0-4 Points) (N = 942)
Ashkenazi Jewish	-.335	-.135*	-.473
Asian	-.456	.088	-.265
Black/African American	-.358*	-.137 <sup>†</sup>	-.328*
Hispanic	-.371	-.015	-.411
Other race	-.249	.030	-.179
Age	.015 <sup>†</sup>	.003	.013 <sup>†</sup>
Education level	.094 <sup>‡</sup>	.029 <sup>‡</sup>	.103 <sup>‡</sup>
Employed	-.195	-.028	-.087
Given birth	-.187	-.102	-.171
Home ownership	.558 <sup>‡</sup>	.111*	.604 <sup>‡</sup>
Household income	.117 <sup>‡</sup>	.024*	.128 <sup>‡</sup>
Married	.159	.034	.112
Resident of underserved region	-.215	-.117 <sup>†</sup>	-.250
Smokes currently	-.363*	-.052	-.466 <sup>†</sup>
Smoked in the past	-.107	-.025	-.117
Informed about breast density by doctor	1.228 <sup>‡</sup>	.322 <sup>‡</sup>	1.011 <sup>‡</sup>
Perceived relative risk of breast cancer	.187 <sup>‡</sup>	.052 <sup>†</sup>	.206 <sup>‡</sup>
Familiarity with other cancer risk factors	.526 <sup>‡</sup>	.100 <sup>‡</sup>	.375 <sup>‡</sup>
Familiarity with screening recommendations	.451 <sup>‡</sup>	.124 <sup>‡</sup>	.441 <sup>‡</sup>

Note: These correlations are not corrected for multiple comparisons. It would be expected that, out of the 57 correlations shown, 1 might be significant at the .01 level and 2 others at the .05 level, based on chance alone. Data provided in the last column are correlation coefficients of the given variable and the accuracy score based on three questions regarding density knowledge (Fig. 2).

\**P* value < .05.

<sup>†</sup>*P* value < .01.

<sup>‡</sup>*P* value < .001.

African-American women remain somewhat less familiar and knowledgeable than others, even with socioeconomic indicators controlled. However, the coefficients for African-American status are smaller in the multivariate result than in the bivariate result, suggesting that some but not all of the bivariate race effect is associated with education and socioeconomic differences between blacks and other Virginia women.

An unexpected finding that emerges in the multivariate results is that women of Ashkenazi Jewish descent score significantly lower on all three knowledge indicators of familiarity and knowledge of breast density, with other factors controlled. As expected based on the general socioeconomic status of Jewish Americans [20], the Ashkenazi Jewish women (less than 3% of our sample) are substantially above the statewide mean in education and household income. In addition, they are

concentrated in urban regions of the state and none reside in a medically underserved area. The coefficients for Ashkenazi background are stronger in the multivariate regression than they are in the bivariate correlations. These results indicate that Ashkenazi women in Virginia are overall only a little below average in their familiarity and knowledge of breast density, but that they are far below the knowledge levels one would predict given their high socioeconomic status.

## DISCUSSION

The current body of research on women's knowledge of breast density is limited. Most prior studies of women's knowledge were based on small samples or used clinically based samples that do not fully represent the broader population of women. The results of our study come

Table 4. Multivariate analysis of three indicators of breast density knowledge

Predictor Variables	Dependent Variables		
	Familiarity With Breast Density (1-4 Scale)	Heard of Relationship Between Breast Density and Breast Cancer	Accuracy of Knowledge About Breast Density (0-4 Points)
Ashkenazi Jewish	-.418 <sup>†</sup>	-.172 <sup>†</sup>	-.555 <sup>‡</sup>
Asian	-.526*	.084	-.369
Black/African American	-.272*	-.108*	-.236
Hispanic	-.138	-.001	-.208
Other race	.111	.119	.180
Age	.007	.002	.008
Education level	.046*	.020 <sup>†</sup>	.055*
Employed	-.115	.001	-.026
Given birth	-.114	-.095	-.105
Home ownership	.202	.041	.265*
Household income	.014	-.014	.026
Married	.041	.034	-.016
Resident of underserved region	-.053	-.081	-.089
Smokes currently	-.248	-.023	-.333
Smoked in the past	-.033	.002	-.050
Informed about breast density by doctor	1.090 <sup>†</sup>	.291 <sup>†</sup>	.840 <sup>†</sup>
Perceived relative breast cancer risk	.107 <sup>†</sup>	.032	.154 <sup>†</sup>
R <sup>2</sup>	.354	.170	.244
N cases	934	910	942

Note: Data provided are correlation coefficients of the given variable and the score of four questions regarding density knowledge (Fig. 2) after controlling for other variables.

\*P value < .05.

<sup>†</sup>P value < .01.

<sup>‡</sup>P value < .001.

from a probability-based, general population sample of more than 1,000 women. The sampling frame for the study included both landline and cellular telephones, increasing the effectiveness in reaching minorities and women of lower income, who are more likely to have only cell phones. Virginia's mandatory breast density notification law was in place for a year before the study was undertaken, so that this important background variable was held constant for all women in the study. The data reported here therefore give a new and clearer picture of the state of knowledge about breast density among the broad population of women subject to current breast cancer screening recommendations.

One important result of this study is that the Virginia breast density notification law seems to be effective in communicating some information: about half of the women who have had a mammogram in the past year report that their health care provider has informed them about the density of their breasts. Because notification in Virginia is required only for women found to be in one of the two reportable dense categories, heterogeneously dense or extremely dense, which is about half of women

undergoing screening mammography [7], this is about the percentage one would expect to be receiving notification. Those who had their last mammogram more than a year before the survey, which would be before the notification law went into effect, were far less likely to say they have ever been notified, a fact that underscores the efficacy of the notification law. These results suggest that women who receive these notifications are reading them.

However, the results also show that being notified about breast density does not equate to understanding what breast density implies in terms of mammographic sensitivity or breast cancer risk. The movement to notify women about their breast density assumes that, given better information, women will make better choices about their breast health. The study results show, however, that merely informing a woman about her breast density is not enough information in itself. The results point to a need for much broader efforts to raise awareness among women of what breast density implies for their cancer risk and their choice of screening practices.

The survey shows, not unexpectedly, that knowledge about breast density is unequally distributed across the

population of women. Not surprisingly, women who see themselves as having higher risk for breast cancer and those who are otherwise well informed about breast cancer are somewhat better informed. A woman's level of education is a strong predictor of her knowledge level. In contrast to earlier, small-sample studies that suggested equal levels of knowledge among black women as compared with white women [21], this survey shows that black women in Virginia are less knowledgeable about breast density than white women, and that this difference is lessened but remains statistically significant when socioeconomic status is statistically controlled. This finding suggests the need for educational programs and educational materials that are culturally appropriate for African-American women and outreach efforts that are targeted to reach that population. The survey results also include the unexpected finding that Ashkenazi Jewish women in Virginia, an urban group high in education and socioeconomic status, are less well informed about breast density than one would expect based on their demographic characteristics. Likewise, these results suggest that additional efforts are needed to bring information about breast density to this group.

The multivariate results also show that women who have been informed by their health care provider about their breast density are more knowledgeable about breast density. However, the main effect of notification is on simple familiarity with the term "breast density." The effect of notification on knowledge of breast density's relationship with breast cancer is much more modest. This result reinforces the idea that notification laws are only a first step in what needs to be a broader campaign of education about what breast density (or absence of breast density) actually means for a woman's health. These efforts may need to include health care providers as well as the population of women of screening age in general.

Though the results reported here point to the need for better education and outreach, there are significant obstacles that will complicate a woman's attempts to apply her knowledge about breast density. About half of the states still do not require notification to women whose mammograms indicate high breast density, and women with low-density breasts are generally not notified of that fact, which could also be of importance to them. Only a few states with density legislation also have mandates for insurance companies to pay for any secondary screening [8,22], but for those states that do not have mandates, women who need the additional tests may end up going without, since some supplemental tests are not yet covered by insurance [22,23].

The results of one published national survey of awareness of breast density [13] are considerably different from the results of our study. In the study by Rhodes et al [13], women were prerecruited to an access panel of people willing to respond to surveys for a small incentive. Internet access was provided free of charge. Because panel members have repeated experience in responding to surveys and have internet access, it is possible that they respond differently to survey questions than do women in the general population [24]. In addition, the survey in that study was performed in October 2012, when only two states had breast density notification laws in effect for at least 1 year (Connecticut, 2009, and Texas, 2011); the study oversampled residents of Connecticut. Compared with our study, the results of the study by Rhodes et al showed a higher awareness of breast density (58% versus 39%), of the increased risk of missed cancer (49% versus 22%), and of the association of density and breast cancer risk (53% versus 14%). These differences may be attributable to study design and how sampling was performed [25]. Our study likely reflects a broader view of the population, because we used random-digit dialing and included cell phones in addition to landlines [18]. Studies of this design continue to provide accurate data on most measures, despite declining response rates [18]; internet access was not required in our study.

Our study has a few limitations. Although the current survey represents a distinct advance in its coverage of a diverse, general population using probability sampling methods, it would be useful to survey a national sample of women, or to compare one or more non-notification states with these results for Virginia to assess if these results are generalizable. The one published national survey of breast density awareness [13] relies on women prerecruited on an access panel. Our study used random-digit dialing including both landlines and cellular telephones, likely accessing a broader population than the previous study. It would take a separate survey effort using this methodology on a national sample to assess conclusively the generalizability of our findings. An additional limitation is that the language of the Virginia breast density notification law was changed to stronger language with an effective date of July 1, 2013 (Appendix 1), which occurred about 2 weeks after initiating the survey. This new verbiage may have influenced results of those who had had a mammogram in the short period of time just before participating in the survey.

The results of our study show that women in Virginia are becoming familiar with the term "breast density," yet

are not sufficiently knowledgeable about its relationship with breast cancer detection or risk. The findings reported here should be augmented with further research into the kind of information and messaging that will best inform women about the implications of breast density. The health care community is still only at the beginning stages of raising women's awareness, increasing understanding, and enabling women to make personalized choices based on their risk. Radiologists are well positioned as leaders to educate women and their primary health care providers about the implications of breast density for mammographic screening and breast cancer risk.

### TAKE-HOME POINTS

- Although density notification laws seem to be adequately communicating awareness, translation to knowledge of the effects of breast density is lacking.
- The strongest single correlate of familiarity of breast density and knowledge was whether or not the woman's health care provider had informed her about the density of her breasts.
- Women who are of low education or African-American are less knowledgeable about breast density and may particularly benefit from public education efforts. In addition, knowledge about breast density among women of Jewish ancestry was lower than would be expected based on their levels of education.
- Improved education about breast density—both for the public and for providers—is necessary to augment new legislation to help women evaluate and manage their breast cancer risk.

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## APPENDIX 1. BREAST DENSITY NOTIFICATION STATEMENT IN VIRGINIA

State law, effective July 2012, states that the text below must be included in the patient result letter if the patient has heterogeneous or extremely dense breast tissue on mammography. The initial statement was updated to include language about obtaining additional screening tests and was effective July 2013.

Initial Statement, effective July 2012:

“Your mammogram demonstrates that you may have dense breast tissue, which can hide cancer or other abnormalities.”

Updated statement, effective July 2013:

“Your mammogram demonstrates that you have dense breast tissue. Dense breast tissue can make it harder to find cancer on a mammogram and may also be associated with an increased risk of breast cancer. This information is given to you to raise your awareness. Use this information to talk to your doctor about your own risks for breast cancer. At that time, ask your doctor if more screening tests might be useful based on your risk. A report of your mammography results has been sent to your referring physician’s office, and you should contact your physician if you have any questions or concerns about this report.